PHYSICS

AIMED AT STUDENTS PREPARING FOR IIT JEE EXAMS

GRAVITATION

Solved Example

1. An artificial satellite is in an elliptical orbit around the earth with aphelion of $6R$ and perihelion of $2R$ where R is radius of the earth

$= 6400 km$. Calculate the eccentricity of the elliptical orbit.

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2. The mean distance of a planet from the sun is approximately $1/4$ times that of the earth from the the sun. Find the number of years required for the planet to make one revolution about the sun.

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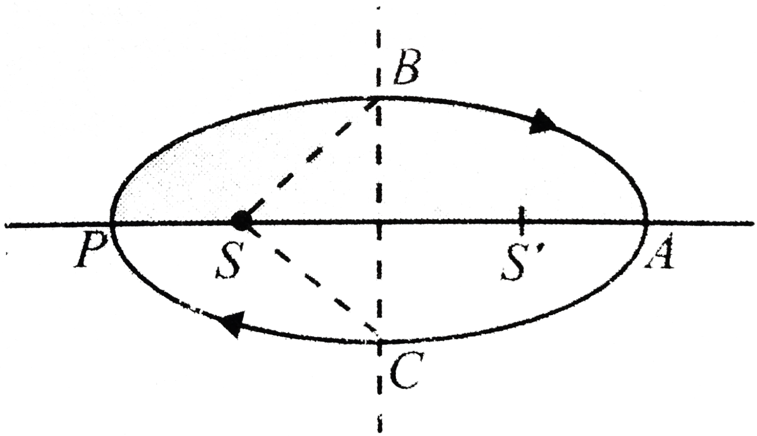
3. Let the speed of the planet at the perihelion P in figure be v_P and the Sun planet distance SP be r_P. Relater r_P, v_P to the corresponding quantities at the aphelion $\left(r_A, v_A\right)$. Will the planet take equal times to transverse BAC and CPB?



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4. Let us consider that our galaxy consists of 2.5×10^{11} stars each of one solar mass. How long will this star at a distance of $50,000$ light year from the galastic entre take to complete one revolution? Take the diameter of the Milky way to be

$10^5 ly. G = 6.67 \times 10^{-11} Nm^2 Kg^{-2}. \left(1ly = 9.46 \times 10^{15} m\right)$

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5. If two particles each of mass m are placed at the two vertices of an equilateral triangle of side

a, then the resultant gravitational force on mass m placed at the third vertex is

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6. Four particles each of mass 'm' are placed at the four vertices of a square 'a' .Find net force on any one the particle.

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7. Four particles, each of mass M and equidistant from each other, move along a circle of radius R under the action of their mutual gravitational attraction. The speed of each particle is:

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8. If four different masses m_1, m_2, m_3 and m_4 are placed at the four corners of a square of side a, the resultant gravitational force on a mass m kept at the centre is

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9. A thin rod of mass M and length L is bent into a semicircle as shown in diagram. What is a gravitational force on a particle with mass m at the centre of curvature?

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10. For particles of equal masses M that move along a circle of radius R under the action of their mutual gravitational attraction. Find the speed of each particle.

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11. Mass M is split into two parts m and $(M - m)$, which are then separated by a certain distance. What is the ratio of (m/M) which maximises the gravitational force between the parts ?

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12. Imagine a light planet revolving around a very massive star in a circular orbit of radius R with a period of revolution T. if the gravitational force of attraction between the planet and the star is proportational to $R^{-5/2}$, then

(a) T^2 is proportional to R^2

(b) T^2 is proportional to $R^{7/2}$

(c) T^2 is proportional to $R^{3/3}$

(d) T^2 is proportional to $R^{3.75}$.

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13. Three sperical balls of masses $1kg$, $2kg$ and $3kg$ are placed at the corners of an equilateral triangle of side $1m$. Find the magnitude of the gravitational force exerted by $2kg$ and $3kg$ masses on $1kg$ mass.

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14. Two particles of masses $1kg$ and $2kg$ are placed at a distance of $50cm$. Find the initial acceleration of the first particle due to gravitational force.

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15. An infinite number of particles each of mass m are placed on the positive X-axis of $1m, 2m, 4m, 8m, \ldots$ from the origin. Find the magnitude of the resultant gravitational force on mass m kept at the origin.

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16. In a double star system, two stars of masses m_1 and m_2 separated by a distance x rotate about their centre of mass. Find the common angular velocity and Time period of revolution.

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17. In Cavendish's experiment, let each small mass be $20g$ and each large mass be $5kg$. The rod connecting the small masses is $50cm$ long, while the small and the large spheres are separated by $10.0cm$. The torsion constant is $4.8 \times 10^{-8} kgm^2 s^{-2}$ and the resulting angular deflection is 0.4°. Calculate the value of universal gravitational constant G from this data.

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18. The mean orbital radius of the Earth around the Sun is $1.5 \times 10^8 km$. Estimate the mass of the Sun.

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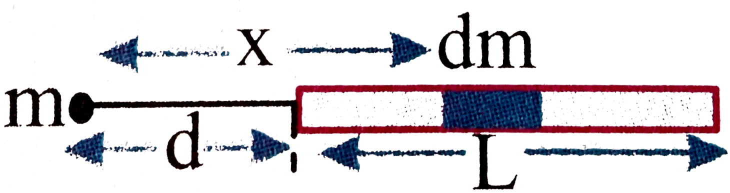
19. A particle of mass m is situated at a distance d from one end of a rod of mass M and length L as shown in diagram. Find the magnitude of the gravitational force between them



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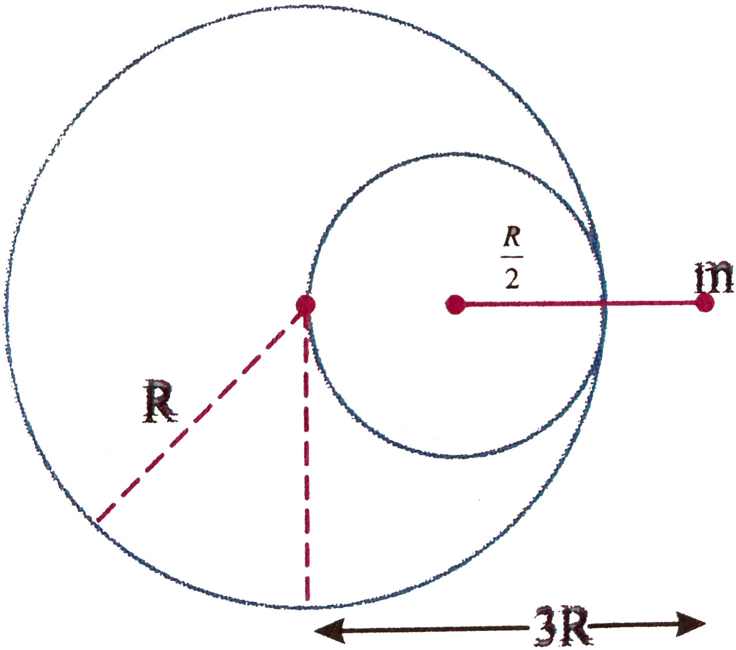
20. The gravitational force acting on a particle, due to a solid sphere of uniform density and radius R, at a distance of $3R$ from the centre of the sphere is F_1. A spherical hole of radius $(R/2)$ is now made in the sphere as shown in diagram. The sphere with hole now exerts a force F_2 on the same particle. ratio of F_1 to F_2 is



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21. A star 2.5 times the mass of the sun is reduced to a size of $12km$ and rotates with a speed of $1.5rps$. Will an object placed on its equator remain stuck to its surface due to gravity? (Mass of the sun $= 2 \times 10^{30} kg$)

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22. What is the time period of rotation of the earth around its axis so that the objects at the equator becomes weightless? ($g = 9.8 m/s^2$, radius of the earth $= 6400 km$)

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23. The height at which the acceleration due to gravity becomes $\frac{g}{9}$ (where g =the acceleration due to gravity on the surface of the earth) in terms of R, the radius of the earth, is :

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24. How much above the surface of the earth does the acceleration due to gravity reduce by 36% of its value on the surface of the earth.

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25. Find the percentage decrease in the weight of the body when taken to a depth of $32km$ below the surface of earth. Radius of the earth is $6400km$

.

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26. A man can jump $1.5m$ on the Earth. Calculate the approximate height he might be able to jump on a planet whose density is one-quarter that of the Earth and whose radius is one-third that of the Earth.

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27. Two bodies of masses $100kg$ and $10,000kg$ are at a distance of $1m$ apart. At what distance from $100kg$ on the line joining them will the resultant gravitational field intensity be zero?

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28. The gravitational field due to a mass distribution is given by $E = -K/x^3$ in x-direction. Taking the gravitational potential to be zero at infinity, find its value at a distance x.

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29. A particle of mass M is placed at the centre of a uniform spherical shell of equal mass and radius a. Find the gravitational potential at a point P at a distance $\frac{a}{2}$ from the centre.

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30. The gravitational field in a region is given by $\vec{E} = -\left(20Nkg^{-1}\right)\left(\hat{i} + \hat{j}\right)$. Find the gravitational potential at the origin $(0, 0)$ in Jkg^{-1}

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31. Calculate the gravitational potential at the centre of base of a solid hemisphere of mass M, radius R.

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32. The gravitational field in a region is given by the equation $E = (5i + 12j)N/kg$. If a particle of mass $2kg$ is moved from the origin to the point

$(12m, 5m)$ in this region, the change in the gravitational potential energy is

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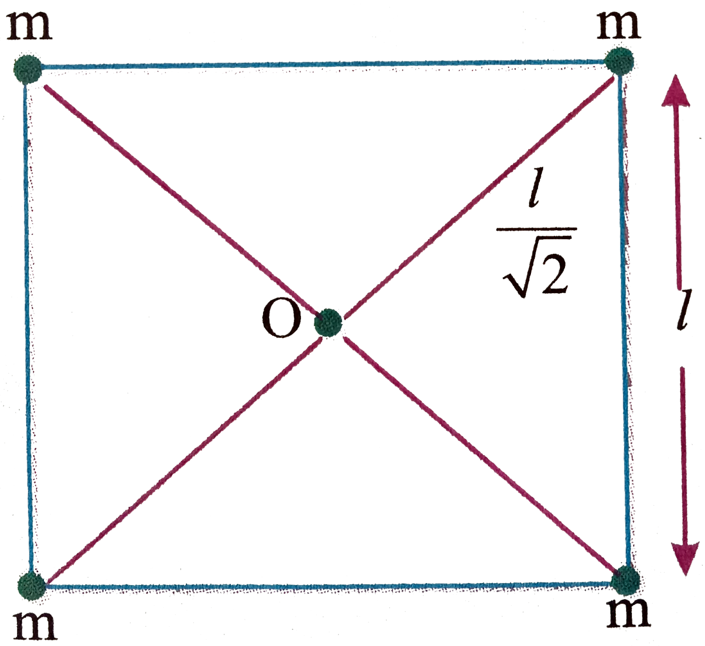
33. Find the gravitational potential energy of a system of four particles, each of mass m placed at the verticles of a square of side l. Also obtain the gravitaitonal potential at centre of the square.



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34. Two bodies of masses m and 4m are placed at a distance r. The gravitational potential at a point on the line joining them where the gravitational field is zero is:

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35. If Earth has mass nine times and radius twice that of the planet Mars, calculate the velocity required by a rocket to pull out of the gravitational force of Mars. Take escape speed on surface of Earth to be $11.2 km/s$

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36. A rocket is fired with a speed, $v = 2\sqrt{gR}$, near the earth's surface and directed upwards. (a) Show that it will escape from the earth. (b) Show that in interstellar space its speed is $v = \sqrt{2gR}$.

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37. A planet in a distant solar systyem is 10 times more massive than the earth and its radius is 10 times smaller. Given that the escape velocity from the earth is $11 kms^{-1}$, the escape velocity from the surface of the planet would be

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38. A satellite orbits the earth at a height of $400km$ above the surface. How much energy must be expanded to rocket the satellite out of the gravitational influence of earth? Mass of the satellite is $200kg$, mass of earth $= 6.0 \times 10^{24}kg$, radius of earth $= 6.4 \times 10^{6}m$, $G = 6.67 \times 10^{-11}Nm^{2}kg^{-2}$.

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39. A body is projected vertically upwards from the surface of the earth with a velocity equal to half of escape velocity of the earth. If R is radius of the earth, maximum height attained by the body from the surface of the earth is

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40. A particle is fired vertically upward fom earth's surface and it goes up to a maximum height of 6400 km. find the initial speed of particle.

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41. If a satellite is revolving around a planet of mass M in an elliptical orbit of semi-major axis a. Show that the orbital speed of the satellite when it is a distance r from the focus will be given by

$$\upsilon^2 = GM\left[\frac{2}{r} - \frac{1}{a}\right]$$

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42. A rocket is fired vertically from the surface of Mars with a speed of $2kms^{-1}$. If 20% of its initial energy is lost due to Martian atmospheric resistance, how far will the rocket go from the surface of Mars before returning to it? Mass of Mars $= 6.4 \times 10^{23} kg$, radius of Mars $= 3395 km$,

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43. Two heavy spheres each of mass $100 kg$ and radius $0.1 m$ are placed $1 m$ apart on a horizontal table. What is the gravitationl field and potential at the mid point of the line joining their centres. The gravitational potential difference between the surface of a planet and a point $20 m$ above it is $16 J/kg$. Calculate the workdone in moving a $2 kg$

mass by $8m$ on a slope of 60° from the horizontal.

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44. The gravitational potential difference between the surface of a planet and a point $20m$ above it is $16J/kg$. Calculate the work done in moving a $4kg$ body by $8m$ on a slope of 60° from the horizontal.

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45. The mass of a spaceship is 1000kg. It is to be launched from the earth's surface out into free space. The value of g and R (radius of earth) are $10\frac{m}{s^2}$ and 6400 km respectively. The required energy for this work will be:

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46. What is the minimum energy required to launch a satellite of mass m from the surface of a planet of mass M and radius R in a circular orbit at an altitude of 2R?

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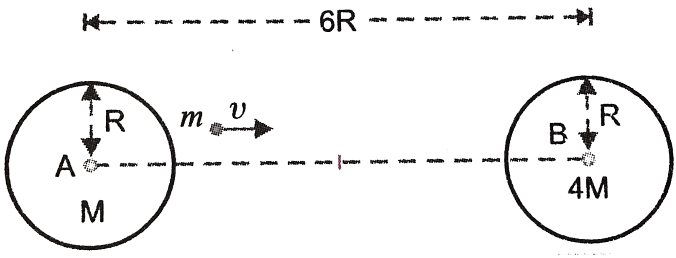
47. Two uniform soild spheres of equal radii R but mass M and $4M$ have a centre to centre separation $6R$, as shows in Fig. (a) The two spheres are held fixed. A projectile of mass$m$ is projected from the surface of the sphere of mass M directly towards the centre of teh second. Obtain an expression for the minimum speed υ of the projectile so that it reaches the surface of second sphere.



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48. A $400 kg$ satellite is in a circular orbit of radius $2R_E$ around the Earth. How much energy is required to transfer it to a circular orbit of radius $4R_E$? What are the changes in the kinetic and potential energies?

Given $g = 9.81m^{-2}, R_E = 6.37 \times 10^6 m$.

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49. A satellite of mass m is orbiting the earth in a circular orbit of radius r. It starts losing energy due to small air resistance at the rate of CJ/s. Then the time teken for the satellite to reach the earth is...........

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50. Two satellites of same mass are launched in the same orbit round the earth so as to rotate opposite to each other. They soon collide inelastically and stick together as wreckage. Obtain the total energy of the system before and just after the collision. Describe the subsequent motion of the wreckage.

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51. A lauching vehicle carrying an artificial satellite of mass m is set for launch on the surface of the earth of mass M and radius R. If the satellite intended to move in a circular orbit of radius $7R$, the minimum energy required to be spent by the launching vehicle on the satellite is

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C.U.Q

1. The time period of an earth satellite in circular orbit is independent of

A. the mass of the satellite

B. radius of its orbit

C. both the mass and radius of the orbit

D. neither the mass of the satellite nor the radius of its obit

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2. If the earth is at one-fourth of its present distance from the sun, the duration of the year would be

A. half the present year

B. one-eighth the present year

C. one-fourth the present year

D. one-sixteenth the present year

Answer: A

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3. The radius vector drawn from the sun to a planet sweeps out___areas in equal time

A. equal

B. unequal

C. greater

D. less

Answer: B

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4. If the area swept by the line joining the sun and the earth from Feb 1 to Feb 7 is A, then the area swept by the radius vector from Feb 8 to Feb 28 is

A. A

B. $2A$

C. $3A$

D. $4A$

Answer: c

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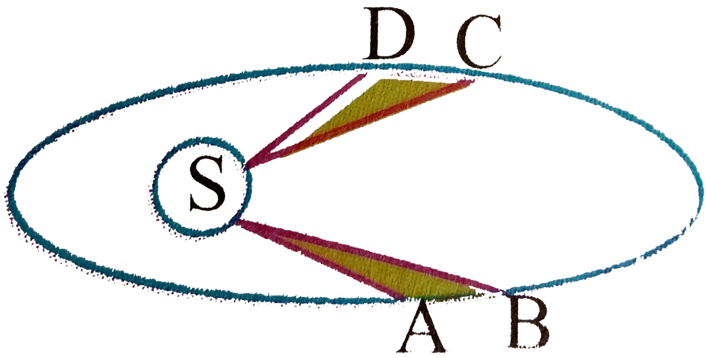
5. The motion of a planet around sun in an elliptical orbit is shown in the following figure. Sun is situated at one focus. The shaded areas are equal. If the planet takes time t_1 and l_2 in moving from A to B and from C to D respectively, then



A. $t_1 > t_2$

B. $t_1 < t_2$

C. $t_1 = t_2$

D. incomplete information

Answer: C

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6. Two satellites are revolving around the earth in circular orbits of same radii. Mass of one satellite is 100 times that of the other. Then their periods of revolutions are in the ratio

A. $100:1$

B. $1:100$

C. $1:1$

D. $10:1$

Answer: C

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7. According to Kepler's second law, line joining the planet to the sun sweeps out equal areas in equal time intervals. This suggests that for the planet

A. radial acceleration is zero

B. tangential acceleration is zero

C. transverse acceleration is zero

D. All

Answer: C

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8. If F_g and F_e are gravitational and electrostatic forces between two electrons at a distance $0.1m$ then F_g/F_e is in the order of

A. 10^{43}

B. 10^{-43}

C. 10^{35}

D. 10^{-35}

Answer: B

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9. $F = \frac{Gm_1m_2}{R^2}$ is valid

A. Between bodies with any shape

B. Between particles

C. Between any bodies with uniform density

D. Between any bodies with same shape

Answer: B

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10. F_g, F_e and F_n represent the gravitational electro-magnetic and nuclear forces respectively, then arrange the increasing order of their strengths

A. F_n, F_c, F_g

B. F_g, F_e, F_n

C. F_e, F_g, F_n

D. F_g, F_n, F_e

Answer: B

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11. Find the false statement

A. Gravitational force acts along the line joining two interacting particles

B. Gravitaional force is independent of medium

C. Gravitational force forms an action-reaction

D. Gravitational force does not obey the principle of superposition.

Answer: D

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12. Law of gravitation is not applicable if (A) Velocity of moving objects are comparable to velocity of light (B) Gravitational field between objectss whose masses are greater than the mass of sun.

A. A is true, B is false

B. A is false, B is true

C. Both A & B are true

D. Both $A\&B$ are false

Answer: C

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13. Among the following the wrong statement is

A. Law of gravitational is framed using Newton's third law of motion.

B. Law of gravitational cannot explain why gravity exists

C. Law of gravitational does not explain the presence of force even when the particles are not in physical contanct

D. When the range is long, gravitational force becomes repulsive

Answer: D

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14. Out of the following interactions, weakest is

A. gravitational

B. electromagnetic

C. nuclear

D. electrostatic

Answer: A

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15. Neutron changing into Proton by emitting electron and anti neutrino. This due to

A. Gravitational force

B. Electromagnetic force

C. Weak nuclear force

D. Strong nuclear force

Answer: C

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16. Attractive Force exists between two protons inside the Nucleus. This is due to

A. Gravitational force

B. Electromagnetic force

C. Weak nuclear force

D. Strong nuclear force

Answer: D

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17. Repulsive force exist between two protons out side the nucleus. This is due to

A. Gravitational force

B. Electromagnetic force

C. Weak nuclear force

D. Strong nuclear force

Answer: B

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18. Radioactive decay exist due to

A. Gravitational force

B. Electromagnetic force

C. Weak nuclear force

D. Strong nuclear force

Answer: C

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19. Two equal masses separated by a distance d attract each other with a force (F). If one unit of mass is transferred from one of them to the other, the force

A. does not change

B. decreases by $\left(G/d^2\right)$

C. becomes d^2 times

D. increases by $\left(2G/d^2\right)$

Answer: B

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20. Which of the following is the evidence to show that there must be force acting on earth nd directed towards Sun?

A. Apparent motion of sun around the earth

B. Phenomenon of day and night

C. Revolution of earth round the sun

D. Deviation of the falling body towards earth

Answer: C

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21. Six particles each of mass$m$ are placed at the corners of a regular hexagon of edge length a. If a point mass m_0 is placed at the centre of the hexagon, then the net gravitational force on the point mass is

A. $\frac{6Gm^2}{a^2}$

B. $\frac{6Gmm_0}{a^2}$

C. zero

D. $\frac{6Gm}{a^4}$

Answer: C

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22. If suddenly the gravitational force of attraction between earth and satellite revolving around it becomes zero, then the satellite will

A. Continue to move in its orbit with same velocity

B. Move tangential to the original orbit with the same velocity

C. Becomes stationary in its orbit

D. Move towards the earth

Answer: B

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23. If the speed of rotation of earth about its axis increases, then the weight of the body at the equator will

A. increases

B. decreases

C. remains unchanged

D. some times decreases sometimes increases

Answer: B

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24. The ratio of accleration due to gravity at a depth h below the surface of earth and at a height h above the surface of earth for h $< <$ radius of earth:

A. constant only when $h < < R$

B. increases linearly with h

C. increaes parabolically with h

D. decreases

Answer: B

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25. If the gravitational force of earth suddenly disappears, then

A. weight of the body is zero

B. mass of the body is zero

C. both mass and weight becomes zero

D. neither the weight nor the mass is zero

Answer: A

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26. Which of the following quantities remain constant in a planatory motion, when seen from the surface of the sun.

A. $K.E.$

B. angular speed

C. speed

D. angular momentum

Answer: D

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27. Average density of earth

A. does not depend on g

B. is a complex function of g

C. is directely proportional to g

D. is inversely proportional to g

Answer: C

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28. A person will ge more quantity of matter in kg-wt at

A. poles

B. a latitude of 60°

C. equator

D. satellite

Answer: C

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29. A pendulum clock which keeps correct time at the surface of the earth is taken into a mine, then

A. it keeps correct time

B. it gains time

C. it loses time

D. none ot these

Answer: C

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30. Two identical trains A and B move with equal speeds on parallel tracks along the equator. A moves from east to west and B moves from west to east. Which train will exert greater force on the track?

A. A

B. B

C. they will exert equal force

D. the mass and the speed of each train must be known to reach a conclusion.

Answer: A

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31. Assuming the earth to be a sphere of uniform density, the acceleration due to gravity

A. at a point outside the earth is inversely proportional to the square of its distance from the centre

B. at a point outside the earth is inversely proportional to its distance from the centre

C. at a point inside is zero

D. at a point inside is inversely proportional to its distance from the centre.

Answer: A

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32. If earth were to rotate faster than its present speed, the weight of an object

A. increases at the equator but remain unchanged at poles

B. decreases at the equator but remain unchanged at the poles

C. remain unchanged at the equator but decreases at the poles

D. remain unchanged at the equator but increases at the poles

Answer: B

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33. The time period of a simple pendulum at the centre of the earth is

A. zero

B. infinite

C. less than zero

D. two second

Answer: B

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34. A body of mass $5kg$ is taken into space. Its mass becomes

A. $5kg$

B. $10kg$

C. $2kg$

D. $30kg$

Answer: A

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35. If the means radius of earth is R, its angular velocity is ω and the acceleration due to gravity at the surface of the earth is g then the cube of the radius of the orbit of a satellite will be

A. $\frac{Rg}{\omega^2}$

B. $\frac{R^2 g}{\omega}$

C. $\frac{R^2 g}{\omega^2}$

D. $\frac{R^2 \omega}{g}$

Answer: C

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36. If $R =$ radius of the earth and $g =$ acceleration due to gravity on the surface of the earth, the acceleration due to gravity at a distance $(r < R)$ from the centre of the earth is proportional to

A. r

B. r^2

C. r^{-2}

D. r^{-1}

Answer: A

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37. If $R =$ radius of the earth and $g =$ acceleration due to gravity on the surface of the earth, the acceleration due to gravity at a distance $(r > R)$ from the centre of the earth is proportional to

A. r

B. r^2

C. r^{-2}

D. r^{-1}

Answer: C

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38. Earth is flattened at poles and bulged at equator. This is due to Tidal waves in the sea are primarily due to

A. revolution of earth around the sun in an elliptical orbit

B. angular velocity of spinning motion about its axis is more at equator

C. centrifugal force is more at equator than poles

D. more centrifugal force at poles than equator

Answer: C

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39. Tidal waves in the sea are primarily due to

A. the gravitational effect of the moon on the earth

B. the gravitational effect of the sun on the earth

C. the gravitational effect of the Venus on the earth

D. the atmospheric effect of the earth itself

Answer: A

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40. Consider earth to be a homogeneous sphere. Scientist A goes deep down in a mine and Scientist B goes high up in a balloon. The gravitational field measured by

A. A goes on decreasing and that of B goes increasing

B. B goes on decreasing and that of A goes increasing

C. Each decreases at the same rate

D. Each decreases at different rates

Answer: D

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41. Intensity of gravitational field inside the hollow spherical shell is

A. Variable

B. minimum

C. maximum

D. zero

Answer: D

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42. The work done by an external agent to shift a point mass from infinity to the centre of the earth is W. Then choose the correct relation.

A. $W = 0$

B. $W > 0$

C. $W < 0$

D. $W \leq 0$

Answer: C

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43. The intensity of the gravitational field of the earth is maximum at

A. centre of earth

B. equator

C. poles

D. same everwhere

Answer: C

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44. Let V_G and E_G denote gravitational potential and field respectively, then choose the wrong statement.

A. $V_G = 0, E_G = 0$

B. $V_G \neq 0, E_G = 0$

C. $V_G = 0, E_G \neq 0$

D. $V_G \neq 0, E_G \neq 0$

Answer: C

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45. Two identical spherical masses are kept at some distance. Potential energy when a mass m is taken from the surface of one sphere to the other

A. increases continuously

B. decreases continuously

C. first increases,then decreases

D. first decreases,then increases

Answer: C

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46. A thin spherical shell of mass M and radius R has a small hole. A particle of mass m released at its mouth. Then

A. the particle will execute $S.H.M$ inside the shell

B. the particle will oscillate inside the shell, but the oscillations are not simple harmonic

C. the particle will not oscillate, but the speed the particle will go on increasing

D. none ot these

Answer: D

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47. The gravitational field is a conservative field. The work done in this field by moving an object from one point to another

A. depends on the end-points only

B. depends on the path along which the object is moved

C. depends on the end-points as well as the path between the points.

D. is not zero when the object is brought back to its initial position.

Answer: A

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48. A hole is drilled through the earth along a diameter and stone is dropped into it. When the stone is at the centre of the earth, it has finite (a) weight (b) acceleration (C) Potential Energy (D) Mass

A. $a\&b$

B. $b\&c$

C. $a, b\&c$

D. $c\&d$

Answer: D

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49. A body has weight (W) on the ground. The work which must be done to lift it to a height equal to the radius of the earth is

A. equal to WR

B. greater than WR

C. less than WR

D. we can't say

Answer: C

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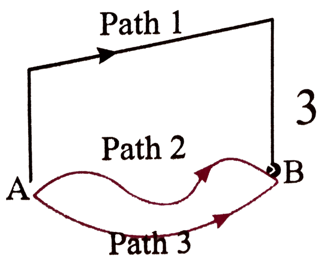
50. A gravitational field is present in a region. A point mass is shifted from A to B, along different paths shown in the figure. If W_1, W_2 and W_3 represent the work done by gravitational force for respective paths, then



3) $W_1 > W_3 > W_2$ 4) none

A. $W_1 = W_2 = W_3$

B. $W_1 > W_2 > W_3$

C. $W_1 > W_3 > W_2$

D. none ot these

Answer: A

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51. The energy requierd to remove an earth satellite of mass m from its orbit of radius r to infinity is

A. $\frac{GMm}{r}$

B. $\frac{-GMm}{2r}$

C. $\frac{GMm}{2r}$

D. $\frac{Mm}{2r}$

Answer: C

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52. A hollow spherical shell is compressed to half its radius. The ggravitational potential at the centre

A. increases

B. decreases

C. remains same

D. during the compression increases then returns to the previous value.

Answer: B

Watch Video Solution

53. For a satellite projected from the earth's surface with a velocity greater than orbital velocity with a nature of the path it takes when its energy is negative, zero and positive respectively is

A. Elliptical,parabolic and hyperbolic

B. Hyperbolic,parabolic and elliptical

C. Elliptrical,circular and parabolic

D. Parabolic,circular and Elliptical

Answer: A

Watch Video Solution

54. If a satellite is moved from one stable circular orbit to a farther stable circular orbit, then the following quantity increases

A. Gravitational force

B. Gravitational $P.E.$

C. linear orbital speed

D. Centripetal acceleration

Answer: B

Watch Video Solution

55. If the universal gravitational constant increases uniformly with time, then a satellite in orbit will still maintain its

A. weight

B. tangential speed

C. period of revolution

D. angular momentum

Answer: D

Watch Video Solution

56. The earth retains its atmosphere, due to

A. the special shape of the earth

B. the escape velocity being greater than the mean

C. the escape velocity being smaller then the mean speed of the molecules of the atmospheric gases.

D. the sun's gravitational effect.

Answer: B

Watch Video Solution

57. Ratio of the radius of a planet A to that of planet B is r. The ratio of acceleration due to gravity for the two planets is x. The ratio of the escape velocities from the two planets is

A. $\sqrt{rx}$

B. $\sqrt{r/x}$

C. $\sqrt{r}$

D. $\sqrt{x/r}$

Answer: A

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58. The ratio of the escape velocity and the orbital velocity is

A. $\sqrt{2}$

B. $\frac{1}{\sqrt{2}}$

C. 2

D. $1/2$

Answer: A

Watch Video Solution

59. The escape velocity from the earth for a rocket is $11.2 km/\sec$. Ignoring the air resistance, the escape velocity of $10 mg$ grain of sand from the earth will be (in $km/\sec$)

A. 0.112

B. 11.2

C. 1.12

D. none

Answer: B

Watch Video Solution

60. The escape velocity for a body projected vertically upwards from the surface of earth is 11km/s. If the body is projected at an angle of 45° with the vertical, the escape velocity will be

A. $11\sqrt{2}km/s$

B. $22km/s$

C. $11km/s$

D. $22\sqrt{2}km/s$

Answer: C

Watch Video Solution

61. A missile is launched with a velocity less than the escape velocity. The sun of its kinetic and potential energy is

A. positive

B. negative

C. zero

D. May be positive or negative depending upon its initial velocity

Answer: B

Watch Video Solution

62. The escape velocity of a body depeds upon mass as

A. m^0

B. m^1

C. m^3

D. m^2

Answer: A

Watch Video Solution

63. The magnitude of potential energy per unit mass of the object at the surface of earth is E. Then escape velocity of the object is

A. $\sqrt{2E}$

B. $4E^2$

C. $\sqrt{E}$

D. $\sqrt{E/2}$

Answer: A

Watch Video Solution

64. A space station is set up in space at a distance equal to the earth's radius from the surface of the earth. Suppose a satellite can be launched from the space station. Let v_1 and v_2 be the escape velocities of the satellite on the earth's surface and space station, respectively. Then

A. $V_2 = V_1$

B. $V_2 < V_1$

C. $V_2 > V_1$

D. no relation

Answer: B

Watch Video Solution

65. The minimum number of geo-stationary satellites required to televise a programme all over the earth is

A. 2

B. 6

C. 4

D. 3

Answer: D

Watch Video Solution

Watch Video Solution

66. When a satellite going around the earth in a circular orbit of radius r and speed v loses some of its energy, then

A. r and v both increases

B. r and v both decreases

C. r will increases and v will decreases

D. r will decreases and v will increases

Answer: D

Watch Video Solution

67. A satellite is orbiting at a certain height in a circular orbit. If the mass of the planet is reduced to half the initial value, the satellite would

A. fall on the planet

B. go to of smaller radius

C. go to orbit of higher radius

D. escape from the planet

Answer: D

Watch Video Solution

68. A satellite is revolving round the earth in an elliptical orbit. Its speed will be

A. same at all points of the orbit

B. different at different points of the orbit

C. maximum at the farthest point

D. minimum at the nearest point

Answer: B

Watch Video Solution

69. An artificial satellite of the earth releases a packet. If air resistance is neglected, the point where the packet will hit, will be

A. ahead

B. exactely below

C. behind

D. it will never reach the earth

Answer: D

Watch Video Solution

70. A satellite is moving in a circular orbit round the earth. If any other planet comes in between them, it will

A. continue to move with the same speed along the same path

B. move with the same velocity tangential to original orbit.

C. Fall down with increasing velocity.

D. come to rest after moving certain distance along original path.

Answer: B

Watch Video Solution

71. A space-ship entering the earth's atmosphere is likely to catch fire. This is due to

A. The surface tension of air

B. the viscocity of air

C. the high temperature of upper atmosphere

D. the greater portion of oxygen in the atmosphere at greater height

Answer: B

Watch Video Solution

72. An astronaut orbiting the earth in a circular orbit $120km$ above the surface of earth, gently drops a ball from the space-ship. The ball will

A. move randomly in space

B. move along with the space-sphip

C. fall vertically down to earth

D. move away from the earth

Answer: B

Watch Video Solution

73. Following physical quantity is constant where a planet that revolves around Sun in an elliptical orbit.

A. kinetic energy

B. potential energy

C. angular momentum

D. linear velocity

Answer: C

Watch Video Solution

74. A satellite launching statian should be

A. Near the equatorial region

B. near the polar region

C. on the polar axis

D. at any place

Answer: A

Watch Video Solution

Watch Video Solution

75. When a satellite in a circular orbit around the earth enters the atmospheric region, it encounters small air resistance to its motion. Then

A. its angular momentum about the earth decreases

B. its kinetic energy decreases

C. its kinetic energy remains constant

D. its period of revolution around the earth increases

Answer: A

Watch Video Solution

76. The period of a satellite moving in a circular orbit near the surface of a planet is independent of

A. mass of the planet

B. radius of the planet

C. mass of the satellite

D. density of planet

Answer: C

Watch Video Solution

77. Out of the following statements, the one which correctly describes a satellite orbiting about the earth is

A. there is no force on the satellite

B. the acceleration and velocity of the satellite are roughly in the same direction.

C. the satellite is always rotating about the earth

D. the satellite must fall, back to earth when fuel is exhusted.

Answer: C

Watch Video Solution

78. When an astronaut goes out of his space-ship into the space he will

A. fall freely on the earth

B. go upwards

C. continue to move along with the satellite in the same orbit.

D. go spiral to the earth

Answer: C

Watch Video Solution

79. When the height of a satellite increases from the surface of the earth.

A. PE decreases,KE increases

B. PE decreases,KE decreases

C. PE increases,KE decreases

D. PE increases,KE increases

Answer: C

Watch Video Solution

80. A satellite S is moving in an elliptical orbit around the earth. The mass of the satellite is very small compared to the mass of the earth.

A. the acceleration of S is always directed towards the centre of the earth

B. the angular momentum of S about the centre of the earth change in direction, but its magnitude remains constant

C. the total mechanical energy of S varies periodically with time

D. the linear momentum of S remains constanta in magnitude

Answer: A

Watch Video Solution

81. If S_1 is surface satellite and S_2 is geostationary satellite, with time periods T_1 and T_2, orbital velocities V_1 and V_2,

A. $T_1 > T_2, V_1 > V_2$

B. $T_1 > T_2, V_1 < V_2$

C. $T_1 < T_2, V_1 < V_2$

D. $T_1 < T_2, V_1 > V_2$

Answer: D

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82. A relay satellite transmits the television programme from one part of the world to another part continuously because its period

A. is greater than period of the earth about its axis

B. is less than period of rotation of the earth about its axis.

C. has no relation with the period of rotation of the earth about its axis

D. is equal to the period of rotation of the earth about its axis.

Answer: D

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83. The following statement is correct about the motion of earth satellite.

A. It is always accelerating towards the earth

B. There is no force acting on the satellite

C. Move away from the earth normallly to the orbit

D. fall down on to the earth

Answer: A

Watch Video Solution

84. An artificial satellite of mass m is revolving round the earth in a circle of radius R. Then work done in one revolution is

A. mgR

B. $\frac{mgR}{2}$

C. $2\pi R \times mg$

D. zero

Answer: D

Watch Video Solution

85. A satellite is revolving round the earth. Its kinetic energy is E_k. How much energy is required by the satellite such that it escapes out of the gravitational field of earth

A. $2E_k$

B. $3E_k$

C. $\frac{E_k}{2}$

D. infinity

Answer: A

Watch Video Solution

86. If the universal gravitational constant increases uniformly with time, then a satellite in orbit will still maintain its

A. weight

B. tangential speed

C. period of revolution

D. angular momentum

Answer: D

Watch Video Solution

87. Two satellites of masses m_1 and $m_2 \left(m_1 > m_2\right)$ are revolving around earth in circular orbits of radii r_1 and $r_2 \left(r_1 > r_2\right)$ respectively. Which of the following statements is true regarding their velocities V_1 and V_2

A. $V_1 = V_2$

B. $V_1 < V_2$

C. $V_1 > V_2$

D. $\frac{V_1}{r_1} = \frac{V_2}{r_2}$

Answer: B

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88. An earth satellite is moved from one stable circular orbit to another larger and stable circular orbit. The following quantities increases for the satellite as a result of this change

A. gravitational potential energy

B. angular velocity

C. linear orbital velocity

D. Centripetal acceleration

Answer: A

Watch Video Solution

89. A satellite is revolving in an elliptical orbit in free space, then the false statement is

A. its mechanical energy is constant

B. its linear momentum is constant

C. its angular momentum is constant

D. its areal velocity is constant

Answer: B

Watch Video Solution

90. When a satellite falls into an orbit of smaller radius its speed

A. decreases

B. increases

C. does not change

D. zero

Answer: B

Watch Video Solution

91. Two artificial satellites are revolving in the same circular orbit. Then they must have the same

A. mass

B. angular momentum

C. kinetic energy

D. period of revolution

Answer: D

Watch Video Solution

92. If satellite is orbiting in space having air and no energy being supplied, then path of that satellite would be

A. circular

B. elliptical

C. spiral of increasing radius

D. spiral of decreasing radius

Answer: D

Watch Video Solution

93. A satellite in vacuum

A. is kept in orbit by solar energy

B. previous energy from gravitational field

C. by remote control

D. no energy is required for revolving

Answer: D

Watch Video Solution

94. Two heavenly bodies $s_1 \& s_2$ not far off from each other, revolve in orbit

A. around their common centre of mass

B. s_1 is fixed and s_2 revolves around s_1

C. s_2 is fixed and s_1 revolves around s_2

D. cannot say

Answer: A

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95. If V, T, L, K and r denote speed, time period, angular momentum, kinetic energy and radius of satellite in circular orbit (a)$V\alpha r^{-1}$,(b) $L\alpha r^{1/2}$ (c)$T\alpha r^{3/2}$,(d) $K\alpha r^{-2}$

A. a, b are true

B. b, c are true

C. a, b, d are true

D. a, b, c are true

Answer: B

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96. Two similar satellites s_1 and s_2 of same mass m possess around completely inelastic collision while orbiting earth in the same circular orbit in opposite direction then

A. total energy of satellite and earth system becomes zero

B. the satellite stick together and fly into space

C. the combined mass falls vertically down

D. the satellite move in opposite direction

Answer: C

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97. For a planet revolving round the sun, when it is nearest to the sun

A. $K.E.$ is min and $P.E.$ is max.

B. both $K.E.$ and $P.E.$ are min

C. $K.E.$ is max. and $P.E.$ is min

D. $K.E.$ and $P.E.$ are equal

Answer: C

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98. A body is dropped from a height equal to radius of the earth. The velocity acquired by it before touching the ground is

A. $V=\sqrt{2gR}$

B. $V=3gR$

C. $V=\sqrt{gR}$

D. $V=2gR$

Answer: C

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99. When projectile attains escape velocity, then on the surface of planet, its

A. $KE > PE$

B. $PE > KE$

C. $KE = PE$

D. $KE = 2PE$

Answer: C

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100. A satellite is moving with constant speed V in a circular orbit around earth. The kinetic energy of the satellite is

A. $\frac{1}{2}mV^2$

B. mV^2

C. $\frac{3}{2}mV^2$

D. $2mV^2$

Answer: A

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101. The orbit of geo-stationary satellite is circular, the time period of satellite dependsd on

A. mass of the Earth

B. radius of the orbit

C. height of the satellite from the surface of Earth

D. all the above

Answer: D

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102. Polar satellites go round the poles of earth in

A. South-east direction

B. north-west direction

C. east-west direction

D. north-south direction

Answer: D

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103. A geo-stationary satellite has an orbital period of

A. 2 hours

B. 6 hours

C. 24 hours

D. 12 hours

Answer: C

Watch Video Solution

104. The time perio of revolution of geo-stationary satellite with respect to earth is

A. $24 hrs$

B. $1yr$

C. infinity

D. zero

Answer: C

Watch Video Solution

105. A synchronous satellite should be at a proper height moving

A. from west to east in equatorial plane

B. from south to north in polar plane

C. from east to west in equatorial plane

D. from north to south in polar plane

Answer: A

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106. The orbital angular velocity vector of a geo-stationary satellite and the spin angular velocity vector of the earth are

A. always in the same direction

B. always in opposite direction

C. always mutually perpendicular

D. inclined at $231/2^\circ$ to each other

Answer: A

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107. It is not possible to keep a geo-stationary satellite over Delhi. Since Delhi

A. is not present in $A.P$

B. is capital of india

C. is not in the equatorial plane of the earth

D. is near Agra.

Answer: C

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108. The angle between the equatorial plane and the orbital plane of a geo-stationary satellite is

A. 45°

B. 0°

C. 90°

D. 60°

Answer: B

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109. The angle between the equatorial plane and the orbital plane of a polar satellite is

A. 45°

B. 0°

C. 90°

D. 60°

Answer: C

Watch Video Solution

110. Pseudo force also called fictitious force such as centrifugal force arises only in

A. Inertial frames

B. Non-inertial frame

C. Both intertial and non-inertial frames

D. Rigid frames

Answer: B

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111. Feeling of weightlessness in a satellite is due to

A. absence of inertia

B. absence of gravity

C. absence of acceleration force

D. free fall of satellite

Answer: D

Watch Video Solution

112. The time period of an earth satellite in circular orbit is independent of

A. the mass of the satellite

B. radius of its orbit

C. both the mass and radius of the orbit

D. neither the mass of the satellite nor the radius of its orbit.

Answer: A

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113. If the earth is at one-fourth of its present distance from the sun, the duration of the year would be

A. half the present year

B. one eighth the present year

C. one fourth the present year

D. one sixteenth the present year

Answer: B

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114. The orbital speed of Jupiter is

A. greater than the orbital speed of earth

B. less than the orbital speed of earth

C. equal to the orbital speed of earth

D. zero

Answer: B

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115. If the area swept by the line joining the sun and the earth from Feb 1 to Feb 7 is A, then the area swept by the radius vector from Feb 8 to Feb 28 is

A. A

B. 2A

C. 3A

D. 4A

Answer: C

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116. Two satellites are revolving around the earth in circular orbits of same radii. Mass of one satellite is 100 times that of the other. Then their periods of revolutions are in the ratio

A. $100 : 1$

B. $1 : 100$

C. $1 : 1$

D. $10 : 1$

Answer: C

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117. According to Kepler's second law, line joining the planet to the sun sweeps out equal areas in equal time intervals. This suggests that for the planet

A. radial acceleration is zero

B. tangential acceleration is zero

C. transverse acceleration is zero

D. All

Answer: C

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118. F_g and F_e represent gravitational and electrostatic force respectively between electrons situated at a distance 10 cm. The ratio of F_g/F_e is of the order of

A. 10^{43}

B. 10^{-43}

C. 10^{35}

D. 10^{-35}

Answer: B

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119. A point mass m is placed inside a spherical shell of radius R and mass M at a distance $\frac{R}{2}$ form the centre of the shell. The gravitational force exerted by the shell on the point mass is

A. $\frac{GMm}{R^2}$

B. $-\frac{GMm}{R^2}$

C. zero

D. $4\frac{GMm}{R^2}$

Answer: C

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120. F_g, F_e and F_n represent the gravitational electro-magnetic and nuclear forces respectively, then arrange the increasing order of their strengths

A. F_n, F_e, F_g

B. F_g, F_e, F_n

C. F_e, F_g, F_n

D. F_g, F_n, F_e

Answer: B

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121. Find the false statement

A. Gravitatioinal force acts along the line joining te two interacting particles

B. Gravitational force is independnet of medium

C. Gravitational force forms an action reaction pair

D. Gravitational force does not obey the principle is superposition.

Answer: D

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122. Law of gravitation is not applicable if (A) Velocity of moving objects are comparable to velocity of light (B) Gravitational field between objectss whose masses are greater than the mass of sun.

A. A is true, B is false

B. A is false, B is true

C. Both A and B are true

D. Both A and B are false

Answer: C

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123. Among the following the wrong statement is

A. Law of gravitation is framed using Newton's third law of motion.

B. Law of gravitation cannot explain why gravity exists

C. Law of gravitation does not explain the presence of force even when the particles are not in physical contact

D. When the range is long, gravitational force becomes repulsive.

Answer: D

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124. Out of the following interactions, weakest is

A. gravitational

B. electromagnetic

C. nuclear

D. electrostatic

Answer: A

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125. Neutron changing into Proton by emitting electron and anti neutrino. This due to

A. Gravitational Force

B. Electromagnetic Force

C. Weak Nuclear Force

D. Strong Nuclear Force

Answer: C

Watch Video Solution

126. Attractive Force exists between two protons inside the Nucleus. This is due to

A. Gravitational Force

B. Electromagnetic Forces

C. Weak Nuclear Force

D. Strong Nuclear Force

Answer: D

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127. Repulsive force exist between two protons out side the nucleus. This is due to

A. Gravitational Forces

B. Electromagnetic Forces

C. Weak Nuclear Force

D. Strong Nuclear Force

Answer: B

Watch Video Solution

128. Radioactive decay exist due to

A. Gravitational Forces

B. Electromagnetic Forces

C. Weak-Nuclear Forces

D. Strong Nuclear Force

Answer: C

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129. Two equal masses separated by a distance d attract each other with a force (F). If one unit of mass is transferred from one of them to the other, the force

A. does not change

B. decreases by $\left(G/d^2\right)$

C. becomes d^2 times

D. increases by $\left(2G/d^2\right)$

Answer: B

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130. Which of the following is the evidence to show that there must be force acting on earth nd directed towards Sun?

