PHYSICS

BOOKS - PRADEEP PHYSICS (HINGLISH)

GRAVIATION

Sample Problem

1. The time period of jupiter is 11.6 years, how far is jupiter from the sun. Distance of earth from the sun is $1.5 \times 10^{11} m$.

A. $4 \times 10^{11} m$

B. $7.68 \times 10^{11} m$

C. $9.11 \times 10^{11} m$

D. $2 \times 10^{11} m$

Answer: B

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2. The time period of a satellite of earth is 8 hours. If the separation between the earth and the satellite is increased to two times the previous value, find the new time period of the satellite.

A. $16\sqrt{2}h$

B. $8h$

C. $16h$

D. $10h$

Answer: A

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3. A sphere of mass $40kg$ is attracted by a second sphere of mass $15kg$, when their centres are $20cm$ apart, with a force of 0.1 miligram weight. Caculate the value of gravitational constant.

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4. The radius of the moon is $1.7 \times 10^6 m$ and its mass is $7.4 \times 10^{22} kg$. If $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$, find the value of acceleration due to gravity on the surface of moon.

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5. Assuming the earth of to be a uniform sphere of radius $6400kg$ and density $5.5g/c.c.$, find the value of g on its surface. $G = 6.66 \times 10^{-11} Nm^2 kg^{-2}$

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6. How much above the surface of earth does the acceleration due to gravity reduces by $64\,\%$ of its value on the earth. Radius of earth $= 6400km.$

A. $5.71 \times 10^6 m$

B. $1.22 \times 10^6 m$

C. $11 \times 10^6 m$

D. $4.27 \times 10^6 m$

Answer: D

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7. 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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8. Determine the speed with which the earth have to roate on its axis so that a person on the equator would weigh $2/5th$ as much as at present. Take the equatorial radius as $6400km$.

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9. On a planet whose size is the same and mass four times as that of our earth, find the amount of work done to lift $3kg$ mass vertically upwards through $3m$ distance on the planet. The value of g on the surface of earth is $10ms^{-2}$

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10. The distance between the moon and earth is $3.8 \times 10^8 m$. Find the gravitional potential at the mid point of the joining them. Given

that the mass of the earth is $6 \times 10^{24} kg$, mass of moon $= 7.4 \times 10^{22} kg$ and $G = 6.67 \times 10^{11} Nm^2 kg^{-2}$.

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11. The distance between earth and moon is $3.8 \times 10^8 m$. Determine the gravitational potential energy of earth-moon system. Given, mass of the earth $= 6 \times 10^{24} kg$, mass of moon $= 7.4 \times 10^{22} kg$ and $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$

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

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13. An artificial satellite revolves round the earth at a height of $1000km$. The radius of the earth is $6.38 \times 10^3 km$. Mass of the earth $6 \times 10^{24} kg$, $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$. Find the orbital speed and period of revolution of the satellite.

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14. A satellite orbits the earth at a height of $3.6 \times 10^6 m$ from its surface. Compute it's a kinetic energy, b. potential energy, c. total energy. Mass of the satellite $= 500kg$ mass of the earth $= 6 \times 10^{24}$ kg, radius of the earth $= 6.4 \times 10^6$, $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

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SOLVED EXAMPLES TYPE A

1. The distance of planet Jupiter from the Sun is 5.2 times that of the earth. Find the period of revolution of Jupiter around the Sun.

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SOLVED EXAMPLES

1. A certain planet's year is 8 times the earth's year. Find the distance of this planet from the sun if the distance of the earth is $1AU$ from the sun.

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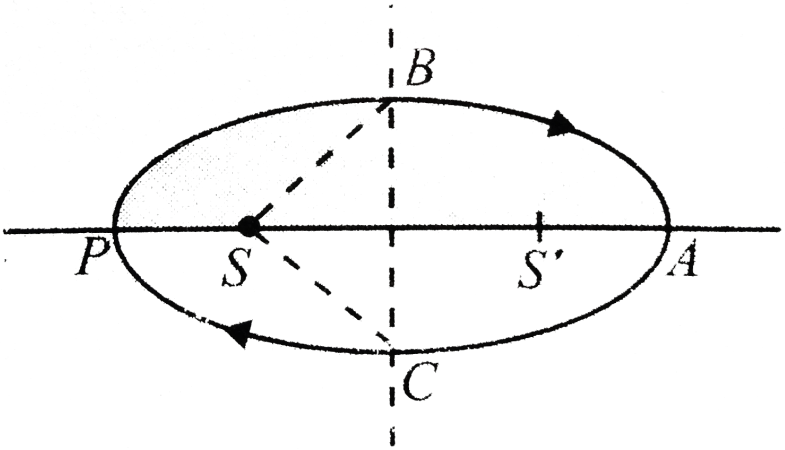
2. Let the speed of the planet at the perihelion P in figure be v_P and the Sun planet distance SP be r_P. Relater r_P, v_P to the corresponding quantities at the aphelion (r_A, v_A). Will the planet

take equal times to transverse BAC and CPB?



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3. 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. $16d$

B. $24d$

C. $27.3d$

D. $19d$

Answer: C

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4. According to kepler's law of periods, $T^2 = kr^3$, where k is a constant. Compute the constant k for (a) the earth and (b) the venus. Given that orbital radii of the earth and the venus are $1.496 \times 10^{11}m$ and $1.082 \times 10^{11}m$, and their respective periods are 1 year and 0.615 year.

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5. If the Earth be at one fourth its present distance from the sun, how many days will be charged in present one year on the surface of earth?

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6. The centres of two identical spheres are $50cm$ apart. If the gravitational force between the spheres be $4.0N$, find the mass of each sphere. Given, $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

A. $2 \times 10^6 kg$

B. $1.22 \times 10^8 kg$

C. $4 \times 10^3 kg$

D. $1.22 \times 10^5 kg$

Answer: D

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7. The mass of planet Jupiter is $1.9 \times 10^{27} kg$ and that of the Sun is $1.99 \times 10^{30} kg$. The mean distance of Jupiter from the Sun is

7.8×10^{11}m. Calculate the gravitational force which Sun exerts on Jupiter. Assuming that Jupiter moves in circular orbit around the Sun, also calculate the speed of Jupiter $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

A. $5 \times 10^4 ms^{-1}$

B. $2 \times 10^8 ms^{-1}$

C. $1.3 \times 10^4 ms^{-1}$

D. $11 \times 10^{10} ms^{-1}$

Answer: C

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8. The distance between earth and moon is $3.8 \times 10^8 m$. Determine the gravitational potential energy of earth-moon system. Given, mass of the earth $= 6 \times 10^{24} kg$, mass of moon $= 7.4 \times 10^{22} kg$ and $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$

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9. How far from Earth must a body be along a line joining the sun to the earth so that resultage gravitational pull on the body due to Earth and sun is zero ? Distance between sun and the Earth is $1.5 \times 10^8 km$. Mass of sun $= 3.25 \times 10^5$ times mass of Earth.

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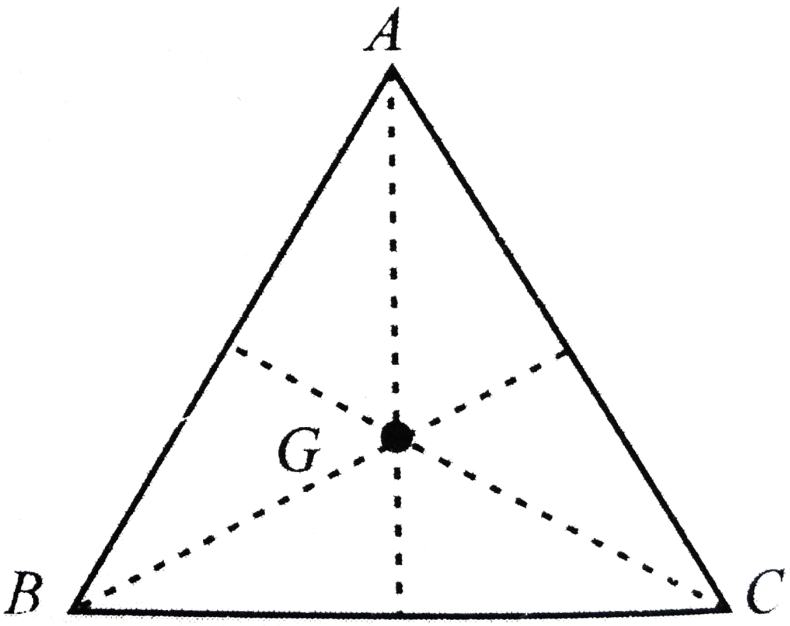
10. Three equal masses of mkg each are fixed at the vertices of an equilateral triangle ABC.