A. Apparent motion of sun around the earth

B. Phenomennon of day and night

C. Revolution of earth round the sun

D. Deviation of the falling body towards earth

Answer: C

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131. Six particles each of mass$m$ are placed at the corners of a regular hexagon of edge length a. If a point mass m_0 is placed at the centre of the hexagon, then the net gravitational force on the point mass is

A. $\frac{6Gm^2}{a^2}$

B. $\frac{6Gmm_0}{a^2}$

C. zero

D. $\frac{6Gm}{a^4}$

Answer: C

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132. If suddenly the gravitational force of attraction between earth and satellite revolving around it becomes zero, then the satellite will

A. continue to move in its orbit with same velocity

B. move tangential to the original orbit with the same velocity

C. Becomes stationary in its orbit

D. Move towards the earth

Answer: B

Watch Video Solution

133. If the speed of rotation of earth about its axis increases, then the weight of the body at the equator will

A. increase

B. decrease

C. remains unchanged

D. some times decrease and sometimes increase

Answer: B

Watch Video Solution

134. The ratio of accleration due to gravity at a depth h below the surface of earth and at a height h above the surface of earth for h $< <$ radius of earth:

A. constant only when $h < < R$

B. increases linearly with h

C. increases parabolically with h

D. decreases

Answer: B

Watch Video Solution

135. If the gravitational force of earth suddenly disappears, then

A. weight of the body is zero

B. mass of the body is zero

C. both mass and weight become zero

D. neither the weight nor the mass is zero

Answer: A

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136. Read the following statements :

S_1 : An object shall weigh more at pole than at equator when weighed by using a physical balance.

S_2 : It shall weigh the same at pole and equator when weighed by using a physical balance.

S_3 : It shall weigh the same at pole and equator when weighed by using a spring balance.

S_4 : It shall weigh more at the pole than at equator when weighed using a spring balance.

Which of the above statements is/are correct ?

A. S1 and S2

B. S1 and S4

C. S2 and S3

D. S2 and S4

Answer: D

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137. Average density of the earth

A. does not depend on g

B. is a compled function of g

C. is directly proportional to g

D. is inversely proportional to g

Answer: C

Watch Video Solution

138. A person will ge more quantity of matter in kg-wt at

A. poles

B. a latitude of 60°

C. equator

D. satellite

Answer: C

Watch Video Solution

139. A pendulum clock which keeps correct time at the surface of the earth is taken into a mine, then

A. it keeps correct time

B. it gains time

C. it loses time

D. None of these

Answer: C

Watch Video Solution

140. Two identical trains A and B move with equal speeds on parallel tracks along the equator. A moves from east to west and B moves from west to east. Which train will exert greater force on the track?

A. A

B. B

C. they will exert equal force

D. The mass and the speed of each train must be known to reach a conclusion.

Answer: A

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141. Assuming the earth to be a sphere of uniform density, the acceleration due to gravity

A. at a point outside the earth is inversely proportional to the square of its distance from the centre

B. at a point outside the earth is inversely proportional to its distance from the centre

C. at a point inside is zero

D. at a point inside is inversely proportional to its distance from the centre.

Answer: A

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142. If earth were to rotate faster than its present speed, the weight of an object

A. Increase at the equator but remain uncharged at the poles

B. Decrease at the equator but remain unchanged at the poles

C. Remain unchanged at the equator but decrease at the poles

D. Remain unchanged at the equator but increase at the poles.

Answer: B

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143. The time period of a simple pendulum at the centre of the earth is

A. zero

B. infinite

C. less than zero

D. two second

Answer: B

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144. The radii of two planets are respectively R_1 and R_2 and their densities are respectively ρ_1 and ρ_2.The ratio of the accelerations due to gravity at their surface is

A. $g_1 : g_2 = \frac{\rho_1}{R_1^2} : \frac{\rho_2}{R_2^2}$

B. $g_1 : g_2 = R_1 : R_2$

C. $g_1 : g_2 = \rho_1 : \rho_2$

D. $g_1 : g_2 = R_1\rho_1 : R_2\rho_2$

Answer: D

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145. If the means radius of earth is R, its angular velocity is ω and the acceleration due to gravity at the surface of the earth is g then the cube of the radius of the orbit of a satellite will be

A. $\frac{Rg}{\omega^2}$

B. $\frac{R^2g}{\omega}$

C. $\frac{R^2g}{\omega^2}$

D. $\frac{R^2\omega}{g}$

Answer: C

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146. If $R =$ radius of the earth and $g =$ acceleration due to gravity on the surface of the earth, the acceleration due to gravity at a distance $(r < R)$ from the centre of the earth is proportional to

A. r

B. r^2

C. r^{-2}

D. r^{-1}

Answer: A

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147. If $R =$ radius of the earth and $g =$ acceleration due to gravity on the surface of the earth, the acceleration due to gravity at a distance $(r > R)$ from the centre of the earth is proportional to

A. r

B. r^2

C. r^{-2}

D. r^{-1}

Answer: C

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148. Earth is flattened at the poles and budges at the eqator. This is due to the fact that

A. revolution of earth around the sun in an elliptical orbit

B. angular velocity of spinning motion about its axis is more at equator

C. centrifugal force is more at equator than poles

D. more centrifugal force at poles than equator

Answer: C

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149. Tidal waves in the samea are primarily due to

A. the gravitational effect of the moon on the earth

B. the gravitational effect of the sun on the earth

C. the gravitational effect of the Venus on the earth

D. The atmosphere effect of the earth itself

Answer: A

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150. Consider earth to be a homogeneous sphere. Scientist A goes deep down in a mine and Scientist B goes high up in a balloon. The gravitational field measured by

A. A goes on decreasing and that of B goes on increasing

B. B goes on decreasing and that of A goes on increasing

C. Each decreases at the same rate

D. Each decreases at different rates.

Answer: D

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151. Intensity of gravitational field inside the hollow spherical shell is

A. Variable

B. Minimum

C. Maximum

D. zero

Answer: D

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152. The work done by an external agent to shift a point mass from infinity to the centre of the earth is W. Then choose the correct relation.

A. $W = 0$

B. $W > 0$

C. $W < 0$

D. $W \leq 0$

Answer: C

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153. The intensity of the gravitational field of the earth is maximum at

A. centre of earth

B. equator

C. poles

D. same everywhere

Answer: C

Watch Video Solution

154. Let V_G and E_G denote gravitational potential and field respectively, then choose the wrong statement.

A. $V_G = 0, E_g = 0$

B. $V_G \neq 0, E_G = 0$

C. $V_G = 0, E_G \neq 0$

D. $V_G \neq 0, E_G \neq 0$

Answer: C

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155. Two identical spherical masses are kept at some distance. Potential energy when a mass m is taken from the surface of one sphere to the other

A. increases continuously

B. decreases continuoulsy

C. first increases, then decreases

D. first decreases, then increases

Answer: C

Watch Video Solution

156. A thin spherical shell of mass M and radius R has a small hole. A particle of mass m released at its mouth. Then

A. the particle will executes S.H.M inside the shell

B. The particle will oscillate inside the shell, but the oscillations are not simple harmonic

C. The particle will not oscillate, but the speed of the particle will go on increases

D. none of these

Answer: D

Watch Video Solution

157. The gravitational field is a conservative field. The work done in this field by moving an object from one point to another

A. depends on the end points only

B. depends on the path along which the object is moved

C. depends on te end points as well as the path between the points.

D. is not zero when the object is brought bacl to its initial position.

Answer: A

Watch Video Solution

158. A hole is drilled through the earth along a diameter and stone is dropped into it. When the stone is at the centre of the earth, it has finite (a) weight (b) acceleration (C) Potential Energy (D) Mass

A. a and b

B. b and c

C. a,b and c

D. c and d

Answer: D

Watch Video Solution

159. A body has weight (W) on the ground. The work which must be done to lift it to a height equal to the radius of the earth is

A. equal to WR

B. greater than WR

C. less than WR

D. we can't say

Answer: C

Watch Video Solution

160. The energy requierd to remove an earth satellite of mass m from its orbit of radius r to infinity is

A. $\frac{GMm}{r}$

B. $\frac{-GMm}{2r}$

C. $\frac{GMm}{2r}$

D. $\frac{Mm}{2r}$

Answer: C

Watch Video Solution

161. A hollow spherical shell is compressed to half its radius. The gravitational potential at the centre

A. increases continuously

B. decreases

C. remains same

D. during the compression increases then returns to the previous value.

Answer: B

Watch Video Solution

162. For a satellite projected from the earth's surface with a velocity greater than orbital velocity with a nature of the path it takes when its energy is negative, zero and positive respectively is

A. Elliptical, parabolic and hyperbolic

B. Hyperbolic, parabolic and elliptical

C. Elliptical, circular and parabolic

D. Parabolic, circular and Elliptical

Answer: A

Watch Video Solution

163. If a satellite is moved from one stable circular orbit to a farther stable circular orbit, then the following quantity increases

A. Gravitational force

B. Gravitational P.E.

C. Linear orbital speed

D. Centrepetal acceleration.

Answer: B

Watch Video Solution

164. If the universal gravitational constant increases uniformly with time, then a satellite in orbit will still maintain its

A. weight

B. tangential speed

C. period of revolution

D. angular moment

Answer: D

Watch Video Solution

165. The earth retains its atmosphere, due to

A. the special shape of the arth

B. the escape velocity being greater than the mean speed of he molecules of the atmosphere gases.

C. the escape velocity being smaller than the mean speed of the molecules of the atmospheric gases.

D. The sun's gravitational effect.

Answer: B

Watch Video Solution

166. Ratio of the radius of a planet A to that of planet B is r. The ratio of acceleration due to gravity for the two planets is x. The ratio of the escape velocities from the two planets is

A. $\sqrt{rx}$

B. $\sqrt{r/x}$

C. $\sqrt{R}$

D. $\sqrt{x/r}$

Answer: A

Watch Video Solution

167. The ratio of the escape velocity and the orbital velocity is

A. $\sqrt{2}$

B. $\frac{1}{\sqrt{2}}$

C. 2

D. $1/2$

Answer: A

Watch Video Solution

168. The escape velocity from the earth for a rocket is $11.2km/\sec$. Ignoring the air resistance, the escape velocity of $10mg$ grain of sand from the earth will be (in $km/\sec$)

A. 0.112

B. 11.2

C. 1.12

D. None of these

Answer: B

Watch Video Solution

169. The escape velocity for a body projected vertically upwards from the surface of earth is 11 km/s. If the body is projected at an angle of 45° with the vertical, the escape velocity will be

A. $11\sqrt{2}$ km/s

B. $22 km/s$

C. $11km/s$

D. $22\sqrt{2}km/s$

Answer: C

Watch Video Solution

170. A missile is launched with a velocity less than the escape velocity. The sum of its kinetic and potential energy is

A. Positive

B. Negative

C. Zero

D. May be positive or negative depending upon its initial velocity.

Answer: B

Watch Video Solution

171. The escape velocity of a body depeds upon mass as

A. m°

B. m^{1}

C. m^3

D. m^2

Answer: A

Watch Video Solution

172. The magnitude of potential energy per unit mass of the object at the surface of earth is E. Then escape velocity of the object is

A. $\sqrt{2E}$

B. $4E^2$

C. $\sqrt{E}$

D. $\sqrt{E/2}$

Answer: A

Watch Video Solution

173. A space station is set up in space at a distance equal to the earth's radius from the surface of the earth. Suppose a satellite can be launched from the space station. Let v_1 and v_2 be the escape velocities of the satellite on the earth's surface and space station, respectively. Then

A. $V_2 = V_1$

B. $V_2 < V_1$

C. $V_2 > V_1$

D. No relation

Answer: B

Watch Video Solution

174. The minimum number of geo-stationary satellites required to televise a programme all over the earth is

A. 2

B. 6

C. 4

D. 3

Answer: D

Watch Video Solution

175. When a satellite going around the earth in a circular orbit of radius r and speed v loses some of its energy, then

A. r and v both increase

B. r and v body decreases

C. r will increase and v will decrease

D. r will decrease and v will increase

Answer: D

Watch Video Solution

176. A satellite is orbiting at a certain height in a circular orbit. If the mass of the planet is reduced to half the initial value, the satellite would

A. fall on the planet

B. go to orbit of smaller radius

C. go to orbit of higher radius

D. escape from the planet

Answer: D

Watch Video Solution

177. A satellite is revolving round the earth in an elliptical orbit. Its speed will be

A. Same at all points of the orbit

B. different at different points of the orbit

C. maximum at the farthest point

D. minimum at the nearest point.

Answer: B

Watch Video Solution

178. An artificial satellite of the earth releases a packet. If air resistance is neglected, the point where the packet will hit, will be

A. ahead

B. exactly below

C. behind

D. it will never reach the earth

Answer: D

Watch Video Solution

179. A satellite is moving in a circular orbit round the earth. If any other planet comes in between them, it will

A. Continue to move with the same speed along the same path

B. Move with the same velocity tangential to original orbit.

C. Fall down with increasing velocity.

D. Come to rest after moving certain distance along original path.

Answer: B

Watch Video Solution

180. A space-ship entering the earth's atmosphere is likely to catch fire. This is due to

A. The surface tension of air

B. The viscosity of air

C. The high temperature of upper atmosphere

D. The greater portion of oxygen in the atmosphere at greater height.

Answer: B

Watch Video Solution

181. An astronaut orbiting the earth in a circular orbit $120 km$ above the surface of earth, gently drops a ball from the space-ship. The ball will

A. Move randimly in space

B. Move along with the space ship

C. Fail vertically down to earth

D. Move away from the earth

Answer: B

Watch Video Solution

182. Following physical quantity is constant where a planet that revolves around Sun in an elliptical orbit.

A. Kinetic energy

B. Potnetial energy

C. Angular momentum

D. Linear velocity

Answer: C

Watch Video Solution

183. A satellite launching statian should be

A. Near the equatorial region

B. Near the polar region

C. On the polar axis

D. At any place

Answer: A

Watch Video Solution

Watch Video Solution

184. When a satellite in a circular orbit around the earth enters the atmospheric region, it encounters small air resistance to its motion. Then

A. Its angular momentum about the earth decreases

B. its kinetic energy decreases

C. its kinetic energy remains constant

D. its period of revolution around the eargh increases

Answer: A

Watch Video Solution

185. The period of a satellite moving in a circular orbit near the surface of a planet is independent of

A. mass of the planet

B. radius of the palnet

C. mass of the satellite

D. density of planet

Answer: C

Watch Video Solution

186. Out of the following statements, the one which correctly describes a satellite orbiting about the earth is

A. There is no force acting on the satelite

B. The acceleration and velocity of the satellite are roughly in the same direction

C. The satellite is always acceleration about the earth

D. The satellite must fall, back to earth when its fuel is exhausted.

Answer: C

Watch Video Solution

187. When an astronaut goes out of his space-ship into the space he will

A. Fall freely on the earth

B. Go upwards

C. Continue to move along with the satellite in the same orbit.

D. Go spiral to the earth

Answer: C

Watch Video Solution

188. When the height of a satellite increases from the surface of the earth.

A. PE decreases, KE increases

B. PE decreases, KE decreases

C. PE increases, KE decreases

D. PE increases, KE increases

Answer: C

Watch Video Solution

189. A satellite S is moving in an elliptical orbit around the earth. The mass of the satellite is very small compared to the mass of the earth.

A. the acceleration of S is always directed towards the centre of the earth

B. the angular momentum of S about the centre of te earth changes in direction, but its magnitude remains constant

C. the total mechanical energy of S varies periodcally with time

D. the linear momentum of S remains constnat in magnitude

Answer: A

Watch Video Solution

190. If S_1 is surface satellite and S_2 is geostationary satellite, with time periods T_1 and T_2, orbital velocities V_1 and V_2

A. $T_1 > T\left(\_(2), V_1 > V_2\right.$

B. $T_2 > T_2, V_1 < V_2$

C. $T_1 < T_2, V_1 < V_2$

D. $T_1 < T_2, V_1 > V_2$

Answer: D

Watch Video Solution

191. A relay satellite transmits the television programme from one part of the world to another part continuously because its period

A. is greater than period of the earth about its axis

B. isless than period of rotation of thearth about its axis.

C. has no relation with the period of rotation of theearth about its axis.

D. is equal to the period of rotation of the earth about its axis.

Answer: D

Watch Video Solution

192. The following statement is correct about the motion of earth satellite.

A. It is always accelerating towards the earth

B. There is no force acting on the satellite

C. Move away from the earth normally to the orbit

D. Fall down on the earth

Answer: A

Watch Video Solution

193. An artificial satellite of mass m is revolving round the earth in a circle of radius R. Then work done in one revolution is

A. mgR

B. $\frac{mgR}{2}$

C. $2\pi R \times mg$

D. Zero

Answer: D

Watch Video Solution

194. A satellite is revolving round the earth. Its kinetic energy is E_k. How much energy is required by the satellite such that it escapes out of the gravitational field of earth

A. $2E_k$

B. $3E_k$

C. $\frac{E_k}{2}$

D. Infinity

Answer: A

Watch Video Solution

195. If the universal gravitational constant increases uniformly with time, then a satellite in orbit will still maintain its

A. weight

B. tangential speed

C. period of revolution

D. angular moment

Answer: D

Watch Video Solution

196. Two satellites of masses of m_1 and $m_2\left(m_1 > m_2\right)$ are revolving round the earth in circular orbits of radius r_1 and $r_2\left(r_1 > r_2\right)$ respectively. Which of the following statements is true regarding their speeds v_1 and v_2?

A. $V_1 = V_2$

B. $V_1 < V_2$

C. $V_1 > V_2$

D. $\frac{V_1}{r_1} = \frac{V_2}{r_2}$

Answer: B

Watch Video Solution

197. An earth satellite is moved from one stable circular orbit to another larger and stable circular orbit. The following quantities increases for the satellite as a result of this change

A. gravitational potential energy

B. angular velocity

C. linear orbital velocity

D. centripetal acceleration

Answer: A

198. A satellite is revolving in an elliptical orbit in free space, then the false statement is

A. its mechanicla energy is constant

B. its linear momentum is constant

C. its angular moment is constant

D. its areal velocity is constant

Answer: B

199. When a satellite falls into an orbit of smaller radius its speed

A. decreases

B. increases linearly with h

C. does not change

D. zero

Answer: B

Watch Video Solution

200. Two artificial satellites are revolving in the same circular orbit. Then they must have the same

A. mass

B. Angular momentum

C. Kinetic energy

D. Period of revolution

Answer: D

Watch Video Solution

201. If satellite is orbiting in space having air and no energy being supplied, then path of that satellite would be

A. circular

B. elliptical

C. spiral of increasing radius

D. sprial of decreasing radius

Answer: D

Watch Video Solution

202. A satellite in vacuum

A. is kept in orbit by solar energy

B. previous energy from gravitational field

C. by remote control

D. no energ is required for revolving.

Answer: D

Watch Video Solution

203. Two heavenly bodies $s_1 \& s_2$ not far off from each other, revolve in orbit

A. around their common centre of mass

B. s_1 is fixed and s_2 revolves around s_1

C. s_2 is fixed and s_1 revolves around s_2

D. cannot say

Answer: A

Watch Video Solution

204. If V, T, L, K and r denote speed, time period, angular momentum, kinetic energy and radius of satellite in circular orbit (a)$V\alpha r^{-1}$,(b) $L\alpha r^{1/2}$ $(c)T\alpha r^{3/2}$,(d) $K\alpha r^{-2}$

A. a,b are true

B. b,c are true

C. a,b,d are true

D. a,b,c are true

Answer: B

Watch Video Solution

205. Two similar satellites s_1 and s_2 of same mass m possess around completely inelastic collision while orbiting earth in the same circular orbit in opposite direction then

A. total energy of satellites and earth system become zero

B. the satellites stick together and fly into space

C. the combined mass falls vertically down

D. the satellite move in opposite direction

Answer: C

Watch Video Solution

206. For a planet revolving round the sun, when it is nearest to the sun

A. K.E. ismin and P.E. is max

B. Both K.E and P.E. are min

C. K.E is max and P.E. is min

D. K.E and P.E are equal

Answer: C

Watch Video Solution

207. A body is dropped from a height equal to radius of the earth. The velocity acquired by it before touching the ground is

A. $V = \sqrt{2gR}$

B. $V = 3gR$

C. $V = \sqrt{gR}$

D. $V = 2gR$

Answer: C

Watch Video Solution

208. When projectile attains escape velocity, then on the surface of planet, its

A. $KE > PE$

B. $PE > KE$

C. $KE = PE$

D. $KE = 2PE$d

Answer: C

Watch Video Solution

209. A satellite moves around the earth in a circular orbit with speed v. If m is the mass of the satellite, its total energy is

A. $-\frac{1}{2}mV^2$

B. mv^2

C. $\frac{1}{2}mV^2$

D. $2mV^2$

Answer: A

Watch Video Solution

210. The orbit of geo-stationary satellite is circular, the time period of satellite depended on

A. mass of the Earth

B. radius of the orbit

C. height of the satellite from the surface of Earth

D. all the above

Answer: D

Watch Video Solution

211. Polar satellites go round the poles of earth in

A. South -east direction

B. north-west direction

C. east-west direction

D. north-south direction

Answer: D

Watch Video Solution

212. A geo-stationary satellite has an orbital period of

A. 2 hours

B. 6 hours

C. 4 hours

D. 12 hours

Answer: C

Watch Video Solution

213. The time period of revolution of geo-stationary satellite with respect to earth is

A. 24 hrs

B. 1 year

C. Infinity

D. zero

Answer: C

Watch Video Solution

214. A synchronous satellite should be at a proper height moving

A. From west to East in equatorial plane

B. From south to North in polar plane

C. From east to west in equatorial plane

D. From north to South in polar plane

Answer: A

Watch Video Solution

215. The orbital angular velocity vector of a geo-stationary satellite and the spin angular velocity vector of the earth are

A. always in the same direction

B. always in opposite direction

C. always mutually perpendicular

D. inclined at $231/2^{\circ}$ to each other

Answer: A

Watch Video Solution

216. It is not possible to keep a geo-stationary satellite over Delhi. Since Delhi

A. is not present in A.P

B. is capital of India

C. is not in the equatorial plane of the earth

D. is near Agra.

Answer: C

Watch Video Solution

217. The angle between the equatorial plane and the orbital plane of a geo-stationary satellite is

A. 45°

B. 0°

C. 90°

D. 60°

Answer: B

Watch Video Solution

218. The angle between the equatorial plane and the orbital plane of a polar satellite is

A. 45°

B. 0°

C. 90°

D. 60°

Answer: C

Watch Video Solution

219. Pseudo force also called fictitious force such as centrifugal force arises only in

A. Inertial frames

B. Non inertial frames

C. Both inertial and non inertial frames

D. Rigid frames

Answer: B

Watch Video Solution

220. Feeling of weightlessness in a satellite is due to

A. absence of inertia

B. absence of gravity

C. absence of accelerating force

D. free fall of satellite

Answer: D

Watch Video Solution

LEVEL I(C.W.)

1. If $'A'$ is areal velocity of a planet of mass M, its angular momentum is

A. M/A

B. $2MA$

C. A^2M

D. AM^2

Answer: B

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2. A planet revolves round the sun in an elliptical orbit of semi minor and semi major axes x and y respectively. Then the time period of revolution is proportional to

A. $(x + y)^{\frac{3}{2}}$

B. $(y - x)^{\frac{3}{2}}$

C. $x^{\frac{3}{2}}$

D. $y^{\frac{3}{2}}$

Answer: D

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3. Let $'A'$ be the area swept by the line joining the earth and the sun during Feb 2012. The area swept by the same line during the first week of that month is

A. $A/4$

B. $7A/29$

C. A

D. $7A/30$

Answer: B

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4. A satellite moving in a circular path of radius r around earth has a time period T. If its radius slightly increases by 4%, then percentage change in its time period is

A. 1%

B. 6%

C. 3%

D. 9%

Answer: B

Watch Video Solution

5. The time of revolution of planet A round the sun is 8 times that of another planet B. The distance of planet A from the sun is how many B from the sun

A. 2

B. 3

C. 4

D. 5

Answer: C

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6. The distance of Neptune and Saturn from the Sun are respectively 10^{13} and 10^{12} meters and their periodic times are respectively T_n and T_s. If their orbits are circular, then the value of T_n / T_s is

A. 100

B. $10\sqrt{10}$

C. $\frac{1}{10\sqrt{10}}$

D. 10

Answer: B

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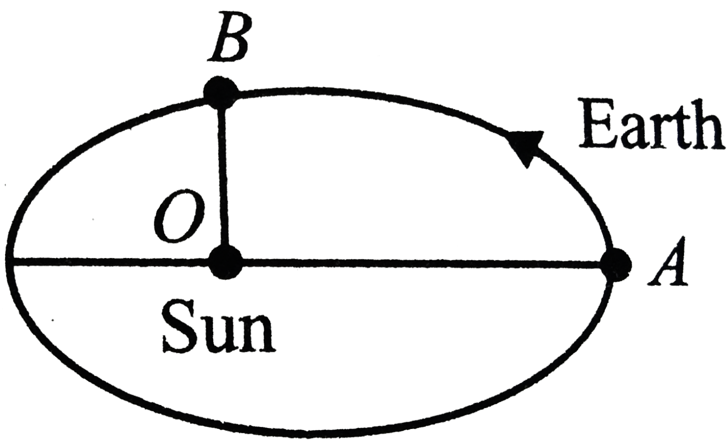
7. The earth moves around the Sun in an elliptical orbit as shown in Fig. The ratio $OA/OB = x$. The ratio of the speed of the earth at B to that at A is nearly



A. $\sqrt{x}$

B. x

C. $x\sqrt{x}$

D. x^2

Answer: B

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8. The period of moon's rotation around the earth is approx. 29 days. IF moon's mass were 2 fold its present value and all other things remain unchanged, the period of Moon's rotation would be nearly

A. $29\sqrt{2}$

B. $29/\sqrt{2}$

C. $29\sqrt{3}$

D. 29

Answer: D

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9. If the mass of earth were 2 times the present mass, the mass of the moon were half the present mass and the moon were revolving round the earth at the same present distance, the time period of revolution of the moon would be (in day)

A. 56

B. 28

C. $14\sqrt{2}$

D. 7

Answer: C

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10. Two sphere of masses m and M are situated in air and the gravitational force between them is F. The space around the masses in now filled with a liquid of specific gravity 3. The gravitational force will now be

A. $\frac{F}{9}$

B. $3F$

C. F

D. $\frac{F}{3}$

Answer: C

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11. The gravitational force between two bodies is $6.67 \times 10^{-7} N$ when the distance between their centres is $10m$. If the mass of first body is $800kg$, then the mass of second body is

A. $1000kg$

B. $1250kg$

C. $1500kg$

D. $2000kg$

Answer: B

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12. Two identical spheres each of radius R are placed with their centres at a distance nR, where n is integer greater than 2. The gravitational force between them will be proportional to

A. $1/R^4$

B. $1/R^2$

C. R^2

D. R^4

Answer: D

Watch Video Solution

13. A satellite is orbiting around the earth. If both gravitational force and centripetal force on the satellite is F, then, net force acting on the satellite to revolve around the earth is

A. $F/2$

B. F

C. $2F$

D. zero

Answer: B

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14. Mass $M = 1$ unit is divided into two parts X and $(1 - X)$. For a given separation the value of X for which the gravitational force between them becomes maximum is

A. $1/2$

B. $3/5$

C. 1

D. 2

Answer: A

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15. If g on the surface of the earth is $9.8m/s^2$, its value at a height of $6400km$ is (Radius of the earth $= 6400km$)

A. $4.9ms^{-2}$

B. $9.8ms^{-2}$

C. $2.45ms^{-2}$

D. $19.6ms^{-2}$

Answer: C

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16. If g on the surface of the earth is $9.8m/s^2$, its value at a depth of $3200km$ is (Radius of the earth $= 6400km$) is

A. $9.8ms^{-2}$

B. zero

C. $4.9ms^{-2}$

D. $2.45ms^{-2}$

Answer: C

Watch Video Solution

17. If mass of the planet is 10% less than that of the earth and radius of the planet is 20% greater than that of the earth then the weight of $40kg$ person on that planet is

A. $10kgwt$

B. $25kgwt$

C. $40kgwt$

D. $60kgwt$

Answer: B

Watch Video Solution

18. The angular velocity of the earth with which it has to rotate so that the acceleration due to gravity on 60° latitude becomes zero is

A. $2.5 \times 10^{-3} rads^{-1}$

B. $1.5 \times 10^{-3} rads^{-1}$

C. $4.5 \times 10^{-3} rads^{-1}$

D. $0.5 \times 10^{-3} rads^{-1}$

Answer: A

Watch Video Solution

19. Assume that the acceleration due to gravity on the surface of the moon is 0.2 times the acceleration due to gravity on the surface of the earth. If R_e is the maximum range of a projectile on the earth's surface, what is the maximum range on the surface of the moon for the same velocity of projection

A. $0.2R_e$

B. $2R_e$

C. $0.5R_e$

D. $5R_e$

Answer: D

Watch Video Solution

20. The value of acceleration due to gravity on the surface of earth is x. At an altitude of h from the surface of the earth, its value is y. If R is the radius of earth, then the value of h is

A. $\left(\sqrt{\frac{x}{y}} - 1\right)R$

B. $\left(\sqrt{\frac{y}{x}} - 1\right)R$

C. $\sqrt{\frac{y}{x}}R$

D. $\sqrt{\frac{x}{y}}R$

Answer: A

Watch Video Solution

21. The point at which the gravitational force acting on any mass is zero due to the earth and the moon system is (The mass of the earth is approximately 81 times the mass of the moon and the distance between the earth and the moon is $3, 85, 000km$).

A. $36, 000km$ from the moon

B. $38, 500km$ from the moon

C. $34500km$ from the moon

D. $30, 000km$ from the moon

Answer: B

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22. Masses $2kg$ and $8kg$ are $18cm$ apart. The point where the gravitational field due to them is zero, is

A. $6cm$ from $8kg$ mass

B. $6cm$ from $2kg$ mass

C. $1.8cm$ from $8kg$ mass

D. $9cm$ from each mass

Answer: B

Watch Video Solution

23. Particles of masses m_1 and m_2 are at a fixed distance apart. If the gravitational field strength at m_1 and m_2 are $\vec{I}_1$ and $\vec{I}_2$ respectively. Then,

A. $m_1\vec{I}_1 + m_2\vec{I}_2 = 0$

B. $m_1\vec{I}_2 + m_2\vec{I}_1 = 0$

C. $m_1\vec{I}_1 - m_2\vec{I}_2 = 0$

D. $m_1\vec{I}_2 - m_2\vec{I}_1 = 0$

Answer: A

Watch Video Solution

24. The PE of three objects of masses $1kg$, $2kg$ and $3kg$ placed at the three vertices of an equilateral triangle of side $20cm$ is

A. $25G$

B. $35G$

C. $45G$

D. $55G$

Answer: D

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25. A small body is initially at a distance r from the centre of earth. r is greater than the radius of the earth. If it takes W joule of work to move the body from this position to another position at a distance $2r$ measured from the centre of earth, how many joule would be required to move it from this position to a new position at a distance of $3r$ from the centre of the earth.

A. $W/5$

B. $W/3$

C. $W/2$

D. $W/6$

Answer: B

Watch Video Solution

26. A body of mass 'm' is raised from the surface fo the earth to a height 'nR'(R-radius of the earth). Magnitude of the change in the gravitational potential energy of the body is (g-acceleration due to gravity on the surface of the earth)

A. $\left(\frac{n}{n+1}\right)mgR$

B. $\left(\frac{n-1}{n}\right)mgR$

C. $\frac{mgR}{n}$

D. $\frac{mgR}{(n-1)}$

Answer: A

Watch Video Solution

27. A person brings a mass $2kg$ from A to B. The increase in kinetic energy of mass is $4J$ and work done by the person on the mass is $-10J$. The potential difference between B and A is ......J/kg

A. 4

B. 7

C. -3

D. -7

Answer: D

Watch Video Solution

28. The work done liftting a particle of mass 'm' from the centre of the earth to the surface of the earth is

A. $-mgR$

B. $\frac{1}{2}mgR$

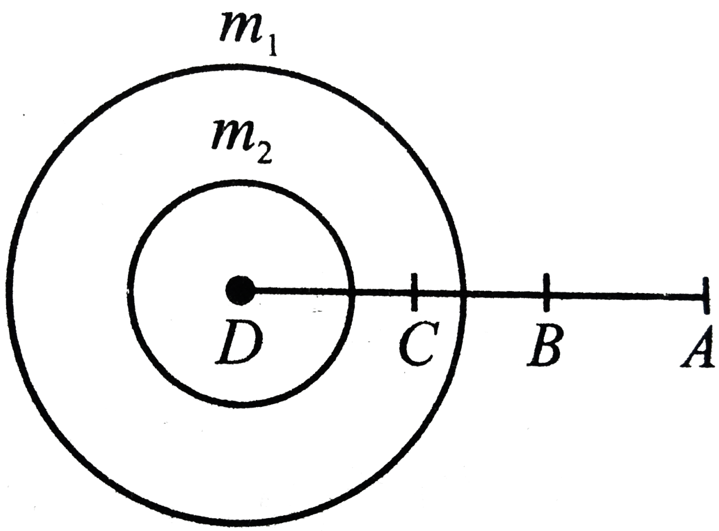
C. Zero

D. mgR

Answer: B

Watch Video Solution

29. Figure shows two shells of masses m_1 and m_2. The shells are concentric. At which point, a particle of mass m shall experience zero force?



A. A

B. B

C. C

D. D

Answer: D

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30. Energy required to move a body of mass m from an orbit of radius 2R to 3R is

A. $\frac{GMm}{12R}$

B. $\frac{GMm}{3R^2}$

C. $\frac{GMm}{8R}$

D. $\frac{GMm}{6R}$

Answer: A

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31. the ratio of escape velocities of two planets if g value on the two planets are $9.9m/s^2$ and $3.3m/s^2$ and there are $6400km$ and $3200km$ respectively is

A. $2.36:1$

B. $1.36:1$

C. $3.36:1$

D. $4.36:1$

Answer: A

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32. The escape velocity from the surface of the earth of radius R and density ρ

A. $2R\sqrt{\frac{2\pi\rho G}{3}}$

B. $2\sqrt{\frac{2\pi\rho G}{3}}$

C. $2\pi\sqrt{\frac{R}{g}}$

D. $\sqrt{\frac{2\pi G\rho}{R^2}}$

Answer: A

Watch Video Solution

33. A body is projected vertically up from surface of the earth with a velocity half of escape velocity. The ratio of its maximum height of ascent and radius of earth is

A. $1:1$

B. $1:2$

C. $1:3$

D. $1:4$

Answer: C

Watch Video Solution

34. A spaceship is launched in to a circular orbit of radius R close to surface of earth. The additional velocity to be imparted to the spaceship in the orbit to overcome the earth's gravitational pull is (g=acceleration due to gravity)

A. $1.414 Rg$

B. $1.414\sqrt{Rg}$

C. $0.414 Rg$

D. $0.414\sqrt{gR}$

Answer: D

Watch Video Solution

35. The escape velocity from the earth is $11 km/s$. The escape velocity from a planet having twice the radius and same density as that of the earth is (in km/s)

A. 22

B. 15.5

C. 11

D. 5.5

Answer: A

Watch Video Solution

36. An object of mass m is at rest on earth's surface. Escape speed of this object is V_e. Same object is orbiting the earth with $h = R$, then escape speed is V_e^1. Then

A. $V_e^1 = \dfrac{V_e}{4}$

B. $V_e = 2V_e^1$

C. $V_e = \sqrt{2}V_e^1$

D. $V_e^1 = \sqrt{2}V_e$

Answer: D

Watch Video Solution

37. A satellite revolves in a circular orbit with speed, $V = \frac{1}{\sqrt{3}}V_e$. If satellite is suddenly stopped and allowed to fall freely onto the earth, the speed with which it hits the earth's surface is

A. $\sqrt{gR}$

B. $\sqrt{\frac{gR}{3}}$

C. $\sqrt{2gR}$

D. $\sqrt{\frac{2}{3}gR}$

Answer: D

Watch Video Solution

38. A space station is set up in space at a distance equal to the earth's radius from the surface of the earth. Suppose a satellite can be launched from the space station. Let v_1 and v_2 be the escape velocities of the satellite on the earth's surface and space station, respectively. Then

A. $v_2 = v_1$

B. $v_2 < v_1$

C. $v_2 > v_1$

D. $1, 2$ and 3 are valid depending on the mass of satellite.

Answer: B

Watch Video Solution

39. The orbital speed for an earth satellite near the surface of the earth is $7km/\sec$. If the radius of the orbit is 4 times the radius of the earth, the orbital speed would be

A. $3.5 km/s$

B. $7 km/s$

C. $7\sqrt{2} km/s$

D. $14 km/s$

Answer: A

Watch Video Solution

40. Two satellite are revolving round the earth at different heights. The ratio of their orbital speeds is $2:1$. If one of them is at a height of the other satellite is (in km)

A. 19600

B. 24600

C. 29600

D. 14600

Answer: A

Watch Video Solution

41. A satellite of mass m revolves around the earth of radius R at a hight x from its surface. If g is the acceleration due to gravity on the surface of the earth, the orbital speed of the satellite is

A. gx

B. $\frac{gR^2}{R + x}$

C. $\frac{gR^2}{R + x}$

D. $\frac{gR}{R - x}$

Answer: B

Watch Video Solution

42. Two satellites M and N go around the earth in circular orbits at heights of R_M and R_N respectively from the surrface of the earth. Assuming the earth to be a uniform sphere of radius R_E, the ratio of velocities of the satellites $\frac{V_M}{V_N}$ is

A. $\left(\frac{R_M}{R_N}\right)^2$

B. $\sqrt{\frac{R_N + R_E}{R_M + R_E}}$

C. $\frac{R_N + R_E}{R_M + R_E}$

D. $\sqrt{\frac{R_N}{R_M}}$

Answer: B

Watch Video Solution

43. A satellite of mass m revolves revolves round the earth of mass M in a circular orbit of radius r with an angular velocity ω. If the angular velocity is $\omega/8$ then the radius of the orbit will be

A. $4r$

B. $2r$

C. $8r$

D. r

Answer: A

Watch Video Solution

44. The moon revolves round the earth 13 times in one year. If the ratio of sun-earth distance to earth-moon distance is 392, then the ratio of masses of sun and earth will be

A. 365

B. 356×10^{-12}

C. 3.56×10^{5}

D. 1

Answer: C

Watch Video Solution

45. A satellite is launched into a circular orbit of radius R around the earth. While a second is lunched into an orbit of radius $1.01R$ The period of the second satellite is longer than the first one by approximately:

A. 0.5%

B. 1.5%

C. 1%

D. 3%

Answer: B

Watch Video Solution

46. An astronaut orbiting in a spaceship round the earth has a centripetal acceleration of

$2.45 m/s^2$. The height of spaceship from earth's surface is (R=radius of earth)

A. $3R$

B. $2R$

C. R

D. $R/2$

Answer: C

Watch Video Solution

47. A satellite moves around the earth in a circular orbit with speed v. If m is the mass of the satellite, its total energy is

A. $\frac{1}{2}mv^2$

B. mv^2

C. $-\frac{1}{2}mv^2$

D. $\frac{3}{2}mv^2$

Answer: C

Watch Video Solution

48. The $K.E.$ of a satellite in an orbit close to the surface of the earth is E. Its max $K.E.$ so as to escape from the gravitational field of the earth is

A. $2E$

B. $4E$

C. $2\sqrt{2}$

D. $\sqrt{2}E$

Answer: A

Watch Video Solution

49. Two satellite of masses $400kg, 500kg$ are revolving around earth in different circular orbits of radii r_1, r_2 such that their kinetic energies are equal. The ratio of r_1 to r_2 is

A. $4:5$

B. $16:25$

C. $5:4$

D. $25:16$

Answer: A

Watch Video Solution

50. The kinetic energy needed to project a body of mass m from the earth's surface to infinity is

A. $\frac{mgR}{2}$

B. $2mgR$

C. mgR

D. $\frac{mgR}{4}$

Answer: C

Watch Video Solution

51. Orbital speed of geo-stationary satellite is

A. $8km/s$ from west to east

B. $11.2km/s$ from east to west

C. $3.1km/s$ from west to east

D. zero

Answer: C

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LEVEL II (C.W.)

1. If the earth shrinks such that its density becomes 8 times to the present values, then new duration of the day in hours will be

A. 24

B. 12

C. 6

D. 3

Answer: C

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2. A planet moves around the sun. at a given point P, it is closest from the sun at a distance d_1, and has a speed V_1. At another point Q, when it is farthest from the sun at a distance d_2, its speed will be

A. $\frac{d_1^2 V_1}{d_2}$

B. $\frac{d_2 V_1}{d_1}$

C. $\frac{d_1 V_1}{d_2}$

D. $\frac{d_2^2 V_1}{d_1^2}$

Answer: C

Watch Video Solution

3. If a graph is plotted between T^2 and r^3 for a planet, then its slope will be be (where M_S is the mass of the sun)

A. $\frac{4\pi^2}{GM}$

B. $\frac{GM}{4\pi^2}$

C. $4\pi GM$

D. zero

Answer: A

Watch Video Solution

4. Two different atrtificial satellites orbiting with same time period around the earth having angular momenta in $2:1$. The ratio of masses of the satellite will be:

A. $2:1$

B. $1:2$

C. $1:1$

D. $1:3$

Answer: A

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5. The ratio of the earth's orbital angular momentum (about the Sun) to its mass is $4.4 \times 10^{15} m^2 s^{-1}$. The area enclosed by the earth's orbit is approximately-__________m^(2).

A. $1 \times 10^{22} m^2$

B. $3 \times 10^{22} m^2$

C. $5 \times 10^{22} m^2$

D. $7 \times 10^{22} m^2$

Answer: D

Watch Video Solution

6. Gravitational force between two point masses m and M separated by a distance r is F. Now if a point mass $3m$ is placed very next to m, the total force on M will be

A. F

B. $2F$

C. $3F$

D. $4F$

Answer: D

Watch Video Solution

7. If there particles, each of mass M, are placed at the three corners of an equilibrium triangle of side, a the force exerted by this system on another particle of mass M placed (i) at the midpoint of side and (ii) at the centre of the triangle are, respectively.

A. $0, \frac{4GM^2}{3a^2}$

B. $\frac{4GM^2}{3a^2}, 0$

C. $\frac{3GM^2}{a^2}, \frac{GM^2}{a^2}$

D. 0, 0

Answer: B

Watch Video Solution

8. Two masses 'M' and '4M' are at a distance 'r' apart on the line joining them. 'P' is point where the resultant gravitational force is zero (such a point is called as null point). The distance of 'P' from the mass '4M' is

A. $\frac{r}{5}$

B. $\frac{r}{3}$

C. $\frac{2r}{3}$

D. $\frac{4r}{5}$

Answer: C

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9. If the mass of one particle is increased by 50% and the mass of another particle llis decreased by 50%, the force between them

A. decreases by 25%

B. decreases by 75%

C. increases by 25%

D. does not change

Answer: A

Watch Video Solution

10. If the distance between the sun and the earth is increased by three times, then the gravitational force between two will

A. remain constant

B. decreases by 63%

C. increases by 63%

D. decreases by 89%

Answer: D

Watch Video Solution

11. Two lead balls of masses m and $5m$ having radii R and $2R$ are separated by $12R$. If they attract each other by gravitational force, the distance covered by small sphere before they touch each other is

A. $10R$

B. $7.5R$

C. $9R$

D. $2.5R$

Answer: B

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12. Three identical particles each of mass "m" are arranged at the corners of an equiliteral triangle of side "L". If they are to be in equilibrium, the speed with which they must revolve under the influence of one another's gravity in a circular orbit circumscribing the triangle is

A. $\sqrt{\frac{3Gm}{L}}$

B. $\sqrt{\frac{Gm}{L}}$

C. $\sqrt{\frac{Gm}{3L}}$

D. $\sqrt{\frac{3Gm}{L^2}}$

Answer: B

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13. Two particles each of mass 'm' are placed at A and C are such $AB = BC = L$. The gravitational force on the third particle placed at D at a distance L on the perpendicular bisector of the line AC is

A. $\frac{Gm^2}{L^2}$ along BD

B. $\frac{Gm^2}{\sqrt{2}L^2}$ along DB

C. $\frac{Gm^2}{L^2}$ along AC

D. $\frac{Gm^2}{\sqrt{2}L^2}$ along BD

Answer: B

Watch Video Solution

14. The height at which the value of acceleration due to gravity becomes 50% of that at the surface of the earth. (radius of the earth $= 6400 km$) is

A. 2630

B. 2640

C. 2650

D. 2660

Answer: C

Watch Video Solution

15. The radius and density of two artificial satellites are R_1, R_2 an,d ,ρ_1, ρ_2 respectively. The ratio of acceleration due to gravitation them will be

A. $\frac{R_2\rho_2}{R_1\rho_1}$

B. $\frac{R_1\rho_2}{R_2\rho_1}$

C. $\frac{R_1\rho_1}{R_2\rho_2}$

D. $\frac{R_2\rho_1}{R_1\rho_2}$

Answer: C

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16. A man weighs 'W' on the surface of the earth and his weight at a height 'R' from surface of the earth is (R is Radius of the earth)

A. $\frac{W}{4}$

B. $\frac{W}{2}$

C. W

D. $4W$

Answer: A

Watch Video Solution

17. The acceleration due to gravity at the latitude 45° on the earth becomes zero if the angular velocity of rotation of the earth is

A. $\sqrt{\frac{2}{gR}}$

B. $\sqrt{2gR}$

C. $\sqrt{\frac{2g}{R}}$

D. $\sqrt{\frac{5R}{2}}$

Answer: C

Watch Video Solution

18. Acceleration due to gravity on moon is $1/6$ of the acceleration due to gravity on earth. If the ratio of densities of earth (ρ_e) and moon (ρ_m) is

$\left(\frac{\rho_e}{\rho_m}\right) = \frac{5}{3}$ then radius of moon (R_m) in terms of R_e will be

A. $\frac{5}{18}R_e$

B. $\frac{1}{6}R_e$

C. $\frac{3}{18}R_e$

D. $\frac{1}{2\sqrt{3}}R_e$

Answer: A

Watch Video Solution

19. The mass of a planet is half that of the earth and the radius of the planet is one fourth that of the earth. If we plan to send an artificial satellite from the planet, the escape velocity will be $\left(V_e = 11 kms^{-1}\right)$

A. $11 kms^{-1}$

B. $5.5 kms^{-1}$

C. $15.55 kms^{-1}$

D. $7.78 kms^{-1}$

Answer: C

Watch Video Solution

20. If a rocket is fired with a velocity, $V = 2\sqrt{2gR}$ near the earth's surface and goes upwards, its speed in the inter-stellar space is

A. $4\sqrt{gR}$

B. $\sqrt{2gR}$

C. $\sqrt{gR}$

D. $\sqrt{4gR}$

Answer: B

Watch Video Solution

21. A projectile is fired vertically upwards from the surface of the earth with a velocity Kv_e, where v_e is the escape velocity and $K < 1$.If R is the radius of the earth, the maximum height to which it will rise measured from the centre of the earth will be (neglect air resistance)

A. $\frac{R}{K^2 - 1}$

B. $\frac{R}{1 - K^2}$

C. $R\left(1 - K^2\right)$

D. $\frac{R}{1 + K^2}$

Answer: B

Watch Video Solution

22. If the radius of the earth shrinks by 0.2% without any change in its mass, the escape velocity from the surface of the earth

A. increases by 0.2%

B. decreases by 0.2%

C. increases by 0.1%

D. increases by 0.4%

Answer: C

Watch Video Solution

23. If d is the distance between the centre of the earth of mass M_1 and the moon of mass M_2, then the velocity with which a body should be projected from the mid point of the line joining the earth and the moon, so that it just escape is

A. $\frac{\sqrt{G(M_1 + M_2)}}{d}$

B. $\sqrt{\frac{G(M_1 + M_2)}{2d}}$

C. $\sqrt{\dfrac{2G(M_1 + M_2)}{d}}$

D. $\sqrt{\dfrac{4G(M_1 + M_2)}{d}}$

Answer: D

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24. The escape velocity of a planet having mass 6 times and radius 2 times as those of the earth is

A. $\sqrt{3}v_e$

B. $3v_e$

C. $\sqrt{2}v_e$

D. $2v_e$

Answer: A

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25. If v_e is the escape velocity of a body from a planet of mass 'M' and radius 'R`. Then the velocity of the satellite revolving at height 'h' from the surface of the planet will be

A. $v_e\sqrt{\frac{R}{R+h}}$

B. $v_e\sqrt{\frac{2R}{R+h}}$

C. $v_e\sqrt{\frac{R+h}{R}}$

D. $v_e\sqrt{\frac{R}{2(R+h)}}$

Answer: D

Watch Video Solution

26. A particle falls towards the earth from inifinity. The velocity with which it reaches the earth is surface is

A. $v = 2gR$

B. $v = \sqrt{2gR}$

C. $V = \sqrt{gR}$

D. $v = gR$

Answer: B

Watch Video Solution

27. Two satellites P, Q are revolving around the earth in different circular orbits. The velocity of P is twice the velocity of Q. The height of P from the earth's surface is $1600km$. The radius of orbit of Q is $(R = 6400km)$

A. $1600km$

B. $20000km$

C. $32000km$

D. $40000km$

Answer: C

Watch Video Solution

28. A planet is revolving around the sun. its distance from the sun at apogee is r_A and that at perigee is r_p. The masses of planet and sun are 'm' and M respectively, V_A is the velocity of planet at apogee and V_P is at perigee respectively and T is the time period of revolution of planet around the sun, then identify the wrong answer.

A. $T^2 = \frac{\pi^2}{Gm}\left(r_A + r_P\right)^3$

B. $T^2 = \frac{\pi^2}{2GM}\left(r_A + r_p\right)^3$

C. $v_A r_A = v_P r_P$

D. $v_A < v_P, r_A > r_p$

Answer: A

Watch Video Solution

29. Suppose the gravitational force varies inversely as the nth power of distance. Then the time period of a planet in circular orbit of radius 'R' around the sun will be proportional to

A. $R^{\left(\frac{n+1}{2}\right)}$

B. $R^{\left(\frac{n-2}{2}\right)}$

C. R^{n}

D. $R^{\left(\frac{n-1}{2}\right)}$

Answer: A

Watch Video Solution

30. An artificial satellite is revolving around the earth in a circular orbit. Its velocity is one-third of the escape velocity. Its height from the earth's surface is (in km)

A. 22400

B. 12800

C. 3200

D. 1600

Answer: A

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Watch Video Solution

31. The work done to increases the radius of orbit of a satellite of mass 'm' revolving around a planet of mass M from orbit of radius R into another orbit of radius $3R$ is

A. $\frac{2GMm}{3R}$

B. $\frac{GMm}{3R}$

C. $\frac{GMm}{6R}$

D. $\frac{GMMm}{24R}$

Answer: B

Watch Video Solution

32. A stone is dropped from a height equal to nR, where R is the radius of the earth, from the surface of the earth. The velocity of the stone on reaching the surface of the earth is

A. $\sqrt{\frac{2g(n+1)R}{n}}$

B. $\sqrt{\frac{2gR}{n+1}}$

C. $\sqrt{\frac{2gnR}{n+1}}$

D. $\sqrt{2gnR}$

Answer: C

Watch Video Solution

33. Three particles of equal mass 'm' are situated at the vertices of an equilateral triangle of side L. The work done in increasing the side of the triangle to $2L$ is

A. $\frac{2G^2m}{2L}$

B. $\frac{Gm^2}{2L}$

C. $\frac{3Gm^2}{2}L$

D. $\frac{3Gm^2}{L}$

Answer: C

Watch Video Solution

34. A small body is at a distance r from the centre of the mercury, where r is greater than the radius of the mercury. The energy required to shift the body from r to $2r$ measured from the centre is E. The energy required to shift it form $2r$ to $3r$ will be

A. E

B. $\frac{E}{2}$

C. $\frac{E}{3}$

D. $\frac{E}{4}$

Answer: C

Watch Video Solution

35. Escape velocity of a body $1kg$ mass on a planet is $100ms^{-1}$. Gravitational potential energy of the body at that planet is

A. $-500J$

B. $-1000J$

C. $-2400J$

D. $5000J$

Answer: A

Watch Video Solution

36. By what percent the energy of the satellite has to be increased to shift it from an orbit of radius r to $\frac{3r}{2}$.

A. 66.7 %

B. 33.3 %

C. 15 %

D. 20.3 %

Answer: B

Watch Video Solution

37. At what height from the surface of the earth, the total energy of satellite is equal to its potential energy at a height $2R$ from the surface of the earth (R=radius of earth)

A. $2R$

B. $R/2$

C. $R/4$

D. $4R$

Answer: B

Watch Video Solution

38. A geostationary satellite is orbiting the earth at a height of 6R above the surface of the earth, where R is the radius of the earth. The time period of another satellite at a height of 2.5 R from the surface of the earth is ...... hours.

A. $12\sqrt{2}hr$

B. $12hr$

C. $6\sqrt{2}hr$

D. $6hr$

Answer: C

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LEVEL III

1. A point mass is orbiting a significant mass M lying at the focus of the elleptical orbit having major and minor axes given by $2a$ and $2b$ respectively. Let r be the distance between the mass M and the point of major axis. The velocity of the particle can be given as

A. $\frac{ab}{2r}\sqrt{\frac{GM}{a^3}}$

B. $\frac{ab}{r}\sqrt{\frac{GM}{b^3}}$

C. $\frac{ab}{r}\sqrt{\frac{GM}{a^3}}$

D. $\frac{2ab}{r}\sqrt{\frac{GM}{\left(\frac{a+b}{2}\right)^2}}$

Answer: A

View Text Solution

2. A planet of mass m revolves in elliptical orbit around the sun of mass M so that its maximum and minimum distance from the sun equal to r_a

and r_p respectively. Find the angular momentum of this planet relative to the sun.

A. $L = m\sqrt{\frac{GMr_p r_a}{(r_p + r_a)}}$

B. $L = m\sqrt{\frac{2GMr_p r_a}{(r_p + r_a)}}$

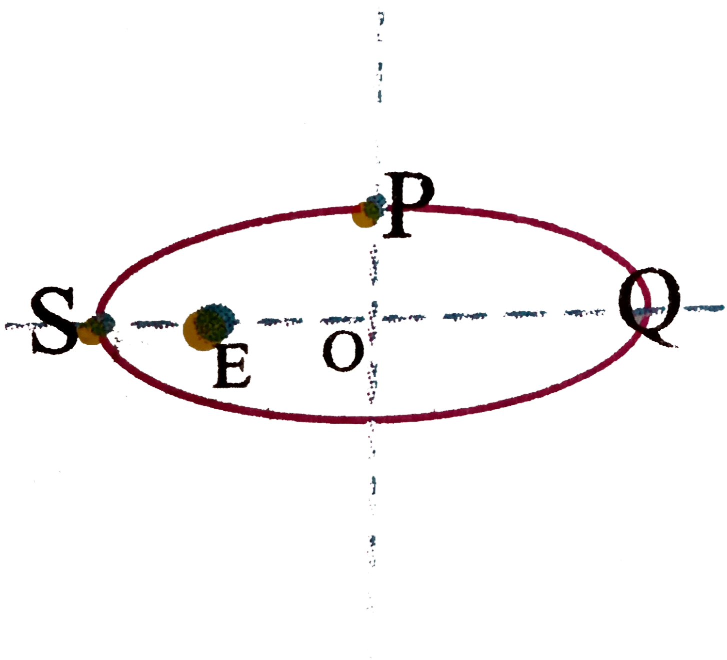
C. $L = M\sqrt{\frac{GMr_p r_a}{(r_p + r_a)}}$

D. $L = M\sqrt{\frac{(r_p + r_a)}{GMr_p r_a}}$

Answer: B

Watch Video Solution

3. A satellite moving in an elliptical orbit around the earth as shown. The minimum and maximum distance of the satellite from earth are 3 units and 5 units respectively. The distance of satellite from earth when it is at P is ....unit



A. 4

B. 3

C. 3.75

D. 6

Answer: A

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4. The longest and the shortest distance of a planet from the sun are R_1 and R_2. Distances from sun when it is normal to major axis of orbit is

A. $\frac{R_1 + R_2}{2}$

B. $\sqrt{\frac{R_1^2 + R_2^2}{2}}$

C. $\frac{R_1 R_2}{R_1 + R_2}$

D. $\frac{2R_1 R_2}{R_1 + R_2}$

Answer: D

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5. A satellite is orbiting just above the surface of a planet of average density D with period T. If G is the universal gravitational constant, the quantity $\frac{3\pi}{G}$ is equal to

A. T^2D

B. $3\pi T^2D$

C. $3\pi D^2T$

D. D^2T

Answer: A

Watch Video Solution

6. A planet revolves around the sun in elliptical orbit of eccentricity 'e'. If 'T' is the time period of the planet then the time spent by the planet between the end of the minor axis and close to the sun is

A. $T\left(\frac{1}{4} - \frac{e}{2\pi}\right)$

B. $\frac{Te}{\pi}$

C. $\left(\frac{e}{\pi} - 1\right)$

D. $\frac{\pi T}{e}$

Answer: A

Watch Video Solution

7. An artificial satellite revolves around the earth in circular orbit of radius r with time period T. The satellite is made to stop in the orbit which makes it fall onto the earth. Time of fall of the satellite onto the earth is given by

A. $\sqrt{3}\frac{T}{6}$

B. $\frac{\sqrt{2}}{8}T$

C. $\frac{T}{\sqrt{3}}$

D. $\sqrt{\frac{2}{3}}\frac{T}{\pi}$

Answer: B

Watch Video Solution

8. A homogeneous spherical heavenly body has a uniform and very narrow frictionless duct along its diameter. Let mass of the body be M and diameter be D. A point mass m moves smoothly inside the duct. Force exerted on this mass when it is at a distance s from the centre of the body is (numerically)

A. $\frac{GMm}{s^2}$

B. $\frac{\pi GMm}{(D/2)^3}s$

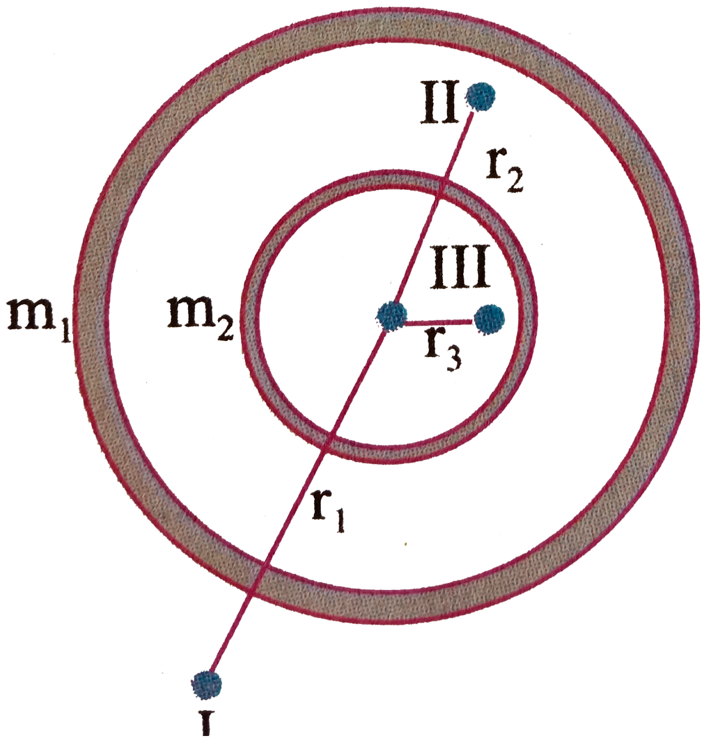
C. $\frac{8GMms}{D^3}$

D. $\frac{GMm}{(R - s)^2}$

Answer: C

Watch Video Solution

9. Two concentric shells of different mass m_1 and m_2 are having a sliding particle of mass m. The forces on the sliding at positions I, II and III are respectively



A. $0, \frac{Gm_1}{r_2^2}, \frac{G(m_1 + m_2)m}{r_1^2}$

B. $\frac{Gm_2}{r_2^2}, 0, \frac{Gm_1}{r_1^2}$

C. $\frac{G(m_1 + m_2)m}{r_1^2}, \frac{Gm_2}{r_2^2}, 0$

D. $\frac{G(m_1 + m_2)m}{r_1^2}, \frac{G(m_2)m}{r_2^2}, 0$

Answer: D

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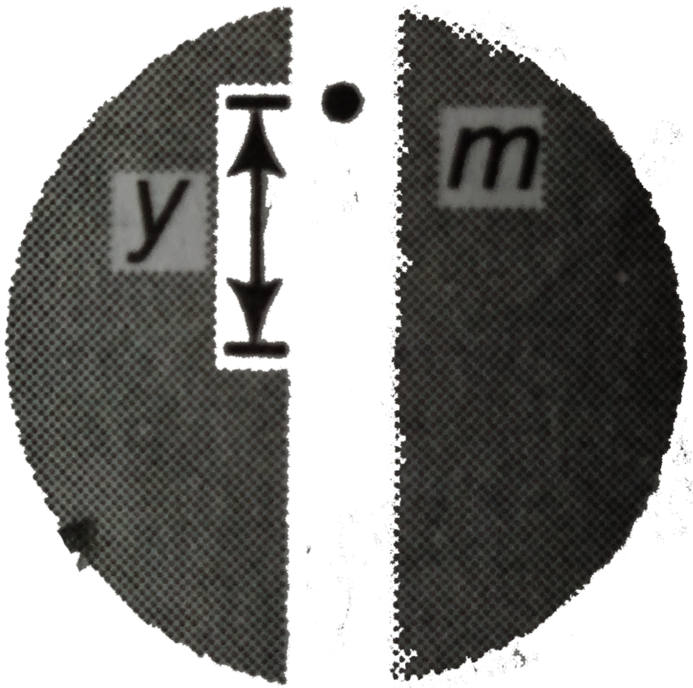
10. Suppose a vertical tunnel is dug along the diameter of earth , which is assumed to be a sphere of uniform mass density ρ. If a body of mass m is thrown in this tunnel, its acceleration at a distance y from the centre is given by



A. $\frac{4\pi}{3} g\rho y$

B. $\frac{3}{4}\pi G\rho y$

C. $\frac{4}{3}\pi\rho y$

D. $\frac{4}{3}\pi G\rho y$

Answer: D

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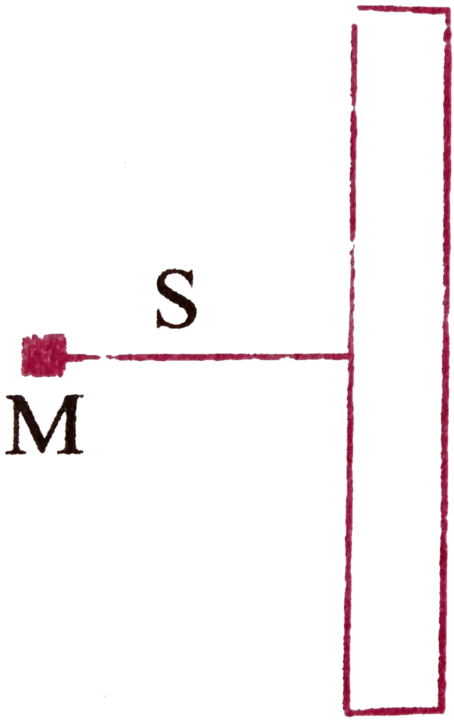
11. A point mass M is at a distance S from an infinitely long and thin rod of linear density D. If G is the gravitational constant then gravitational force between the point mass and the rod is



A. $2\frac{GMD}{S}$

B. $\frac{MGD}{S}$

C. $\frac{MGD}{2S}$

D. $\frac{2}{3}\frac{MGD}{S}$

Answer: A

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12. A cavity of radius $R/2$ is made inside a solid sphere of radius R. The centre of the cavity is located at a distance $R/2$ from the centre of the sphere. The gravitational force on a particle of a mass $'m'$ at a distance $R/2$ from the centre of the sphere on the line joining both the centres of sphere and cavity is (opposite to the centre of cavity). [Here $g = GM/R^2$, where M is the mass of the solide sphere]

A. $\frac{mg}{2}$

B. $\frac{3mg}{8}$

C. $\frac{mg}{16}$

D. $\frac{mg}{4}$

Answer: B

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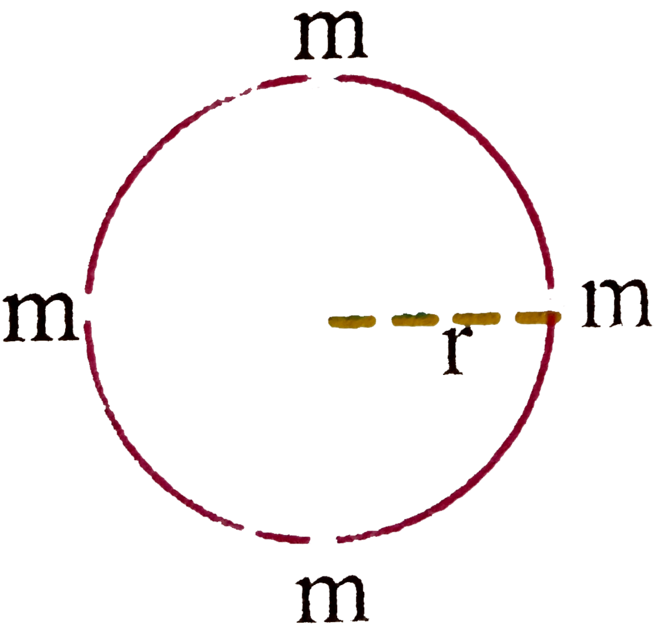
13. Four masses 'm' each are orbitinting in a circular of radius r in the same direction under gravitational force. Velocityof each particle is



A. $\sqrt{\frac{Gm}{r}\frac{\left(1+2\sqrt{2}\right)}{2}}$

B. $\sqrt{\frac{Gm}{r}}$

C. $\sqrt{\frac{Gm}{r}\left(1+2\sqrt{2}\right)}$

D. $\sqrt{\frac{Gm}{2r}\left(\frac{1+2\sqrt{2}}{2}\right)}$

Answer: C

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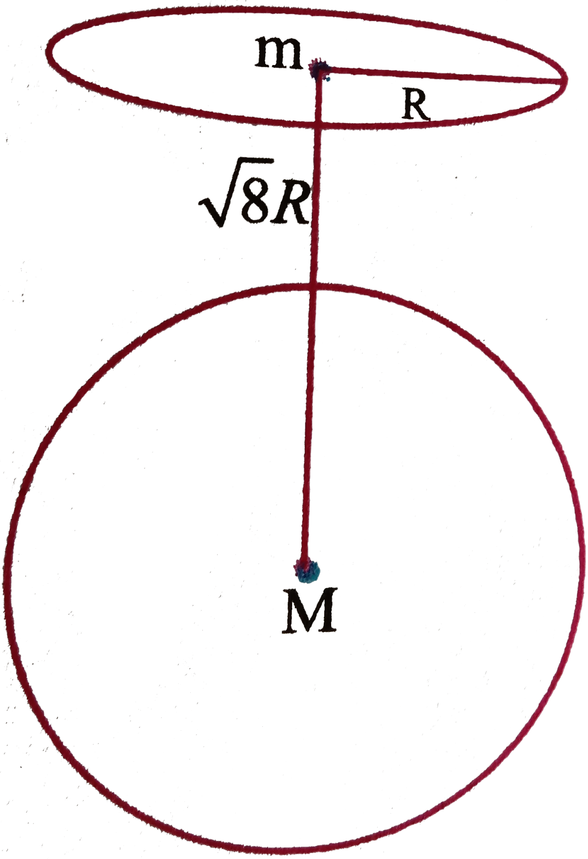
14. The centres of a ring of mass m and a sphere of mass M of equal radius R, are at a distance $\sqrt{8}R$ apart as shown. The force of attraction between the ring and the sphere is



A. $\frac{2\sqrt{2}}{27}\frac{GmM}{R^2}$

B. $\frac{GmM}{8R^2}$

C. $\frac{GmM}{9R^2}$

D. $\frac{\sqrt{2}}{9}\frac{GmM}{9R^2}$

Answer: A

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15. A mass m extends a vertical helical spring of spring constant k by xm at the surface of the earth. Extension in spring by the same mass at height h meter above the surface of the earth is

A. $\frac{GMm}{k(R+h)}$

B. $\frac{GMm}{kR^2}$

C. $\frac{(R+h)^2}{R^2}$

D. $\frac{R^2}{(R+h)^2}x$

Answer: D

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16. A straight rod of length L extends from $x = a$ to $x = L + a$. Find the gravitational force exerts on a point mass m at $x = 0$ is (if the linear density of rod$\mu = A + Bx^2$)

A. $Gm\left[\frac{A}{a}+BL\right]$

B. $Gm\left[A\left(\frac{1}{a}-\frac{1}{a+L}\right)+BL\right]$

C. $Gm\left[BL+\frac{A}{a+L}\right]$

D. $Gm\left[BL-\frac{A}{a}\right]$

Answer: B

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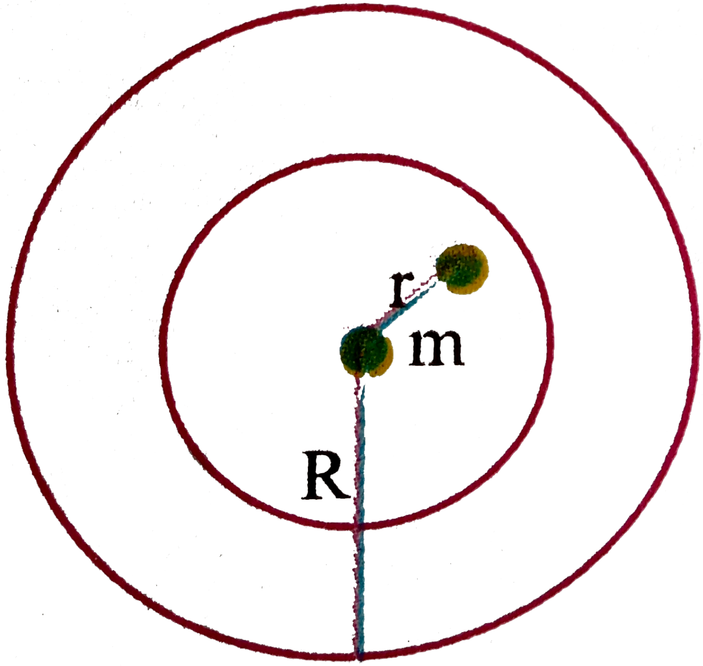
17. A mass m is placed in the cavity inside hollow sphere of mass M as shown in the figure. The gravitational force on m is



A. $\frac{GMm}{R^2}$

B. $\frac{GMm}{r^2}$

C. $\frac{GMm}{(R - r)^2}$

D. zero

Answer: D

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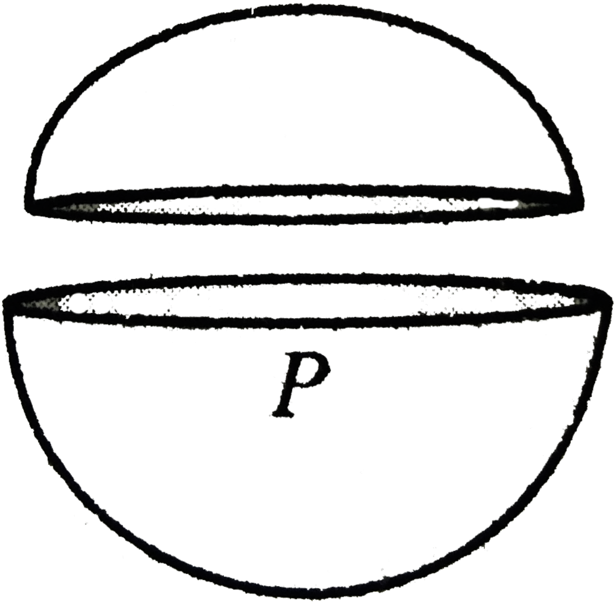
18. A spherical shell is cut into two pieces along a chord as shown in the figure. P is a point on the plane of the chord. The gravitational field at P due to the upper part is I_1, and that due to the lower part is I_2. What is the relation between them?



A. $I_1 > I_2$

B. $I_1 < I_2$

C. $I_1 = I_2$

D. no definite relation

Answer: C

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19. The magnitudes of the gravitational field at distance r_1 and r_2 from the centre of a uniform sphere of radius R and mass M are E_1 and E_2 respectively. Then:

A. $\frac{E_1}{E_2} = \frac{r_1}{r_2}$ if $r_1 < R$ and $r_2 < R$

B. $\frac{E_1}{E_2} = \frac{r_2^2}{r_1^2}$ if $r_1 < R$ and $r_2 < R$

C. $\frac{E_1}{E_2} = \frac{r_2^2}{r_2^3}$ if $r_1 < R$ and $r_2 < R$

D. $\frac{E_1}{E_2} = \frac{r_1^2}{r_2^2}$ if $r_1 < R$ and $r_2 < R$

Answer: A

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20. Two masses $90kg$ and $160kg$ are $5m$ apart. The gravitational field intensity at a point $3m$ from $90kg$ and $4m$ from $160kg$ is

A. $10G$

B. $5G$

C. $5\sqrt{2}G$

D. $10\sqrt{2}G$

Answer: D

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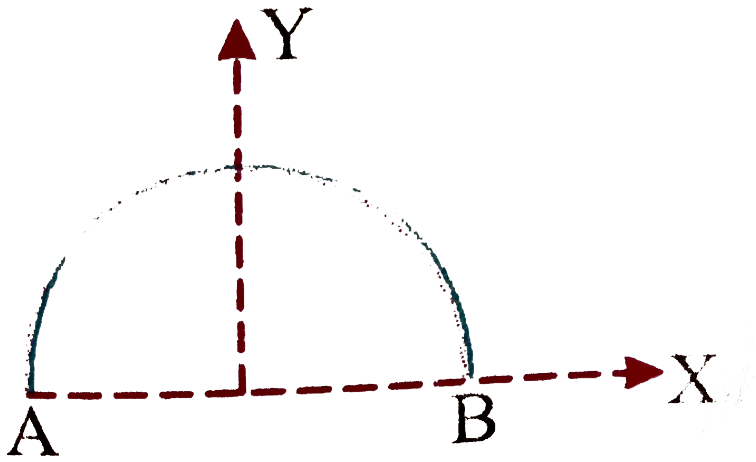
21. Gravitational field intensity at the centre of the semi circle formed by a thin wire AB of mass m

and length L is



A. $\frac{Gm^2}{L^2}(\hat{i})$

B. $\frac{Gm^2}{\pi L^2}(\hat{j})$

C. $\frac{2\pi Gm}{L^2}(\hat{i})$

D. $\frac{2\pi Gm}{L^2}(\hat{j})$

Answer: D

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22. Two equal masses each m are hung from a balance whose scale pans differ in vertical height by h. The error in weighing is

A. $\pi G\rho mh$

B. $\frac{1}{3}G\rho mh$

C. $\frac{8}{3}\pi G\rho mh$

D. $\frac{4}{3}\pi G\rho mh$

Answer: C

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23. If earth were to rotate on its own axis such that the weight of a person at the equator becomes half the weight at the poles, then its time period of rotation is (g = acceleration due to gravity near the poles and R is the radius of earth) (Ignore equatorial bulge)

A. $2\pi\sqrt{\frac{2R}{g}}$

B. $2\pi\sqrt{\frac{R}{2g}}$

C. $2\pi\sqrt{\frac{R}{3g}}$

D. $2\pi\sqrt{\frac{R}{g}}$

Answer: A

Watch Video Solution

24. Four particles each of mass m are placed at the vertices of a square of side l. the potential at the centre of square is

A. $-\sqrt{32}\frac{GM}{L}$

B. $-\sqrt{64}\frac{GM}{L^2}$

C. zero

D. $-\sqrt{16}\frac{GM}{L}$

Answer: A

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25. The gravitational potential of two homogeneous spherical shells A and B of same surface density at their respective centres are in the ratio $3:4$. If the two shells collapse into a single one such that surface charge density remains the same, then the ratio of potential at an internal point of the new shell to shell A is equal to

A. $3:2$

B. $4:3$

C. $5:3$

D. $5:6$

Answer: C

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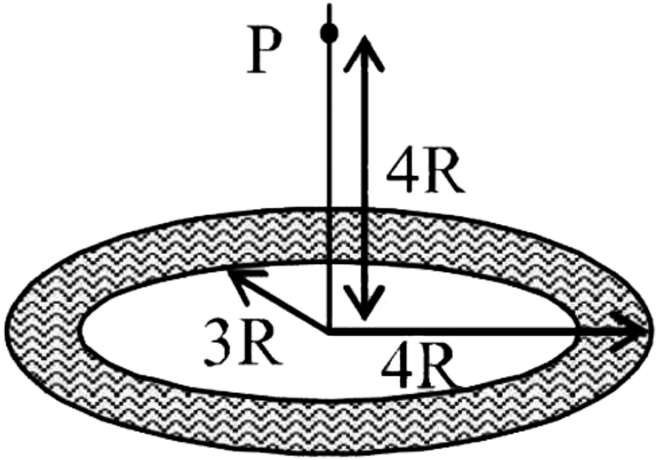
26. A thin uniform disc (see figure) of mass M has outer radius 4R and inner radius 3R. The work required to take a unit mass for point P on its axis to infinity is



A. $\frac{2GM}{7R}\left(4\sqrt{2}-5\right)$

B. $-\frac{2GM}{7R}\left(4\sqrt{2}-5\right)$

C. $\frac{GM}{2R}$

D. $\frac{2GM}{5R}\left(\sqrt{2}-1\right)$

Answer: A

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27. The gravitational force in a region is given by, $\vec{F} = ay\hat{i} + ax\hat{j}$. The work done by gravitational force to shift a point mass m from $(0, 0, 0)$ is $\left(x_0, y_0, z_0\right)$ is

A. ma$x_0y_0z_0$

B. max_0y_0

C. -max_0y_0

D. 0

Answer: B

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28. Two identical thin ring each of radius R are co-axially placed at a distance R. If the ring have a uniform mass distribution and each has mass m_1 and m_2 respectively, then the work done in moving a mass m from the centre of one ring to that of the other is :

A. zero

B. $\frac{Gm(m_1 - m_2)(\sqrt{2} - 1)}{\sqrt{2}R}$

C. $\frac{Gm\sqrt{2}(m_1 + m_2)}{R}$

D. $\frac{Gm_1m(\sqrt{2}+1)}{m_2R}$

Answer: B

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29. The gravitational field in a region due to a certain mass distribution is given by $\vec{E} = (4\hat{i} - 3\hat{j})N/kg$. The work done by the field in moving a particle of mass $2kg$ from $(2m, 1m)$ to $\left(\frac{2}{3}m, 2m\right)$ along the line $3x + 4y = 10$ is

A. $-\frac{25}{3}N$

B. $-\frac{50}{3}N$

C. $\frac{25}{3}N$

D. zero

Answer: B

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30. A particle of mass $1kg$ is placed at a distance of $4m$ from the centre and on the axis of a uniform ring mass $5kg$ and radius $3m$. The work done to increase the distance of the particle from $4m$ to $3\sqrt{3}$m is

A. $\frac{G}{3}J$

B. $\frac{G}{4}J$

C. $\frac{G}{5}J$

D. $\frac{G}{6}J$

Answer: D

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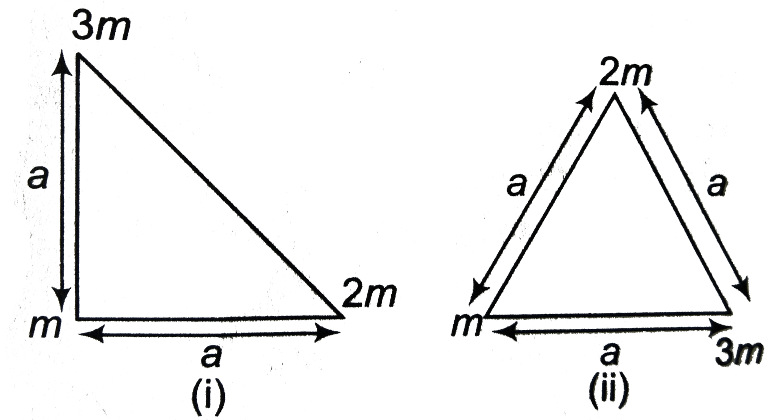
31. Consider two configurations of a system of three particles of masses m, $2m$ and $3m$. The work done by gravity in changing the configuration of the system from figure (i) to figure (ii) is



A. zero

B. $-\frac{6Gm^2}{a}\left(1+\frac{1}{\sqrt{2}}\right)$

C. $-\frac{6Gm^2}{a}\left(1-\frac{1}{\sqrt{2}}\right)$

D. $\frac{6Gm^2}{a}\left(2-\frac{1}{\sqrt{2}}\right)$

Answer: C

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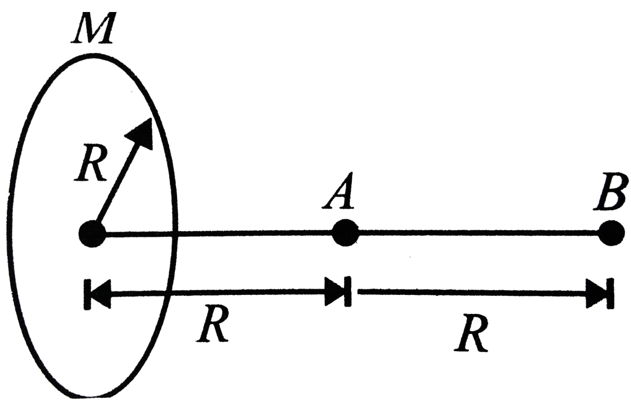
32. A ring having non-uniform distribution of mass M and radius R is being considered. A point mass m_0 is taken slowly towards the ring. In doing so, work done by the external force against the gravitational force exerted by ring is



A. $\frac{GMm_0}{\sqrt{2}R}$

B. $\frac{GMm_0}{R}\left[\frac{1}{\sqrt{2}-\frac{1}{\sqrt{5}}}\right.$

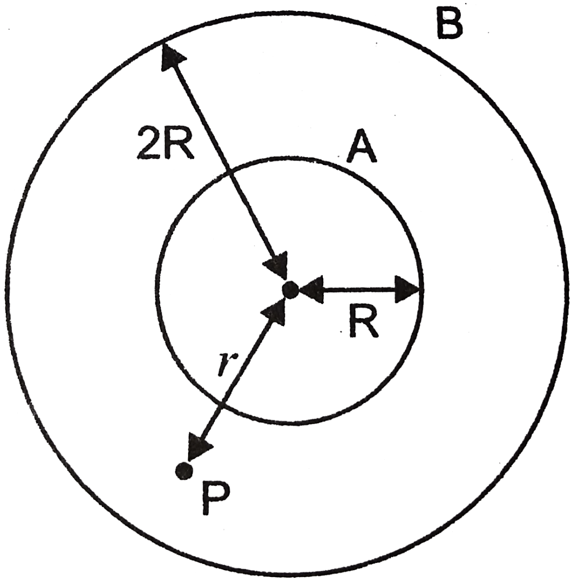
C. $\frac{GMm_0}{R}\left[\frac{1}{\sqrt{5}}-\frac{1}{\sqrt{2}}\right]$

D. $\frac{GMm_0}{\sqrt{5}R}$

Answer: B

Watch Video Solution

33. Two concentric spherical shells A and B of radii R and $2R$ and mases $4M$, and M, respectively are placed in space as shown in Fig. The gravitational potential at P at a disatnce $r(R < r < 2R)$from the centre of shells is



A. $-\frac{4GM}{R}$

B. $-\frac{9GM}{2R}$

C. - $\frac{4GM}{3R}$

D. - $\frac{19GM}{6R}$

Answer: D

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34. The potential energy of body of mass m given by $U = px + qy + rz$. The magnitude of the acceleration of the body will be

A. $\frac{p+q+r}{m}$

B. $\frac{\sqrt{p^2+q^2+r^2}}{m}$

C. $\dfrac{\sqrt{p^3 + q^3 + r^3}}{m}$

D. $\dfrac{\sqrt{p^4 + q^4 r^4}}{m}$

Answer: B

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35. A particle is placed in a field characterized by a value of gravitational potential given by $V = -kxy$, where k is a constant. If $\vec{E}_g$ is the gravitational field then

A. $\vec{E}_g = k\left(x\hat{i} + y\hat{j}\right)$ and is conservative in nature

B. $\vec{E}_g = k\left(y\hat{i} + x\hat{j}\right)$ and is conservative in nature

C. $\vec{E}_g = k\left(x\hat{i} + y\hat{j}\right)$ and is non-conservative in nature

D. $\vec{E}_g = k\left(y\hat{i} + x\hat{j}\right)$ and is non-conservative in nature

Answer: B

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36. A thin rod of length L is bent to form a semi circle. The mass of the rod is M. What will be the gravitational potential at the centre of the circle?

A. $\frac{-GM}{L}$

B. $\frac{-GM}{2\pi L}$

C. $\frac{-\pi GM}{2L}$

D. $\frac{-\pi GM}{L}$

Answer: D

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37. If the gravitational field intensity at a point is given by $g = \frac{GM}{r^{2.5}}$. Then, the potential at a distance r is

A. $\frac{2GM}{3r^{1.5}}$

B. $\frac{-GM}{r^{3.5}}$

C. $-\frac{2GM}{3r^{1.5}}$

D. $\frac{GM}{r^{3.5}}$

Answer: A

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38. In a certain region of space, the gravitational field is given by $-k/r$, where r is the distance and k is a constant. If the gravitational potential for the gravitational potential V?

A. $k\log\left(r/r_0\right)$

B. $k\log\left(r_0/r\right)$

C. $V_0 + k\log\left(r/r_0\right)$

D. $V_0 + k\log\left(r_0/r\right)$

Answer: C

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39. Distance between the centres of two stars is $10a$. The masses of these stars are M and $16M$ and their radii a and $2a$ respectively. A body of mass m is fired straight from the surface of the larger star towards the surface of the smaller star. What should be its minimum initial speed to reach the surface of the smaller star? Obtain the expression in terms of G, M and a.

A. $\sqrt{\frac{GM}{a}}$

B. $\frac{1}{2}\sqrt{\frac{5GM}{a}}$

C. $\frac{3}{2}\sqrt{\frac{GM}{a}}$

D. $\frac{3\sqrt{5}}{2}\sqrt{\frac{GM}{a}}$

Answer: D

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40. There is crater of depth $R/100$ on the surface of the moon (raduis R). A projectile is fired vertically upwards from the crater with a velocity, which is equal to the escape velocity v from the surface of the moon. The maximum height attained by the projectile, is :

A. $90R$

B. $95R$

C. $99.5R$

D. $50R$

Answer: C

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41. Graviational acceleration on the surface of plane fo $\frac{\sqrt{6}}{11}g$. where g is the gracitational acceleration on the surface of the earth. The average mass density of the planet is $\frac{2}{3}$ times that of the earth. If the escape speed on the surface of the earht is taken to be $11 kms^{-1}$ the escape speed on teh surface of the planet in kms^{-1} will be

A. 3

B. 6

C. 9

D. 12

Answer: A

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42. Two spherical planets P and Q have the same uniform density ρ, masses M_p and M_Q and surface areas A and 4A respectively. A spherical planet R also has uniform density ρ and its mass is $\left(M_P + M_Q\right)$. The escape velocities from the plantes P,Q and R are $V_P V_Q$ and V_R respectively. Then

A. $V_Q > V_R > V_P$

B. $V_R > V_Q > V_P$

C. $V_R / V_P = 3$

D. $V_P / V_Q = \frac{1}{2}$

Answer: B::D

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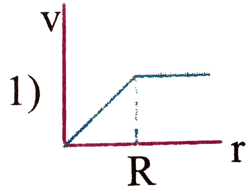
43. A spherically symmetric gravitational system of particles has a mass density

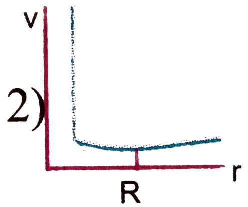
$\rho = \begin{cases} \rho_0 & for \quad r < R \\ 0 & for \quad r > R \end{cases}$ where ρ_0 is a constant.

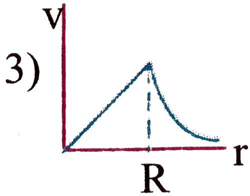
A test mass can undergo circular motion under the influence of the gravitational field of particles.

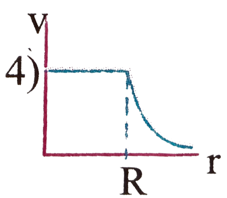
Its speed v as a function of distahce $r(0 < r < OO)$

form the centre of the system is represented by

A. 

B. 

C. 

D. 

Answer: C

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44. A satellite is moving with a constant speed 'V' in a circular orbit about the earth. An object of mass 'm' is ejected from the satellite such that it just escapes form the gravitational pull of the earth. At the tme of its ejection, the kinetic energy of the object is

A. $\frac{1}{2}mv^2$

B. mv^2

C. $\frac{3}{2}mv^2$

D. $2mv^2$

Answer: B

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NCERT BASED QUESTIONS

1. The earth is an approximate sphere. If the interior contained matter which is not of the same density every where, then on the surface of the earth, the acceleration due to gravity

A. will be directed towards the centre but not the same everwhere

B. will have the same value everywhere but not directed towards the centre.

C. will be same everywhere in magnitude directed towards the centre.

D. cannot be zero at any point

Answer: D

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2. As observed from the earth, the sun appears to move an approx. circular orbit. For the motion of another planet like mercury as observed from the earth, this would

A. the similary ture.

B. not be true because the force between earth and mercury is not inverse square law.

C. not be true because the major gravitational force on mercury is due to sun.

D. not be true because mercury is influenced by force other than gravitational forces.

Answer: C

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3. Different points in the earth are at slightly different distance from the sun and hence experience different force due to gravitation. For a rigid body, we know that if various forces act at various points in it, the resultant motion is as if a net force acts on the CM (centre of mass) causing translation and a net torque at the CM causing rotation around an axis through the CM. for the earth-sun system (approximating the earth as a uniform density sphere).

A. the torque is zero

B. the torque cause the earth to spin

C. the right body result is not applicable since the earth is not ever approximately a rigid body.

D. the torque causes the earth to move around the sun

Answer: A

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4. Satellites orbiting the earth have finite life and sometimes debris of satellites fall to the earth. This is because,

A. the solar cells and batteries in satellities run out

B. the laws of gravitational predict a trajectory spiralling in wards.

C. of viscous force causing the speed of satellite and hence height to gradually decreases

D. of collisions with other satellites

Answer: C

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5. Both earth and moon are subjected to the gravitational force of the sun. as observed from the sun, the orbit of the moon

A. will be elliptical

B. will not be strictly elliptical because the total gravitational force on it not central

C. is not elliptical but will necessarily be a closed curve.

D. deviates considerably from being elliptical due to influence of planets other than earth.

Answer: B

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6. In our solar system, the inter-planetery region has chunks of matter (much smaller in size compared to planets) called asteriods. They

A. Will not move around the sun since they have vary small masses compared to sun

B. will move in an irregular way because of their small masses and will drift away into unter space.

C. wiil move around the sun in closed orbits but not obey kepler's laws

D. will move in orbits like planets and obey kepler's laws.

Answer: D

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7. Choose the wrong option.

A. Inertial mass is a measure of difficulty of acceleration a body by an exertnal force whereas the gravitational mass is relevant in determining the gravitational force on it an external mass.

B. That the acceleration mass and inertial mass are equal is an experimental result.

C. That the acceleration due to gravity on earth is the same for all bodies is due to gravity on earth is the same for all bodies is due to the equality of gravitational mass and inertial mass

D. Gravitational mass of a particle like proton can depend on the presence of neighbouring heavy objects but the inertial mass cannot.

Answer: D

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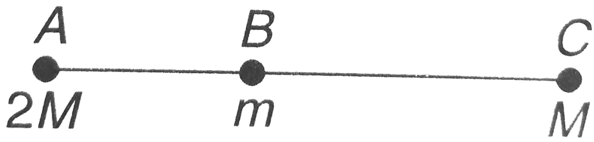
8. particles of masses 2M m and M are resectively at points A , B and C with $AB = \frac{1}{2}(BC)$ m is much - much smaller than M and at time $t = 0$ they are all at rest as given in figure . As subsequent times before any collision takes palce .



A. m will remainsat rest

B. m will move towards M.

C. m will move towards $2M$

D. m will have oscillatory motion.

Answer: C

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9. Which of the following options are correct ?

A. Acceleration due to gravity decreases with increasing altitude.

B. Acceleration due to gravity increases with increasing depth (assume the earth to be a sphere of uniform density)

C. acceleration due to gravity increases with increasing latitude.

D. accleration due to gravity is independent of the mass of the earth

Answer: A::C

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10. If the law of gravitational, instead of being inverse-square law, becomes an inverse-cube law

A. planets will not have elliptical orbits

B. circular orbits of planets is not possible

C. projectile motion of a stone thrown by hand on the surface of the earth will be approximately parabolic.

D. There will be gravitational force inside a spherical shell of uniform density.

Answer: A::C

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11. If the mass of sun were len times smaller and gravitational consitant G were ten times larger in magnitudes

A. Walking on ground would became more difficult.

B. the acceleration due to gravity on earth will not change.

C. raindrops will fall much faster.

D. airplanes will have to travel much faster.

Answer: A::C::D

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12. If the sun and the planets carried huge amounts of opposite charges

A. all there of Kepler's laws would still be valid

B. only the third law will be valid

C. the second law will not change

D. the first law will still be valid.

Answer: C::D

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13. There have been suggestions that the value of the gravitational constant G becomes smaller when considered over very large time period (in billions of years) in the future. If the happens for our earth.

A. nothing will change

B. we will becomes hotter after billions of years.

C. we will be going around but not strictly in losed orbits

D. after sufficiently long time we will leave the solar system

Answer: C::D

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14. Supposing Newton's law of gravitation for gravitation force F_1 and F_2 between two masses m_1 and m_2 at positions r_1 and r_2 read

$F_2 = -F_2 = \frac{r_{12}}{r_{12}^3} GM_0^2 \left(\frac{m_1 m_2}{M_0^2}\right)^n$ where M_0 is a constant dimension of mass, $r_{12} = r_1 - r_2$ and n is number. In such a case.

A. the acceleration due to gravity on earth will be different for different objects

B. none of the three laws kepler will be valid

C. only the third law will become invalid

D. for n negative, an object lighter than water will sink in water.

Answer: A::C::D

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15. Which of the following are true?