a. What is the force acting on a mass $2m$ placed at the centroid G of the triangle?

b. What is the force if the mass at the vertex A is doubled? Take

$AG = BG = CG = 1m$



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11. 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

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12. Assuming the earth of to be a uniform sphere of radius $6400kg$ and density $5.5g/c.c.$, find the value of g on its surface. $G = 6.66 \times 10^{-11} Nm^2 kg^{-2}$

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13. If the radius of the earth be increased by a factor of 5, by what factor its density be changed to keep the value of g of the same?

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14. A planet whose size is the same and mass is 4 times as that of Earth, find the amount of energy needed to lift a $2kg$ mass vertically

upwards through $2m$ distance on the planet. The value of g on the surface of Earth is $10ms^{-2}$.

A. $80J$

B. $160J$

C. $100J$

D. $24J$

Answer: B

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15. A man can jump $2.0m$ high on the earth. Up to what height he can jump on a planet whose density is one quarter that of Earth and radius in one-third of the Earth's radius.

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16. If the radius of the Earth shrinks by 2%, mass remaing same, then how would the have of acceleration due to gravity change?

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17. Two lead spheres of $20cm$ and $2cm$ diametre respectively are planet with centres $100cm$ apart. Calculate the attraction between them, given the radius of the Earth as $6.37 \times 10^8 cm$ and its mean density as $5.53 \times 10^3 kgm^{-3}$. Speciffic gravity of lead $= 11.5$. If the lead spheres are replaced by bress sphere of the same radii, would the force of attraction be the same?

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18. At what height from the surface of earth will the value of g be reduced by 36% from the value on the surface? Take radius of earth $R = 6400km$.

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19. A body weighs $64N$ on the surface of Earth. What is the gravitational force on it due to the earth, at a height equal to half the radius of Earth ? Acceleration due to gravity on the surface of Earth is $10ms^{-2}$.

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20. Find the percentage decrease in the wight of the body when taken to a heigh of $16km$ above the surface of Earth. Radius of the earth is $6400km$.

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21. A body hanging from a spring stretches it by $2cm$ at the earth's surface. How much will the same body stretch the spring at a place

$800cm$ above the earth's surface? Radius of the earth is $6400km$.

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22. An object weighs $10N$ at north pole of Earth. In a geostationary satellite distance $7R$ from centre of Earth (of radius R), what will be its (a) true weight (b) apparent weight?

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23. At what depth from the surface of earth, the value of acceleration due to gravity is reduced by $40\,\%$ of its value on the surface of earth. Radius of the earth $= 6.4 \times 10^6 m$.

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24. Assuming the Earth to be a sphere of uniform mass density, how much would a body weight half way down to the centre of the Earth, if it weighed $300N$ on the surface of Earth.

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25. Find the percentage decrease in the weight of the body when taken $64km$ below the surface of the Earth. Take redius of the Earth $= 6400km.$

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26. Determine the speed with which the earth would have to rotate on its axis , so that a person on the equator would weigh $\frac{3}{5}$ th as much as the person. Take $R = 6400km.$

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27. Calculate that imaginary angular velocity of the Earth for which effective acceleration due to gravity at the equator becomes zero. In this condition, find the length (in hours) of a day? Radius of Earth $= 6400km.\ g = 10ms^{-2}$.