A. A polar satellite goes around the earth's pole in north south direction

B. A geostationary satellite goes around the earth in east-west direction

C. A geostationary satellite goes around the earth in west-east direction

D. A polar satellite goes around the earth in eastwest-direction

Answer: A::C

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16. The centre of mass of an extended body on the surface of the earth and its centre of gravity

A. are always at the same point for any size of the body

B. are always at the same point only for spherical bodies

C. can never be at the same point

D. in close to each other for objects, say of sizes less than $100m$

Answer: D

Watch Video Solution

17. An artificial satellite is going round the earth, close to its surface. What is the time taken by it to complete one round? Given radius of the earth=6400 km.

A. $14.11 hr$

B. $141.1 hr$

C. $1.414 hr$

D. $0.1414 hr$

Answer: C

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18. A satellite revolves in an orbit close to the surface of a planet of mean density $5.51 \times 10^3 kgm^{-3}$. Calculate the time period of satellite.

Given $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

A. $562.7s$

B. $5062.7s$

C. $506.27s$

D. $56.27s$

Answer: B

Watch Video Solution

19. An artifical satellitee of mass $100kg$ is in a circular orbit at $500km$ above the Earth's surface. Take redius of Earth as $6.5 \times 10^6 m$.(a) Find the acceleration due to gravity at any point along the satellite path (b) What is the centripetal acceleration o fthe satellite?

A. $8.45ms^{-2}$, $8.45ms^{-2}$

B. $8.45ms^{-2}$, $0.845ms^{-2}$

C. $0.845ms^{-2}$, $0.845ms^{-2}$

D. $0.845ms^{-2}$, $8.45ms^{-2}$

Answer: A

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20. A body is to be projected vertically upwards from earth's surface to reach a height of $9R$, where R is the radius of earth. What is the velocity required to do so? Given $g = 10ms^{-2}$ and radius of earth $= 6.4 \times 10^6 m$.

A. $1.073 \times 10^4 ms^{-1}$

B. $1.73 \times 10^4 ms^{-1}$

C. $10.73 \times 10^4 ms^{-1}$

D. $17.3 \times 10^4 ms^{-1}$

Answer: A

Watch Video Solution

21. Given that $T^2 = kR^3$, express the constant k of the above relation in days and kilometres. Given, $k = 10^{-13}s^2m^{-3}$. The Moon is at a distance of $3.84 \times 10^5 km$ from the earth. Obtain its time period of revolution in days.

A. 28

B. 2.8

C. 27.3

D. 2.73

Answer: C

Watch Video Solution

22. Which of the following is correct?

A. an astronaut in going from earth to moon will experience weightlessness once.

B. When a thin unform spherical shell gradually shrinks maintaining its shape, the gravitational potential at its centre decreases.

C. In the case fo spherical shell, the piot of V versus r is continuous.

D. In the case spherical shell, the plot of gravitational field intensity, I versus r, is continuous

Answer: A::B::C

Watch Video Solution

23. An object is weighted at the North Pole by a beam balance and a spring balance, giving readings of W_B and W_S respectively. It is again weighed in the same manner at the equator, giving readings of W'_B and W'_S respectively.

Assume that the acceleration due to gravity is the same everywhere and that the balance are quite sensitive, Choose the wrong option

A. $W_B = W_S$

B. $W'_B = W'_S$

C. $W_B = W'_B$

D. $W'_S < W_S$

Answer: A::C::D

Watch Video Solution

24. For a planet moving and the sun in an elliptical orbit, which of the following quantities remain constant?

(i) The total energy of the 'sun plus planet' system

(ii) The angular momentum of the planet about the sun

(iii) The force of attraction between the two

(iv) The linear momentum of the planet

A. The total energy of 'the sun planet' system

B. The angular momentum of the planet about the sun.

C. The force of attraction between the two

D. The linear momentum of the planet

Answer: A::B::C

Watch Video Solution

25. If a satellite orbits as close to the earth's surface as possible,

A. its speed is maximum

B. time period of its rotation is minimum

C. the total energy of the earth plus satellite system is minimum

D. the total energy of the earth plus satellite system is maximum

Answer: A::B::C

Watch Video Solution

26. A satellite is to be geo-stationary, which of the following are essential conditions?

A. it must always be stationed above the equator

B. it must be rotate from west to east

C. it must be about $36,000km$ above the earth surface

D. its orbits must be circular, and not elliptical

Answer: A::B::C::D

Watch Video Solution

LEVEL -I(H.W)

1. In planetary motion the areal velocity of possition vector of a planet depends of angular velocity (ω) and the distance of the planet from sun (r). If so the correct relation for areal velocity is

A. $\frac{dA}{dt} \propto \omega r$

B. $\frac{dA}{dt} \propto \omega^2 r$

C. $\frac{dA}{dt} \propto \omega r^2$

D. $\frac{dA}{dt} \propto \sqrt{\omega r}$

Answer: C

Watch Video Solution

2. If a and b are the nearest and farthest distances of a planet from the sun and the planet is revolving in an elliptical orbit, then square of the time period of revolution of that planets is directly proportional to

A. a^3

B. b^3

C. $(a + b)^3$

D. $(a - b)^3$

Answer: C

Watch Video Solution

3. Let A be the area swept by the line joining the earth and the sun during Feb 2007. The area swept by the same line during the first week of that month is

A. $A/4$

B. $7A/29$

C. A

D. $7A/30$

Answer: A

Watch Video Solution

4. The period of a satellite in a circular orbit of radius R is T, the period of another satellite in a circular orbit of radius $4R$ is

A. $2T$

B. $2\sqrt{2}T$

C. $4T$

D. $8T$

Answer: D

Watch Video Solution

5. The period of revolution of an earth's satellite close to the surface of the earth is 60 minute. The period of another the earth's satellite in an orbit at a distance of three times earth's radius from its surface will be (in minutes)

A. 90

B. $90 \times \sqrt{8}$

C. 270

D. 480

Answer: D

Watch Video Solution

6. If a planet of mass m is revolving around the sun in a circular orbit of radius r with time period, T then mass of the sun is

A. $4\pi^2 r^3 / GT$

B. $4\pi^2 r^3 / GT^2$

C. $4\pi^2 r / GT$

D. $4\pi^2 r^3 / G^2 T^2$

Answer: B

Watch Video Solution

7. The period of revolution of a planet around the sun in a circular orbit is same as that of period of similar planet revolving around a star of twice the raduis of first orbit and if M is the mass of the sun then the mass of star is

A. $2M$

B. $4M$

C. $8M$

D. $16M$

Answer: C

Watch Video Solution

8. A planet moves around the sun in an elliptical orbit. When earth is closest from the sun, it is at a distance r having a speed v. When it is at a distance $4r$ from the sun its speed will be:

A. $4v$

B. $\frac{v}{4}$

C. $2v$

D. $\frac{v}{2}$

Answer: B

Watch Video Solution

9. A planet of mass m is the elliptical orbit about the sun $\left(m < < M_{\text{sun}}\right)$ with an orbital period T. If A be the area of orbit, then its angular momentum would be:

A. $\frac{2mA}{T}$

B. mAT

C. $\frac{mA}{2T}$

D. $2mAT$

Answer: A

Watch Video Solution

10. The gravitational force between two particles of masses m_1 and m_2 separeted by the same distance, then the gravitational force between them will be

A. greater than F

B. less than F

C. F

D. zero

Answer: C

Watch Video Solution

11. The mass of a ball is four times the mass of another ball. When these balls are separated by a distance of $10cm$, the gravitational force between them is $6.67 \times 10^{-7}N$. The masses of the two balls are in kg.

A. $10, 20$

B. $5, 20$

C. $20, 30$

D. $20, 40$

Answer: B

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12. Gravitational force between two point masses m and M separated by a distance r is F. Now if a point mass $3m$ is placed very next to m, the total force on M will be

A. F

B. $2F$

C. $3F$

D. $4F$

Answer: A

Watch Video Solution

13. Three uniform spheres each of mass m and diameter D are kept in such a way that each touches the other two, then magnitudes of the gravitational force on any one sphere due to the other two is

A. $\frac{3Gm^2}{D^2}$

B. $\frac{2\sqrt{3}Gm^2}{D^2}$

C. $\frac{\sqrt{3Gm^2}}{4D^2}$

D. $\frac{\sqrt{3}Gm^2}{D^2}$

Answer: D

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14. A $3kg$ mass and $4kg$ mass are placed on X and Y axes at a distance of 1 meter from the origin and a $1kg$ mass is placed at the origin. Then the resultant gravitational force on $1kg$ mass is

A. $7G$

B. G

C. $5G$

D. $3G$

Answer: C

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15. The height at which the value of g is half that on the surface of the earth of radius R is

A. R

B. $2R$

C. $0.414R$

D. $0.75R$

Answer: C

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16. The depth at which the value of g becomes 25% of that at the surface of the earth is (in KM)

A. 4800

B. 2400

C. 3600

D. 1200

Answer: A

Watch Video Solution

17. If the radius of the earth decreases by 10%, the mass remaining unchanged, what will happen to the acceleration due to gravity?

A. decreases by 19%

B. incraeses by 19%

C. decreases by more than 19%

D. increases by more than 19%

Answer: D

Watch Video Solution

18. The acceleration due to gravity at the poles is $10ms^{-2}$ and equitorial radius is $6400km$ for the earth. Then the angular velocity of rotaiton of the earth about its axis so that the weight of a body at the equator reduces to 75% is

A. $\frac{1}{1600} rads^{-1}$

B. $\frac{1}{800} rads^{-1}$

C. $\frac{1}{400} rads^{-1}$

D. $\frac{1}{200} rads^{-1}$

Answer: A

Watch Video Solution

19. The maximum horizontal range of projectile on the earth is R. Then for the same velocity of projection, its maximum range on another planet is $\frac{5R}{4}$. Then, ratio of acceleration due to gravity on that planet and on the earth is

A. $5:4$

B. $4:5$

C. $25:16$

D. $16:25$

Answer: B

Watch Video Solution

20. A particle hanging from a massless spring stretches it by $2cm$ at the earth's surface. How much will the same particle stretch the spring at a height? Of $2624Km$ from the surface of the earth? (Radius of the earth $= 6400km$)

A. $1cm$

B. $2cm$

C. $3cm$

D. $4cm$

Answer: A

Watch Video Solution

Watch Video Solution

21. The value of acceleration due to gravity 'g' on the surface of a planet with radius double that of the earth and same mean density as that of the earth is (g_e =acceleration due to gravity on the surface of the earth)

A. $g_p = 2g_e$

B. $g_p = g_e/2$

C. $g_p = g_e/4$

D. $g_p = 4g_e$

Answer: A

Watch Video Solution

22. If g is acceleration due to gravity on the surface of the earth, having radius R, the height at which the acceleration due to gravity reduces to $g/2$ is

A. $R/2$

B. $\sqrt{2}R$

C. $\frac{R}{\sqrt{2}}$

D. $\left(\sqrt{2} - 1\right)R$

Answer: D

Watch Video Solution

23. There are two bodies of masses $100kg$ and $1000kg$ separated by a distance $1m$. The intensity of gravitational field at the mid point of the line joining them will be

A. $2.4 \times 10^{-6} N/kg$

B. $2.4 \times 10^{-7} N/kg$

C. $2.4 \times 10^{-8} N/kg$

D. $2.4 \times 10^{-9} N/kg$

Answer: B

Watch Video Solution

24. Masses $4kg$ and $36kg$ are $16cm$ apart. The point where the gravitational field due to them is zero is

A. $6cm$ from $4kg$ mass

B. $4cm$ from $4kg$ mass

C. $1.8cm$ from $36kg$

D. $9cm$ from each mass

Answer: B

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25. Two particle of masses $4kg$ and $8kg$ are kept at $x = -2m$ and $x = 4m$ respectivley. Then, the gravitational field intensity at the origin is

A. G

B. $2G$

C. $G/2$

D. $G/4$

Answer: C

Watch Video Solution

26. Three particles each of mass m are kept at the vertices of an euilateral triangle of side L. The gravitational field at the centre due to these particle is

A. zero

B. $\frac{3GM}{L^2}$

C. $\frac{9GM}{L^2}$

D. $\frac{2GM}{L^2}$

Answer: A

Watch Video Solution

27. Three particles each of mass m are palced at the corners of an equilateral triangle of side b. The gravitational potential energy of the system of particle is

A. $\frac{-3Gm^2}{2b}$

B. $\frac{-Gm^2}{2b}$

C. $\frac{-3Gm^2}{b}$

D. $\frac{-Gm^2}{b}$

Answer: C

Watch Video Solution

28. If W is the weight of a satellite on the surface of the earth, then the energy required to lauch that satellite from the surface of earth into a circular orbit of radius $3R$ is (here R is the radius of the earth)

A. $5WR/6$

B. $6WR/5$

C. $2WR/3$

D. $3WR/2$

Answer: A

Watch Video Solution

29. A body of mass m is lifted from the surface of earth of height equal to $R/3$ where R is the radius of earth, potential energy of the body increases by

A. $mgR/3$

B. $mgR/4$

C. $2mgR/3$

D. $mgR/9$

Answer: B

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30. An object of mass $2kg$ is moved from infinity to a point P. Initially that object was at rest but on reaching P its speed is $2m/s$. The then potential at P is ....J/kg.

A. 8

B. -2

C. 4

D. -4

Answer: B

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31. If mass of the earth is M, radius is R, and gravitational constant is G, then workdone to take $1kg$ mass from earth surface to infinity will be

A. $\sqrt{\frac{GM}{2R}}$

B. $\frac{GM}{R}$

C. $\sqrt{\frac{2GM}{R}}$

D. $\frac{GM}{2R}$

Answer: B

Watch Video Solution

32. A body of mass m is placed on the earth surface is taken to a height of $h = 3R$, then, change in gravitational potential energy is

A. $\frac{mgR}{4}$

B. $\frac{2mgR}{3}$

C. $\frac{3mgR}{4}$

D. $\frac{mgR}{6}$

Answer: C

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Watch Video Solution

33. A body is released from a height $5R$ where R is the radius of the earth. Then that body reaches the ground with a velocity equal to

A. $\sqrt{\frac{5gR}{3}}$

B. $\sqrt{\frac{3gR}{5}}$

C. $\sqrt{5gR}$

D. $\sqrt{3gR}$

Answer: A

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Watch Video Solution

34. The difference in PE of an object of mass $10kg$ when it is taken from a height of $6400Km$ to $12800Km$ from the surface of the earth is $\left(M_E = 6 \times 10^{24}kg\right)$

A. $1.045 \times 10^8 J$

B. $1.565 \times 10^8 J$

C. $2.65 \times 10^8 J$

D. $4.5 \times 10^8 J$

Answer: A

Watch Video Solution

35. If the gravitational potential energy of a body at a distance r from the centre of the earth is U, then it's weight at that point is

A. U

B. $\frac{U^2}{r}$

C. $U^2 r$

D. $\frac{U}{r}$

Answer: D

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36. The escape velocity of an object on a planet whose radius is 4 times that of the earth and g value 9 tims that on the earth, in Kms^{-1}, is

A. 33.6

B. 67.2

C. 16.8

D. 25.2

Answer: B

37. The escape velocity of a sphere of mass m is given by

A. $\sqrt{\frac{2GMm}{R_e}}$

B. $\sqrt{\frac{2GM}{R_e^2}}$

C. $\sqrt{\frac{2GMm}{R_e^2}}$

D. $\sqrt{\frac{2GM}{R_e}}$

Answer: D

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38. A body is projected up with a velocity equal to $3/4th$ of the escape velocity from the surface of the earth. The height it reaches is (Radius of the earth is R)

A. $10R/9$

B. $9R/7$

C. $9R/8$

D. $10R/3$

Answer: B

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39. A spacecraft is launched in a circular orbit very close to earth. What additional velocity should be given to the spacecraft so that it might escape the earth's gravitational pull.

A. $20.2Kms^{-1}$

B. $3.25Kms^{-1}$

C. $8Kms^{-1}$

D. $11.2Kms^{-1}$

Answer: B

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40. If the escape velocity on the earth is $11.2 km/s$, its value for a planet having double the radius and 8 times the mass of the earth is ...... (in Km/s)

A. 11.2

B. 22.4

C. 5.6

D. 8

Answer: B

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41. The escape velocity of a body from earth's surface is v_e. The escape velocity of the same body from a height equal to $7R$ from earth's surface will be

A. $\frac{V_e}{\sqrt{2}}$

B. $\frac{V_e}{2}$

C. $\frac{V_e}{2\sqrt{2}}$

D. $\frac{V_e}{4}$

Answer: C

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42. The escape velocity of a body from the surface of the earth is V_1 and from an altitude equal to twice the radius of the earth, is, V_2. Then

A. $V_1 = V_2$

B. $V_1 = 7V_2$

C. $V_1 = \sqrt{3}V_2$

D. $V_1 = \sqrt{2}V_2$

Answer: C

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43. The ratio of the orbital speeds of two satellites of the earth if the satellite are at heights $6400km$ and $19200km$(Raduis of the earth= $6400km$)

A. $\sqrt{2} : 1$

B. $\sqrt{3} : 1$

C. $2 : 1$

D. $3:1$

Answer: A

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44. An artificial satellite is revolving in a circular orbit at height of $1200km$ above the surface of the earth. If the radius of the earth is $6400km$ and mass is $6 \times 10^{24}kg$, the orbital velocity is

A. $7.26kms^{-1}$

B. $4.26kms^{-1}$

C. $9.26 kms^{-1}$

D. $2.26 kms^{-1}$

Answer: A

Watch Video Solution

45. The mean radius of the orbit of a satellite is 4 times as great as that of the parking orbit of the earth. Then its period of revolution around the earth is

A. 4 days

B. 8 days

C. 16 days

D. 96 days

Answer: B

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46. If the mass of earth were 4 times the present mass, the mass of the moon were half the present mass and the moon were revolving around the earth at twice the present distance, the time period of revolution of the moon would be (Indays)

A. $56\sqrt{2}$

B. $28\sqrt{2}$

C. $14\sqrt{2}$

D. $7\sqrt{2}$

Answer: B

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47. A satellite of mass m revolves around the earth of mass M in a circular orbit of radius r, with an angular velocity ω. If raduis of the orbit becomes $9r$, then angular velocity of this orbit becomes

A. 9ω

B. $\frac{\omega}{9}$

C. 27ω

D. $\frac{\omega}{27}$

Answer: D

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48. A satellite of mass m is in a circular orbit of radius r round the Earth. Calculate its angular momentum with respect to the centre of the orbit in terms of the mass M of the Earth and G.

A. $\sqrt{GMm^2r}$

B. $2m\sqrt{GMr}$

C. $2M\sqrt{Gmr}$

D. $\sqrt{\frac{GM}{r}}$

Answer: A

Watch Video Solution

49. Two satellite of masses $400kg, 500kg$ are revolving around earth in different circular orbits of radii r_1, r_2 such that their kinetic energies are equal. The ratio of r_1 to r_2 is

A. $\sqrt{5} : \sqrt{4}$

B. $16 : 25$

C. $\sqrt{4} : \sqrt{5}$

D. $25 : 16$

Answer: A

Watch Video Solution

50. Angular momentum of a satellite revolving round the earth in a circular orbit at a height R above the surface is L. Here R is radius of the earth. The magnitude of angular momentum of another satellite of the same mass revolving very close to the surface of the earth is

A. $L/2$

B. $L/\sqrt{2}$

C. $\sqrt{2}L$

D. $2L$

Answer: B

Watch Video Solution

51. The $K.E.$ of a satellite is $10^4 J$. It's $P.E.$ is

A. $-10^4 J$

B. $2 \times 10^4 J$

C. $-2 \times 10^4 J$

D. $-4 \times 10^4 J$

Answer: C

Watch Video Solution

52. The energy required to move a body of mass m from an orbit of radius $3R$ to $4R$ is

A. $\frac{GMm}{2R}$

B. $\frac{GMm}{6R}$

C. $\frac{GMm}{12R}$

D. $\frac{GMm}{24R}$

Answer: D

Watch Video Solution

53. $K.E.$ of an orbiting satellite is K. The minimum additional $K.E.$ required so that it goes to infinity is

A. K

B. $2K$

C. $3K$

D. $K/2$

Answer: A

Watch Video Solution

54. Imagine a geo-stationary satellite of the earth which is used as an inter-continental telecast station. At what height will it have to be established?

A. $10^3 m$

B. $6.4 \times 10^3 m$

C. $35.94 \times 10^6 m$

D. infinity

Answer: C

Watch Video Solution

55. The height of a geo-stationary satellite above the centre of the earth is (in KM)

A. 6400

B. 12800

C. 36000

D. 42000

Answer: D

Watch Video Solution

56. How much faster than it's normal rate should the earth rotate about it's axis so that the weight of the body at the equator becomes zero $\left(R = 6.4 \times 10^6 m, g = 9.8 m/s^2\right)$ (in times)

A. nearly 17

B. nearly 12

C. nearly 10

D. nearly 14

Answer: A

Watch Video Solution

LEVEL-II (H.W)

1. Two satellites S_1 and S_2 are revolving round a planet in coplanar and concentric circular orbit of radii R_1 and R_2 in te same direction respectively. Their respective periods of revolution are 1 hr and 8 hr. the radius of the orbit of satellite S_1 is equal to 10^4km. Find the relative speed in kmph when they are closest.

A. $\frac{\pi}{2} \times 10^4$

B. $\pi \times 10^4$

C. $2\pi \times 10^4$

D. $4\pi \times 10^4$

Answer: B

Watch Video Solution

2. Two metal spheres each of radius r are kept in contact with each other. If d is the density of the material of the sphere,then the gravitational force between those spheres is proportional to

A. d^2r^6

B. d^2r^4

C. $\frac{d^2}{r^4}$

D. $\frac{r^2}{d^2}$

Answer: B

Watch Video Solution

3. Two leads spheres of same radii are in contact with eacth other. The gravitational force of attraction between them is F. If two leads spheres of double the previous radii are in contanct with eacth other, the gravitational force of attraction between them now will be

A. $2F$

B. $32F$

C. $8F$

D. $16F$

Answer: D

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4. The gravitational force between two bodies is decreased by 36% when the distance between them is increased by $3m$. The initial distance between them is

A. $6m$

B. $9m$

C. $12m$

D. $15m$

Answer: C

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5. Two particle of masses m and $2m$ are at a distance $3r$ apart at the ends of a straight line AB. C is the centre of mass of the system. The magnitude of the gravitational force on a unit mass placed at C due to the masses is

A. zero

B. $\frac{7Gm}{4r^2}$

C. $\frac{9Gm}{4r^2}$

D. $\frac{3Gm}{2r^2}$

Answer: B

Watch Video Solution

6. If the distance between two bodies is increased by 25%, then the $\%$ change in the gravitational force is

A. Decreases by 36%

B. Incraeses by 36%

C. Increases by 64%

D. Decreases by 64%

Answer: A

Watch Video Solution

7. Three point masses each of mass m rotate in a circle of radius r with constant angular velocity ω due to their mutual gravitational attraction. If at any instant, the masses are on the vertices of an equilateral triangle of side a, then the value of ω is

A. $\sqrt{\frac{Gm}{a^3}}$

B. $\sqrt{\frac{3Gm}{a^3}}$

C. $\sqrt{\frac{Gm}{3a^2}}$

D. zero

Answer: B

Watch Video Solution

8. The angular momentum (L) of the earth revolving round the sun uis proportional to r^n, where r is the orbital radius of the earth. The value of n is (assume the orbit to be circular)

A. $\frac{1}{2}$

B. 1

C. $-\frac{1}{2}$

D. 2

Answer: A

Watch Video Solution

9. Four particles having masses, m, 2m, 3m, and 4m are placed at the four corners of a square of edge a. Find the gravitational force acting on a particle of mass m placed at the centre.

A. $4\sqrt{2}\frac{Gm^2}{a^2}$

B. $\frac{3\sqrt{2}Gm^2}{a^2}$

C. $\frac{2\sqrt{2}Gm^2}{a^2}$

D. $\frac{\sqrt{2}Gm^2}{a^2}$

Answer: A

Watch Video Solution

10. If the radius of the earth is made three times, keeping the mass constant, then the weight of a body on the earth's surface will be as compared to its previous value is

A. one third

B. one ninth

C. three times

D. nine times

Answer: B

Watch Video Solution

11. The difference in the value of g at poles and at a sphere of latitude, 45° is

A. $R\omega^2$

B. $\frac{R\omega^2}{2}$

C. $\frac{R\omega^2}{4}$

D. $\frac{R\omega^2}{3}$

Answer: B

Watch Video Solution

12. The angular velocity of the earth's rotation about its axis is ω. An object weighed by a spring balance gives the same reading at the equator as at height h above the poles. The value of h will be

A. $\frac{\omega^2 R^2}{g}$

B. $\frac{\omega^2 R^2}{2g}$

C. $\frac{2\omega^2 R^2}{g}$

D. $\frac{2\omega^2 R^2}{3g}$

Answer: B

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13. The radius and acceleration due to gravity of the moon are $\frac{1}{4}$ and $\frac{1}{5}$ that of the earth, the ratio of the mass of the earth to mass of the moon is

A. $1:80$

B. $80:1$

C. $1:20$

D. $20:1$

Answer: B

Watch Video Solution

14. The difference in the value of g at poles and at a latitude is $\frac{3}{4}R\omega^2$. The latitude angle is

A. 60°

B. 30°

C. 45°

D. 95°

Answer: B

Watch Video Solution

15. A particle hanging from a spring stratches it by $1cm$ at earth's surface. Radius of the earth is $6400km$. At a place $800km$ above the earth's surface, the same particle will stretch the spring by

A. $0.79cm$

B. $1.2cm$

C. $4cm$

D. $17cm$

Answer: A

Watch Video Solution

16. A tunnel is dug along a diameter of the earth. Find the force on a particle of mass m placed in the tunnel at a distance x from the centre.

A. $\dfrac{GM_e m}{R^3}$

B. $\dfrac{GM_e m}{R^2}x$

C. $\dfrac{GM_e m}{R^3 x}$

D. $\dfrac{GM_e}{R^3 x}$

Answer: A

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17. The mass of the earth is 9 times that of the mars. The radius of the earth twice that of the mars. The escape velocity of the earth is $12 km/s$. The escape velocity on the mars is ....km/s

A. $4\sqrt{2} km/s$

B. $2\sqrt{2} km/s$

C. $6\sqrt{2} km/s$

D. $8\sqrt{2} km/s$

Answer: A

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18. The escape velocity of a body from the earth is $11.2 km/s$. If a body is projected with a velocity twice its escape velocity, then the velocity of the body at infinity is (in km/s)

A. 19.4

B. 194

C. 1.94

D. 0.194

Answer: A

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19. A particle is kept at rest at a distance R (earth's radius) above the earth's surface. The minimum speed with which it should be projected so that is does not return is

A. $\sqrt{\frac{GM}{R}}$

B. $\sqrt{\frac{GM}{2R}}$

C. $\sqrt{\frac{GM}{3R}}$

D. $\sqrt{\frac{GM}{4R}}$

Answer: A

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20. $16kg$ and $9kg$ are separated by $25m$. The velocity with which a body should be projected from the mid point of the line joining the two masses so that it just escape is

A. $\sqrt{g}$

B. $\sqrt{2grR}$

C. $\sqrt{G}$

D. $2\sqrt{G}$

Answer: D

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21. The escape velocity from the earth is $11 km/s$. The escape velocity from a planet having twice the radius and same density as that of the earth is (in km/s)

A. 11

B. $22\sqrt{3}$

C. $33\sqrt{3}$

D. $44\sqrt{3}$

Answer: C

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22. The speed of a satellite that revolves around earth at a height $3R$ from earth's surface is ($g = 10m/s^2$ at the surface of earth, radius of earth $R = 6400km$) in kms^{-1}

A. $2\sqrt{2}$

B. 4

C. $4\sqrt{2}$

D. 8

Answer: B

Watch Video Solution

23. If an artificial satellite is moving in a circular orbit around earth with speed equal to one fourth of V_e from earth, then height of the satellite above the surface of the earth is

A. $7R$

B. $4R$

C. $3R$

D. R

Answer: A

Watch Video Solution

24. The radii of circular orbits of two satellite A and B of the earth are $4R$ and R, respectively. If the speed of satellite A is $3v$, then the speed of satellite B will be

A. $12V$

B. $6V$

C. $4V$

D. $3V$

Answer: B

Watch Video Solution

25. A satellite moving in a circular path of radius r around earth has a time period T. If its radius slightly increases by 4%, then percentage change in its time period is

A. $\frac{3}{2}\left(\frac{T}{r}\right)\Delta r$

B. $\left(\frac{T}{r}\right)\Delta r$

C. $\frac{3}{2}\left(\frac{T^2}{r^2}\right)\Delta r$

D. $\frac{3}{2}\left(\frac{T^2}{r}\right)\Delta r$

Answer: A

Watch Video Solution

26. A satellite is orbiting the earth in an orbit with a velocity $4km/s$, then the acceleration due to gravity at that height is (in ms^{-2})

A. 0.4

B. 0.62

C. 0.87

D. 1.21

Answer: B

Watch Video Solution

27. A stone is dropped from a height equal to $3R$, above the surface of earth. The velocity of stone on reaching the earth's surface is

A. $\sqrt{g\frac{R}{2}}$

B. $\sqrt{\frac{3}{2}gR}$

C. $\sqrt{2gR}$

D. $\sqrt{gR}$

Answer: B

Watch Video Solution

Watch Video Solution

28. If g is the acceleration due to gravity on the earth's surface, the gain in the potential energy of an object of mass m raised from the surface of the earth to a height equal to the radius R of the earth, is

A. $2mgR$

B. mgR

C. $mgR/4$

D. $mgR/2$

Answer: D

Watch Video Solution

29. The work done in bringing three particles each of mass $10g$ from a large distance to the vertices of an equilateral triangle of side $10cm$ is (approximately)

A. $10^{-13}J$

B. $2 \times 10^{-13}J$

C. $4 \times 10^{-13}J$

D. $10^{-11} J$

Answer: B

Watch Video Solution

30. The energy required to shift the body revolving around a planet from r to $2r$ is E. The energy required to shift it from $2r$ to $4r$ is (measured from centre of planet)

A. E

B. $\frac{E}{2}$

C. $\frac{E}{3}$

D. $\frac{E}{4}$

Answer: B

Watch Video Solution

31. By what percent the energy of the satellite has to be increased to shift it from an orbit of radius r to $3r$.

A. 66.7%

B. 33.3%

C. 15%

D. 20.3%

Answer: A

Watch Video Solution

32. At what height from the surface of the earth, the total energy of satellite is equal to its potential energy at a height $3R$ from the surface of the earth (R=radius of earth)

A. $4R$

B. $3R$

C. $2R$

D. R

Answer: D

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LEVEL-V

1. A spherical hollow is made in a lead sphere of radius R such that its surface touches the outside surface of the lead sphere and passes through the centre. The mass of the lead sphere before hollowing was M. The force of attraction that this sphere would exert on a particle of mass m which lies at a distance d from the centre joining the centre of the sphere and the hollow is

A. $\dfrac{GMm}{d^2}$

B. $\dfrac{GMm}{d^2}\left[1 - \dfrac{1}{8\left(1 - \dfrac{R}{2d}\right)^2}\right]$

C. $\frac{GMm}{d^2}\left[1 - \frac{1}{8\left(1 + \frac{R}{2d}\right)^2}\right]$

D. $\frac{GMm}{8d^2}$

Answer: B

Watch Video Solution

2. A thin rod of mass M and length L is bent into a semicircle as shown in diagram. What is a gravitational force on a particle with mass m at the centre of curvature?

A. $\frac{4\pi^2 GMm}{L^2}$

B. $\frac{GMm}{4\pi^2 L^2}$

C. $\frac{2\pi GMm}{L^2}$

D. zero

Answer: D

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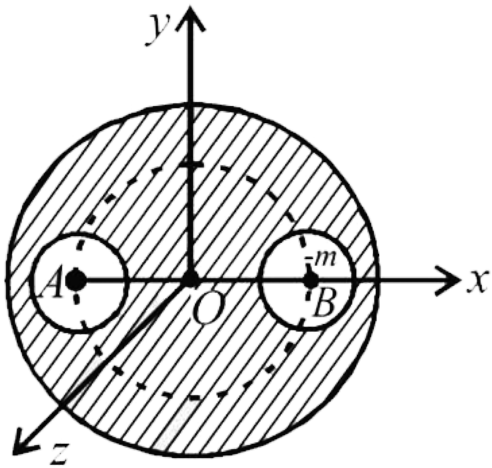
3. A solid sphere of uniform density and radius 4 units is located with its centre at the origin O of coordinates. Two sphere of equal radii 1 unit, with their centres at A(-2,0 ,0) and B(2,0,0) respectively, are taken out of the solid leaving behind spherical cavities as shown if fig Then:



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4. The gravitational potential due to earth at infinite distance from it is zero. Let the gravitational potential at a point P be $-5 J kg^{-1}$.

Suppose, we arbitrarily assume the gravitational potential at infinity to be $+10 J kg^{-1}$, then the gravitational potential at P will be

A. $-5 J kg^{-1}$

B. $+5 J kg^{-1}$

C. $-15 J kg^{-1}$

D. $+15 J kg^{-1}$

Answer: B

Watch Video Solution

5. A body starts from rest from a point distant r_0 from the centre of the earth. It reaches the surface of the earth whose radius is R. The velocity acquired by the body is

A. $2GM\sqrt{\frac{1}{R} - \frac{1}{r_0}}$

B. $\sqrt{2GM\left(\frac{1}{R} - \frac{1}{r_0}\right)}$

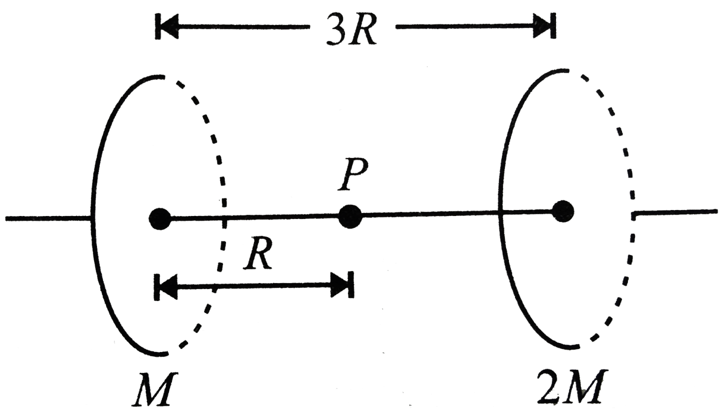
C. $GM\sqrt{\frac{1}{R} - \frac{1}{r_0}}$

D. $\sqrt{GM\left(\frac{1}{R} - \frac{1}{r_0}\right)}$

Answer: B

Watch Video Solution

6. Two rings having masses M and $2M$ respectively, having the same radius are placed coaxially as shown in the figure.



If the mass distribution on both the rings is non-uniform, then the gravitational potential at point P is

A. $-\frac{GM}{R}\left[\frac{1}{\sqrt{2}}+\frac{2}{\sqrt{5}}\right]$

B. $-\frac{GM}{R}\left[1+\frac{2}{2}\right]$

C. zero

D. cannot be determined from given information

Answer: A

Watch Video Solution

7. A point P lies on the axis of a fixed ring of mass M and radius R, at a distance $2R$ from its centre O

. A small particle starts from P and reaches O under gravitational attraction only. Its speed at O will be

A. $\sqrt{\frac{2GM}{R}\left(1 - \frac{1}{\sqrt{5}}\right)}$

B. $\sqrt{\frac{2GM}{R}}$

C. $\sqrt{\frac{2GM}{R}\left(\sqrt{5} - 1\right)}$

D. zero

Answer: A

Watch Video Solution

8. The gravitational field due to a mass distribution is given by $E = \frac{K}{x^3}$ in X-direction. Taking the gravitational potential to be zero at infinity, find its value at a distance x.

A. $\frac{2K}{x^2}$

B. $\frac{K}{2x^2}$

C. $\frac{K}{x^2}$

D. $\frac{3K}{2x^2}$

Answer: B

Watch Video Solution

9. An artificial satellite of the earth is launched in circular orbit in the equatorial plane of the earth and the satellite is moving from west to east. With respect to a person on the equator, the satellite is completing one round trip in $24h$. Mass of the earth is $M = 6 \times 10^{24} kg$. For this situation the orbital radius of the satellite is

A. $2.66 \times 10^{4} km$

B. $6400 km$

C. $36,000 km$

D. $29,600 km$

Answer: A

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10. A satellite is orbiting around earth in a circular orbit of radius r. A particle of mass m is projected from satellite in forward direction with velocity $v = \sqrt{\frac{2}{3}}$ times orbital velocity (this velocity is with respect to the earth). During subsequent motion of the particle, its minimum distance from the centre of earth is

A. $\frac{r}{2}$

B. r

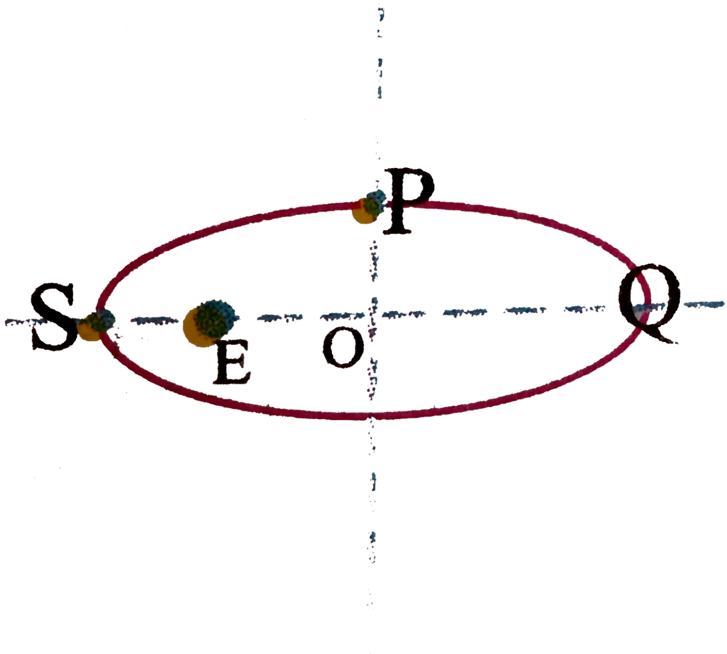
C. $\frac{2r}{3}$

D. $\frac{4r}{3}$

Answer: A

Watch Video Solution

11. A satellite moving in an elliptical orbit around the earth as shown. The minimum and maximum distance of the satellite from earth are 3 units and 5 units respectively. The distance of satellite from earth when it is at P is ....unit



A. 4 units

B. 3 units

C. 3.75 units

D. none of these

Answer: A

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12. An exploratory rocket of mass m is an orbit about the sun at radius of $R_{ES}/10$ (one tenth of the radius of the earth's orbit about the sun). To exit this orbit, it fires its engine over a short period of time. This quickly doubles the velocity of the rocket while halving its mass the burn, what is the kinetic energy of the rocket? take mass of sun as M_S

A. $\frac{GM_S m}{2R_{ES}}$

B. $\frac{10GM_S m}{R_{ES}}$

C. $\frac{20GM_S m}{R_{ES}}$

D. $\frac{5GM_S m}{R_{ES}}$

Answer: B

Watch Video Solution

13. A shell is fired vertically from the earth with speed v_{esc}/N, where N is some number greater than one and v_{esc} is escape speed on the earth.

Neglecting the rotation of the earth and air resistance, the maximum altitude attained by the shell will be (R_E is radius of the earth):

A. $\frac{R_E}{N^2 - 1}$

B. $\frac{R_E}{N^2}$

C. $\frac{NR_E}{N^2 - 1}$

D. $\frac{N^2 R_E}{N^2 - 1}$

Answer: A

Watch Video Solution

14. A planet of small mass m moves around the sun of mass M along an elliptical orbit such that its minimum and maximum distance from sun are r and R respectively. Its period of revolution will be:

A. $2\pi\sqrt{\frac{(r+R)^3}{6GM}}$

B. $2\pi\sqrt{\frac{(r+R)^3}{3GM}}$

C. $\pi\sqrt{\frac{(r+R)^3}{2GM}}$

D. $2\pi\sqrt{\frac{(r+R)^3}{GM}}$

Answer: C

Watch Video Solution

15. A satellite revolving around the planet in a circular orbit is to be raised to a bigger circular orbit. The required energy can be supplied to the satellite for achieving the bigger orbit:

A. ine one stage

B. in minimum two stages

C. in minimum four stages

D. in minimum three stages

Answer: B

Watch Video Solution

16. A spherical uniform planet is rotating about its axis. The velocity of a point on its equator is V. Due to the rotation of planet about its axis the acceleration due to gravity g at equator is $1/2$ of g at poles. The escape velocity of a particle on the planet in terms of V.

A. $v_e = 2v$

B. $v_e = \sqrt{3}v$

C. $v_e = v$

D. $v_e = v/2$

Answer: A

Watch Video Solution

17. The escape speed from jupiter is approximately $59.5 kms^{-1}$ and its radius is about 12 times that to earth. From this we may estimate the mean density of jupiter to be about (radius of earth =escape speed from the earth is $11.2 kgm^{-1}$

A. 5 times that of earth

B. 0.2 times that of the earth

C. 2.5 times that of the earth

D. 0.4 times that of earth

Answer: A

Watch Video Solution

18. As observed from a place in Australia the pole star

A. appears in the sothern direction

B. appears at about 30° above the horizon

C. much brighter than that seen from india

D. can never be seen

Answer: A

Watch Video Solution

19. The volume of mass and radius of sun are given by $M_o = 2 \times 10^{30} kg$ and $R_o = 7 \times 10^5 km$ respectively. The pressure at the centre is bout $\left(g = 6.67 \times 10^{-11} m^3 . kg^{-1} s^{-2}\right)$

A. $2 \times 10^{14} Nm^{-2}$

B. $2 \times 10^{15} Nm^{-2}$

C. $5 \times 10^{14}. Nm^{-2}$

D. $7 \times 10^{15} Nm^{-2}$

Answer: A

Watch Video Solution

20. Assume that the gas inside the sun behvaes very much like the perfect gas, the temperature at the centre of the sun is nearly (the number density of gas particles $\frac{2\rho}{M_H}$, Boltzmann constant $k_B = 1.4 \times 10^{-23} J.K^{-1}$ and mass of proton $M_H = 1.67 \times 10^{-27} kg$)

A. $3 \times 10^7 K$

B. $2 \times 10^7 K$

C. $4 \times 10^7 K$

D. $6 \times 10^7 K$

Answer: A

View Text Solution

21. In order to simulate different values of g aspiring astronauts are put on a plane which dives in a parabola given by the equation $x^2 = 500y$. Where x is horizontal, y is vertically upwards, both being measured in meter. The x-component of the velocity of the plane is constant throughout, and has the value of $360 km/h$. the effective g("g-force") experienced by an astronaut on the plane equals

A. $4g$

B. $3g$

C. $\frac{g}{5}$

D. $5g$

Answer: A

Watch Video Solution

22. The eccentricity of the earth's orbit is 0.0167, the ratio of its maximum speed in its orbit to its minimum speed is

A. 1.67

B. 1.034

C. 1

D. 0.167

Answer: A

Watch Video Solution

23. The time taken by the earth to travels over half its orbit, remote from the sun, separated by the minor axis is about 2 days more then half the year, then the eccentricity of the orbit is

A. $1/30$

B. $1/60$

C. $1/15$

D. $1/70$

Answer: A

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24. If a spherically symmetric star of radius R collapsed under its own weight, neglecting any forces other than gravitational ones, what is the time required for collapse?

A. $\dfrac{8\pi^2 R^3}{(GM)^{0.5}}$

B. $\frac{2\pi^2 R^3}{(3GM)^{0.5}}$

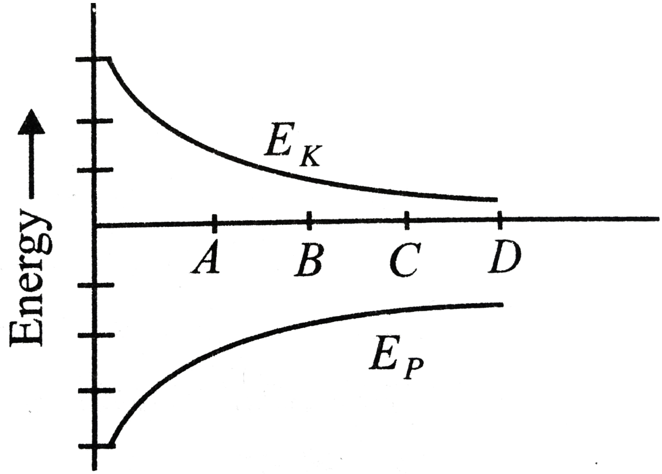
C. $\frac{\pi^2 R^3}{(8GM)^{0.5}}$

D. $\left(\frac{2R^3}{GM}\right)^{0.5}$

Answer: A

Watch Video Solution

25. Figure shows the kinetic energy (E_k) and potential energy (E_p) curves for a two-particle system. Name the point(s) at which the system is a bound system.



A. A

B. B

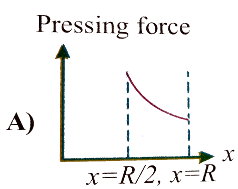
C. C

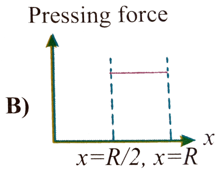
D. D

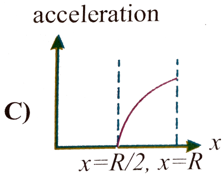
Answer: A::B::C::D

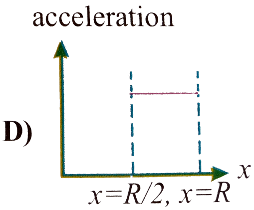
Watch Video Solution

26. A tunnel is dug along a chord of the earth at a perpendicular distance $R/2$ from the earth's centre. The wall of the tunnel may be assumed to be frictionless. A particle is released from one end of the tunnel. The pressing force by the particle on the wall, and the acceleration of the particle vary with x (distance of the particle from the centre) according to

A. 

B. 

C. 

D. 

Answer: B::C

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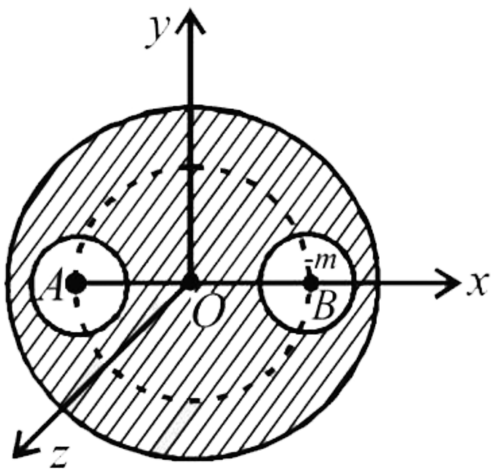
27. A solid sphere of uniform density and radius 4 units is located with its centre at the origin O of coordinates. Two sphere of equal radii 1 unit, with their centres at A(-2,0 ,0) and B(2,0,0) respectively, are taken out of the solid leaving behind spherical cavities as shown if fig Then:



A. the gravitational force due to this object at the origin is zero

B. the gravitational force at the point $B(2, 0, 0)$

is zero

C. the gravitational potential is the same at all

points of the circle $z^2 + y^2 = 36$

D. the gravitational potential is same at all

points of the cirlcle $y^2 + z^2 = 4$

Answer: A::C::D

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28. A double star consists of two stars having masses M and $2M$. The distance between their centres is equal to r. They revolve under their mutual gravitational interaction. Then, which of the following statements are not correct?

A. Heavier star revolves in orbit of radius $2r/3$

B. both the stars revolve with same angular speed, period of which is equal to $\frac{2\pi}{\sqrt{\frac{2GM}{3}}} r^{\frac{3}{2}}$

C. Kinetic energy of the heavier star is twice that of the other star

D. Heavier star revolves in orbits of radius $r/3$

Answer: A:B:C

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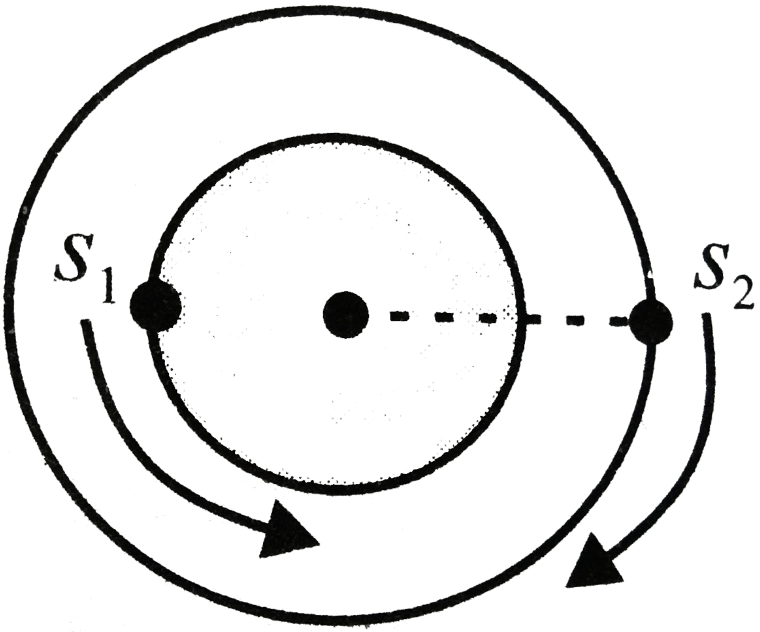
29. Two satellites S_1 and S_2 are revolving around the earth in coplanar concentric orbits in the opposite sense. At $t = 0$, the position of satellites are shown in the diagram. The periods of S_1 and S_2 are $4h$ and $24h$, respectively. The radius of orbit of S_1 is $1.28 \times 10^4 km$. For this situation, mark the correct statement (s).



A. The angular velocity of S_2 as observed by S_1

at $t = 12h$ is $0.486\pi rads^{-1}$

B. The two satellites are closest to each other

for the first time at $t = 12h$ and then after every $2h$ they are closest to each other

C. The orbital velocity of S_1 is $0.64\pi \times 10^4 km$

D. The velocity of S_1 relative to S_2 is continuously changing in magnitude and direction both

Answer: A::B::C::D

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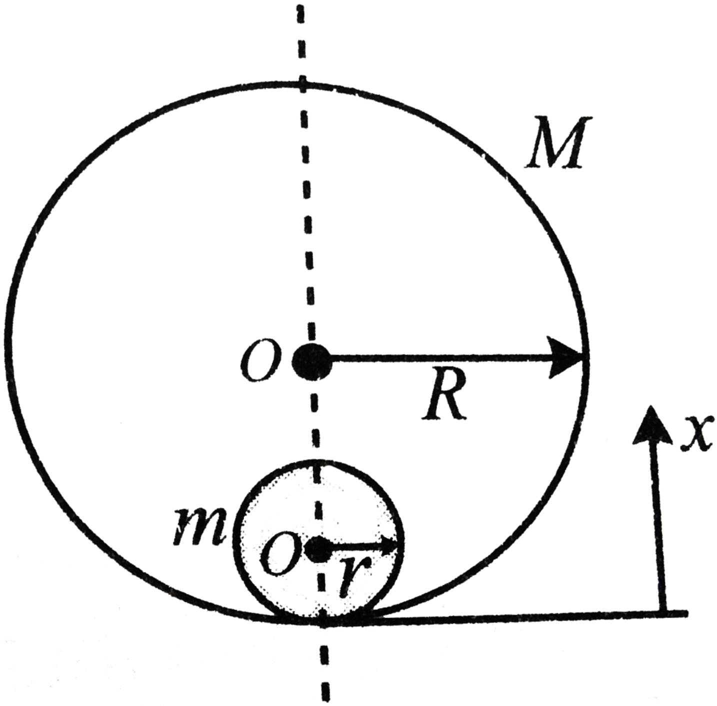
30. A solid sphere of mass m and radius r is placed inside a hollow thin spherical shell of mass M and radius R as shown in the figure. A particle of mass m' is placed on the line joining the two centres at a distance x from the point of contact of the sphere and the shell. Find the magnitude of the resultant gravitational force on this particle due to the sphere and the shell if



$r < x < 2r$

A. $\dfrac{Gmm'(2r - x)}{2r^3}$

B. $\dfrac{Gmm'(x - r)}{2r^3}$

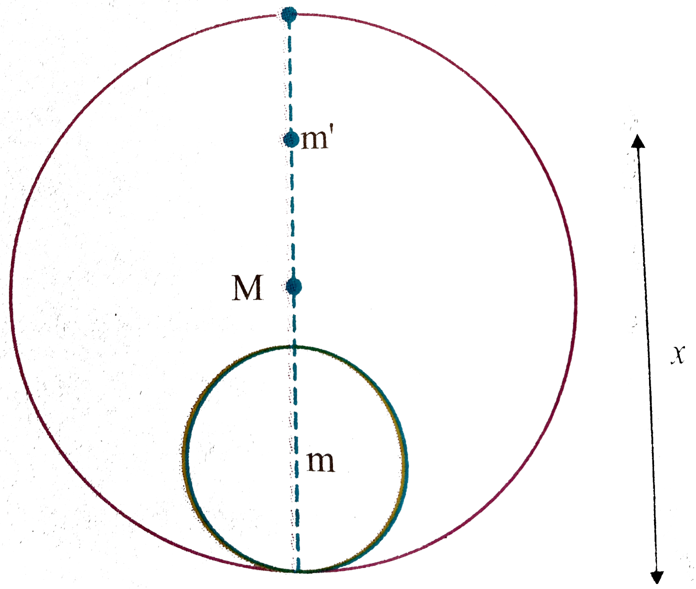
C. $\dfrac{Gmm'(x - r)}{r^3}$

D. $\dfrac{Gmm'(2x - r)}{r^3}$

Answer: C

Watch Video Solution

31. A solid sphere of mass m radius r is placed inside a hollow thin spherical shell of mass M and radius $2r$ as shown in figure. A particle of mass m' is placed on the line joining the two centres at a distance x from the point of contact of the sphere and the shell. find the magnitude of the resultant gravitational force on this particle due to the sphere and the shell if



$2r < x < 2R$

A. $\frac{Gmm'}{4(x - r)^2}$

B. $\frac{Gmm'}{(x - r)^2}$

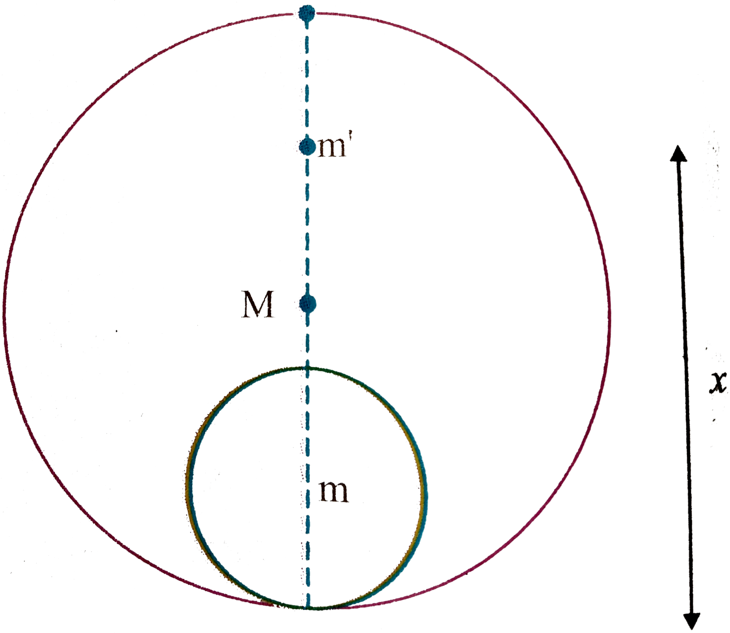
C. $\frac{Gmm'}{(x - r)^3}$

D. $\frac{2Gmm'}{(x - r)^2}$

Answer: B

Watch Video Solution

32. A solid sphere of mass m radius r is placed inside a hollow thin spherical shell of mass M and radius $2r$ as shown in figure. A particle of mass m' is placed on the line joining the two centres at a distance x from the point of contact of the sphere and the shell. find the magnitude of the resultant gravitational force on this particle due to the sphere and the shell if



$x > 2R$

A. $\dfrac{2GMm'}{(x - r)^2} + \dfrac{Gmm'}{(x + r)^2}$

B. $\dfrac{GMm'}{2(x - R)^2} + \dfrac{2Gmm'}{(x - r)^2}$

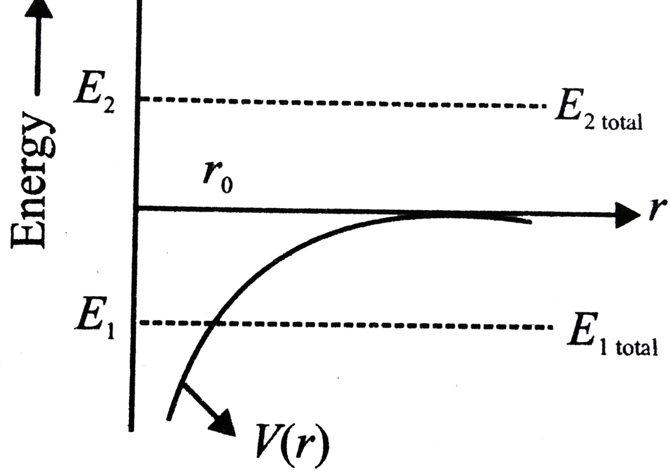
C. $\dfrac{GMm'}{2(x - r)^2} + \dfrac{2GMm'}{(x + r)^2}$

D. $\dfrac{GMm'}{(x - R)^2} + \dfrac{Gmm'}{(x - r)^2}$

Answer: D

Watch Video Solution

33. In the graph shown, the PE of earth-satellite system is shown by a solid line as a function of distance r (the separation between earth's centre and satellite). The total energy of the two objects which may or may not be bounded to the earth are shown in the figure by dotted lines.



Based on the above information, answer the following questions.

Mark the correct statement(s).

A. The object having total energy E_1 is a bounded one

B. The object having total energy E_2 is a bounded one

C. Both the objects are bounded

D. Both the objects are unbounded

Answer: A

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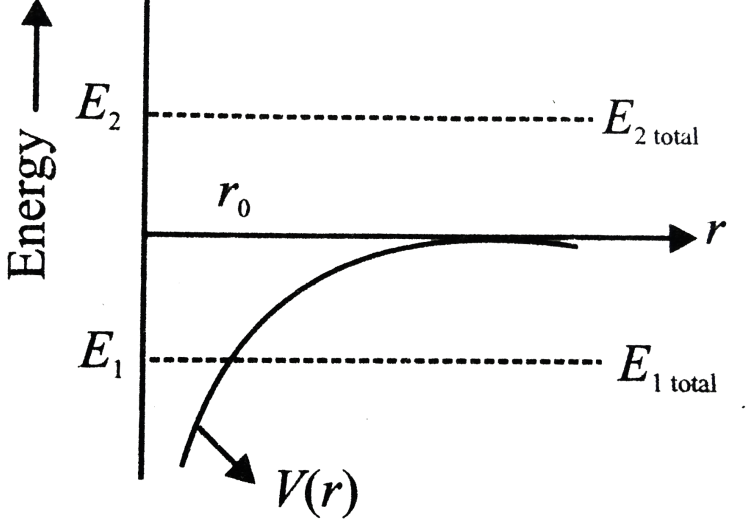
34. In the graph shown, the PE of earth-satellite system is shown by a solid line as a function of distance r (the separation between earth's centre and satellite). The total energy of the two objects which may or may not be bounded to the earth are shown in the figure by dotted lines.



Based on the above information, answer the following questions.

If object having total energy E_1 is having the same PE curve as shown in the figure, then

A. r_0 is the maximum distance of object from earth's centre

B. this object and earth system is a bounded one

C. the KE of the object is zero when $r = r_0$

D. all of the above

Answer: D

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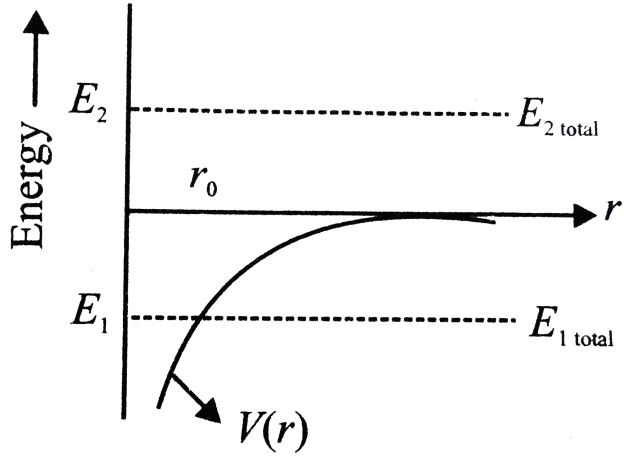
35. In the graph shown, the PE of earth-satellite system is shown by a solid line as a function of distance r (the separation between earth's centre and satellite). The total energy of the two objects which may or may not be bounded to the earth are shown in the figure by dotted lines.



Based on the above information, answer the following questions. If both the objects have the same *PE* curve as shown in the figure, then

A. for objects having total energy E_2 all values of r are possible

B. for object having total energy E_2 values of $r < r_0$ are only possible

C. for object having total energy E_1 all values of r are possible

D. none of the above

Answer: A

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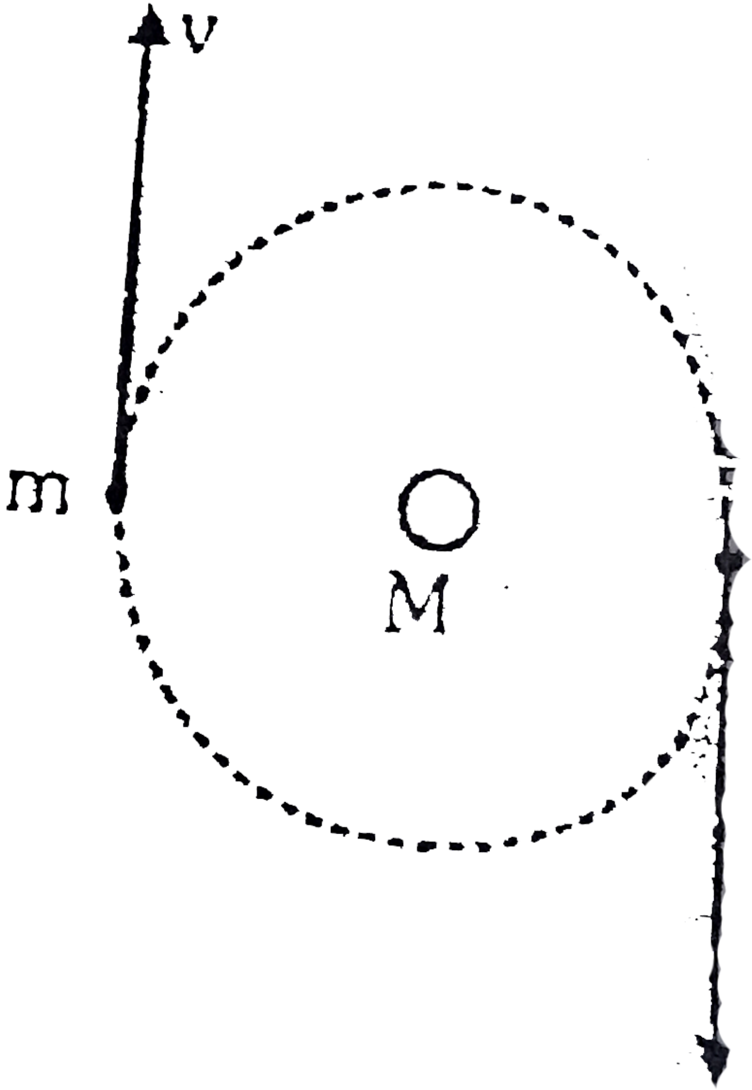

36.

A triple star system consists of two stars each of

mass m in the same circular orbit about central star with mass $M = 2 \times 10^{33} kg$. The two outer stars always lie at opposite ends of a diameter of their common circular orbit the radius of the circular orbit is $r = 10^{11}$ m and the orbital period each star is $1.6 \times 10^{7} s$ [take $\pi^2 = 10$ and $G = \frac{20}{3} \times 10^{-11} Mn^2 kg^{-2}$]

Q. The mass m of the outer stars is:

A. $\frac{16}{15} \times 10^{30} kg$

B. $\frac{11}{8} \times 10^{30} kg$

C. $\frac{15}{16} \times 10^{30} kg$

D. $\frac{8}{11} \times 10^{30} kg$

Answer: B

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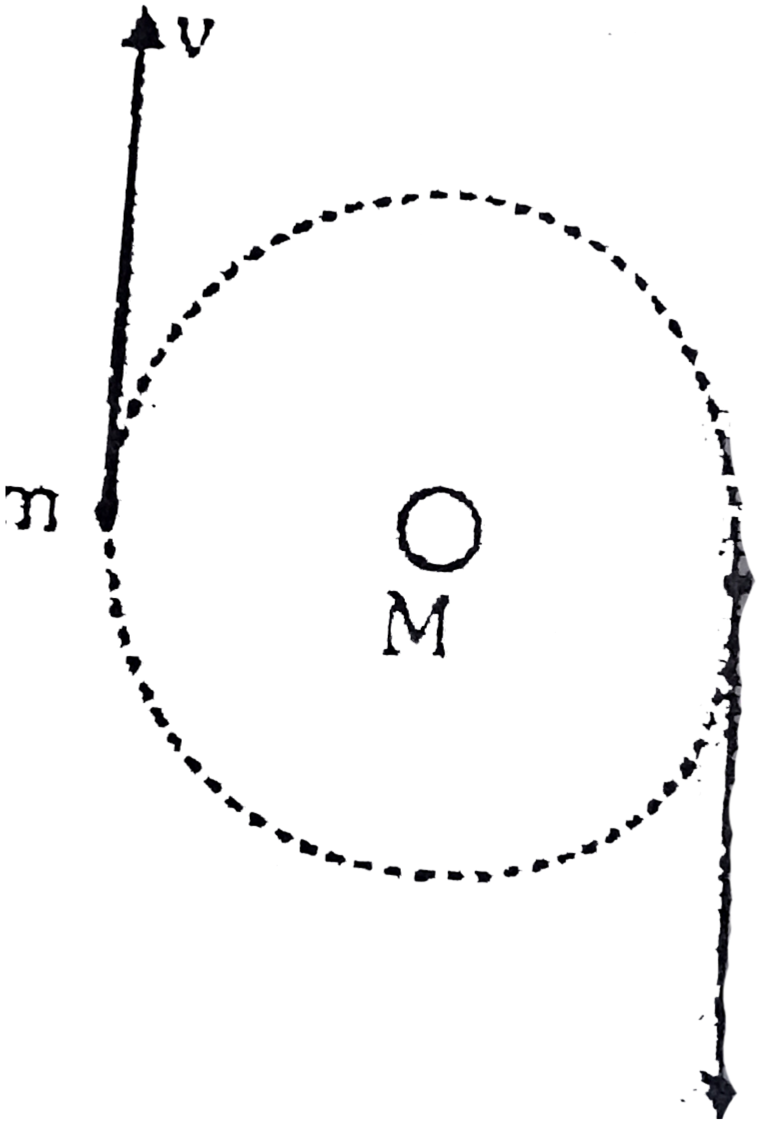

37.

A triple stars system consists of two stars each of mass m in the same circular orbit about central star with mass $M = 2 \times 10^{33} kg$. The two outer stars always lie at opposite ends of a diameter of their common circular orbit the radius of the circular orbit is $r = 10^{11}$ m and the orbital period each star is $1.6 \times 10^7 s$ [take $\pi^2 = 10$ and $G = \frac{20}{3} \times 10^{-11} Mn^2 kg^{-2}$]

Q. The orbital velocity of each star is

A. $\frac{5}{4}\sqrt{10} \times 10^3 m/s$

B. $\frac{5}{4}\sqrt{10} \times 10^5 m/s$

C. $\frac{5}{4}\sqrt{10} \times 10^2 m/s$

D. $\frac{5}{4}\sqrt{10} \times 10^4 m/s$

Answer: D

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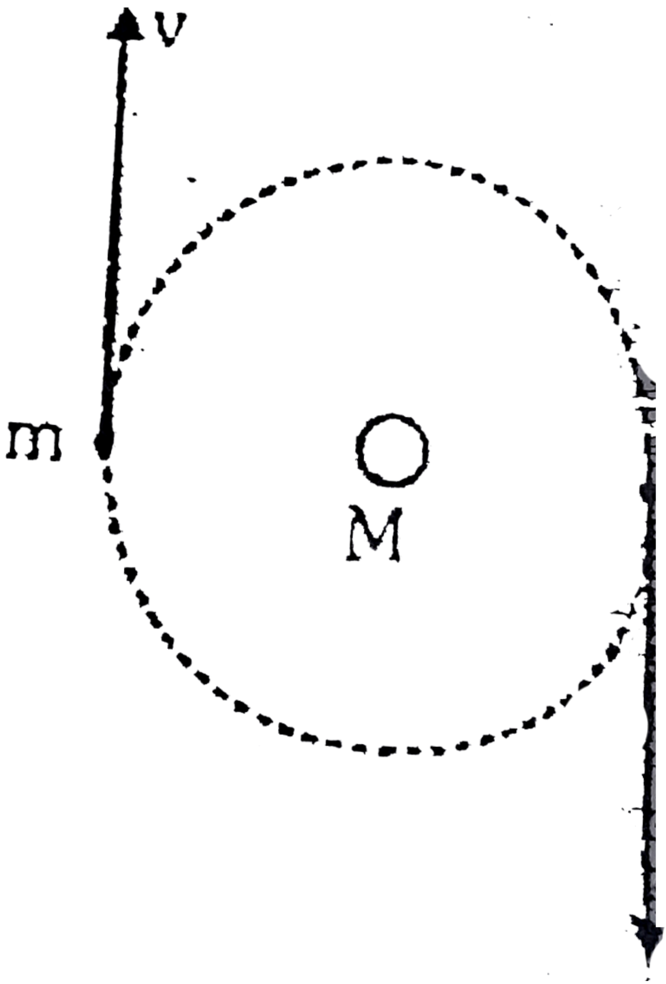

38.

A triple star system consists of two stars each of mass m in the same circular orbit about central star with mass $M = 2 \times 10^{33} kg$. The two outer stars always lie at opposite ends of a diameter of their common circular orbit the radius of the circular orbit is $r = 10^{11}$ m and the orbital period each star is $1.6 \times 10^{7} s$ [take $\pi^2 = 10$ and $G = \frac{20}{3} \times 10^{-11} Mn^2 kg^{-2}$]

Q. The total mechanical energy of the system is

A. $-\frac{1375}{64} \times 10^{35} J$

B. $-\frac{1375}{64} \times 10^{38} J$

C. $-\frac{1375}{64} \times 10^{34} J$

D. $-\frac{1375}{64} \times 10^{37} J$

Answer: B

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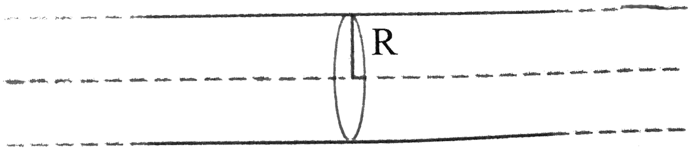
39. Consider a hypothetical planet which is very long and cylinderical. The density of the planet is ρ, its radius is R.



What is the possible orbital speed of the satellite in moving around the planet in circular orbit in a plane which is perpendicular to the axis of planet?

A. $R\sqrt{\pi G\rho}$

B. $2R\sqrt{\pi G\rho}$

C. $R\sqrt{2\pi G\rho}$

D. $R\sqrt{\frac{G\rho}{2\pi}}$

Answer: C

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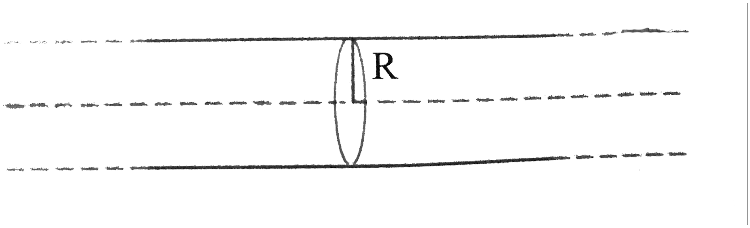
40. Consider a hypothetical planet which is very long and cylinderical. The density of the planet is ρ, its radius is R.



If an object is projected radially outwards from the surface such that it reaches upto a maximum distance of $3R$ from the axis then what should be the speed of projection?

A. $R\sqrt{\frac{2}{3}\pi\rho G}$

B. $2R\sqrt{\pi\rho G\ln 3}$

C. $R\sqrt{\frac{4}{3}\pi\rho G}$

D. $R\sqrt{\frac{2}{3}\pi\rho G\ln 3}$

Answer: B

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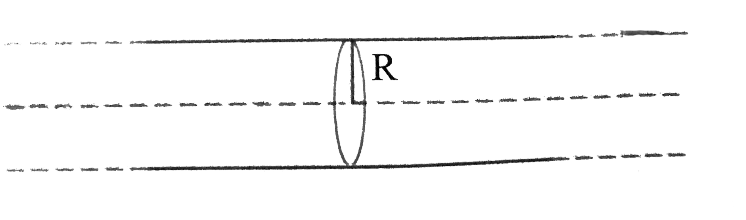
41. Consider a hypothetical planet which is very long and cylinderical. The density of the planet is ρ, its radius is R.



Assume that the planet is rotating abouts its axis with time period T. How far from the axis of the planet do the synchronous telecommunications satellite orbit?

A. $RT\sqrt{\pi G\rho}$

B. $2RT\sqrt{\pi G\rho}$

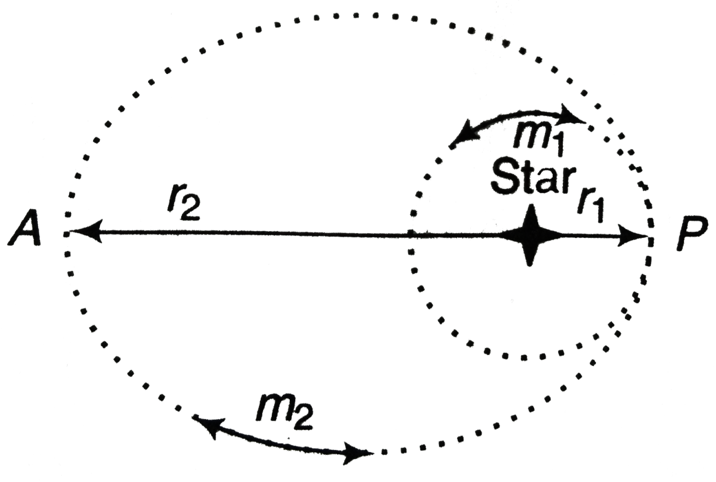
C. $RT\sqrt{2\pi G\rho}$

D. $RT\sqrt{\frac{G\rho}{2\pi}}$

Answer: D

Watch Video Solution

42. Two planets of equal mass orbit a much massive star (figure). Planet m_1 moves in circular orbit of radius $1 \times 10^8 km$ with period $2yr$. Planet m_2 moves in an elliptical orbit with closest distance $r_1 = 1 \times 10^8 km$ and farthest distance $r_2 = 1.8 \times 10^8 km$, as shown.



(a) Using the fact that the mean radius of an elliptical orbit is the length of the semi-major axis, find the period of $m_2's$ orbit.

(b) Which planet has the greater speed at point P ? Which has the greater total energy?

(c) Compare the speed of planet m_2 at P with that at A.

A. $3.31 yr$

B. $2.21 yr$

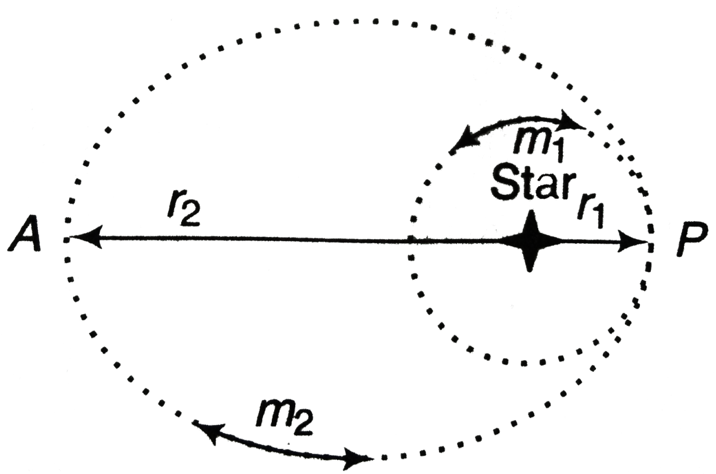
C. $4.25 yr$

D. $1.52 yr$

Answer: A

Watch Video Solution

43. Two planets of equal mass orbit a much massive star (figure). Planet m_1 moves in circular orbit of radius $1 \times 10^8 km$ with period $2yr$. Planet m_2 moves in an elliptical orbit with closest distance $r_1 = 1 \times 10^8 km$ and farthest distance $r_2 = 1.8 \times 10^8 km$, as shown.



(a) Using the fact that the mean radius of an elliptical orbit is the length of the semi-major axis, find the period of $m_2's$ orbit.

(b) Which planet has the greater speed at point P ? Which has the greater total energy?

(c) Compare the speed of planet m_2 at P with that at A.

A. $5.29 \times 10^{20} kg$

B. $1.49 \times 10^{25} kg$

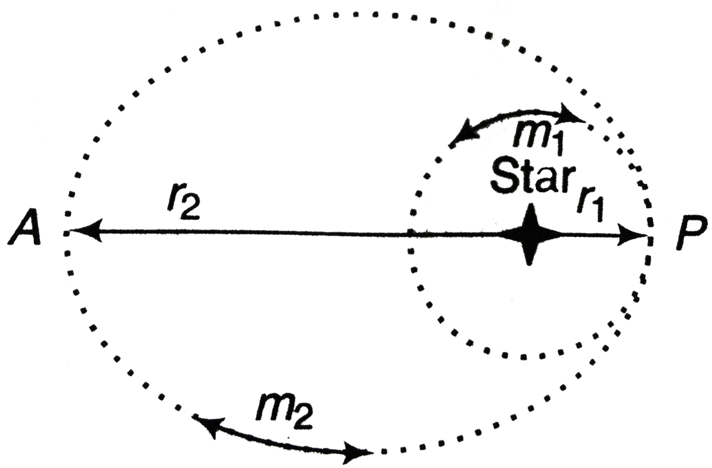
C. $1.49 \times 10^{29} kg$

D. $1.49 \times 10^{30} Kg$

Answer: C

Watch Video Solution

44. Two planets of equal mass orbit a much massive star (figure). Planet m_1 moves in circular orbit of radius $1 \times 10^8 km$ with period $2yr$. Planet m_2 moves in an elliptical orbit with closest distance $r_1 = 1 \times 10^8 km$ and farthest distance $r_2 = 1.8 \times 10^8 km$, as shown.



(a) Using the fact that the mean radius of an elliptical orbit is the length of the semi-major axis, find the period of $m_2's$ orbit.

(b) Which planet has the greater speed at point P ? Which has the greater total energy?

(c) Compare the speed of planet m_2 at P with that at A.

A. $V_P = 2.4V_A$

B. $V_P = 3.6V_A$

C. $V_P = 4.2V_A$

D. $V_P = 1.8V_A$

Answer: D

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45. A star can be considered as spherical ball of hot gas of radius R. Inside the star, the density of the gas is ρ_r at radius r and mass of the gas within this region is M_r.

The correct differential equation for variation of mass with respect to radius is (refer to the adjacent figure)

A. $\frac{dM_1}{dr} = \frac{A}{3}\pi\rho_r r^3$

B. $\frac{dM_r}{dr} = 4\pi\rho_r r^2$

C. $\frac{dM_r}{dr} = \frac{2}{3}\pi\rho_r r^2$

D. $\frac{dM_r}{dr} = \frac{1}{3}\pi\rho_r r^2$

Answer: B

Watch Video Solution

46. A star can be considered as spherical ball of hot gas of radius R. Inside the star, the density of the gas is ρ_r at radius r and mass of the gas within this region is M_r.

A star in it's prime age is said to be under quilibrium due to gravitational pull and outward radiation pressure (p). consider the shell of thikness dr as in the figure of previous question. if the pressure on this shell is dp then the correc equation is (G is universal gravitational constant)

A. $\frac{dp}{dr} = -\frac{GM_r}{r^2}\rho r$

B. $\frac{dp}{dr} = \frac{GM_r}{r^2}\rho r$

C. $\frac{dp}{dr} = -\frac{2}{3}\frac{GM_r}{r^2}\rho r$

D. $\frac{dp}{dr} = \frac{2}{3}\frac{GM_r}{r^2}\rho r$

Answer: A

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47. A planet revolves about the sun in an elliptical orbit of semi-major axis $2 \times 10^{12} m$. The areal velocity of the planet when it is nearest to the sun is $4.4 \times 10^{16} m/s$. The least distance between the planet and the sun is $1.8 \times 10^{12} m/s$. The minimum speed of the planet in km/s is $10K$. determine the value of K.

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48. The gravitational potential energy of satellite revolving around the earth in circular orbit is $4MJ$. Find the additional energy (in MJ) that should be given to the satellite so that it escape from the gravitational field of the earth.

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49. A particle is projected from the surface of earth with intial speed of 4 km/s. Find the maximum height attained by the particle. Radius of earth = 6400 km and $g = 9.8 m/s^2$

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50. Earth is a sphere of uniform mass density. If the weight of the body is $10nN$ half way down. The body weighed $100N$ on the surface. An infinite collection of equal masses of $2kg$ each are kept on a horizontal line (X-axis) at positions $x = 1m, 2m, 4m, 8m......$ find the gravitational potential at $x = 0$ in GJ unit.

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51. Three uniform spheres, each having a mass $M = 5kg$ and radius $a = 2.5m$ are kept in such a way that each touches the other two. Find the magnitude of the gravitational force in GN on any of the spheres due to the other two.

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52. Three uniform spheres, each having a mass $M = 5kg$ and radius $a = 2.5m$ are kept in such a way that each touches the other two. Find the

magnitude of the gravitational force in GN on any of the spheres due to the other two.

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53. A cord of length $64m$ is used to connected a $100kg$ astronaut to spaceship whose mass is much larger than that of the astronuat. Estimate the value of the tension in the cord. Assume that the spaceship is orbiting near earth surface. Assume that the spaceship and the astronaut fall on a straight line from the earth centre. the radius of the earth is $6400km$.

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54. Two satellites of mass ratio $1:2$ are revolving around the earth in circular orbits such that the distance of the second satellite is four times as compared to the distance of the first satellite. Find the ratio of the centripetal forces.

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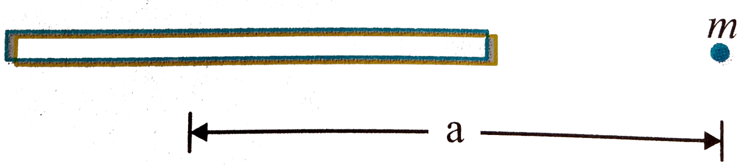
LEVEL-VI

1. Find the potential energy of the gravitational interaction of a point mass m and a rod of mass m and length l, if they are along a straight line. Point mass is at a distance of a from the end of the rod.



Find the potential energy of the gravitational

A. $U = \frac{-Gm^2}{l} \ln\left(\frac{2a + l}{2a - l}\right)$

B. $U = \frac{-Gm^2}{l^2} \ln\left(\frac{2a + l}{2a - l}\right)$

C. $U = \frac{-Gm^2}{l^2} \ln\left(\frac{2a - l}{2a + l}\right)$

D. $U = \frac{-Gm^2}{l^2} \ln\left(\frac{2a - l}{2a + l}\right)^2$

Answer: A

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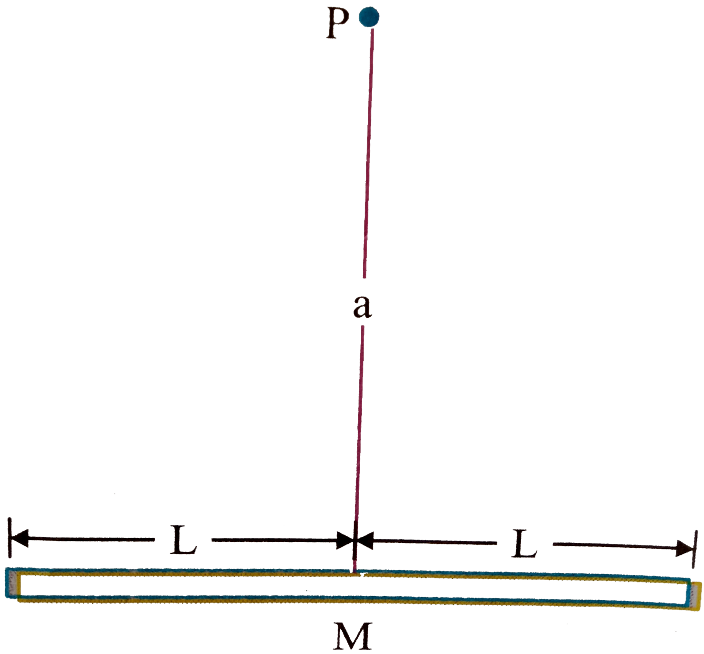
2. Mass M is distributed uniformly along a line of length $2L$. A particle of mass m is at a point that is at a distance a above the centre of the line on the its perpendicular bisector (Point P in figure). The gravitational force that the line exert on the particle is



A. $\frac{GMm}{\sqrt{L^2 + a^2}}$

B. $\frac{GMm}{a\left(L^2 + a^2\right)}$

C. $\frac{GMm}{a\sqrt{L^2 + a^2}}$

D. $\frac{GMm}{a\left(L^2+a^2\right)^2}$

Answer: C

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3. A planet of mass m moves along an ellipse around the sun so that its maximum and minimum distance from the sun are equal to r_1 and r_2 respectively. Find the angular momentum of this planet relative to the centre of the sun. mass of the sun is M.

A. $m\sqrt{\frac{2GMr_1r_2}{(r_1+r_2)^2}}$

B. $m\sqrt{\frac{2GMr_1^2r_2^2}{(r_1+r_2)^2}}$

C. $m\sqrt{\frac{2GMr_1^2r_2^2}{(r_1+r_2)}}$

D. $m\sqrt{\frac{2GMr_1r_2}{(r_1+r_2)}}$

Answer: B

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4. Inside a uniform sphere of density ρ there is a spherical cavity whose centre is at a distance l from the centre of the sphere. Find the strength of the gravitational field inside the cavity.

A. $E = \frac{-2}{3}\pi G\rho l$

B. $E = \frac{-4}{3}\pi G\rho l$

C. $E = \frac{-4}{3}\pi^2 G\rho l$

D. $E = \frac{-4}{3}\pi G\rho^2 l^2$

Answer: B

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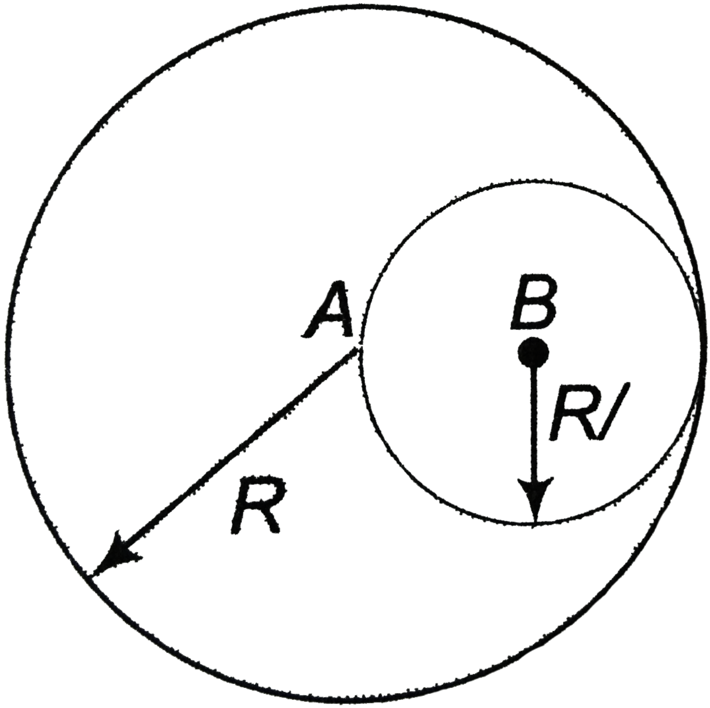
5. Inside a fixed sphere of radius R and uniform density ρ, there is spherical cavity of radius $\frac{R}{2}$ such that surface of the cavity passes through the centre of the sphere as shown in figure. A particle of mass m_0 is released from rest at centre B of the cavity. Calculate velocity with which particle strikes the centre A of the sphere. Neglect earth's gravity. Initially sphere and particle are at rest.



A. $\sqrt{\frac{2}{3}\pi G\rho R^2}$

B. $\sqrt{\frac{2}{3}\pi G\rho^2 R^2}$

C. $\sqrt{\frac{2}{5}\pi G\rho R^2}$

D. $\sqrt{\frac{2}{3}\pi^2 G^2 \rho^2 R^2}$

Answer: A

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6. A ring of radius $R = 4m$ is made of a highly dense material. Mass of the ring is $m_1 = 5.4 \times 10^9 kg$ distributed uniformly over its circumference. A highly dense particle of mass $m_2 = 6 \times 10^8 kg$ is placed on the axis of the ring at a distance $x_0 = 3m$ from the centre. Neglecting all other forces, except mutual gravitational interacting of the two. Caculate

(i) displacemental of the ring when particle is at the centre of ring, and

(ii) speed of the particle at that instant.

A. $(i)0.4m(ii)16cms^{-1}$

B. $(i)0.3m(ii)18cm/s$

C. $(i)0.2m(ii)12cm/s$

D. $(i)0.6m(ii)24cm/s$

Answer: B

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7. A cosmic body A moves to the sun with velocity v_0(when far from the sun) and aiming parameter l, the arm of the vector v_0, relative to the centre of the sun. find the minimum distance by which this body will get to the sun. mass of the sum is M.

A. $\frac{GM}{v_0^2}\left[\sqrt{1 + \left(\frac{lv_0^2}{GM}\right)^2} - 1\right]$

B. $\frac{GM}{v_0^2} - 1$

C. $\frac{GM}{v_0^2}\left[\sqrt{1 + \left(\frac{lv_0^2}{GM}\right)^2} + 1\right]$

D. $GMlv_0^2 - 1$

Answer: A

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8. Two satellite S_1 and S_2 revolve around a planet in coplanar circular orbits in the opposite sense. The periods of revolutions are T and ηT respectively. Find the angular speed of S_2 as observed by an astronouts in S_1, are observed by an astronaut in S_1, when they are closest to each other.

A. $\omega = \dfrac{2\pi\left(n^{-\frac{1}{3}} + 1\right)}{T\left(n^{\frac{1}{3}} - 1\right)}$

B. $\omega = \dfrac{2\pi\left(n^{-\frac{1}{3}} + 1\right)}{T^{2}\left(n^{\frac{2}{3}} - 1\right)}$

C. $\omega = \dfrac{2\pi\left(n^{-\frac{1}{3}} + 1\right)}{T\left(n^{\frac{2}{3}} - 1\right)}$

D. $\omega = \dfrac{2\pi\left(n^{-\frac{2}{3}} + 1\right)}{T\left(n^{-\frac{1}{3}} - 1\right)}$

Answer: C

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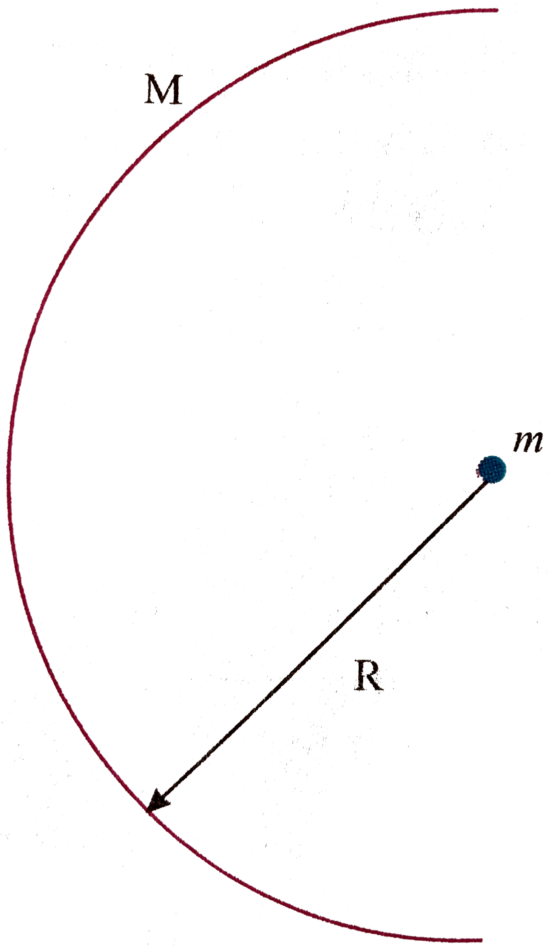
9. A particle of mass m is placed on centre of curvature of a fixed, uniform semi-circular ring of radius R and mass M as shown in figure. Calculate:

(a) interaction force between the ring and the particle and

(b) work required to displace the particle from centre of curvature to infinity.



A. $(a) F = \frac{2GM}{\pi R^2}, (b) \frac{GM}{R}$

B. $(a) F = \frac{2GMm}{\pi^2 R}, (b) \frac{GMm}{R^2}$

C. $(a)F = -\frac{2GMm}{\pi R^2}(b) - \frac{GMm}{R}$

D. $(a)F = \frac{2GMm}{\pi R^2}(b)\frac{GMm}{R}$

Answer: D

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10. Given a thin homogenous disc of radius a and mass m_1. A particle of mass m_2 is placed at a distance l from the disc on it's axis of symmetry. Initially both are motionless in free space but they ultimately collide because of gravitational attraction. find the relative velocity at the time of

collision. assume $a < \quad < 1$.