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28. Suppose Earth is perfect sphere of radius $6.4 \times 10^6 m$. It is rotating about its polar axis with a period of 1 day. What is the difference in the value of acceleration due to gravity on pole and at a place of latitude 60°?

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29. Determine the gravitational potential on the surface of earth, given that radius of the earth is $6.4 \times 10^6 m$: its mean density is

$5.5 \times 10^3 kgm^{-3}, G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

A. $-6.297 \times 10^7 Jkg^{-1}$

B. $3.11 \times 10^{11} Jkg^{-1}$

C. $4 \times 10^8 Jkg^{-1}$

D. $-2 \times 10^9 Jkg^{-1}$

Answer: A

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30. 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

$G = 6.66 \times 10^{-11} Nm^2 kg^{-2}$.

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31. At a point above the surface of Earth, the gravitational potential is $-5.12 \times 10^7 Jkg^{-1}$ and the acceleration due to gravity is $6.4ms^{-2}$. Assuming the mean redius of the earth to be $6400km$, calcualte the height of this point above the Earth's surfcae.

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32. Three particles, each of mass m are placed at the vertices of an equilateral triangle of side a. What are the gravitation field and gravitational potential at the centroid of the triangle.

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33. A point mass body of mass $2kg$ is placed at a distance $20cm$ from one end of a uniform rod of length $2m$ and mass $10kg$. Calculate

(i) gravitational intensity at the location of point mass body due to the rod.

(ii) gravitational force on the body due to the rod. Use $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

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34. A body is released from a point of distance R' from the centre of earth. Its velocity at the time of striking the earth will be $(R' > R_e)$

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35. 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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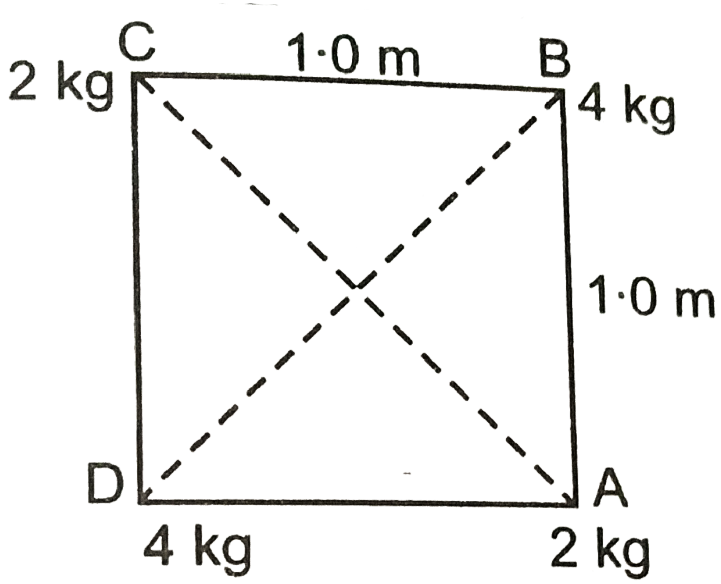
36. Four point mass bodies of masses as shown in Fig. are placed at the vertices of a square $ABCD$, gravitational force on the body at A . Given, $G = 6.6 \times 10^{-11} Nm^2 kg^{-2}$



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37. 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 $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

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38. An Earth satellite has time percircular, calculate its height. Given, radius Earth $= 6380km$, g at the surface of Earth $= 9.8ms^{-2}$.

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39. You are given the following data : $g = 9.81ms^{-2}$, radius of earth $= 6.37 \times 10^6 m$ the distance the Moon from the earth $= 3.84 \times 10^8 m$ and the time period of the Moon's revolution $= 27.3days$. Obtain the mass of the earth in two different ways. $G = 6.67 \times 10^{-11} Nm^2 kg^2$.

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40. 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?