A. $\left[2G(m_1 + m_2)\left(\frac{2}{a} - \frac{1}{l}\right)\right]$

B. $\left[2G(m_1 + m_2)\left(\frac{2}{a} - \frac{1}{l}\right)\right]^{\frac{1}{2}}$

C. $\left[2G(m_1 + m_2)\left(\frac{2}{a} - \frac{1}{l}\right)^2\right]$

D. $\left[2G(m_1 + m_2)^2\left(\frac{1}{a} - \frac{1}{l}\right)\right]$

Answer: B

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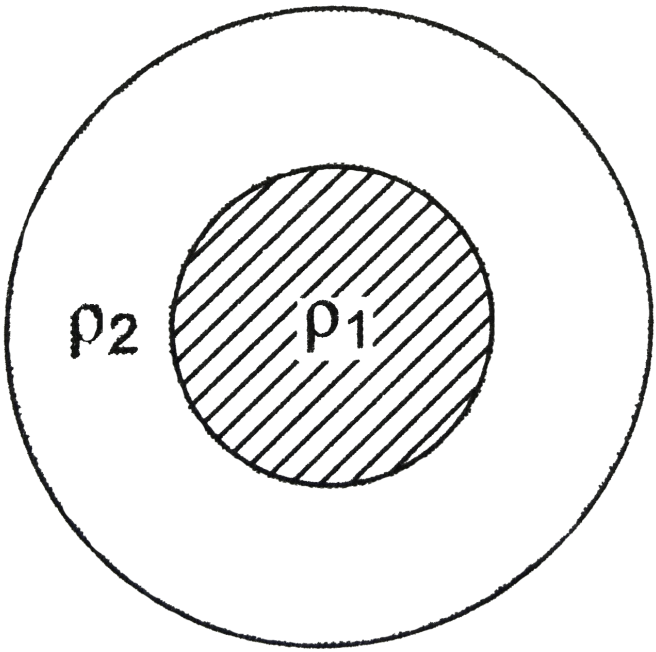
11. The density of the core a planet is ρ_1 and that of the outer shell is ρ_2. The radii of the core and that of the planet are R and $2R$ respectively. The acceleration due to gravity at the surface of the planet is same as at a depth R. Find the ratio of $\frac{\rho_1}{\rho_2}$



A. $\frac{3}{7}$

B. $\frac{9}{4}$

C. $\frac{7}{3}$

D. $\frac{3}{8}$

Answer: C

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12. A projectile of mass m is fired from the surface of the earth at an angle $\alpha = 60^{\circ}$ from the vertical. The initial speed v_0 is equal to $\sqrt{\frac{GM_e}{R_e}}$. How high does the projectile rise ? Neglect air resistance and the earth's rotation.

A. $\frac{R_e}{2}$

B. $\frac{R_e}{5}$

C. $\frac{R_e}{4}$

D. $\frac{R_e}{8}$

Answer: A

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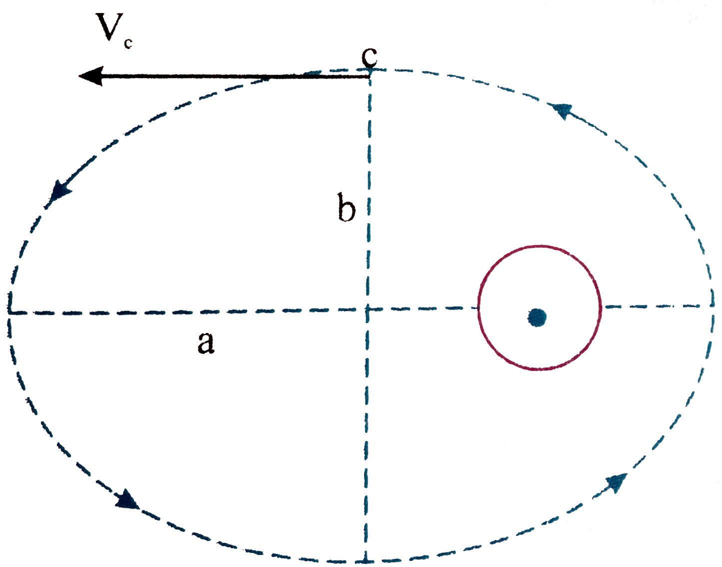
13. find the velocity of a satellite travelling in an elliptical orbit, when it reaches point C, at the end of the semi-minor axis.



A. $V_c = R\sqrt{\frac{a}{g}}$

B. $V_c = R^2\sqrt{\frac{g}{a}}$

C. $V_c = R\sqrt{\frac{g}{a}}$

D. $V_c = R\sqrt{\frac{g}{a^2}}$

Answer: C

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14. In astronomy order of magnitude estimation plays an important role. The derivative $\frac{dp}{dt}$ can be taken difference ration $\frac{\Delta P}{\Delta r}$. Consider the star has a radius R, pressure at its centre is P_e and pressure at outer layer is zero is the average mass is $\frac{M_Q}{2}$ and average radius $\frac{R_o}{2}$ then the expression for P_c is

A. $P_c = \frac{3}{2}\frac{GM_0^2}{\pi R_0^4}$

B. $P_c = \frac{2}{3\pi}\frac{GM_0^2}{R_0^4}$

C. $P_c = \frac{2}{3}\frac{GM_0^2}{\pi R_0^4}$

D. $P_c = \frac{3}{2}\frac{GM_0^2}{R_0^4}$

Answer: A

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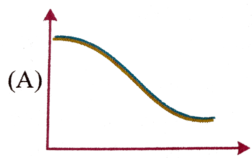
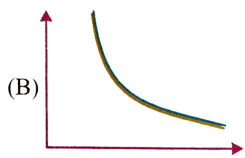
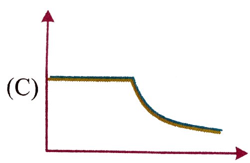
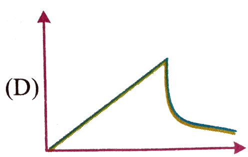
15. A narrow tunnel is dug across a planet diametrically and a small body is dropped from a large height, so that it falls into the tunnel. The variation of its kinetic energy (KE) with distance (r) from the centre is represented by

A. 

B. 

C. 

D. 

Answer: A

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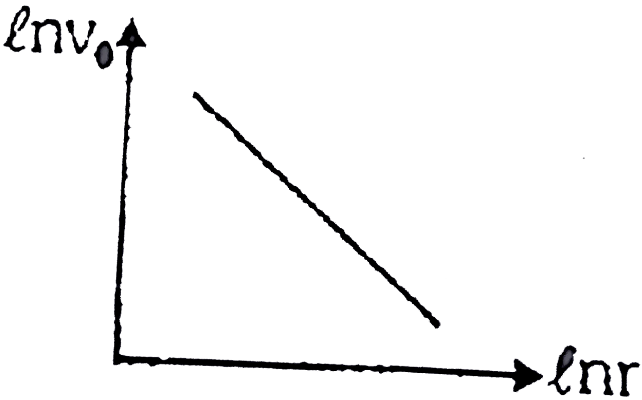

16.

If the law of gravitation be such that the force of attraction between two particles vary inversely as the $5/2^{th}$ power of their separation then the graph of orbital velocity v_0 plotted against the distance r of a satellite from the earth's centre on a log-log scale is shown alongside the slope on a line will be

A. $-\frac{3}{4}$

B. $-\frac{3}{2}$

C. -1

D. $-\frac{5}{2}$

Answer: A

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17. A small satellite revolves around a heavy planet in a circular orbit. At a point in its orbit an impulse acts suddenly and instantaneously increases its kinetic energy K times without change in its direction of motion. The ratio of maximum to the minimum distance from the planet is [Assume mass of satellite is negligible small compared to that of planet]

A. $\frac{K}{K+2}$

B. K

C. $\frac{K+2}{K}$

D. $\frac{1}{K}$

Answer: B

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18. A satellite is orbiting around the earth in an orbitin equatorial plane of radius $2R_e$ where R_e is the radius of earth. Find the area on earth, this satellite covers for communication purpose in its complete revolution.

A. $\sqrt{3}\pi R_e^2$

B. $2R_e^2$

C. $2\sqrt{3}\pi R_e^2$

D. $\sqrt{2}\pi R_e^2$

Answer: C

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19. A planet moves aruond the sun in an elliptical orbit such that its kinetic energy is K_1 and K_2 when it is nearest to the sun and farthest from the sun respectively. The smallest distance and the largest distance between the planet and the sun are r_1 and r_2 respectively.

A. If total energy of the planet is E then

$$\frac{r_2}{r_1} = \frac{E - K_1}{K_2 - E}$$

B. If the total energy of the planet is E, then

$$\frac{r_2}{r_1} = \frac{E - K_2}{E - K_1}$$

C. If $r_2 = 2r_1$, the total energy of the planet

energy of the planet in terms of K_1 and K_2

is $\left(2K_1 - K_2\right)$

D. If $r_2 = 2r_1$, the total energy of the plenet

energy of the planet in terms of K_1 and K_2

is $\left(2K_2 - K_1\right)$

Answer: D

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20. A smooth tunnel is dug along the radius of the earth that ends at the centre. A ball is released from the surface of earth along the tunnel. If the coefficient of restitution is 0.2 between the surface and ball, then the distance travelled by the ball before second collision at the centre is

A. $\frac{6R}{5}$

B. $\frac{7R}{5}$

C. $\frac{9R}{5}$

D. $\frac{3R}{2}$

Answer: B

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21. A cannon shell is fired to hit a target at a horizontal distance R. However, it breaks into two equal parts at its highest point. One part A returns to the cannon. The other part is:

A. Will fall at a distance R beyond the target

B. Will fall at a distance $3R$ beyond the target

C. Will hit the target

D. Have nine times the kinetic energy of A

Answer: A::D

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22. A particle moving with kinetic energy $3J$ makes an elastic head-on collision with a stationary particle which has twice its mass. During the impact :-

A. The minimum kinetic energy of system is 1J

B. The minimum elastic potential energy of the system is 2J

C. Momentum and total energy are conserved at energy instant

D. The ratio of kinetic energy to potential energy of the system first decreases and then increases.

Answer: A::B::C::D

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23. Consider a thin spherical shell of uniform density of mass M and radius R:

A. The gravitational field inside the shell will be zero

B. The gravitational self energy of shell is $\frac{GM^2}{2R}$

C. Attractive force experience by unit area of the shell pull the other half is $\frac{GM^2}{2R^2}$

D. Net gravitational force with which one hemisphere of the shell arracts other, is $\frac{GM^2}{8R^2}$

Answer: A::B::D

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24. A satellite moves in an elliptical orbit about the earth. The minimum and maximum distance of the satellite from the centre of earth are 7000km and 8750km respectively. For this situation, mark the correct statements (s). [Take $M_e = 6 \times 10^{24} kg$]

A. The maximum speed of the satellite during its motion is $5.64 km/s$

B. The minimum speed of the satellite during its motion is $4.51 km/s$

C. The length of major axis of orbit is $15750 km$

D. none of the above

Answer: D

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25. The gravitational potential change uniformly from $-20J/kg$ to $-40J/kg$ as one moves along X-axis from $x = -1m$ to $x = +1m$. Mark the correct statement (s) about gravitational field intensity of origin.

A. The gravitational field intensity at $x = 0$ must be equal to $10N/kg$.

B. The gravitational field intensity at $x = 0$ may be equal to $10N/kg$.

C. The gravitational field intensity at $x = 0$ may be greater than $10N/kg$.

D. The gravitational field intensity at $x = 0$ must not be less than $10N/kg$.

Answer: A D

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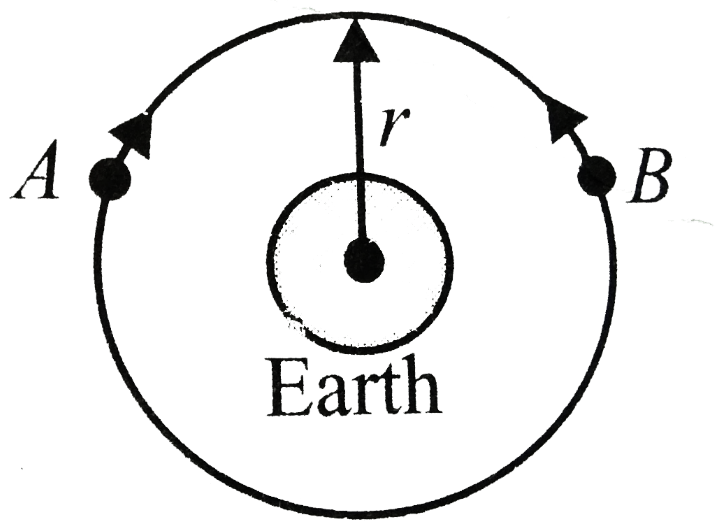
26. Consider two satellites A and B of equal mass m, moving in the same circular orbit about the earth, but in the opposite sense as shown in Fig.

The orbital radius is r. The satellites undergo a collision which is perfectly inelastic. For this situation, mark out the correct statement(s). [Take mass of earth as M]



A. The total energy of the two satellite plus earth system just before collision is $-\frac{GMm}{r}$

B. The total energy of the two satellites plus earth system just before collision is $-\frac{2GMm}{r}$

C. The total energy of two satellites plus earth system just after collision is $-\frac{GMm}{2r}$

D. The combined mass (two satellites) will fall towards the earth just after collision.

Answer: A::B::D

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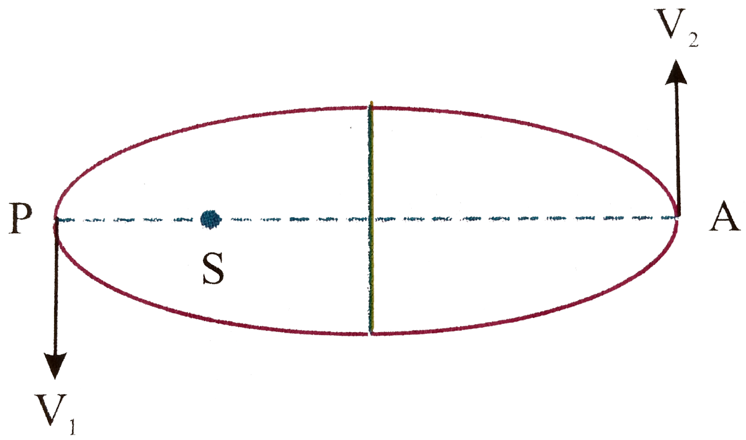
27.



A planet of mass m is moving in an elliptical orbit around the sun of mass M. The semi major axis of its orbit is a, eccentricity is e.

Find speed of planet V_1 at perihelion P

A. $\sqrt{\frac{GM}{a}\frac{(1+e)}{(1-e)}}$

B. $\frac{1+e}{1-e}\sqrt{\frac{GM}{a}}$

C. $\sqrt{\frac{GM}{a^3}\frac{(1+e)}{(1-e)}}$

D. $\sqrt{\frac{GM}{a^3}\frac{\left(1+e^2\right)}{\left(1-e^2\right)}}$

Answer: A

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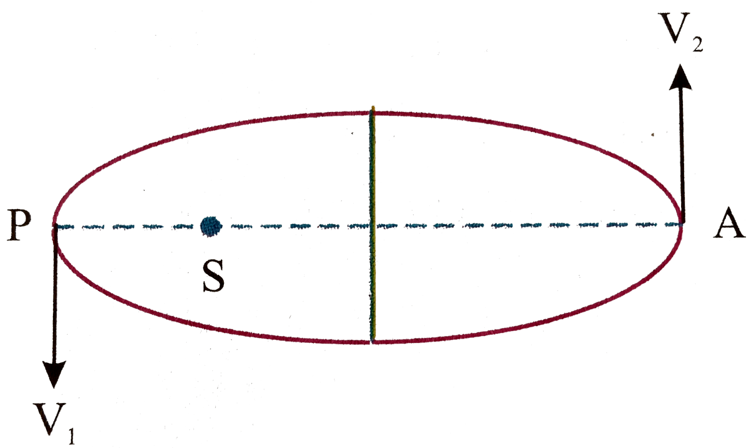

28.

A planet of mass m is moving in an elliptical orbit around the sun of mass M. The semi major axis of its orbit is a, eccentricity is e.

Find speed of planet V_2 at aphelion A.

A. $\sqrt{\frac{GM}{a}\frac{(1+e)}{(1-e)}}$

B. $\sqrt{\frac{GM}{a}\frac{(1-e)}{(1+e)}}$

C. $\sqrt{\frac{GM}{a^3}\frac{\left(1+e^2\right)}{\left(1-e^2\right)}}$

D. $\sqrt{\frac{GM}{a^3}\frac{\left(1-e^2\right)}{\left(1+e^2\right)}}$

Answer: B

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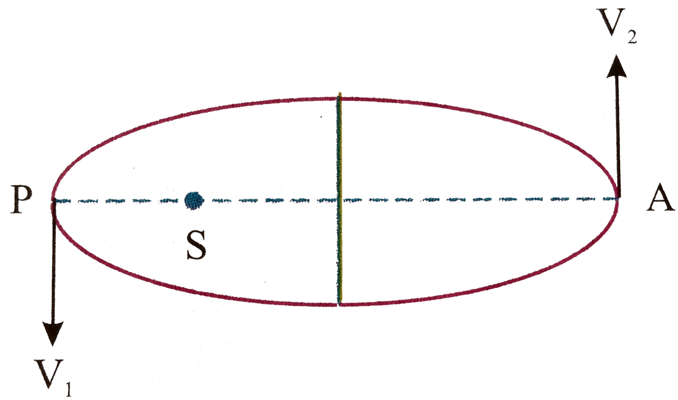
29.



A planet of mass m is moving in an elliptical orbit around the sun of mass M. The semi major axis of its orbit is a, eccentricity is e.

Find total energy of planet interms of given parameters.

A. $-\dfrac{GMm}{4a}$

B. $-\dfrac{GMm^2}{2a}$

C. $-\dfrac{GMm}{8a}$

D. $-\dfrac{GMm}{2a}$

Answer: D

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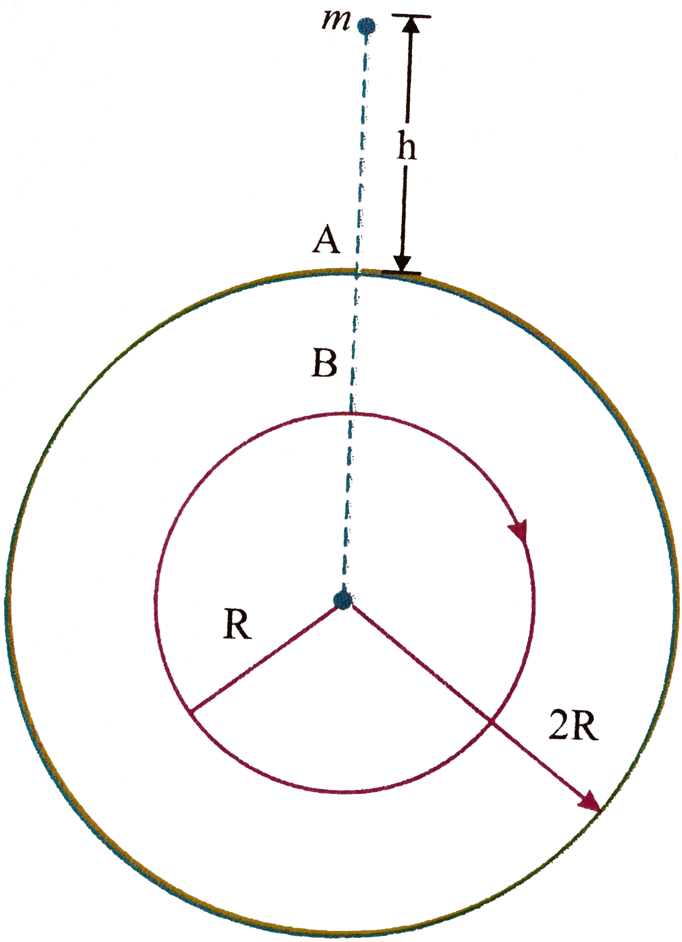

30.

Sphere of mass M and radius R is surrounded by a spherical shell of mass $2M$ and radius $2R$ as shown. A small particle of mass m is released from rest from a height $h(< < R)$ above the shell.

There is hole in the shell.

In what time will it enter the hole at A?

A. $2\sqrt{\frac{hR^2}{GM}}$

B. $\sqrt{\frac{2hR^2}{GM}}$

C. $\sqrt{\frac{hR^2}{GM}}$

D. none of these

Answer: A

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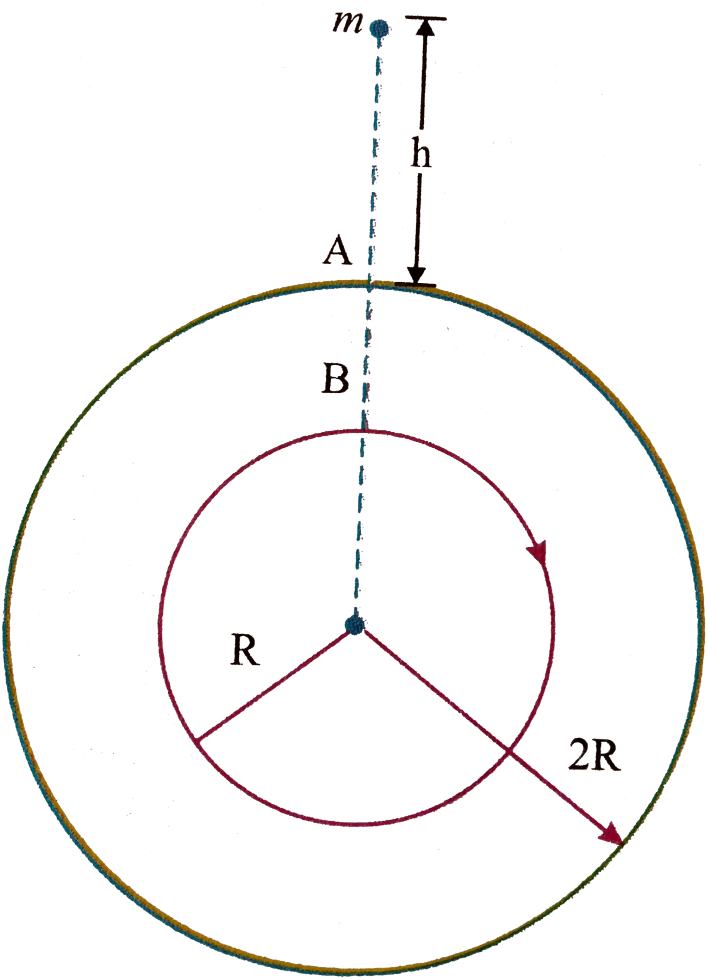
31.



Sphere of mass M and radius R is surrounded by a spherical shell of mass $2M$ and radius $2R$ as shown. A small particle of mass m is released from rest from a height $h(< < R)$ above the shell.

There is hole in the shell.

What time will it take to move from A to B?

A. $= \frac{R^2}{\sqrt{GMh}}$

B. $> \frac{R^2}{\sqrt{GMh}}$

C. $< \frac{R^2}{\sqrt{GMh}}$

D. none of these

Answer: C

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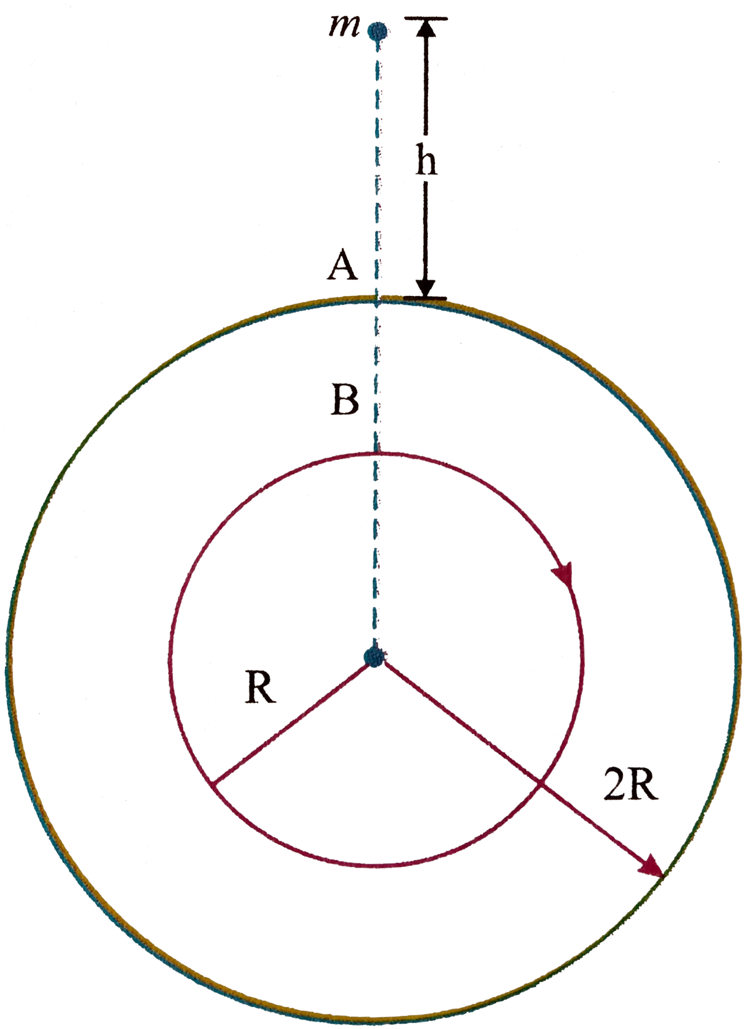

32.

Sphere of mass M and radius R is surrounded by

a spherical shell of mass $2M$ and radius $2R$ as shown. A small particle of mass m is released from rest from a height $h(< < R)$ above the shell. There is hole in the shell.

With what approximate speed will it collide at B?

A. $\sqrt{\frac{2GM}{R}}$

B. $\sqrt{\frac{GM}{2R}}$

C. $\sqrt{\frac{3GM}{2R}}$

D. $\sqrt{\frac{GM}{R}}$

Answer: D

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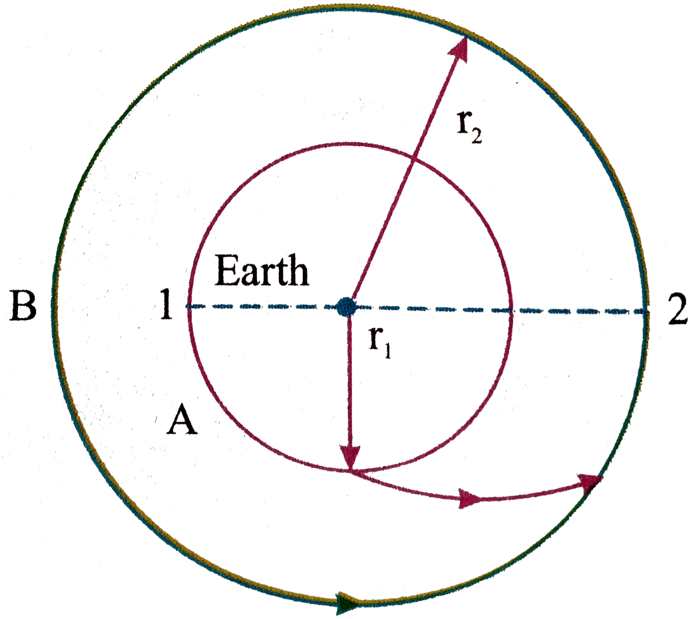
33.



Two satellites A and B are revolving around the earth in circular orbits of radius r_1 and r_2 respectively with $r_1 < r_2$. Plane of motion of the two are same. At position $1, A$ is given an impulse in the direction of velocity by firing a rocket so that it follows an elliptical path to meet B at

position 2 as shown. focal lengths of the elliptical path are r_1 and r_2 respectively. at position $2, A$ is given another impulse so that velocities of A and B at 2 become equal and the two move together. for any elliptical path of the satellite time period of revolution is given Kepler's planetry law as $T^2 \alpha r^3$ where a is semi-major axis of the ellipse which is $\frac{r_1 + r_2}{2}$ in this case. also angular momentum of any satellite revolving around the earth will remain a constant about earth's centre as force of gravity on the satellite which keeps it in elliptical path is given its position vector relative to the earth centre.

When A is given its first impulse at that moment

A. A, B and the earth centre are in same straight line

B. B is a head of A angularly

C. B is behind of A angularly

D. none of the above

Answer: B

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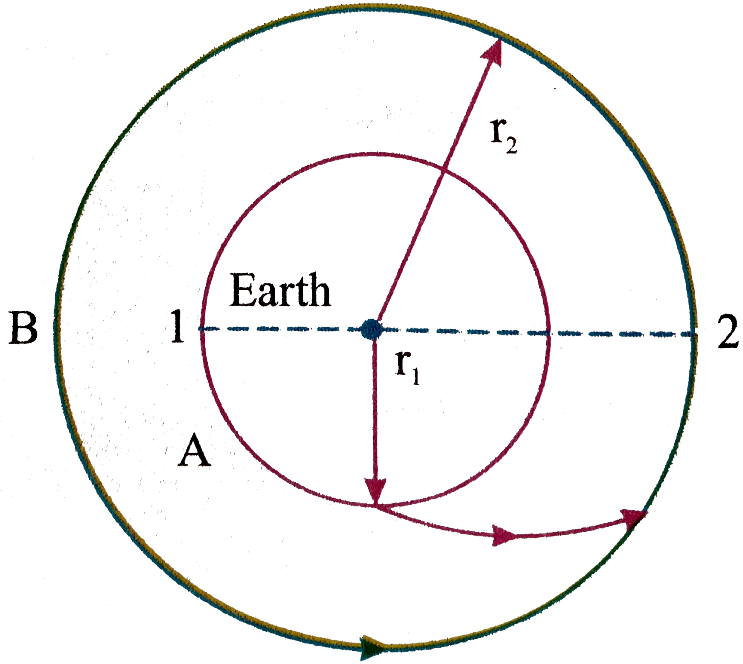
34.



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If the two have same mass

A. A would have more potential energy than B while on their initial circular paths

B. A would have more kinetic energy than B while on their initial circular paths

C. Relative to earth's centre, angular momentum of A when it is in elliptical path would be less than angular momentum of B

D. During the whole process angular momentum of B would be more than angular momentum of A

Answer: B::C

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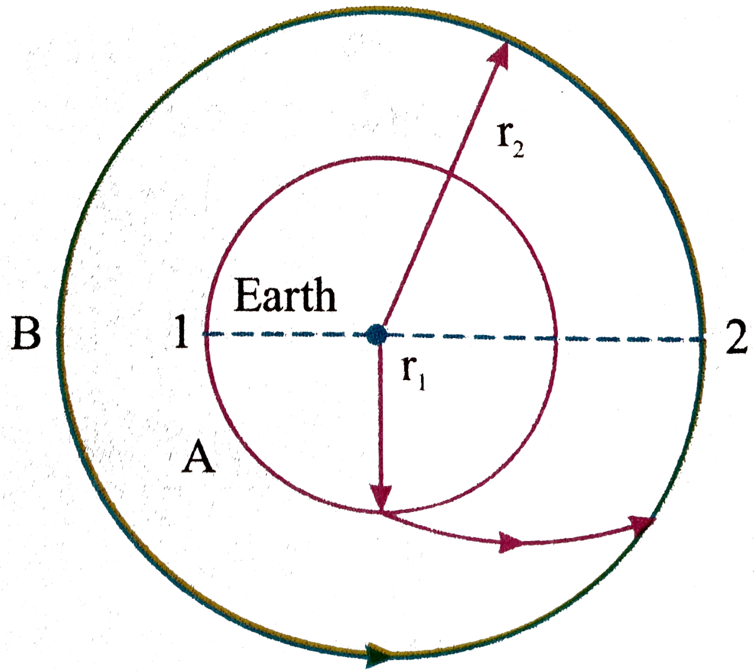
35.



Two satellites A and B are revolving around the earth in circular orbits of radius r_1 and r_2 respectively with $r_1 < r_2$. Plane of motion of the two are same. At position $1, A$ is given an impulse in the direction of velocity by firing a rocket so that it follows an elliptical path to meet B at

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If $r_2 = 3r_1$ and time period of revolution for B be T then time taken by A in moving from position 1 to position 2 is

A. $T\frac{\sqrt{3}}{\sqrt{2}}$

B. $T\frac{\sqrt{3}}{2}$

C. $\frac{T\sqrt{2}}{3\sqrt{3}}$

D. $\frac{T\sqrt{2}}{3}$

Answer: C

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36. A mass of $6 \times 10^{24} kg$ is to be compressed in a sphere in such a way that the escape velocity from its surface is $3 \times 10^{8} m/s$. Find the radius of the sphere (in mm).

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37. Two equal masses are held at a distance of $3.0 cm$ in a line and released simulataneously. What will be the separation between them after $2s$?

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38. Two satellites S_1 and S_2 are to be set in the orbits of $\frac{R}{4}$ and $\frac{R}{6}$ above the earth's surface. They revolve around the earth in a coplanar circular orbit in the opposite sense. What will be the ratio of speeds of projection from the earth's surface?

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39. Distance between the centres of two stars is $10a$. The masses of these stars are M and $16M$ and their radii a and $2a$ respectively. A body of mass m is fired straight from the surface of the larger star towards the surface of the smaller star. What should be its minimum initial speed to reach the surface of the smaller star? Obtain the expression in terms of G, M and a.

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40. Two particles A and B of masses $1kg$ and $2kg$, respectively, are kept at a very large separation. When they are released, they move under their gravitational attraction. Find the speed (in $10^{-5} m/s$) of A when that of B is $3.6 cm/hr$.

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41. An artificial satellite is moving in a circular orbit around the earth with a speed of equal to half the magnitude of escape velocity from earth.

(i). Determine the height of the satellite above the earth's surface

(ii). If the satellite is stopped suddenly in its orbit and allowed to fall freely on the earth. Find the speed with it hits and surface of earth. Given `M="mass of earth & R "="Radius of earth"

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42. A larger spherical mass M is fixed at one position and two identical point masses m are kept on a line passing through the centre of M. The point masses are connected by rigid massless rod of length l and this assembly is free to move along the line connecting them. All three masses interact only throght their mutual gravitational interaction. When the point mass nearer to M is at a distance r =3l form M, the tensin in the rod is zero for $m = k\left(\frac{M}{288}\right)$. The value of k is

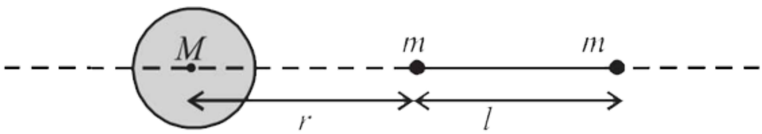

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ILLUSTRATION

1. An artificial satellite is in an elliptical orbit around the earth with aphelion of $6R$ and

perihelion of $2R$ where R is radius of the earth $= 6400km$. Calculate the eccentricity of the elliptical orbit.

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2. The mean distance of a planet from the sun is apprximately 1/4 times that of earth from the sun. Find the number of years required for planet to make one revolution about the sun.

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3. A speed of the palnet at the perihelion P be V_p and the sun -planet distance SP be r_P as shown in fig. Relate $\{r_p, v_p\}$ to the corresponding quantities at the aphelion $\{r_A, V_A\}$. Will the planet take equal times to traverse BAC and CPB?

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4. Let us consider that our galaxy consists of 2.5×10^{11} stars each of one solar mass. How long will this star at a distance of $50,000$ light year from the galastic entre take to complete one revolution? Take the diameter of the Milky way to be

$10^5 ly$. $G = 6.67 \times 10^{-11} Nm^2 Kg^{-2}$. $\left(1 ly = 9.46 \times 10^{15} m\right)$

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5. If two particles each of mass m are placed at the two vertices of an equilateral triangle of side a, then the resultant gravitational force on mass m placed at the third vertex is

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6. Four particles each of mass m are kept at the four vertices of a square of side 'a' . Find gravitational potential energy of this system.

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7. For particles each of mass M and equidistant from each other, move along a circle of radius R under the action of their mutual gravitational attraction. The speed of eacth particle is

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8. If four different masses m_1, m_2, m_3 and m_4 are placed at the four corners of a square of side a, the resultant gravitational force on a mass m kept at the centre is

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9. Two particles of equal mass go around a circle of radius R under the action of their mutual gravitational attraction. Find the speed of each particle.

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10. Mass M is split into two parts m and $(M - m)$, which are then separated by a certain distance. What is the ratio of (m/M) which maximises the gravitational force between the parts ?

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11. Imagine a light planet revolving around a very massive star in a circular orbit of radius r with a period of revolution T. On what power of r will the square of time period will depend if the gravitational force of attraction between the planet and the star is proportional to $r^{-5/2}$.

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12. Three spherical balls of masses 1 kg, 2 kg and 3 kg are placed at the corners of an equilaterial triangle of side 1m.Find the magnitude of the gravitational force exerted by 2 kg and 3 kg masses on 1 kg mass.

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13. Two particles of masses $1kg$ and $2kg$ are placed at a distance of $50cm$. Find the initial acceleration of the first particle due to gravitational force.

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14. An infinite number of particles each of mass m are placed on the positive X-axis of $1m, 2m, 4m, 8m, \ldots$ from the origin. Find the magnitude of the resultant gravitational force on mass m kept at the origin.

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15. In a double star system, two stars of masses m_1 and m_2 separated by a distance x rotate about their centre of mass. Find the common angular velocity and Time period of revolution.

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16. In Cavendish's experiment, let each small mass be $20g$ and each large mass be $5kg$. The rod connecting the small masses is $50cm$ long, while the small and the large spheres are separated by

$10.0cm$. The torsion constant is $4.8 \times 10^{-8} kgm^2 s^{-2}$ and the resulting angular deflection is 0.4°. Calculate the value of universal gravitational constant G from this data.

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17. The mean orbital radius of the Earth around the Sun is $1.5 \times 10^8 km$. Estimate the mass of the Sun.

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18. A particle of mass m is situated at a distance d from one end of a rod of mass M and length L as shown inf ig. Find the magnitude of the gravitational force between them.

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19. The gravitationa force acting on a particle, due to a solid sphere of uniform density and radius R at a distance of 3R from the cenre of the sphere is F_1. A spherical hole of radius (R/2) isnow made in the sphere as shown in the figure. The sphere with hole now exerts a force F_2 on the same particle. Ratio F_1 to F_2 is

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20. A star 2.5 times the mass of the sun is reduced to a size of $12km$ and rotates with a speed of $1.5rps$. Will an object placed on its equator remain stuck to its surface due to gravity? (Mass of the sun $= 2 \times 10^{30}kg$)

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21. What is the time period of rotation of the earth around its axis so that the objects at the equator becomes weightless? ($g = 9.8 m/s^2$, radius of the earth $= 6400 km$)

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22. The height at which the acceleration due to gravity becomes $\frac{g}{9}$ (where g = the acceleration due to gravity on the surface of the earth) in terms of R, the radius of the earth is

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23. How much above the surface of the earth does the acceleration due to gravity reduce by 36% of its value on the surface of the earth.

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24. Find the percentage decrease in the weight of the body when taken to a depth of $32km$ below the surface of earth. Radius of the earth is $6400km$

.

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25. A man can jump $1.5m$ on the Earth. Calculate the approximate height he might be able to jump on a planet whose density is one-quarter that of the Earth and whose radius is one-third that of the Earth.

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26. Two bodies of masses $100kg$ and $10, 000kg$ are at a distance of $1m$ apart. At what distance from

$100kg$ on the line joining them will the resultant gravitational field intensity be zero?

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27. The gravitational field due to a mass distribution is given by $E = -K/x^3$ in x-direction. Taking the gravitational potential to be zero at infinity, find its value at a distance x.

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28. A particle of mass M is placed at the centre of a uniform spherical shell of equal mass and radius a. Find the gravitational potential at a point P at a distance $\frac{a}{2}$ from the centre.

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29. The gravitational field in a region is given by $\vec{E} = -\left(20Nkg^{-1}\right)\left(\hat{i} + \hat{j}\right)$. Find the gravitational potential at the origin $(0, 0)$ in Jkg^{-1}

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30. Calculate the gravitational potential at the centre of base of a solid hemisphere of mass M, radius R.

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31. The gravitational field in a region is given by the equation $E = (5i + 12j)N/kg$. If a particle of mass $2kg$ is moved from the origin to the point $(12m, 5m)$ in this region, the change in the gravitational potential energy is

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32. Find the gravitational potential energy of a system of four particles , each of mass m placed at the vertices of a square of side l. Also obtain the gravitational potential at centre of the square

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33. Two bodies of masses m and 4m are placed at a distance r. The gravitational potential at a point on the line joining them where the gravitational field is zero is:

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34. If Earth has mass nine times and radius twice that of the planet Mars, calculate the velocity required by a rocket to pull out of the gravitational force of Mars. Take escape speed on surface of Earth to be $11.2 km/s$

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35. A rocket is fired with a speed $v = 2\sqrt{gR}$ near the earth's surface and directed upwards.

(a) Show that it will escape from the earth.

(b) Show that in interstellar space its speed is $v = \sqrt{2gR}$.

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36. A planet in a distant solar systyem is 10 times more massive than the earth and its radius is 10 times smaller. Given that the escape velocity from the earth is $11 kms^{-1}$, the escape velocity from the surface of the planet would be

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37. A satellite orbits the earth at a height of $400 km$ above the surface. How much energy must be expanded to rocket the satellite out of the gravitational influence of earth? Mass of the satellite is $200 kg$, mass of earth $= 6.0 \times 10^{24} kg$, radius of earth $= 6.4 \times 10^{6} m$, $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

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38. A body is projected vertically upwards from the surface of the earth with a velocity equal to half of escape velocity of the earth. If R is radius of the earth, maximum height attained by the body from the surface of the earth is

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39. A particle is fired vertically upward fom earth's surface and it goes up to a maximum height of 6400 km. find the initial speed of particle.

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40. If a satellite is revolving around a planet of mass M in an elliptical orbit of semi-major axis a. Show that the orbital speed of the satellite when it is at a distance r from the planet will be given by $v^2 = GM\left[\frac{2}{r} - \frac{1}{a}\right]$

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41. A rocket is fired vertically from the surface of Mars with a speed of $2kms^{-1}$. If 20% of its initial energy is lost due to Martian atmospheric resistance, how far will the rocket go from the surface of Mars before returning to it? Mass of Mars $= 6.4 \times 10^{23} kg$, radius of Mars $= 3395 km$,

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42. Two heavy sphere each of mass $100 kg$ and radius $0.10 m$ are placed $1.0 m$ apart on a horizontal table. What is the gravitational field and potential at the mid point of the line joining the centres of the sphere? Is an object placed at

that point in equilibrium? If so, is the equilbrium stable or unstable.

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43. Two heavy spheres each of mass $100kg$ and radius $0.1m$ are placed $1m$ apart on a horizontal table. What is the gravitationl field and potential at the mid point of the line joining their centres.

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44. The mass of a spaceship is 1000kg. It is to be launched from the earth's surface out into free space. The value of g and R (radius of earth) are $10\frac{m}{s^2}$ and 6400 km respectively. The required energy for this work will be:

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45. What is the minimum energy required to launch a satellite of mass m from the surface of a planet of mass M and radius R in a circular orbit at an altitude of 2R?

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46. Two uniform solid spheres of equal radii R, but mass M and 4M have a centre to centre separation 6R, as shown in fig. The two spheres are held fixed. A projectile of mass m is projected from he surface of the sphere of mass M directly towards the centre of the second sphere. Obtain an expression for the minimum speed v of the projectile so that it reaches the surface of the second sphere.

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47. A satellite of mass m is orbiting the earth in a circular orbit of radius r. It starts losing energy due to small air resistance at the rate of CJ/s. Then the time teken for the satellite to reach the earth is...........

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48. Two satellites of same mass are launched in the same orbit round the earth so as to rotate opposite to each other. They soon collide inelastically and stick together as wreckage. Obtain the total energy of the system before and just after the collision. Describe the subsequent motion of the wreckage.

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49. A lauching vehicle carrying an artificial satellite of mass m is set for launch on the surface of the earth of mass M and radius R. If the satellite intended to move in a circular orbit of radius $7R$, the minimum energy required to be spent by the launching vehicle on the satellite is

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EVALUATE YOURSELF -1

1. A planet of mass M is revolving round the sun in an elliptical orbit. If its angular momentum is J then the area swept per second by the line joining planet to sun will be :-

A. JM

B. $\frac{J}{2M}$

C. $\frac{JM}{2}$

D. $\frac{J}{M}$

Answer: B

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2. A satellite of mass m is circulating around the earth with constant angular velocity. If the radius is R_0 and mass of earth is M, then the angular momentum about the centre of the earth is

A. $m\sqrt{GMR_0}$

B. $m\sqrt{GmR_0}$

C. $m\sqrt{S}\left(GM/R_0\right)$

D. $M\sqrt{GM/R_0}$

Answer: A

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3. According to Kepler's second law, the radius vector to a planet from the Sun sweeps out equal areas in equal intervals of time. This law is a consequence of the conservation of ___________.

A. linear momentum

B. angular momentum

C. energy

D. Newton's law of gravitation

Answer: B

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EVALUATE YOURSELF -2

1. A planet of mass 3×10^{26} kg moves around a star with a constant speed of $2 \times 10^{6} ms^{-1}$ in a circle of radius 1.5×10^{12} m. The gravitatiional force acting on the planet is

A. 6.67×10^{22}dyne

B. 8×10^{27} dyne

C. $8 \times 10^{26} N$

D. $6.67 \times 10^{20} N$

Answer: B

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2. Gravitational force

A. May be attractive or repulsive

B. Always attractive field force

C. May be contact force

D. Depends on nature of medium

Answer: B

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3. Two spherical bodies of mass M and 5M & radii R & 2R respectively are released in free space with initial separation between their centres equal to

12R. If they attract each other due to gravitational force only, then the distance covered by the smallar body just before collision is

A. 2.5 R

B. 4.5R

C. 7.5 R

D. 1.5 R

Answer: C

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4. The force on a 1 kg mass on earth of radius R is 10 N. Then the force on a satellite revolving around the earth in the mean orbit 3R//2 will be (mass of satelite is 100 kg),

A. $4.44 \times 10^2 N$

B. $6.66 \times 10^2 N$

C. $500 N$

D. $3.33 \times 10^2 N$

Answer: A

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5. A rocket is fired from the earth to the moon. The distance between the earth and the moon is r and the mass of the earth is 81 times the mass of the moon. The gravitational force on the rocket will be zero when its distance from the moon is

A. $\frac{r}{5}$

B. $\frac{r}{10}$

C. $\frac{r}{15}$

D. $\frac{r}{20}$

Answer: B

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EVALUATE YOURSELF -3

1. As we go from the equator to the poles, the value of g

A. Remains the same

B. Decreases

C. Increases

D. Decreases upto a latitude of 45°

Answer: C

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2. If earth were to rotate faster than its present speed, the weight of an object

A. Increase at the equator but remain uncharged at the poles

B. Decrease at the equator but remain unchanged at the poles

C. Remain unchanged at the equator but decrease at the poles

D. Remain unchanged at the equator but increase at the poles.

Answer: B

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3. If the earth suddenly shrinks (without changing mass) to half of its present radius, the acceleration due to gravity will be

A. $g/2$

B. $4g$

C. $g/4$

D. $2g$

Answer: B

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4. At what height from the ground will the value of ' g ' be the same as that in 10 km deep mine below the surface of earth

A. 20 km

B. 10 km

C. 15 km

D. 5 km

Answer: D

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5. If R is the radius of the earth and g the acceleration due to gravity on the earth's surface, the mean density of the earth is

A. $\frac{4\pi G}{3gR}$

B. $\frac{3\pi R}{4gG}$

C. $\frac{3g}{4\pi RG}$

D. $\frac{\pi Rg}{12G}$

Answer: C

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6. If g denotes the value of acceleration due to gravity at a point distance r from the centre of earth of radius R. If $r < R$, then

A. $g \propto r^2$

B. $g \propto r$

C. $g \propto 1/r^2$

D. $g \propto 1/r$

Answer: B

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7. If the change in the value of g at a height h above the surface of earth is the same as at a depth d below it (both h and d are much smaller than the radius of the earth), then

A. $d = h$

B. $d = 2h$

C. $d = h/2$

D. $d = h^2$

Answer: B

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8. A body is weighed with a spring balance in a train at rest, shown a weight W. When the train begins to move with a velocity υ around the equator from west to east and if the angular velocity of the train is ω then the weight shown by spring balance is

A. W

B. $W\left(1 + \frac{2V\omega}{g}\right)$

C. $W\left(1 - \frac{2V\omega}{g}\right)$

D. $W\left(1 + V^2/R\right)$

Answer: C

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9. A body hanging frm a spring stretches it by 1 cm at the earth's surface. How much will the same body stretch the spring at aplace 1600 km above the earth surface ? Radius of the earth=6400 km.

A. 16/50 cm

B. 16/25 cm

C. 25/16 cm

D. 50/16

Answer: B

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10. The value of ' g ' at a particular point is $9.8 m/s^2$. Suppose the earth suddenly shrinks uniformly to half its present size without losing any mass. The value of ' g ' at the same point (assuming that the distance of the point from the centre of earth does not shrink) will now be

A. $4.9ms^{-2}$

B. $3.1ms^{-2}$

C. $9.8ms^{-2}$

D. $19.6ms^{-2}$

Answer: C

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EVALUATE YOURSELF-4

1. Three particles each of mass m are palced at the corners of an equilateral triangle of side b. The gravitational potential energy of the system of particle is

A. $\frac{3GM}{a^2}$

B. $\frac{3GM^2}{a}$

C. $-\frac{3GM^2}{a^2}$

D. $\frac{3GM^2}{a}$

Answer: B

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2. In preivous questions the work done if the side of the triangle is changed from a to 2a , is :

A. $\frac{3GM}{2a}$

B. $\frac{3GM^2}{2a}$

C. $\frac{3GM^2}{(4a)^2}$

D. $\frac{4GM}{2a}$

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3. The gravitational field due to a mass distribution is $E = K/x^3$ in the x - direction. (K is a constant). Taking the gravitational potential to be zero at infinity, its value at a distance x is

A. K/x

B. $K/2x$

C. K/x^2

D. $K/2x^2$

Answer: B

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4. The change in the gravitational potential energy when a body of a mass m is raised to a height nR above the surface of the earth is (here R is the radius of the earth)

A. $mgR\left(\frac{n}{n - 1}\right)$

B. $nmgR$

C. $mgR\left(\frac{n^2}{n^2 + 1}\right)$

D. $mgR\left(\frac{n}{n + 1}\right)$

Answer: D

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5. If g is the acceleration due to gravity on the earth's surface, the gain in the potential energy of an object of mass m raised from the surface of the earth to a height equal to the radius R of the earth, is

A. $\frac{1}{2}mgR$

B. $2mgR$

C. mgR

D. $\frac{1}{4}mgR$

Answer: D

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6. A body of mass m is placed on the earth surface is taken to a height of $h = 3R$, then, change in gravitational potential energy is

A. $\frac{1}{4}mgR$

B. $\frac{2}{3}mgR$

C. $\frac{3}{4}mgR$

D. $\frac{1}{2}mgR$

Answer: A

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7. Two masses $800kg$and $600kg$ are at a distance $25cm$ apart. Compute the magnitude of the intensity of the gravitational field at a point disatnce $20cm$ from the $800kg$ mass and $15cm$ frm the $600kg$ mass

$G = 6.66 \times 10^{-11} Nm^2 kg^{-2}$.

A. 2cm

B. 4cm

C. 6cm

D. 8cm

Answer: C

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8. The gravitatiional potential at a place varies inverely proportional to x^2 (i.e. $V = k/x^2$), the gravitational field at that place is

A. -k/x

B. k/x

C. $-2k/x^3$

D. $2k/x^3$

Answer: C

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EVALUATE YOURSELF-5

1. In a satellite if the time of revolution is T, then kinetic energy is proportional to

A. $\frac{1}{T}$

B. $\frac{1}{T^2}$

C. $\frac{1}{T^3}$

D. $T^{-2/3}$

Answer: D

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2. The mass of a planet is six times that of the earth. The radius of the planet is twice that of the earth. It's the escape velocity from the earth is v, then the escape velocity from the planet is:

A. $\sqrt{3}v$

B. $\sqrt{2}v$

C. v

D. $\sqrt{5}v$

Answer: A

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3. The kinetic energy of a satelliete in its orbit around the earht is E. What shoud be the kinetic energy of the satellite so as to enable it to escape crom the gravitational pull of the Earth?

A. 4E

B. 2E

C. sqrt(2)E

D. E

Answer: B

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4. A satellite of mass m is revolving at a height R above theh sruface of Earth. Here R is the radius of the Earth. The gravitational potential energy of this satellite

A. $-mgR$

B. $-\frac{mgR}{2}$

C. $-\frac{mgR}{3}$

D. $-\frac{mgR}{7}$

Answer: B

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5. A person brings a mass of 1 kg from infinity to a point . Initally the mass was at rest but it moves at a speed of 2 ms^{-1} as it reaches A. The work done by the person on the mass is -3J. The potential at A is

A. $-3J/kg$

B. $-2J/kg$

C. $-5J/kg$

D. None of these

Answer: C

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6. A satellite of mass 50 kg moves from a point where the gravitational potential due to the Earth is $-20MNkg^{-1}$ to another point where the gravitational potential is $-60MJkg^{-1}$.During the change of position, it has moved

A. Close to the Earth and lost 2000 MJ of potential energy

B. Closer to the Earth and lost 20 MJ of potential energy

C. Farther from the Earth and gained 2000 MJ of potential energy

D. Farther from the Earth and gained 40 MJ of potential energy

Answer: A

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7. The gravitational force between two objects is proportional to $1/R$ (and not as $1/R^2$) where R is separation between them, then a particle in circular orbit under such a force would have its orbital speed v proportional to

A. $(1/R)^2$

B. $(1/R)$

C. R

D. R^0

Answer: D

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8. A satellite of mass m moves around the Earth in a circular orbit with speed v. The potential energy of the satellite is

A. $\frac{1}{2}mv^2$

B. - $\frac{1}{2}mv^2$

C. $\frac{3}{4}mv^2$

D. $\frac{5}{4}mv^2$

Answer: B

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9. v_e and v_p denotes the escape velocity from the earth and another planet having twice the radius and the same mean density as the earth. Then

A. $v_e = v_p$

B. $v_e = v_p/2$

C. $v_e = 2v_p$

D. $v_e = v_p/4$

Answer: B

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10. The ratio of the radius of the earth to that of the motion is 10. the ratio of the acceleration due to gravity on the earth to that on the moon is 6. The ratio of the escape velocity from the earth's surface to that from the moon is

A. 10

B. 6

C. nearly 8

D. 1.66

Answer: C

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EXERCISE -I (C.W.)

1. If $'A'$ is areal velocity of a planet of mass M, its angular momentum is

A. M/A

B. 2MA

C. A^2M

D. AM^2

Answer: B

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2. A planet revolves round the sun in an elliptical orbit of semi minor and semi major axes x and y respectively. Then the time period of revolution is proportional to

A. $(x+y)^{\frac{3}{2}}$

B. $(y-x)^{\frac{3}{2}}$

C. $x^{\frac{3}{2}}$

D. $y^{\frac{3}{2}}$

Answer: D

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3. Let $'A'$ be the area swept by the line joining the earth and the sun during Feb 2012. The area swept by the same line during the first week of that month is

A. A/4

B. 7A/29

C. A

D. 7A/30

Answer: B

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4. A satellite moving in a circular path of radius r around earth has a time period T. If its radius slightly increases by 4%, then percentage change in its time period is

A. 0.01

B. 0.06

C. 0.03

D. 0.09

Answer: B

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5. The time of revolution of planet A round the sun is 8 times that of another planet B. The distance of planet A from the sun is how many B from the sun

A. 2

B. 3

C. 4

D. 5

Answer: C

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6. The distance of Neptune and Saturn from the Sun are respectively 10^{13} and 10^{12} meters and their periodic times are respectively T_n and T_s. If their orbits are circular, then the value of T_n / T_s is

A. 100

B. $10\sqrt{10}$

C. $\frac{1}{10\sqrt{10}}$

D. 10

Answer: B

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7. The period of moon's rotation around the earth is approx. 29 days. IF moon's mass were 2 fold its present value and all other things remain unchanged, the period of Moon's rotation would be nearly

A. $29\sqrt{2}$

B. $29/\sqrt{2}$

C. $29\sqrt{3}$

D. 29

Answer: D

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8. If the mass of earth were 2 times the present mass, the mass of the moon were half the present mass and the moon were revolving round the earth at the same present distance, the time period of revolution of the moon would be (in day)

A. 56

B. 28

C. $14\sqrt{2}$

D. 7

Answer: C

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9. Two sphere of masses m and M are situated in air and the gravitational force between them is F. The space around the masses in now filled with a liquid of specific gravity 3. The gravitational force will now be

A. $\frac{F}{9}$

B. $3F$

C. F

D. $\frac{F}{3}$

Answer: C

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10. The gravitational force between two bodies is $6.67 \times 10^{-7} N$ when the distance between their centres is $10m$. If the mass of first body is $800kg$, then the mass of second body is

A. 1000 kg

B. 1250 kg

C. 1500 kg

D. 2000 kg

Answer: B

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11. Two identical spheres each of radius R are placed with their centres at a distance nR, where n is integer greater than 2. The gravitational force between them will be proportional to

A. $1/R^4$

B. $1/R^2$

C. R^2

D. R^4

Answer: D

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12. A satellite is orbiting around the earth. If both gravitational force and centripetal force on the satellite is F, then, net force acting on the satellite to revolve around the earth is

A. F/2

B. F

C. 2F

D. Zero

Answer: B

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13. Mass $M = 1$ unit is divided into two parts X and $(1 - X)$. For a given separation the value of X for which the gravitational force between them becomes maximum is

A. 43832

B. 43895

C. 1

D. 2

Answer: A

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14. If g on the surface of the earth is $9.8 m/s^2$, its value at a height of 6400 km is (Radius of the earth =6400 km)

A. $4.9ms^2$

B. $9.8ms^2$

C. $2.45ms^{-2}$

D. $19.6ms^{-2}$

Answer: C

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15. If g on the surface of the earth is $9.8ms^{-2}$, its value of a depth of 3200 km,

(Radius of the earth =6400 km) is

A. $9.8ms^2$

B. zero

C. $4.9ms^{-2}$

D. $2.45ms^{-2}$

Answer: C

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16. If mass of the planet is 10% less than that of the earth and radius of the planet is 20% greater than that of the earth then the weight of $40kg$ person on that planet is

A. 10 kg wt

B. 25 kg wt

C. 40 kg wt

D. 60 kg wt

Answer: B

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17. The angular velocity of the earth with which it has to rotate so that the acceleration due to gravity on 60° latitude becomes zero is

A. $2.5 \times 10^{-3} rads^{-1}$

B. $1.5 \times 10^{-3} rads^{-1}$

C. $4.5 \times 10^{-3} rads^{-1}$

D. $0.5 \times 10^{-3} rads^{-1}$

Answer: A

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18. Assume that the acceleration due to gravity on the surface of the moon is 0.2 times the acceleration due to gravity on the surface of the earth. If R_e is the maximum range of a projectile on the earth's surface, what is the maximum range on the surface of the moon for the same velocity of projection

A. $0.2R_e$

B. $2R_e$

C. $0.5R_e$

D. $5R_e$

Answer: D

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19. The value of acceleration due to gravity at the surface of earth

A. $\left(\sqrt{\frac{x}{y}} - 1\right)R$

B. $\left(\sqrt{\frac{y}{x}} - 1\right)R$

C. $\sqrt{\frac{y}{x}}R$

D. $\sqrt{\frac{x}{y}}R$

Answer: A

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20. The point at which the gravitational force acting on any mass is zero due to the earth and the moon system is (The mass of the earth is approximately 81 times the mass of the moon and the distance between the earth and the moon is $3, 85, 000 km$).

A. 36000 km from the moon

B. 35800 km from the moon

C. 34500 km from the moon

D. 30,000 km from the moon

Answer: B

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21. Masses $2kg$ and $8kg$ are $18cm$ apart. The point where the gravitational field due to them is zero, is

A. 6 cm from 8kg mass

B. 6 cm from 2 kg mass

C. 1.8cm from 8 kg mass

D. 9 cm from each mass

Answer: B

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22. Particles of masses m_1 and m_2 are at a fixed distance apart. If the gravitational field strength at m_1 and m_2 are $\vec{I}_1$ and $\vec{I}_2$ respectively. Then

A. $m_1\vec{I}_1 + m_2\vec{I}_2 = 0$

B. $m_1\vec{I}_2 + m_2\vec{I}_1 = 0$

C. $m_1\vec{I}_1 - m_2\vec{I}_2 = 0$

D. $m_1\vec{I}_2 - m_2\vec{I}_1 = 0$

Answer: A

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23. The PE of three objects of masses $1kg$, $2kg$ and $3kg$ placed at the three vertices of an equilateral triangle of side $20cm$ is

A. 25 G

B. 35G

C. 45G

D. 55G

Answer: D

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24. A small body is initially at a distance r from the centre of earth. r is greater than the radius of the earth. If it takes W joule of work to move the body from this position to another position at a distance $2r$ measured from the centre of earth, how many joule would be required to move it from this position to a new position at a distance of $3r$ from the centre of the earth.

A. W/5

B. W/3

C. W/2

D. W/6

Answer: B

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25. A body of mass 'm' is raised from the surface fo the earth to a height 'nR'(R-radius of the earth). Magnitude of the change in the gravitational potential energy of the body is (g-acceleration due to gravity on the surface of the earth)

A. $\left(\frac{n}{n+1}\right)mgR$

B. $\left(\frac{n-1}{n}\right)mgR$

C. $\frac{mgR}{n}$

D. $\frac{mgR}{(n-1)}$

Answer: A

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26. A person brings a mass $2kg$ from A to B. The increase in kinetic energy of mass is $4J$ and work done by the person on the mass is $-10J$. The potential difference between B and A is ......J/kg

A. 4

B. 7

C. -3

D. -7

Answer: D

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27. The work done liftting a particle of mass 'm' from the centre of the earth to the surface of the earth is

A. $-mgR$

B. $\frac{1}{2}mgR$

C. zero

D. mgR

Answer: B

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28. The figure shows two shells of masses m_1 and m_2. The shells are concentric. At which point, a particle of mass m shall experience zero force?

A. A

B. B

C. C

D. D

Answer: D

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29. Energy required to move a body of mass m from an orbit of radius 2R to 3R is

A. $\frac{Gmm}{12R}$

B. $\frac{GMm}{3R^2}$

C. $\frac{GMm}{8R}$

D. $\frac{GMm}{6R}$

Answer: A

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30. the ratio of escape velocities of two planets if g value on the two planets are $9.9m/s^2$ and $3.3m/s^2$ and there are $6400km$ and $3200km$ respectively is

A. $2.36:1$

B. $1.36:1$

C. $3.36:1$

D. $4.36:1$

Answer: A

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31. The escape velocity from the surface of the earth of radius R and density ρ

A. $2R\sqrt{\frac{2\pi\rho G}{3}}$

B. $2\sqrt{\frac{2\pi\rho G}{3}}$

C. $2\pi\sqrt{\frac{R}{g}}$

D. $\sqrt{\frac{2\pi G\rho}{R^2}}$

Answer: A

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32. A body is projected vertically up from surface of the earth with a velocity half of escape velocity. The ratio of its maximum height of ascent and radius of earth is

A. $1:1$

B. $1:2$

C. $1:3$

D. $1:4$

Answer: C

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33. A spaceship is launched in to a circular orbit of radius R close to surface of earth. The additional velocity to be imparted to the spaceship in the orbit to overcome the earth's gravitational pull is (g=acceleration due to gravity)

A. 1.414 Rg

B. $1.414\sqrt{Rg}$

C. $0.414Rg$

D. $0.414\sqrt{gR}$

Answer: D

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34. The escape velocity from the earth is $11km/s$. The escape velocity from a planet having twice the radius and same density as that of the earth is (in km/s)

A. 22

B. 15.5

C. 11

D. 5.5

Answer: A

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35. An object of mass m is at rest on earth's surface. Escape speed of this object is V_e. Same object is orbiting the earth with $h = R$, then escape speed is V_e^1. Then

A. $V_3^1 = \frac{V_e}{4}$

B. $V_e = 2V_e^1$

C. $V_e) = \sqrt{2}V_e^1$

D. $V_e^1 = \sqrt{2}V_e$

Answer: C

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36. A satellite revolves in a circular orbit with speed, $V = \frac{1}{\sqrt{3}} V_e$. If satellite is suddenly stopped and allowed to fall freely onto the earth, the speed with which it hits the earth's surface is

A. $\sqrt{gR}$

B. $\sqrt{\frac{gR}{3}}$

C. $\sqrt{2gR}$

D. $\sqrt{\frac{2}{3}gR}$

Answer: D

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37. A space station is set up in space at a distance equal to the earth's radius from the surface of the earth. Suppose a satellite can be launched from the space station. Let v_1 and v_2 be the escape velocities of the satellite on the earth's surface and space station, respectively. Then

A. $v_2 = v_1$

B. $v_2 < v_1$

C. $v_2 > v_1$

D. 1,2, and 3 are valid depending on the mass of satellite.

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38. The orbital speed for an earth satellite near the surface of the earth is $7km/\sec$. If the radius of the orbit is 4 times the radius of the earth, the orbital speed would be

A. 3.5 km/sec

B. 7 km/sec

C. $7\sqrt{2}$ km/sec

D. 14 km/sec

Answer: A

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39. Two satellite are revolving round the earth at different heights. The ratio of their orbital speeds is $2:1$. If one of them is at a height of the other satellite is (in km)

A. 19600

B. 24600

C. 29600

D. 14600

Answer: A

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40. A satellite of mass m revolves around the earth of radius R at a hight x from its surface. If g is the acceleration due to gravity on the surface of the earth, the orbital speed of the satellite is

A. gx

B. $\left(\frac{gR^2}{R+x}\right)^{1/2}$

C. $\frac{gR^2}{R+x}$

D. $\frac{gR}{R-x}$

Answer: B

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41. Two satellites M and N go around the earth in circular orbits at heights of R_M and R_N respectively from the surface of the earth.

Assuming the earth to be a uniform sphere of radius R_E, the ratio of velocities of the satellites $\frac{V_M}{V_N}$ is

A. $\left(\frac{R_M}{R_N}\right)^2$

B. $\sqrt{\frac{R_N + R_E}{R_M + R_E}}$

C. $\frac{R_N + R_E}{R_M + R_E}$

D. $\sqrt{\frac{R_N}{R_M}}$

Answer: B

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42. A satellite of mass m revolves revolves round the earth of mass M in a circular orbit of radius r with an angular velocity ω. If the angular velocity is $\omega/8$ then the radius of the orbit will be

A. 4r

B. 2r

C. 8r

D. r

Answer: A

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43. The moon revolves round the earth 13 times in one year. If the ratio of sun-earth distance to earth-moon distance is 392, then the ratio of masses of sun and earth will be

A. 365

B. $356x10^{-12}$

C. 3.56×10^{5}

D. 1

Answer: C

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44. A satellite is launched into a circular orbit of radius R around the earth. A second satellite is launched into an orbit of radius (1.01) R. The period of the second satellite is larger than the first one by approximately

A. 0.005

B. 0.015

C. 0.01

D. 0.03

Answer: B

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45. An astronaut orbiting in a spaceship round the earth has a centripetal acceleration of $2.45 m/s^2$. The height of spaceship from earth's surface is (R=radius of earth)

A. 3R

B. 2R

C. r will increase and v will decrease

D. R/2

Answer: C

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46. A satellite moves around the earth in a circular orbit with speed v. If m is the mass of the satellite, its total energy is

A. $\frac{1}{2}mv^2$

B. mv^2

C. $\frac{1}{2}mv^2$

D. $\frac{3}{2}mv^2$

Answer: C

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47. The $K.E.$ of a satellite in an orbit close to the surface of the earth is E. Its max $K.E.$ so as to escape from the gravitational field of the earth is

A. 2E

B. 4E

C. $2\sqrt{2}E$

D. $\sqrt{2}E$

Answer: A

Watch Video Solution

48. Two satellite of masses $400kg, 500kg$ are revolving around earth in different circular orbits of radii r_1, r_2 such that their kinetic energies are equal. The ratio of r_1 to r_2 is

A. $4:5$

B. $16:25$

C. $5:4$

D. $25:16$

Answer: A

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49. The kinetic energy needed to project a body of mass m from the earth surface (radius R) to infinity is

A. $\frac{mgR}{2}$

B. $2mgR$

C. mgR

D. $\frac{mgR}{4}$

Answer: C

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50. Orbital speed of geo-stationary satellite is

A. 8km/sec from west to east

B. 11.2km/sec from east to west

C. 3.1 km/sec from west to east

D. zero

Answer: C

Watch Video Solution

EXERCISE -I (H.W.)

1. In planetary motion the areal velocity of possition vector of a planet depends of angular velocity (ω) and the distance of the planet from sun (r). If so the correct relation for areal velocity is

A. $\frac{dA}{dt} \propto \omega r$

B. $\frac{dA}{dt} \propto \omega^2 r$

C. $\frac{dA}{dt} \propto \omega r^2$

D. $\frac{dA}{dt} \propto \sqrt{\omega r}$

Answer: C

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2. If a and b are the nearest and farthest distances of a planet from the sun and the planet is revolving in an elliptical orbit, then square of the time period of revolution of that planets is directly proportional to

A. a^3

B. b^3

C. $(a + b)^3$

D. $(a - b)^3$

Answer: C

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3. A planet is revolving round the sun in an elliptical orbit, If v is the velocity of the planet when its position vector from the sun is r, then areal velocity of the planet is

A. $\frac{1}{2}(\vec{r} \times \vec{v})$

B. $\vec{r} \times \vec{v}$

C. $\vec{v} \times \vec{r}$

D. $\frac{1}{2}(\vec{v} \times \vec{r})$

Answer: A

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4. The period of a satellite in a circular orbit of radius R is T, the period of another satellite in a circular orbit of radius $4R$ is

A. $2T$

B. $2\sqrt{2}T$

C. $4T$

D. $8T$

Answer: D

Watch Video Solution

5. The period of revolution of an earth's satellite close to the surface of the earth is 60 minute. The period of another the earth's satellite in an orbit at a distance of three times earth's radius from its surface will be (in minutes)

A. 90

B. $90 \times \sqrt{8}$

C. 270

D. 480

Answer: D

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Watch Video Solution

6. If a planet of mass m is revolving around the sun in a circular orbit of radius r with time period, T then mass of the sun is

A. $4\pi^2 r^3 / GT$

B. $4\pi^2 r^3 / GT^2$

C. $4\pi^2 r / GT$

D. $4\pi^2 r^3 / G^2 T^2$

Answer: B

Watch Video Solution

7. The period of revolution of a planet around the sun in a circular orbit is same as that of period of similar planet revolving around a star of twice the raduis of first orbit and if M is the mass of the sun then the mass of star is

A. 2M

B. 4M

C. 8M

D. 16M

Answer: C

Watch Video Solution

8. A planet moves around the sun in an elliptical orbit. When earth is closest from the sun, it is at a distance r having a speed v. When it is at a distance $4r$ from the sun its speed will be:

A. 4v

B. $\frac{v}{4}$

C. $2v$

D. $\frac{v}{2}$

Answer: B

Watch Video Solution

9. A planet of mass m is the elliptical orbit about the sun $\left(m < < M_{\text{sun}}\right)$ with an orbital period T. If A be the area of orbit, then its angular momentum would be:

A. $\frac{2mA}{T}$

B. mAT

C. $\frac{mA}{2T}$

D. $2mAT$

Answer: A

Watch Video Solution

10. The gravitational force between two particles of masses m_1 and m_2 separeted by the same distance in different medium, then the gravitational force between them will be

A. graater than F

B. less than F

C. F

D. Zero

Answer: C

Watch Video Solution

11. The mass of a ball is four times the mass of another ball. When these balls are separated by a distance of $10cm$, the gravitational force between them is $6.67 \times 10^{-7}N$. The masses of the two balls are in kg.

A. 10,20

B. 5,20

C. 20,30

D. 20,40

Answer: B

Watch Video Solution

12. Gravitational force between two point masses m and M separated by a distance r is F. Now if a point mass $3m$ is placed very next to m, the total force on M will be

A. F

B. 2F

C. 3F

D. 4F

Answer: A

Watch Video Solution

13. Three uniform spheres each of mass m and diameter D are kept in such a way that each touches the other two, then magnitudes of the gravitational force on any one sphere due to the other two is

A. $\frac{3Gm^2}{D^2}$

B. $\frac{2\sqrt{3}m^2}{D^2}$

C. $\frac{\sqrt{3}Gm^2}{4D^2}$

D. $\frac{\sqrt{3}Gm^2}{D^2}$

Answer: D

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14. A $3kg$ mass and $4kg$ mass are placed on X and Y axes at a distance of 1 meter from the origin and a $1kg$ mass is placed at the origin. Then the resultant gravitational force on $1kg$ mass is

A. 7G

B. G

C. 5G

D. 3G

Answer: C

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15. The height at which the value of g is half that on the surface of the earth of radius R is

A. R

B. 2R

C. 0.414R

D. 0.75R

Answer: C

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16. The depth at which the value of g becomes 25% of that at the surface of the earth is (in KM)

A. 4800

B. 2400

C. 3600

D. 1200

Answer: A

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17. If the radius of the earth decreases by 10%, the mass remaining unchanged, what will happen to the acceleration due to gravity?

A. decreases by 19%

B. increases by 19%

C. decreases by more than 19%

D. increases by more than 19%

Answer: D

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18. The acceleration due to gravity at the poles is $10 ms^{-2}$ and equitorial radius is $6400 km$ for the earth. Then the angular velocity of rotaiton of the earth about its axis so that the weight of a body at the equator reduces to 75% is

A. $\frac{1}{1600} \text{rad} s^{-1}$

B. $\frac{1}{800} \text{rad} s^{-1}$

C. $\frac{1}{400} \text{rad} s^{-1}$

D. $\frac{1}{200} \text{rad} s^{-1}$

Answer: A

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19. The maximum horizontal range of projectile on the earth is R. Then for the same velocity of projection, its maximum range on another planet is $\frac{5R}{4}$. Then, ratio of acceleration due to gravity on that planet and on the earth is

A. $5:4$

B. $4:5$

C. $25:16$

D. $16:25$

Answer: B

Watch Video Solution

20. A particle hanging from a massless spring stretches it by $2cm$ at the earth's surface. How much will the same particle stretch the spring at a height Of $2624Km$ from the surface of the earth? (Radius of the earth $= 6400km$)

A. 1cm

B. 2cm

C. 3cm

D. 4cm

Answer: A

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21. The value of acceleration due to gravity 'g' on the surface of a planet with radius double that of the earth and same mean density as that of the earth is (g_e =acceleration due to gravity on the surface of the earth)

A. $g_p = 2g_e$

B. $g_p = g_e/2$

C. $g_p = g_e/4$

D. $g_p = 4g_e$

Answer: A

Watch Video Solution

22. If g is acceleration due to gravity on the surface of the earth, having radius R, the height at which the acceleration due to gravity reduces to $g/2$ is

A. $R/2$

B. $\sqrt{2}R$

C. $\frac{R}{\sqrt{2}}$

D. $(\sqrt{2} - 1)R$

Answer: D

Watch Video Solution

23. There are two bodies of masses $100kg$ and $1000kg$ separated by a distance $1m$. The intensity of gravitational field at the mid point of the line joining them will be

A. $2.4 \times 10^{-6} N/kg$

B. $2.4 \times 10^{-7} N/kg$

C. $2.4 \times 10^{-8} N/kg$

D. $2.4 \times 10^{-9} N/kg$

Answer: B

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24. Masses $4kg$ and $36kg$ are $16cm$ apart. The point where the gravitational field due to them is zero is

A. 6 cm from 4 kg mass

B. 4 cm from 4 kg mass

C. 1.8 cm from 36 kg mass

D. 9 cm from each mass

Answer: B

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25. Two particle of masses $4kg$ and $8kg$ are kept at $x = -2m$ and $x = 4m$ respectivley. Then, the gravitational field intensity at the origin is

A. G

B. 2G%

C. $G/2$

D. $G/4$

Answer: C

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26. Three particles each of mass m are kept at the vertices of an euilateral triangle of side L. The gravitational field at the centre due to these particle is

A. zero

B. $\frac{3GM}{L^2}$

C. $\frac{9GM}{L^2}$

D. $\frac{2GM}{E^2}$

Answer: A

Watch Video Solution

27. Three particles each of mass m are palced at the corners of an equilateral triangle of side b. The gravitational potential energy of the system of particle is

A. $\frac{-3Gm^2}{2b}$

B. $\frac{-Gm^2}{2b}$

C. $\frac{-3Gm^2}{b}$

D. $\frac{-Gm^2}{b}$

Answer: C

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28. If W is the weight of a satellite on the surface of the earth, then the energy required to lauch that satellite from the surface of earth into a circular orbit of radius $3R$ is (here R is the radius of the earth)

A. 5WR/6

B. 6WR/5

C. 2WR/3

D. 3WR/2

Answer: A

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29. A body of mass m is lifted from the surface of earth of height equal to $R/3$ where R is the radius of earth, potential energy of the body increases by

A. mgR/3

B. mgR/4

C. 2mgR/3

D. mgR/9

Answer: B

Watch Video Solution

30. An object of mass 2 Kg is moved from infinity to a poitn P. Initially that object was st rest but on reching P its speed is 2m/s. The workdone in moving that object is -4J. Then potential at P is .... J/kg

A. 8

B. -8

C. 4

D. -4

Answer: B

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31. If mass of the earth is M, radius is R, and gravitational constant is G, then workdone to take $1kg$ mass from earth surface to infinity will be

A. $\sqrt{\frac{GM}{2R}}$

B. $\frac{\sqrt{GM}}{R}$

C. $\sqrt{\frac{2GM}{R}}$

D. $\frac{GM}{2R}$

Answer: B

Watch Video Solution

32. A body of mass m is placed on the earth surface is taken to a height of $h = 3R$, then, change in gravitational potential energy is

A. $\frac{mgR}{4}$

B. $\frac{2mgR}{3}$

C. $\frac{3mgR}{4}$

D. $\frac{mgR}{6}$

Answer: C

Watch Video Solution

33. A body is released from a height $5R$ where R is the radius of the earth. Then that body reaches the ground with a velocity equal to

A. $\sqrt{\frac{5gR}{3}}$

B. $\sqrt{\frac{3gR}{5}}$

C. $\sqrt{5gR}$

D. $\sqrt{3gR}$

Answer: A

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34. The difference in PE of an object of mass $10kg$ when it is taken from a height of $6400Km$ to

$12800 Km$ from the surface of the earth is

$\left(M_E = 6 \times 10^{24} kg\right)$

A. $1.045 \times 10^8 J$

B. $1.565 \times 10^8 J$

C. $2.65 \times 10^8 J$

D. $4.5 \times 10^8 J$

Answer: A

Watch Video Solution

35. If the gravitational potential energy of a body at a distance r from the centre of the earth is U, then it's weight at that point is

A. U

B. $\frac{U^2}{r}$

C. $U^2 r$

D. $\frac{U}{r}$

Answer: D

Watch Video Solution

36. The escape velocity of an object on a planet whose radius is 4 times that of the earth and g value 9 tims that on the earth, in Kms^{-1}, is

A. 33.6

B. 67.2

C. 16.8

D. 25.2

Answer: B

Watch Video Solution

37. The escape velocity of a sphere of mass m is given by

A. $\sqrt{\frac{2GMm}{R_e}}$

B. $\sqrt{\frac{2GM}{R_e^2}}$

C. $\sqrt{\frac{2GMm}{R_e^2}}$

D. $\sqrt{\frac{2GM}{R_e}}$

Answer: D

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38. A body is projected up with a velocity equal to $3/4th$ of the escape velocity from the surface of the earth. The height it reaches is (Radius of the earth is R)

A. 10 R/9

B. 9R/7

C. 9R/8

D. 10R/3

Answer: B

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39. A spacecraft is launched in a circular orbit very close to earth. What additional velocity should be given to the spacecraft so that it might escape the earth's gravitational pull.

A. $20.2 Kms^{-1}$

B. $3.25 Kms^{-1}$

C. $8 Kms^{-1}$

D. $11.2 Kms^{-1}$

Answer: B

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40. If the escape velocity on the earth is $11.2km - s^{-1}$, its value for a planet having double the radius and 8 times the mass of earth is

A. 11.2

B. 22.4

C. 5.6

D. 8

Answer: B

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41. The escape velocity of a body from earth's surface is v_e. The escape velocity of the same body from a height equal to $7R$ from earth's surface will be

A. $\frac{V_e}{\sqrt{2}}$

B. $\frac{V_e}{2}$

C. $\frac{V_e}{2\sqrt{2}}$

D. $\frac{V_e}{4}$

Answer: C

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42. The escape velocity of a body from the surface of the earth is V_1 and from an altitude equal to twice the radius of the earth, is, V_2. Then

A. $V_1 = V_2$

B. $V_1 = 7V_2$

C. $V_1 = \sqrt{3}V_2$

D. $V_1 = \sqrt{2}V_2$

Answer: C

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43. The ratio of the orbital speeds of two satellites of the earth if the satellite are at heights $6400km$ and $19200km$(Raduis of the earth= $6400km$)

A. $\sqrt{2}:1$

B. $\sqrt{3}:1$

C. $2:1$

D. $3:1$

Answer: A

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44. An artificial satellite is revolving in a circular orbit at height of $1200 km$ above the surface of the earth. If the radius of the earth is $6400 km$ and mass is $6 \times 10^{24} kg$, the orbital velocity is

A. $7.26 kms^{-1}$

B. $4.26 kms^{-1}$

C. $9.26 kms^{-1}$

D. $2.26 kms^{-1}$

Answer: A

Watch Video Solution

45. The mean radius of the orbit of a satellite is 4 times as great as that of the parking orbit of the earth. Then its period of revolution around the earth is

A. 4 days

B. 8 days

C. 16 days

D. 96 days

Answer: B

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46. If the mass of earth were 4 times the present mass, the mass of the moon were half the present mass and the moon were revolving around the earth at twice the present distance, the time period of revolution of the moon would be (Indays)

A. $56\sqrt{2}$

B. $28\sqrt{2}$

C. $14\sqrt{2}$

D. $7\sqrt{2}$

Answer: B

Watch Video Solution

47. A satellite of mass m revolves around the earth of mass M in a circular orbit of radius r, with an angular velocity ω. If raduis of the orbit becomes $9r$, then angular velocity of this orbit becomes

A. 9ω

B. $\frac{\omega}{9}$

C. 27ω

D. $\frac{\omega}{27}$

Answer: D

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48. A satellite of mass m is revolving in a circular orbit of radius r. The relation between the angular momentum J of satellite and mass m of earth will be -

A. $\sqrt{GMm^2r}$

B. $2m\sqrt{GMr}$

C. $2M\sqrt{Gmr}$

D. $\sqrt{\frac{Gm}{r}}$

Answer: A

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49. Two satellite of masses 40kg, 50kg are revolving around earth in different circular orbits of radii r_1, r_2 such that their kinetic energies are equal. The ratio of r_1, r_2 is

A. $\sqrt{5} : \sqrt{4}$

B. $16 : 25$

C. $\sqrt{45} : \sqrt{4}$

D. $25 : 16$

Answer: A

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50. Angular momentum of a satellite revolving round the earth in a circular orbit at a height R above the surface is L. Here R is radius of the earth. The magnitude of angular momentum of another satellite of the same mass revolving very close to the surface of the earth is

A. $L/2$

B. $L/\sqrt{2}$

C. $\sqrt{2}L$

D. $2L$

Answer: B

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51. The $K.E.$ of a satellite is $10^4 J$. It's $P.E.$ is

A. -$10^4 J$e

B. $2 \times 10^4 J$

C. -$2 \times 10^4 J$

D. -$4 \times 10^4 J$

Answer: C

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Watch Video Solution

52. The energy required to move a body of mass m from an orbit of radius $3R$ to $4R$ is

A. $\frac{GMm}{2R}$

B. $\frac{Gm}{6R}$

C. $\frac{GMm}{12R}$

D. $\frac{GMm}{24R}$

Answer: D

Watch Video Solution

53. $K.E.$ of an orbiting satellite is K. The minimum additional $K.E.$ required so that it goes to infinity is

A. K

B. 2K

C. 3K

D. K/2

Answer: A

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54. Imagine a geo-stationary satellite of the earth which is used as an inter-continental telecast station. At what height will it have to be established?

A. $10^3 m$

B. $6.4 \times 10^3 m$

C. $35.94 \times 10^6 m$

D. Infinity

Answer: C

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55. The height of a geo-stationary satellite above the centre of the earth is (in KM)

A. 6400

B. 12800

C. 36000

D. 42000

Answer: D

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56. How much faster than it's normal rate should the earth rotate about it's axis so that the weight of the body at the equator becomes zero $\left(R = 6.4 \times 10^6 m, g = 9.8 m/s^2\right)$ (in times)

A. nearly 17

B. nearly 12

C. nearly 10

D. nearly 14

Answer: A

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EXERCISE -II (C.W.)

1. If the earth shrinks such that its density becomes 8 times to the present values, then new duration of the day in hours will be

A. 24

B. 12

C. 6

D. 3

Answer: C

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2. A planet moves around the sun. at a given point P, it is closest from the sun at a distance d_1, and has a speed V_1. At another point Q, when it is farthest from the sun at a distance d_2, its speed will be

A. $\frac{d_1^2 V_1}{d_2}$

B. $\frac{d_2 V_1}{d_1}$

C. $\frac{d_1 V_1}{d_2}$

D. $\frac{d_2^2 V_1}{d_1^2}$

Answer: C

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3. If a graph is plotted between T^2 and r^3 for a planet then, its slope will be

A. $\frac{4\pi^2}{GM}$

B. $\frac{GM}{4\pi^2}$

C. $4\pi GM$

D. Zero

Answer: A

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4. Two different atrtificial satellites orbiting with same time period around the earth having angular momenta in $2:1$. The ratio of masses of the satellite will be:

A. $2:1$

B. $1:2$

C. $1:1$

D. $1:3$

Answer: A

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5. The ratio of the earth's orbital angular momentum (about the Sun) to its mass is $4.4 \times 10^{15} m^2 s^{-1}$. The area enclosed by the earth's orbit is approximately-__________m^(2).

A. $1 \times 10^{22} m^2$

B. $3 \times 10^{22} m^2$

C. $5 \times 10^{22} m^2$

D. $7 \times 10^{22} m^2$

Answer: D

Watch Video Solution

6. Gravitational force between two point masses m and M separated by a distance r is F. Now if a point mass $3m$ is placed very next to m, the total force on M will be

A. F

B. 2F

C. 3F

D. 4F

Answer: D

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7. If there particles, each of mass M, are placed at the three corners of an equilateral triangle of side, a the force exerted by this system on another particle of mass M placed (i) at the midpoint of side and (ii) at the centre of the triangle are, respectively.

A. $0, \frac{4GM^2}{3a^2}$

B. $\frac{4GM^2}{3a^2}, 0$

C. $\frac{3Gm^2}{a^2}, \frac{GM^2}{a^2}$

D. $0, 0$

Answer: B

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8. Two masses 'M' and '4M' are at a distance 'r' apart on the line joining them. 'P' is point where the resultant gravitational force is zero (such a point is called as null point). The distance of 'P' from the mass '4M' is

A. $\frac{r}{5}$

B. $\frac{r}{3}$

C. $\frac{2r}{3}$

D. $\frac{4r}{5}$

Answer: B

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9. If the mass of one particle is increased by 50% and the mass of another particle llis decreased by 50%, the force between them

A. decreases by 25%

B. decreases by 75%

C. increases by 25%

D. does not change

Answer: A

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10. If the distance between the sun and the earth is increased by three times, then the gravitational force between two will

A. remain constant

B. decrease by 63%

C. increase by 63%

D. decrease by 89%

Answer: D

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11. Two lead balls of masses m and $5m$ having radii R and $2R$ are separated by $12R$. If they attract each other by gravitational force, the distance covered by small sphere before they touch each other is

A. 10 R/9

B. 7.5 R

C. 9 R

D. 2.5 R

Answer: B

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12. Three identical particles each of mass "m" are arranged at the corners of an equiliteral triangle of side "L". If they are to be in equilibrium, the speed with which they must revolve under the influence of one another's gravity in a circular orbit circumscribing the triangle is

A. $\sqrt{\frac{3Gm}{L}}$

B. $\sqrt{\frac{Gm}{L}}$

C. $\sqrt{\frac{Gm}{3L}}$

D. $\sqrt{\frac{3Gm}{L^2}}$

Answer: B

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13. Two particles each of mass 'm' are placed at A and C are such $AB = BC = L$. The gravitational force on the third particle placed at D at a distance L on the perpendicular bisector of the line AC is

A. $\frac{Gm^2}{L^2}$ along BD

B. $\frac{Gm^2}{\sqrt{2}L^2}$ alogn DB

C. $\frac{Gm^2}{L^2}$ along AC

D. $\frac{Gm^2}{L^2}$ along BD

Answer: B

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14. The height at which the value of acceleration due to gravity becomes 50% of that at the surface of the earth. (radius of the earth $= 6400 km$) is

A. 2650

B. 2430

C. 2250

D. 2350

Answer: A

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15. The radius and density of two artificial satellites are R_1, R_2 an,d ,ρ_1, ρ_2 respectively. The ratio of acceleration due to gravitation them will

be

A. $\frac{R_2\rho_2}{R_1\rho_1}$

B. $\frac{R_1\rho_2}{R_2\rho_1}$

C. $\frac{R_1\rho_1}{R_2\rho_2}$

D. $\frac{R_2\rho_1}{R_1\rho_2}$

Answer: C

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16. A man weighs 'W' on the surface of the earth and his weight at a height 'R' from surface of the earth is (R is Radius of the earth)

A. $\frac{W}{4}$

B. $\frac{\circ}{2}$

C. W

D. $4W$

Answer: A

Watch Video Solution

17. The acceleration due to gravity at the latitude 45° on the earth becomes zero if the angular velocity of rotation of the earth is

A. $\sqrt{\frac{2}{gR}}$

B. $\sqrt{2gR}$

C. $\sqrt{\frac{2g}{R}}$

D. $\sqrt{\frac{5R}{2}}$

Answer: C

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18. Acceleration due to gravity on moon is $1/6$ of the acceleration due to gravity on earth. If the ratio of densities of earth $\left(\rho_e\right)$ and moon $\left(\rho_m\right)$ is $\left(\frac{\rho_e}{\rho_m}\right)=\frac{5}{3}$ then radius of moon $\left(R_m\right)$ in terms of R_e will be

A. $\frac{5}{18}R_e$

B. $\frac{1}{6}R_e$

C. $\frac{3}{18}R_e$

D. $\frac{1}{2\sqrt{3}}R_e$

Answer: A

Watch Video Solution

19. The mass of a planet is half that of the earth and the radius of the planet is one fourth that of the earth. If we plan to send an artificial satellite from the planet, the escape velocity will be $\left(V_e = 11kms^{-1}\right)$

A. $11kms^{-1}$

B. $5.5kms^{-1}$

C. $15.55kms^{-1}$

D. $7.78kms^{-1}$

Answer: C

Watch Video Solution

20. If a rocket is fired with a velocity, $V = 2\sqrt{gR}$ near the earth's surface and goes upwards, its speed in the inter-stellar space is

A. $4\sqrt{gR}$

B. $\sqrt{2gR}$

C. $\sqrt{gR}$

D. $\sqrt{4gR}$

Answer: B

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21. A projectile is fired vertically upwards from the surface of the earth with a velocity Kv_e, where v_e is the escape velocity and $K < 1$.If R is the radius of the earth, the maximum height to which it will rise measured from the centre of the earth will be (neglect air resistance)

A. $\frac{1 - K^2}{R}$

B. $\frac{R}{1 - K^2}$

C. $R\left(1 - K^2\right)$

D. $\dfrac{R}{1 + K^2}$

Answer: B

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22. If the radius of the earth shrinks by $0.2\,\%$ without any change in its mass, the escape velocity from the surface of the earth

A. increases by 0.2%

B. decreases by 0.2%

C. increases by 0.1%

D. increases by 0.4%

Answer: C

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23. If d is the distance between the centre of the earth of mass M_1 and the moon of mass M_2, then the velocity with which a body should be projected from the mid point of the line joining the earth and the moon, so that it just escape is

A. $\sqrt{\frac{G(M_1 + M_2)}{d}}$

B. $\sqrt{\frac{G(M_1 + M_2)}{2d}}$

C. $\sqrt{\frac{2G(M_1 + M_2)}{d}}$

D. $\sqrt{\frac{4G(M_1 + M_2)}{d}}$

Answer: D

Watch Video Solution

24. The escape velocity of a planet having mass 6 times and radius 2 times as those of the earth is

A. $\sqrt{3}v_e$

B. $3v_e$

C. $\sqrt{2}v_e$

D. $2v_e$

Answer: A

Watch Video Solution

25. If v_e is the escape velocity of a body from a planet of mass 'M' and radius 'R`. Then the velocity of the satellite revolving at height 'h' from the surface of the planet will be

A. $v_e\sqrt{\frac{R}{R+h}}$

B. $v_e\sqrt{\frac{2R}{R+h}}$

C. $v_e\sqrt{\frac{R+h}{R}}$

D. $v_e\sqrt{\frac{R}{2(R+h)}}$

Answer: D

Watch Video Solution

26. A particle falls towards the earth from inifinity. The velocity with which it reaches the earth is surface is

A. $v = 2gR$

B. $v = \sqrt{2gR}$

C. $v = \sqrt{gR}$

D. $v = R/g$

Answer: B

Watch Video Solution

27. Two satellites P, Q are revolving around the earth in different circular orbits. The velocity of P is twice the velocity of Q. The height of P from the earth's surface is $1600km$. The radius of orbit of Q is $(R = 6400km)$

A. 1600 km

B. 20000 km

C. 32000 km

D. 40000 km

Answer: C

Watch Video Solution

28. A planet is revolving around the sun. its distance from the sun at apogee is r_A and that at perigee is r_p. The masses of planet and sun are 'm' and M respectively, V_A is the velocity of planet at apogee and V_P is at perigee respectively and T is the time period of revolution of planet around the sun, then identify the wrong answer.