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41. Calculate (i) kinetic energy (ii) potential energy and (iii) total energy of a satellite of mass $200kg$ orbiting around the earth in an orbit of height $100km$ from the surface of earth. Given, mass of earth $= 10^{25} kg$,radius of earth $= 6.4 \times 10^6 m, G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

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42. In a two stage launch of a satellite, the first stage bringe the satlilte to a height of $500km$ and the second stage given it the

necessary critical speed to put it in circular orbit around the Earth. Which stage requires more expenditude of fuel?

(Neglect damping due to air resistance, especially in the first stage).

Mass of the Earth $= 6.0 \times 10^{24} kg$,radius of Earth $= 6400 km$, $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

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43. Determine the escape speed of Moon. Given, the radius of Moon is $1.74 \times 10^6 m$, its mass is $7.36 \times 10^{22} kg$. Does your answer throw light on why the moon has no atmosphere?

$G = 6.67 \times 10^{-11} nm^2 kg^{-2}$.

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44. Jupiter has a mass 320 times that of the earth and its readius is 11.2 times that of the earth. Determine the escape velocity from the

surface of jupiter, given that the escape velocity from the surface of earth is $11.2 kms^{-1}$.

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45. A block hole is a body from whose surface nothing may even escape. What is the condition for a uniform spherical body of mass M to be a block hole? What should be the radius of such a black hole if its mass is nine times the mass of the earth?

Mass of earth $= 6 \times 10^{24} kg$,

$G = 6.61 \times 10^{-11} Nm^2 kg^{-2}$.

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46. Calculate the minimum speed required by a rocket to pull out of the gravitational force of Mars. Given that the earth has a mass 9

times and radius twice of the planet Mars. Escape speed on the surface of earth is $11.2 kms^{-1}$.

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47. Two bodies of masses m_1 and m_2 are placed at a distance r apart. Show that the position where the gravitational field due to them is zero, the potential is given by

$-G\left(m_1+m_2+2\sqrt{m_1+m_2}\right)/r$

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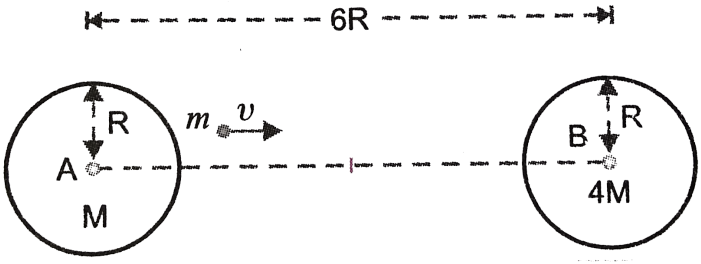
48. Two uniform soild spheres of equal radii R but mass M and $4M$ have a centre to centre separation $6R$, as shows in Fig. (a) The two spheres are held fixed. A projectile of mass m is projected from the surface of the sphere of mass M directly towards the centre of ten second. Obtain an expression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

projectile so that it reaches the surface of second sphere.



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49. The planet Mars has two moons. Phobos and Delmos (i) phobos has period 7 hours, 39 minutes and an orbital radius of $9.4 \times 10^3 km$. Calculate the mass of Mars. (ii) Assume that Earth and mars move in a circular orbit around the sun, with the martian orbit being 1.52 times the orbital radius of the Earth. What is the length of the martian year in days? $\left(G = 6.67 \times 10^{-11} Nm^2 kg^{-2}\right)$

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

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SOLVED EXAMPLES TYPE B

1. A sphere of mass $40kg$ is attracted by a second sphere of mass $60kg$ with a force equal to $4mg$. If $G = 6 \times 10^{-11} Nm^2 kg^{-2}$, calculate the distance between them. Acceleration due to gravity $= 10ms^{-2}$.

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SOLVED EXAMPLES TYPE C

1. A body weighs $54kgf$ on the surface of Earth. How much will it weigh on the surface of mers whose mass is $1/9$ and the redius is $1/2$ of that of earth?

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SOLVED EXAMPLES TYPE D

1. At what height from the surface of earth will the value of g becomes $40\,\%$ from the value at the surface of earth. Take radius of the earth $= 6.4 \times 10^6 m$.

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SOLVED EXAMPLES TYPE E

1. How much below the surface of Earth does the acceleration due to gravity become $70\,\%$ of its value on the surface of Earth. Radius of Earth $= 6.4 \times 10^6 m$.

A. $0.6 \times 10^7 m$

B. $1.92 \times 10^6 m$

C. $1.1 \times 10^4 m$

D. $8 \times 10^4 m$

Answer: B

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SOLVED EXAMPLES TYPE F

1. If the Earth were a perfect sphere of radius $6.37 \times 10^6 m$, rotating about its polar exis with a period of 1 day $\left(= 8.64 \times 10^4 s\right)$ how

much would the acceleration due to gravity differ from the poles to equator?

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SOLVED EXAMPLES TYPE G

1. Two bodies of masses $100kg$ and $10,000kg$ are at a distance $1m$ apart. At which point on the line joining them will the resultant gravitational field intensity is zero? What is the gravitational potential at that point ?

$G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

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SOLVED EXAMPLES TYPE H

1. 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

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SOLVED EXAMPLES TYPE I

1. A remote sensing satellite of the Earth in a circular orbit at a height of $400km$ above the surface of Earth. What is the (a) orbital speed, and (b) period of revolution of satellite ? Radius of Earth $= 6 \times 10^6 m$ and acceleration due to gravity the surface of Earth is $10m/s^2$.

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SOLVED EXAMPLES TYPE J

1. Calculate the escape speed for an atmospheric particle $1600km$ above the Earth's surface, given that the radius of the Earth is $6400km$ amd acceleration due to gravity on the surface of Earth is $9.8ms^{-2}$.

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SOLVED EXAMPLES TYPE K

1. A $400kg$ 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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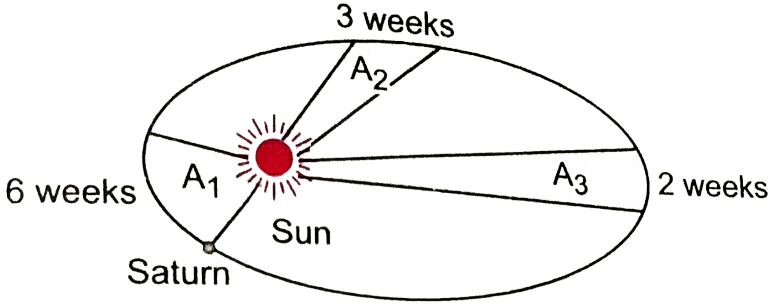
CONCEPTUAL PROBLEMS I.

1. The line that joins the saturn to the sun sweeps area A_1, A_2 and A_3 in time intervals of 6 weeks, 3 weeks and 2 weeks respectively as shows in the Fig. What is the correct relation between A_1, A_2 and A_3?



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CONCEPTUAL PROBLEMS

1. 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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2. A planet of mass m moves around the Sun of mass Min an elliptical orbit. The maximum and minimum distance of the planet from the Sun are r_1 and r_2, respectively. Find the relation between the time period of the planet in terms of r_1 and r_2.

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3. 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

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4. The distance of two plenets from the sun are $10^{11}m$ and $10^{10}m$ respectively. What is the ratio of time period of these two planets ?

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5. 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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6. Three uniform spheres each having a mass M and radius a are kept in such a way that each touches the other two. Find the magnitude of the gravitational force on any of the spheres due to the other two.

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7. We know that both Moon and the sun produce our ocean tides. We also know that moon plays the greater role because it is closer. Does its closeness mean it pulls with more gravitational force than the sun on the Earth's oceans?

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8. Two identical copper spheres of radius R are in contact with each other. If the gravitational attraction between them is F, find the relation between F and R.

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9. Under what conditions can the electric flux ϕ_E be found through a closed surface?

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10. Assertion : We can not move even a finger without disturbing all the stars.