A. $I^2 = \frac{\pi^2}{2Gm}\left(r_A + r_P\right)^3$

B. $T^2 = \frac{\pi^2}{2GM}\left(r_A + r_P\right)^3$

C. $v_A r_A = v_P r_P$

D. $v_A < v_P, r_A > r_P$

Answer: A

Watch Video Solution

29. Suppose the gravitational force varies inversely as the nth power of distance. Then the time period of a planet in circular orbit of radius 'R' around the sun will be proportional to

A. $R\left(\frac{n+1}{2}\right)$

B. $R\left(\frac{n-2}{2}\right)$

C. R^n

D. $R\left(\frac{n-1}{2}\right)$

Answer: A

Watch Video Solution

30. An artificial satellite is revolving around the earth in a circular orbit. Its velocity is one-third of the escape velocity. Its height from the earth's surface is (in km)

A. 22400

B. 12800

C. 3200

D. 1600

Answer: A

Watch Video Solution

31. The work done to increases the radius of orbit of a satellite of mass 'm' revolving around a planet of mass M from orbit of radius R into another orbit of radius $3R$ is

A. $\frac{2GMm}{3R}$

B. $\frac{GMm}{3R}$

C. $\frac{GMm}{6R}$

D. $\frac{GMm}{24R}$

Answer: B

Watch Video Solution

32. A stone is dropped from a height equal to nR, where R is the radius of the earth, from the surface of the earth. The velocity of the stone on reaching the surface of the earth is

A. $\sqrt{\frac{2g(n+1)R}{n}}$

B. $\sqrt{\frac{2gR}{n+1}}$

C. $\sqrt{\frac{2gnR}{n+1}}$

D. $\sqrt{2gnR}$

Answer: C

Watch Video Solution

33. Three particles of equal mass 'm' are situated at the vertices of an equilateral triangle of side L. The work done in increasing the side of the triangle to $2L$ is

A. $\frac{2G^2m}{2L}$

B. $\frac{Gm^2}{2L}$

C. $\frac{3Gm^2}{2L}$

D. $\frac{3Gm^2}{L}$

Answer: C

Watch Video Solution

34. A small body is at a distance r from the centre of the mercury, where r is greater than the radius of the mercury. The energy required to shift the body from r to $2r$ measured from the centre is E. The energy required to shift it form $2r$ to $3r$ will be

A. E

B. $\frac{E}{2}$

C. $\frac{E}{3}$

D. $\frac{E}{4}$

Answer: C

Watch Video Solution

35. Escape velocity of a body $1kg$ mass on a planet is $100ms^{-1}$. Gravitational potential energy of the body at that planet is

A. $-5000J$

B. $-1000J$

C. $-2400J$

D. $5000J$

Answer: A

Watch Video Solution

36. By what percent the energy of the satellite has to be increased to shift it from an orbit of radius r to $\frac{3r}{2}$.

A. 66.7%

B. 33.3%

C. 15%

D. 20.3%

Answer: B

Watch Video Solution

37. At what height from the surface of the earth, the total energy of satellite is equal to its potential energy at a height $2R$ from the surface of the earth (R=radius of earth)

A. 2R

B. R/2

C. R/4

D. 4R

Answer: B

Watch Video Solution

38. A geostationary satellite is orbiting the earth at a height of 6R above the surface of the earth, where R is the radius of the earth. The time period of another satellite at a height of 2.5 R from the surface of the earth is ...... hours.

A. $12\sqrt{2}hr$

B. $12hr$

C. $6\sqrt{2}hr$

D. $6hr$

Answer: C

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EXERCISE -II (H.W.)

1. Two satellites S_1 and S_2 are revolving round a planet in coplanar and concentric circular orbit of radii R_1 and R_2 in te same direction respectively. Their respective periods of revolution are 1 hr and 8 hr. the radius of the orbit of satellite S_1 is equal to 10^4km. Find the relative speed in kmph when they are closest.

A. $\frac{\pi}{2} \times 10^4$

B. $\pi \times 10^4$

C. $2\pi \times 10^4$

D. $4\pi \times 10^4$

Answer: B

Watch Video Solution

2. Two metal spheres each of radius r are kept in contact with each other. If d is the density of the material of the sphere,then the gravitational force between those spheres is proportional to

A. d^2r^6

B. d^2r^4

C. $\frac{d^2}{r^4}$

D. $\frac{r^2}{d^2}$

Answer: B

Watch Video Solution

Watch Video Solution

3. Two leads spheres of same radii are in contact with eacth other. The gravitational force of attraction between them is F. If two leads spheres of double the previous radii are in contanct with eacth other, the gravitational force of attraction between them now will be

A. 2F

B. 32F

C. 8F

D. 16F

Answer: D

Watch Video Solution

4. The gravitational force between two bodies is decreased by 36% when the distance between them is increased by $3m$. The initial distance between them is

A. 6m

B. 9m

C. 12m

D. 15m

Answer: C

Watch Video Solution

5. Two particle of masses m and $2m$ are at a distance $3r$ apart at the ends of a straight line AB. C is the centre of mass of the system. The magnitude of the gravitational force on a unit mass placed at C due to the masses is

A. zero

B. $\frac{7Gm}{4r^2}$

C. $\frac{9Gm}{4r^2}$

D. $\frac{3Gm}{2r^2}$

Answer: B

Watch Video Solution

6. If the distance between two bodies is increased by 25%, then the $\%$ change in the gravitational force is

A. decreases by 36%

B. increases by 36

C. increases by 64

D. decreases by 64

Answer: A

Watch Video Solution

7. Three point masses each of mass m rotate in a circle of radius r with constant angular velocity ω due to their mutual gravitational attraction. If at any instant, the masses are on the vertices of an equilateral triangle of side a, then the value of ω is

A. $\sqrt{\frac{Gm}{a^3}}$

B. $\sqrt{\frac{3Gm}{a^3}}$

C. $\sqrt{\frac{Gm}{3a^3}}$

D. zero

Answer: B

Watch Video Solution

8. The angular momentum (L) of the earth revolving round the sun uis proportional to r^n, where r is the orbital radius of the earth. The value of n is (assume the orbit to be circular)

A. $\frac{1}{2}$

B. 1

C. $-\frac{1}{2}$

D. 2

Answer: A

Watch Video Solution

9. Four particles having masses, m, 2m, 3m, and 4m are placed at the four corners of a square of edge a. Find the gravitational force acting on a particle of mass m placed at the centre.

A. $4\sqrt{2}\frac{Gm^2}{a^2}$

B. $\frac{3\sqrt{2}Gm^2}{a^2}$

C. $\frac{2\sqrt{2}Gm^2}{a^2}$

D. $\frac{\sqrt{2}Gm^2}{a^2}$

Answer: A

Watch Video Solution

10. If the radius of the earth is made three times, keeping the mass constant, then the weight of a body on the earth's surface will be as compared to its previous value is

A. one third

B. one ninth

C. three times

D. nine times

Answer: B

Watch Video Solution

11. The difference in the value of g at poles and at a sphere of latitude, 45° is

A. $R\omega^2$

B. $\frac{R\omega^2}{2}$

C. $\frac{R\omega^2}{4}$

D. $\frac{R\omega^2}{3}$

Answer: B

Watch Video Solution

12. The angular velocity of the earth's rotation about its axis is ω. An object weighed by a spring balance gives the same reading at the equator as at height h above the poles. The value of h will be

A. $\frac{\omega^2 R^2}{g}$

B. $\frac{\omega^2 R^2}{2g}$

C. $\frac{2\omega^2 R^2}{g}$

D. $\frac{2\omega^2 R^2}{3g}$

Answer: B

Watch Video Solution

13. The radius and acceleration due to gravity of the moon are $\frac{1}{4}$ and $\frac{1}{5}$ that of the earth, the ratio of the mass of the earth to mass of the moon is

A. $1:80$

B. $80:1$

C. $1:20$

D. $20:1$

Answer: B

Watch Video Solution

14. The difference in the value of g at poles and at a latitude is $\frac{3}{4}R\omega^2$. The latitude angle is

A. 60°

B. 30°

C. 45°

D. 95°

Answer: B

Watch Video Solution

15. A particle hanging from a spring stratches it by $1 cm$ at earth's surface. Radius of the earth is $6400 km$. At a place $800 km$ above the earth's surface, the same particle will stretch the spring by

A. 0.79 cm

B. 1.2 cm

C. 4 cm

D. 17 cm

Answer: A

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Watch Video Solution

16. A tunnel is dug along a diameter of the earth. Find the force on a particle of mass m placed in the tunnel at a distance x from the centre.

A. $\frac{Gm_e m}{R^3}$

B. $\frac{GM_e m}{R^2}$

C. $\frac{GM_e m}{R^3 x}$

D. $\frac{GM_e m R^3}{x}$

Answer: A

Watch Video Solution

17. The mass of the earth is 9 times that of the mars. The radius of the earth twice that of the mars. The escape velocity of the earth is $12 km/s$. The escape velocity on the mars is ....km/s

A. $4\sqrt{2}$ km/sec

B. $2\sqrt{2}$ km/sec

C. $6\sqrt{2}$ km/sec

D. $8\sqrt{2}$ km/sec

Answer: A

Watch Video Solution

18. The escape velocity of a body from the earth is $11.2km/s$. If a body is projected with a velocity twice its escape velocity, then the velocity of the body at infinity is (in km/s)

A. 19.4

B. 194

C. 1.94

D. 0.194

Answer: A

Watch Video Solution

19. A particle is kept at rest at a distance R (earth's radius) above the earth's surface. The minimum speed with which it should be projected so that is does not return is

A. $\sqrt{\frac{GM}{R}}$

B. $\sqrt{\frac{GM}{2R}}$

C. $\sqrt{\frac{GM}{3R}}$

D. $\sqrt{\frac{GM}{4R}}$

Answer: A

Watch Video Solution

20. $16kg$ and $9kg$ are separated by $25m$. The velocity with which a body should be projected from the mid point of the line joining the two masses so that it just escape is

A. $\sqrt{g}$

B. $\sqrt{2gR}$

C. $\sqrt{G}$

D. $2\sqrt{G}$

Answer: D

Watch Video Solution

21. The escape velocity from the earth is about 11 km/s. The escape velocity from a planet having twice the radius and the twice mean density as the earth, is

A. 11

B. $22\sqrt{3}$

C. $33\sqrt{3}$

D. $44\sqrt{3}$

Answer: C

Watch Video Solution

22. The escape velocity for a planet is v_e. A particle starts from rest at a large distance from the planet, reaches the planet only under gravitational attraction, and passes through a smooth tunnel through its centre. Its speed at the centre of the planet will be

A. v_e

B. $\sqrt{1.5}v_e$

C. $1.5v_e$

D. $2v_e$

Answer: B

Watch Video Solution

23. The speed of a satellite that revolves around earth at a height $3R$ from earth's surface is ($g = 10m/s^2$ at the surface of earth, radius of earth $R = 6400km$) in kms^{-1}

A. $2\sqrt{2}$

B. 4

C. $4\sqrt{2}$d

D. 8

Answer: B

Watch Video Solution

24. If an artificial satellite is moving in a circular orbit around earth with speed equal to one fourth of V_e from earth, then height of the satellite above the surface of the earth is

A. 7R

B. 4R

C. 3R

D. R

Answer: A

Watch Video Solution

25. Two satellites A and B go around a planet in circular orbits of radii 4 R and R respectively. If the speed of the satellite A is 3 V, then the speed of the satellite B will be

A. 12V

B. 6V

C. 4V

D. 3V

Answer: B

Watch Video Solution

26. A satellite is moving on a circular path of radius r around earth has a time period T. if its radius slightly increases by Δr, determine the change in its time period.

A. $\frac{3}{2}\left(\frac{T}{r}\right)\Delta r$

B. $\left(\frac{T}{r}\right)\Delta r$

C. $\frac{3}{2}\left(\frac{T^2}{r^2}\right)\Delta r$

D. $\frac{3}{2}\left(\frac{T^2}{r}\right)\Delta r$

Answer: A

Watch Video Solution

27. A satellite is orbiting the earth in an orbit with a velocity $4km/s$, then the acceleration due to gravity at that height is (in ms^{-2})

A. 0.4

B. 0.62

C. 0.87

D. 1.21

Answer: B

Watch Video Solution

28. A stone is dropped from a height equal to $3R$, above the surface of earth. The velocity of stone on reaching the earth's surface is

A. $\sqrt{g\left(\frac{R}{2}\right)}$

B. $\sqrt{\frac{3}{2}gR}$

C. $\sqrt{2gR}$

D. $\sqrt{gR}$

Answer: A

Watch Video Solution

29. If g is the acceleration due to gravity on the earth's surface, the gain in the potential energy of an object of mass m raised from the surface of the earth to a height equal to the radius R of the earth, is

A. 2mgR

B. mgR/4

C. mgR/4

D. mgR/2

Answer: D

Watch Video Solution

30. The work done in bringing three particles each of mass $10g$ from a large distance to the vertices of an equilateral triangle of side $10cm$ is (approximately)

A. $10^{-13}J$

B. $2 \times 10^{-13}J$

C. $4 \times 10^{-13} J$

D. $10^{-11} J$

Answer: B

Watch Video Solution

31. The energy required to shift the body revolving around a planet from r to $2r$ is E. The energy required to shift it from $2r$ to $4r$ is (measured from centre of planet)

A. E

B. $\frac{E}{2}$

C. $\frac{E}{3}$

D. $\frac{E}{4}$

Answer: B

Watch Video Solution

32. By what percent the energy of the satellite has to be increased to shift it from an orbit of radius r to $3r$.

A. $66.7\ \%$

B. 33.3 %

C. 15 %

D. 20.3 %

Answer: A

Watch Video Solution

33. At what height from the surface of the earth, the total energy of satellite is equal to its potential energy at a height $3R$ from the surface of the earth (R=radius of earth)

A. 4R

B. 3R

C. 2R

D. R

Answer: D

Watch Video Solution

34. A point P $\left(R\sqrt{3}m, 0, \right)$ lies on the axis of a ring of mass M and radius R. The ring is located in y - z plane with its centre at origin. A small particle of mass m start from P and reaches O under gravitational attraction only. Its speed at O will be.

A. $\sqrt{\frac{GM}{R}}$

B. $\sqrt{\frac{Gm}{R}}$

C. $\sqrt{\frac{Gm}{\sqrt{2}R}}$

D. $\sqrt{\frac{GM}{\sqrt{2}R}}$

Answer: A

Watch Video Solution

EXERCISE -III

1. The earth is assumed to be a sphere of raduis R. A plateform is arranged at a height R from the surface of the fv_e, where v_e is its escape velocity form the surface of the earth. The value of f is

A. $\sqrt{2}$

B. $\frac{1}{\sqrt{2}}$

C. $\frac{1}{3}$

D. $\frac{1}{2}$

Answer: B

Watch Video Solution

2. The motion of planets in the solar system is an exmaple of the conservation of

A. mass

B. linear momentum

C. energy

D. angular moment

Answer: D

Watch Video Solution

3. Two satellite are revolving around the earth with velocities v_1 and v_2 and in radii r_1 and $r_2\left(r_1 > r_2\right)$ respectively. Then

A. $v_1 = v_2$

B. $v_1 > v_2$

C. $v_1 < v_2$

D. $\frac{V_1}{r_1} = \frac{V_2}{r_2}$

Answer: C

Watch Video Solution

4. Two satellites of earth S_1 and S_2 are moving in the same orbit. The mass of S_1 is four times the mass of S_2. Which one of the following statements is true?

A. The period of S_1 is four times that of S_2

B. The potential energies of earth and satellite in the two cases are equal

C. S_1 and S_2 are moving with the same speed

D. The kinetic energies of the two satellites are equal

Answer: C

Watch Video Solution

5. An asteroid of mass m is approaching earth, initially at a distance $10R_E$ with speed v_i. It hits earth with a speed v_f (R_E and M_E are radius and mass of earth),. Then

A. $v_f^2 = v_i^2 + \frac{2Gm}{M_e R}\left(1 - \frac{1}{10}\right)$

B. $v_f^2 = v_i^2 + \frac{2GM_e}{R_e}\left(1 + \frac{1}{10}\right)$

C. $v_f^2 = v_i^2 + \frac{2GM_e}{R_e}\left(1d - \frac{1}{10}\right)$

D. $v_f^2 = v_i^2 + \frac{2Gm}{R_e}\left(1 - \frac{1}{10}\right)$

Answer: C

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6. imagine a new planet having the same density as that of earth but it is 3 times bigger than the earth is size. If the acceleration due to gravity on the surface of earth is g and that on the surface of the new planet is g', then find the relation between g and g'.

A. $g' = 3g$

B. $g' = \frac{g}{9}$

C. $g' = 9g$

D. $g' = 27g$

Answer: A

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7. A roller coaster is designed such that riders experience "weightlessness" as they go round the top of a hill whose radius of curvature is $20m$. The speed of the car at the top of the hill is between

A. 14m/s and 15m/s

B. 15m/s and 16m/s

C. 16m/s and 17 m/s

D. 13 m/s and 14 m/s

Answer: A

Watch Video Solution

8. Two bodies of mass m_1 and m_2 are initially at rest placed infinite distance apart. They are then allowed to move towards each other under mutual gravitational attaction. Show that their relative velocity of approach at separation r betweeen them is

$$v = \frac{\sqrt{2G\left(m_1 + m_2\right)}}{r}$$

A. $\left[2G\frac{\left(m_1 - m_2\right)}{r}\right]^{1/2}$

B. $\left[\frac{r}{2G\left(m_1 m_2\right)}\right]^{1/2}$

C. $\left[\frac{2G}{r}(m_1 + m_2)\right]^{1/2}$

D. $\left[\frac{2G}{r}m_1m_2\right]^{1/2}$

Answer: C

Watch Video Solution

9. For a satellite moving in an orbit around the earth, ratio of kinetic energy to potential energy is

A. 2

B. $\frac{1}{2}$

C. $\frac{1}{\sqrt{2}}$

D. $\sqrt{2}$

Answer: B

Watch Video Solution

10. Acceleration due to gravity on moon is $1/6$ of the acceleration due to gravity on earth. If the ratio of densities of earth (ρ_e) and moon (ρ_m) is $\left(\frac{\rho_e}{\rho_m}\right) = \frac{5}{3}$ then radius of moon (R_m) in terms of R_e will be

A. $\frac{5}{18}R_e$

B. $\frac{1}{6}R_e$

C. $\frac{3}{18}R_e$

D. $\frac{1}{2\sqrt{3}}R_e$

Answer: A

Watch Video Solution

11. The radii of circular orbits of two satellite A and B of the earth are $4R$ and R, respectively. If the speed of satellite A is $3v$, then the speed of satellite B will be

A. $\frac{3v}{4}$

B. $6v$

C. $12v$

D. $\frac{3v}{2}$

Answer: B

Watch Video Solution

12. A particle of mass M is situated at the centre of a spherical shell of same mass and radius 'a'. The gravitational potential at a point situated at $\frac{a}{2}$ distance from the centre, will be

A. $-\frac{3GM}{a}$

B. $-\frac{2GM}{a}$

C. $-\frac{GM}{a}$

D. $-\frac{4GM}{a}$

Answer: A

Watch Video Solution

13. If the value of g at the surface of the earth is $9.8 m/\sec^2$, then the value of g at a place 480 km above the surface of the earth will be (Radius of the earth is 6400 km)

A. $8.4 m/s^2$

B. $9.8 m/s^2$

C. $7.2 m/s^2$

D. $4.2 m/s^2$

Answer: A

Watch Video Solution

14. A satellite orbiting the circular orbit of radius R complete one revolution in $3h$. If orbital radius of geostationary satellite is $36000km$, then the orbital radius R of satellite is

A. 6000 km

B. 9000 km

C. 12000 km

D. 15000 km

Answer: B

Watch Video Solution

15. A plenet moving along an elliptical orbit is closest to the sun at a distance r_1 and farthest away at a distance of r_2. If v_1 and v_2 are the linear velocities at these points respectively, then the ratio $\frac{v_1}{v_2}$ is

A. $\frac{r_2}{r_1}$

B. $\left(\frac{r_2}{r_1}\right)^2$

C. $\frac{r_1}{r_2}$

D. $\left(\frac{r_1}{(r_2)^2}\right)$

Answer: A

Watch Video Solution

16. A particle of mass m is thrown upwards from the surface of the earth, with a velocity u. The mass and the radius of the earth are, respectively, M and R. G is gravitational constant g is acceleration due to gravity on the surface of earth. The minimum value of u so that the particle does not return back to earth is

A. $\sqrt{\frac{2GM}{R}}$

B. $\sqrt{\frac{2GM}{R^2}}$

C. $\sqrt{2gR^2}$

D. $\sqrt{\frac{4GM}{R^2}}$

Answer: A

Watch Video Solution

17. The gravitational potential energy of a body of mass ' m ' at the earth's surface $-mgR_e$. Its gravitational potential energy at a height R_e from the earth's surface will be (Here R_e is the radius of the earth)

A. $-2mgR_e$

B. $2mgR_e$

C. $\frac{1}{2}mgR_e$

D. $-\frac{1}{2}mgR_e$

Answer: D

18. The height a which the weight of a body becomes $1/16th$ its weight on the surface of earth (radius R) is

A. 4R

B. 5R

C. 15R

D. 3R

Answer: D

Watch Video Solution

19. A spherical planet far out in space has a mass M_0 and diameter D_0. A particle of mass m falling freely near the surface of this planet will experience an accelertion due to gravity which is equal to

A. $4GM_P m/D_P^2$

B. $4GM_P/D_P^2$

C. $GM_P m/D_P^2$

D. GM_P/D_P^2

Answer: B

Watch Video Solution

20. A geostationary satellite is orbiting the earth at a height of $5R$ above the surface of the earth, $2R$ being the radius of the earth. The time period of another satellite in hours at a height of $2R$ form the surface of the earth is

A. $\frac{6}{\sqrt{2}}$

B. 5

C. 10

D. $6\sqrt{2}$

Answer: D

Watch Video Solution

21. If v_e is escape velocity and v_0, is orbital velocity of satellite for orbit close to the earth's surface. Then are related by

A. $v_0 = \sqrt{2}v_e$

B. $v_0 = v_e$

C. $v_e = \sqrt{2v_0}$

D. $v_e = \sqrt{2}v_0$

Answer: D

Watch Video Solution

22. Which one of the following plots represents the variation of the gravitational field on a particle with distance r due to a thin spherical shell of raduis R? (r is measured from the centre of the spherical shell).

A.

B.

C.

D.

Answer: B

Watch Video Solution

23. An artificial satellite moving in circular orbit around the earth has total (kinetic + potential) energy E_0. Its potential energy and kinetic energy respectively are :

A. $-E_0$

B. $1.5E_0$

C. $2E_0$

D. E_0

Answer: C

Watch Video Solution

24. A lauching vehicle carrying an artificial satellite of mass m is set for launch on the surface of the earth of mass M and radius R. If the satellite intended to move in a circular orbit of radius $7R$, the minimum energy required to be spent by the launching vehicle on the satellite is

A. $\frac{GMm}{R}$

B. $-\frac{13GMm}{14R}$

C. $\frac{GMm}{7R}$

D. $-\frac{GMm}{14R}$

Answer: B

Watch Video Solution

25. A body of mass m taken form the earth's surface to the height is equal to twice the radius (R) of the earth. The change in potential energy of body will be

A. $mg2R$

B. $\frac{2}{3}mgR$

C. $3mgR$

D. $\frac{1}{3}mgR$

Answer: A

Watch Video Solution

26. Infinite number of bodies, each of mass $2kg$, are situated on x-axis at distance $1m, 2m, 4m, 8m$......... respectively, from the origin. The resulting gravitational potential the to this system at the origing will be

A. $-G$

B. $-\frac{8}{3}G$

C. $-\frac{4}{3}G$

D. $-4G$

Answer: D

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27. The value of ' g ' at a particular point is $9.8m/s^2$. Suppose the earth suddenly shrinks uniformly to half its present size without losing any mass. The value of ' g ' at the same point (assuming that the distance of the point from the centre of earth does not shrink) will now be

A. $9.8ms^{-2}$

B. $4.9ms^{-2}$

C. $19.6ms^{-2}$

D. $39.2ms^{-2}$

Answer: A

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28. The escape velocity for the earth is 11.2 km / sec . The mass of another planet is 100 times that of the earth and its radius is 4 times that of the earth. The escape velocity for this planet will be

A. 280 km/s

B. 56.0 km/s

C. 112 km/s

D. 66 km/s

Answer: B

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29. a projectile is fired from the surface of the earth with a velocity of $5ms^{-1}$ and angle θ with the horizontal. Another projectile fired from another planet with a velocity of $3ms^{-1}$ at the same angle follows a trajectory which is identical with the trajectory of the projectile fired from the earth.The value of the acceleration due to gravity on the planet is in ms^{-2} is given $\left(g = 9.8ms^{-2}\right)$

A. 3.5

B. 5.9

C. 16.3

D. 110.8

Answer: A

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30. A black hole is an object whose gravitational field is so strong that even light cannot escape from it. To what approximate radius would earth (mass $= 5.98 \times 10^{24} kg$) have to be compressed to be a black hole?

A. $10^{-9} m$

B. $10^{-6} m$

C. $10^{-2} m$

D. $100 m$

Answer: C

31. Dependence of intensity of gravitational field (E) of earth with distance (r) from centre of earth is correctly represented by

A.

B.

C.

D.

Answer: A

32. The orbital velocity of an artifical satellite in a circular orbit just above the earth's surface is V_0. For a satellite orbiting at an altitude of half of earth's radius, the orbital velocity is

A. $\frac{3}{2}v$

B. $\sqrt{\frac{3}{2}}v$

C. $\sqrt{\frac{2}{3}}v$

D. $\frac{2}{3}v$

Answer: C

Watch Video Solution

33. Change in acceleration due to gravity is same upto a height h from the surface of the earth and below the surface at a depth x, then relation between x and h is (h and $x < \, < \, < R$)

A. $x = h$

B. $x = 2h$

C. $x = \frac{h}{2}$

D. $x = h^2$

Answer: B

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34. Kepler's third law states that square of period revolution (T) of a planet around the sun is proportional to third power of average distance i between sun and planet i.e. $T^2 = Kr^3$

here K is constant

if the mass of sun and planet are M and m respectively then as per Newton's law of gravitational the force of alteaction between them is $F = \frac{GMm}{r^2}$, here G is gravitational constant. The relation between G and K is described as

A. $GK = 4\pi^2$

B. $GMK = 4\pi^2$

C. $K = G$

D. $K = \frac{1}{G}$

Answer: B

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35. Two spherical bodies of mass M and 5M & radii R & 2R respectively are released in free space with initial separation between their centres equal to 12R. If they attract each other due to gravitational force only, then the distance covered by the smallar body just before collision is

A. 2.5 R

B. 4.5 R

C. 7.5 R

D. 1.5 R

Answer: C

Watch Video Solution

36. A satellite S is moving in an elliptical orbit around the earth. The mass of the satellite is very small compared to the mass of the earth.

A. The acceleration of S is always directed towards the centred of the earth.

B. the angular momentum of S about the centre of te earth changes in direction, but its magnitude remains constant

C. the total mechanical energy of S varies periodcally with time

D. the linear momentum of S remains constnat in magnitude

Answer: A

Watch Video Solution

37. A remote-sensing satellite of earth revolves in a circular orbit at a hight of $0.25 \times 10^6 m$ above the surface of earth. If earth's radius is

$6.38 \times 10^6 m$ and $g = 9.8 ms^{-2}$, then the orbital speed of the satellite is

A. $6.67 kms^{-1}$

B. $7.76 kms^{-1}$

C. $8.56 kms^{-1}$

D. $9.13 kms^{-1}$

Answer: B

Watch Video Solution

38. Given raduis of earth $'R'$ and length of a day $'T'$ the height of a geostationary satellite is [G-Gravitational constant M-mass of earth]

A. $\left(\frac{4\pi^2GM}{T^2}\right)^{1/3}$

B. $\left(\frac{4\pi GM}{R^2}\right)^{1/3}$ - R

C. $\left(\frac{GMT^2}{4\pi^2}\right)^{1/3}$ - R

D. $\left(\frac{GMT^2}{4\pi^2}\right)^{1/3}$ + R

Answer: C

Watch Video Solution

39. A uniform ring of mas m and radius a is placed directly above a uniform sphere of mass M and of equal radius. The centre of the ring is at a distance $\sqrt{3}$ a from the centre of the sphere. Find the gravitational force exerted by the sphere on the ring.

A. $\dfrac{\sqrt{3}GMm}{8a^2}$

B. $\dfrac{2GMm}{3a^2}$

C. $\dfrac{7GMm}{\sqrt{2}a^2}$

D. $\frac{3GMm}{a^2}$

Answer: A

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40. The ratio of escape velocity at earth (v_e) to the escape velocity at a planet (v_y) whose radius and density are twice

A. $1:\sqrt{2}$

B. $1:2$

C. $1:2\sqrt{2}$

D. $1:4$

Answer: C

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41. The escape velocity from the earth is about 11 km/s. The escape velocity from a planet having twice the radius and the twice mean density as the earth, is

A. $22 kms^{-1}$

B. $11 kms^{-1}$

C. $5.5 kms^{-1}$

D. $15.5 kms^{-1}$

Answer: A

Watch Video Solution

42. A body of mass 2 m is placed one earth's surface. Calculate the change in gravitational potential energy, if this body is taken from earth's surface to a height of h, where h=4R.

A. $\frac{2mgh}{R}$

B. $\frac{2}{3}mgR$

C. $\frac{8}{5}mgR$

D. $\frac{mgR}{2}$

Answer: C

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EXERCISE -IV

1. The earth is an approximate sphere. If the interior contained matter which is not of the same density every where, then on the surface of the earth, the acceleration due to gravity

A. will be directed towards the centre but not the same every where

B. will have the same value every but not directied towards the centre

C. will be same everywhere in magnitude directed towards the centre

D. Cannot be zero at any point.

Answer: A

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2. Different points in the earth are at slightly different distance from the sun and hence experience different force due to gravitation. For a rigid body, we know that if various forces act at various points in it, the resultant motion is as if a net force acts on the CM (centre of mass) causing translation and a net torque at the CM causing rotation around an axis through the CM. for the earth-sun system (approximating the earth as a uniform density sphere).

A. the torque is zero

B. the torque causes the earth to spin

C. the rigid body result is not applicable since the earth is not even approximately a rigid body

D. the torque causes the earth to move around the sun

Answer: B

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3. Satellites orbiting the earth have finite life and sometimes debris of satellites fall to the earth. This is because,

A. The solar cels and batteries in satellites run out

B. the laws of gravitation predict a trajectory spiralling inwards.

C. of viscous forces causing the speed of satellite and hence height to gradually decrease

D. of collisions with other satellites

Answer: C

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4. Particles of masses 2M, m and M are respectively at points A, B and C with AB=1/2(CB). M is much -much smaller than M and at time t =0, they are at rest as given in figure.

At subsequent times before any collision takes place

A. m will remain at rest

B. m will move towards M

C. m will move towards 2M

D. m will hve oscillatory motion

Answer: C

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5. A point mass is orbiting a significant mass M lying at the focus of the elliptical orbit having major and minor axes given by 2 a and 2b respectively. Let r be the distance between the mas M and the end point of major or axis. Velocity of the particle can be given as

A. $\frac{ab}{r}\sqrt{\frac{GM}{a^3}}$

B. $\frac{ab}{r}\sqrt{\frac{GM}{b^3}}$

C. $\frac{ab}{2r}\sqrt{\frac{GM}{r^3}}$

D. $\frac{2ab}{r}\sqrt{\frac{GM}{\left(\frac{a+b}{2}\right)^3}}$

Answer: A

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6. A planet of mass m revolves in elliptical orbit around the sun of mass M so that its maximum and minimum distance from the sun equal to r_a and r_p respectively. Find the angular momentum of this planet relative to the sun.

A. $L = m\sqrt{\frac{GMr_p r_a}{\left(r_p + r_a\right)}}$

B. $L = m\sqrt{\frac{2GM_p r_a}{\left(r_p + r_a\right)}}$

C. $L = M\sqrt{\frac{Gm_p r_a}{\left(r_p + r_a\right)}}$

D. $L = M\sqrt{\frac{\left(r_p + r_a\right)}{Gmr_p r_a}}\Big)$

Answer: B

Watch Video Solution

7. A planet revolves around the sun in elliptical orbit of eccentricity 'e'. If 'T' is the time period of the planet then the time spent by the planet between the end of the minor axis and close to the sun is

A. $T\frac{1}{4} - \frac{e}{2\pi}$

B. $\frac{Te}{\pi}$

C. $\left(\frac{e}{\pi - 1}\right)$

D. $\frac{\pi T}{e}$

Answer: A

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8. The gravitational field in a region is given by $\vec{E} = \left(3\hat{i} - 4\hat{j}\right)Nkg^{-1}$. Find out the work done (in joule) in displacing a particle by $1m$ along the line $4y = 3x + 9$.

A. 3J

B. 4J

C. 0J

D. 2J

Answer: C

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9. A solid sphere of uniform density and mas M has radius 4M. Its centre is at the origin of the coordinate system. Two speres of radii 1 m are taken out so tht their centres are at $P(0, -2, 0)$ and $Q(0, 2, 0)$ respectively. This leaves two sphericla cavities. What is the gravitational field at the origin of the coordinate axes?

A. $\frac{31GM}{1024}$

B. $\frac{GM}{1024}$

C. $31GM$

D. zero

Answer: D

View Text Solution

10. A point P lies on the axis of a fixed ring of mass M and radius R, at a distance $2R$ from its centre O. A small particle starts from P and reaches O under gravitational attraction only. Its speed at O will be

A. zero

B. $\sqrt{\frac{2GM}{R}}$

C. $\sqrt{\frac{2GM}{R}\left(\sqrt{5}-1\right)}$

D. $\sqrt{\frac{2GM}{R}\left(1-\frac{1}{\sqrt{5}}\right)}$

Answer: D

Watch Video Solution

11. Two having masses M and 2M, respectively, having the same radius R are placed coaxially as shown in the figure. If the mass distribution on both the rings is non uniform, then the gravitational potential at point P is

A. $\frac{-GM}{R}\left[\frac{1}{\sqrt{2}}+\frac{2}{\sqrt{4}}\right]$

B. $\frac{-GM}{R}\left[1+\frac{2}{2}\right]$

C. zero

D. cannot be determined from the given information

Answer: A

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12. A point of mass m is released from rest at a distance of 3R from the cente of a then walled hollow spehre of radius R and mass M as shown.

The hollow sphere is fixed in position and the motion is due to only gravitational attraction of the hollow sphere. There is a very small hole in the hollow sphere through which the point mass falls as shown. Then the velocity of point mas when it passes through point P at distance R/2 from the centre of the sphere is

A. $\sqrt{\frac{2GM}{3R}}$

B. $\sqrt{\frac{5GM}{3R}}$

C. $\sqrt{\frac{25GM}{24R}}$

D. $\sqrt{\frac{4GM}{3R}}$

Answer: D

View Text Solution

13. A small body of superdense material, whose mass is twice the mass of the earth but whose size is very small compared to the size of the earth, starts form rest at a height $H < < R$ above the earth's surface, and reaches the earth's surface in time t. then t is equal to

A. $\sqrt{2H/g}$

B. $\sqrt{H/g}$

C. $\sqrt{2H/3g}$

D. $\sqrt{4H/3g}$

Answer: C

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14. From a solid sphere of mass m and radius R, a spherical portion of raidus R/2 is removed, as shown in the figure. Taking gravtitational potential V=0 at $r = 0$, the potential at the centre of the cavity thus formed is (G=Gravitational constant).

A. $\frac{-GM}{2R}$

B. $\frac{-GM}{R}$

C. $\frac{-2GM}{3R}$

D. $\frac{-2GM}{R}$

Answer: B

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15. The density of the core of a planet is ρ_1 and that of the outer shell is ρ_2. The radii of the core and that of the planet are R and 2R respectively. The acceleration due to gravity at the surface of the planet is same as at a depth R. The ratio of denisty ρ_1/ρ_2 will be

A. $\frac{7}{3}$

B. $\frac{5}{3}$

C. $\frac{8}{3}$

D. $\frac{1}{3}$

Answer: A

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16. Two concnetric shells of different masses m_1 and m_2 are having a sliding particle of mass m. The forces on the particle at position I, II and II are

A. $0, \frac{Gm_1}{r_2^2}, \frac{G(m_1 + m_2)m}{r_1^2}$

B. $\frac{Gm_2}{r_2^2}, 0, \frac{Gm_1}{r_1^2}$

C. $\frac{G(m_1+m_2)m}{r_1^2}, \frac{Gm_2}{r_2^2}, 0$

D. $\frac{G(m_1+m_2)m}{r_1^2}, \frac{G(m_2)m}{r_2^2}, 0$

Answer: D

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17. Suppose a vertical tunnel is dug along the diameter of earth assumed to be a sphere of uniform mass having density ρ. If a body of mass m is a dropped in this tunnel, its acceleration at a distance y from the centre is given by

A. $\frac{4\pi}{3} G\rho y m$

B. $\frac{3}{4} \pi G\rho y$

C. $\frac{4}{3} \pi \rho y$

D. $\frac{4}{3} \pi G\rho y$

Answer: D

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18. The centres of a ring of mass m and a sphere of mass M of equal radius R, are at a distance $\sqrt{8}$ R apart as shwon in fig. The force of attraction between the ring and the sphere is

A. $\frac{2\sqrt{2}}{27}\frac{GmM}{R^2}$

B. $\frac{GmM}{8R^2}$

C. $\frac{GmM}{9R^2}$

D. $\frac{\sqrt{2}}{9}\frac{GmM}{9R^2}$

Answer: A

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19. A mass m extends a vertical helical spring of spring constant k by xm at the surface of the earth. Extension in spring by the same mass at height h meter above the surface of the earth is

A. $\frac{Gmm}{k(R+h)}$

B. $\frac{GMm}{kR^2}$

C. $\frac{(R+h)^2}{R^2}x$

D. $\frac{R^2}{(R+h)^2}x$

Answer: D

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20. A spherical shell is cut into two pieces along a chord as shown in the figure. P is point on the plane of the chord. The gravitational field at P due to the upper part is I_1 and that due to the lower part is I_2.What is the relation between them?

A. $I_1 > I_2$

B. $I_1 < I_2$

C. $I_1 = I_2$

D. no definite relation

Answer: C

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21. The magnitudes of the gravitational field at distance r_1 and r_2 from the centre of a uniform sphere of radius R and mass M are E_1 and E_2 respectively. Then:

A. $\frac{E_1}{E_2} = \frac{r_1}{r_2}$ ir $r_1 < R$ and $r_2 < R$

B. $\frac{E_1}{E_2} = \frac{r_2^2}{r_1^2}$ if $r_1 < R$ and $r_2 < R$

C. $\frac{E_1}{E_2} = \frac{r_1^3}{r_2^3}$ if $r_1 < R$ and $r_2 < R$

D. $\frac{E_1}{E_2} = \frac{r_1^2}{r_2^2}$ ir $r_1 < R$ and $r_2 < R$

Answer: A

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22. Gravitational field intensity at the centre of the semi circle formed by a thin wire AB of mass m and length L is

A. $\frac{Gm^2}{L^2}(\hat{i})$

B. $\frac{Gm^2}{\pi L^2}(\hat{j})$

C. $\frac{2\pi Gm}{L^2}(\hat{i})$

D. $\frac{2\pi Gm}{L^2}(\hat{j})$

Answer: D

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23. Two equal masses each m are hung from a balance whose scale pans differ in vertical height by h. The error in weighing is

A. $\pi G\rho mh$

B. $\frac{1}{3}G\rho mh$

C. $\frac{8}{3}\pi G\rho mh$

D. $\frac{4}{3}\pi G\rho mh$

Answer: C

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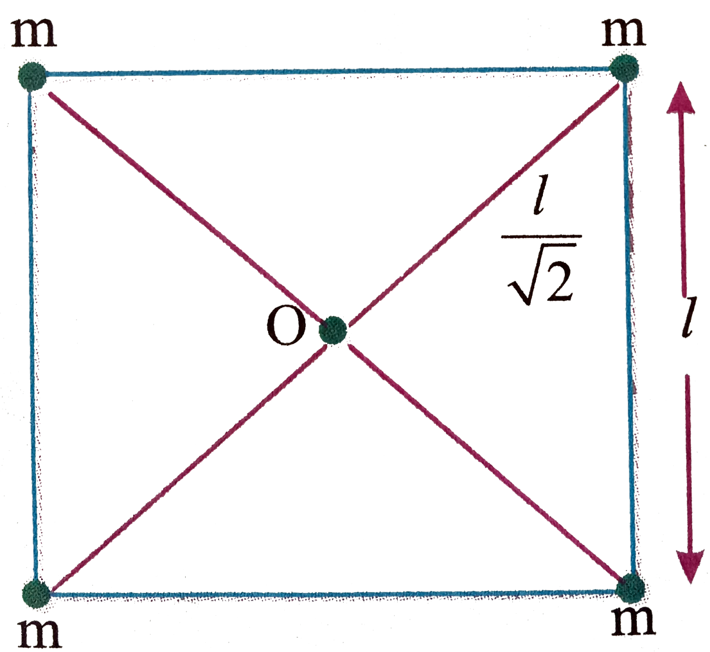
24. Find the gravitational potential energy of a system of four particles, each of mass m placed at the verticles of a square of side l. Also obtain the gravitaitonal potential at centre of the square.



A. $-\sqrt{32}\frac{GM}{L}$

B. $-\sqrt{64}\frac{GM}{L^2}$

C. zero

D. $-\sqrt{16}\frac{GM}{L}$

Answer: A

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25. A thin uniform annula disc (see figure) of mass M has outer radius 4R and inner radius 3R. The work required to take a unit mass from point P on its axis on infinity is

A. $\frac{2GM}{7R}\left(4\sqrt{2} - 5\right)$

B. $-\frac{2GM}{7R}\left(4\sqrt{2} - 5\right)$

C. $\frac{GM}{2R}$

D. $\frac{2GM}{5R}\left(\sqrt{2} - 1\right)$

Answer: A

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26. The gravitational force in a region is given by,

$\vec{F} = may\hat{i} + \max\hat{j}$ The work done by gravitational force to shift a point mass m from $(0, 0, 0)$ is $\left(x_0, y_0, z_0\right)$ is

A. $\max 0y_0z_0$

B. $\max 0x_0y_0$

C. - $\max 0y_0$

D. zero

Answer: B

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27. The gravitational field in a region due to a certain mass distribution is given by $\vec{E} = \left(4\hat{i} - 3\hat{j}\right)N/kg$. The work done by the field in moving a particle of mass $2kg$ from $(2m, 1m)$ to $\left(\frac{2}{3}m, 2m\right)$ along the line $3x + 4y = 10$ is

A. $-\frac{25}{3}N$

B. $-\frac{50}{3}N$

C. $\frac{25}{3}N$

D. zero

Answer: B

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28. A particle of mass $1kg$ is placed at a distance of $4m$ from the centre and on the axis of a uniform ring mass $5kg$ and radius $3m$. The work done to increase the distance of the particle from $4m$ to $3\sqrt{3}$m is

A. $\frac{G}{3}J$

B. $\frac{G}{4}J$

C. $\frac{G}{5}J$

D. $\frac{G}{6}j$

Answer: D

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29. Consider two configuration in fig (i) and fig (ii)

The work done by external agent in changing the configuration from fig (i) to fig (ii) is

A. zero

B. $-\frac{6Gm^2}{a}\left(1+\frac{1}{\sqrt{2}}\right)$

C. $-\frac{6Gm^2}{a}\left(1-\frac{1}{\sqrt{2}}\right)$

D. $\frac{6Gm^2}{a}\left(\frac{21}{\sqrt{2}}\right)$

Answer: C

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30. Two concentric sphereical shells A and B of radii R and 2R and masses 4 M and M respectively are as shown. The gravitational potential at pont p at distance $r(R < r < 2R)$ from centre of shell is $(r = 1.5R)$

A. - $\dfrac{4GM}{R}$

B. - $\dfrac{9GM}{2R}$

C. - $\dfrac{4GM}{3R}$

D. - $\dfrac{19GM}{6R}$

Answer: D

View Text Solution

31. A particle is placed in a field characterized by a value of gravitational potential given by $V = -kxy$

, where k is a constant. If $\vec{E}_g$ is the gravitational field then

A. $\vec{E}_g = k\left(x\hat{i} + y\hat{j}\right)$ and is conservation in nature

B. $\vec{E}_g = k\left(y\hat{i} + x\hat{j}\right)$ and is conservation in nature

C. $\vec{E}_g = k\left(x\hat{i} + y\hat{j}\right)$ and is non conservation in nature

D. $\vec{E}_g = k\left(y\hat{i} + x\hat{j}\right)$ and is non conservatiion in nature

Answer: B

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32. In a certain region of space, the gravitational field is given by $-\frac{k}{r}$ where r is the distance and k is a constant. If the gravitaional potential at $r = r_0$ be V_0, then what is the expression for the gravitaional potential (V)-

A. $k\text{In}\left(r/r_0\right)$

B. $k\text{In}\left(r_0/r\right)$

C. $V_0 k \text{in}(r/r_0)$

D. $V_0 + k\text{In}(r_0/r)$

Answer: C

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33. Graviational acceleration on the surface of plane fo $\frac{\sqrt{6}}{11}g.$ where g is the gracitational acceleration on the surface of the earth. The average mass density of the planet is $\frac{2}{3}$ times that of the earth. If the escape speed on the surface of the earht is taken to be $11 kms^{-1}$ the escape speed on teh surface of the planet in kms^{-1} will be

A. 3

B. 2

C. 9

D. 12

Answer: A

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34. A spherically symmetric gravitational system of particles has a mass density

$$\rho = \begin{cases} \rho_0 & \text{for } r < R \\ 0 & \text{for } r > R \end{cases}$$ where ρ_0 is a constant.

A test mass can undergo circular motion under the influence of the gravitational field of particles. Its speed v as a function of distahce $r(0 < r < OO)$ form the centre of the system is represented by

A.

B.

C.

D.

Answer: C

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35. A satellite is moving with a constant speed 'V' in a circular orbit about the earth. An object of mass 'm' is ejected from the satellite such that it just escapes form the gravitational pull of the earth. At the tme of its ejection, the kinetic energy of the object is

A. $\frac{1}{2}mv^2$

B. mv^2

C. $\frac{3}{2}mv^2$

D. $2mv^2$

Answer: B

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36. If earth were to rotate on its own axis such that the weight of a person at the equator becomes half the weight at the poles, then its time period of rotation is (g = acceleration due to gravity near the poles and R is the radius of earth) (Ignore equatorial bulge)

A. $2\pi\sqrt{\frac{2R}{g}}$

B. $2\pi\sqrt{\frac{R}{2g}}$

C. $2\pi\sqrt{\frac{R}{3g}}$

D. $2\pi\sqrt{\frac{R}{g}}$

Answer: A

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37. Two identical thin ring each of radius R are co-axially placed at a distance R. If the ring have a uniform mass distribution and each has mass m_1

and m_2 respectively, then the work done in moving a mass m from the centre of one ring to that of the other is :

A. zero

B. $\frac{Gm(m_1 - m_2)(\sqrt{2} - 1)}{\sqrt{2}R}$

C. $\frac{Gm\sqrt{2}(m_1 + m_2)}{R}$

D. $\frac{Gm_1m(\sqrt{2} + 1)}{m_2R}$

Answer: B

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38. Two bodies of masses m and M are placed at distance d apart. The gravitational potential (V) at the position where the gravitational field due to them is zero V is

A. $V = -\frac{G}{d}(m+M)$

B. $V = -\frac{Gm}{d}$

C. $V = -\frac{GM}{d}$

D. $V - \frac{G}{d}\left(\sqrt{m}+\sqrt{M}\right)^2$

Answer: D

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39. An asteroids as moving towards a planet of mass M and radius R,from a large distance with intial speed v_0 and impact parameter d as shown in the figure. The minimum value of v_0 such that the asteriod does not his the planet is

A. $\sqrt{\frac{2GMR}{d^2 - R^2}}$

B. $\sqrt{\frac{4GMr}{d^2 - R^2}}$

C. $\sqrt{\frac{2GMR}{d^2 + R^2}}$

D. $\sqrt{\frac{4GMR}{d^2 + Rr^2}}$

Answer: A

View Text Solution

40. A satellite is revolving in a circular orbit at a height 'h' from the earth's surface (radius of earth R, $h << R$). The minimum increase in its orbital velocity required, so that the satellite could escape from the earth's gravitational field, is close to :(Neglect the effect of atmosphere.)

A. $\sqrt{2gR}$

B. $\sqrt{gR}\left(\sqrt{2} - 1\right)$

C. $\sqrt{gR/2}$

D. $\sqrt{gR}$

Answer: B

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