Reason : Every body in this universe attracts every other body with a force which is unversely proportional to the square of distance between them.

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11. We are living at the bottom of the gravitational well. Comment.

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12. What would happen if gravity suddenly disappears?

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13. The distance between two bodies A and B is r. Taking the gravitational force according to the law of inverses square of r, the acceleration of the body A is a. If the gravitational force follows an inverse fourth power law, then what would be the acceleration of the body A?

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14. Where will a body weigh more, $2km$ above the surface of earth or $2km$ below the surface of earth ?

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15. The mass and diameter of a planet are twice those of earth. What will be the period of oscillation of a pendulum on this plenet. If it is a 2 second's pendulum on earth?

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16. Will $1kg$ sugar be more at poles or at the equator?

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17. Since the Moon is gravitational attracted to the Earth, why does it not simply crash into the Earth?

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18. A body is taken from the centre of the Earth to the Moon. What will be the changes in the weight of the body?

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19. Three equal masses m are placed at the three corners of an equilateral tringle of side a. find the force exerted by this system on another particle of mass m placed at a. the mid point of a side b. at the centre of the triangle.

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20. What is the potential energy of a body of mass m relative of the surface of Earth of radius R, at a (a) height $h = R$ above its surface (b) depth $d = R$ below its surface.

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21. The magnitude 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 F_1 and F_2 respectively. Then:

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22. In a certain region of space gravitational field is given by $I = -(k/r)$. Taking the reference point to be at $r = r_0$, with gravitational potential $V = V_0$, find the gravitational potential at distance r.

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23. A spherical cavity is made inside a sphere of density, d. Its centre lies at a distance l, from the centre of sphere, show that the

gravitational strength, I, of the field inside the cavity is $= (4/3) \times \pi Gld.$

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24. The magnitude 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 F_1 and F_2 respectively. Then:

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25. A projectile is fired from the surface of earth of radius R with a velocity kv_e (where v_e is the escape velocity from surface of earth and $k < 1$). Neglecting air resistance, the maximum height of rise from centre of earth is

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26. The radius and mass of Earth are R and M. The acceleration due to gravity at its surface is g. Calculate the work required in raising a body of mass m to a height h from the surface of earth.

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27. A rocket of mass m is field vertically from the surface of Mars of mass M, radius R with a sped v. If $20\,\%$ of its initial energy is lost due to Martain atmosheric resistance, how far will the rocket go from the surface of Mars before returing to it? Let G be the gravational constant.

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28. What are the conditions under which a rocket, fired from the earth, launches an artificial satellite of the earth?

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29. Why rockets are launched from west to east in the equatorial plane?

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30. Two indentical geostationary satellite each of mass m are moving with equal speed v in the same orbit but their sense of rotation brings them on a collision course. What will happen to the debris?

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31. If suddenly the gravitational force of attraction between Earth and a stellite revolving around it becomes zero, then the stellite will

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32. A rocket is accelerated to speed $v = 2\sqrt{gR}$ near the earth's surface ($R =$ radius of earth). Show that very far from earth its speed will be $v = \sqrt{2gR}$.

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33. Air friction increases the velocity of the satellite. Explain.

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34. The masses and radii of the Earth and the Moon are M_1, R_1 and M_2, R_2 respectively. Their centres are at a distance d apart. The minimum speed with which a particel of mass m should be projected from a point midway between the two centres so as to escape to infinity is .....

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35. Assertion: if an earth satellite moves to a lower orbit, there is some dissipation of energy but the satellite speed increases.

Reason: The speed of satellite is a constant quantity.

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36. Our sun is not enough to become a black hole. But if it were, and it collapsed, would the Earth be draw into it?

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CONCEPTUAL PROBLEMS II.

1. Gravitational force is a weak force but still it is considered the most important force. Why ?

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CONCEPTUAL PROBLEMS III.

1. Draw graphs showing the variation of accleeration due to gravity with (a) height above the Earth's surface, (b) depth below the Earth's surface.

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CONCEPTUAL PROBLEMS IV.

1. Two bodies of masses m_1 and m_2 are initially at rest at infinite distance apart. They are then allowed to move towards each other under mutual gravitational attraction. Their relative velocity of approach at a separation distance r between them is.

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CONCEPTUAL PROBLEMS V.

1. Why does Moon have no atmosphere?

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VERY SHORT ANS. QUESTIONS I.

1. A planet revolves in an ellipticle orbit around the sun. the semimjor and semiminor axis are a and b. How time-period is related with them?

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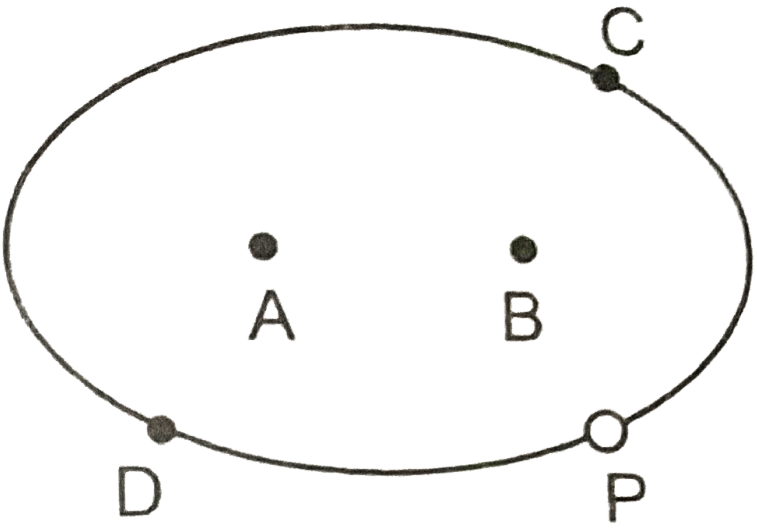
VERY SHORT ANS. QUESTIONS

1. Identify the portion of sun in the Fig. if the linear speed of the planet is greater at C compared to that at D.



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2. The linear speed of a planet around the sun is not constant in its orbit. Comment.

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3. If Earth be at one half its present distance from the sun, how many days will there be in a year?

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4. A planet is revolving around the sun in an elliptical orbit. Which out of the following remains constant.

(a) Linear speed (b) angular momentum

(c) kinetic energy (d) potential energy (e) total energy throughout its orbit.

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5. A geo-stationary stellite orbits around the earth in a circular orbit of radius 36,000km. Then, the time period of a spy stellite orbitting a few hundred km above the earth's surface $(R_{earth} = 6400km)$ will approximately be

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6. Why is Newton's law of gravitational called a universal law?

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7. On Earth value of $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

What is its value on Moon, where g is nearly one-sixth than that of Earth?

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8. When a stone of mass m is falling on the Earth of mass M, find the acceleration of Earth if any?

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9. When a body falls towards Earth, Earth moves towards the body. Why is earth's motion not noticed?

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10. Does the graviatational force of attraction of the Earth on a body become zero at some height above the earth? Explain.

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11. Is it possible to shield a body from gravitational effects?

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12. Why does a tunnis ball bounce heigher on a hill than on plains?

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13. What are the two factors which determine why some bodies in solar system have atmosphere and others do not?

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14. The value of g on the Moon is $1/6$th of that of Earth. If a body is taken from the Earth to the Moon, then what will be the change in its (i) weight, (ii) intertial mass and (iii) gravitational mass?

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15. Moon travellers tie heavy weight at their back before landing on the Moon. Why ?

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16. If a man goes from the surface of Earth to a height equal to the radius of the Earth, then what will be his weight relative to that on the Earth? What if he goes equally below the surface of Earth?

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17. Mass of a body cannot be changed without changing weight can be changed without changing mass. Explain.

Watch Video Solution

18. Where will the true weight of the body be zero?

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19. Gravitational force acts on all objects in properties to their masses. Why then, a heavy object does not fall faster than a light

object?

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20. Assuming that the Earth is a sphere of radius R. At what altiude will the value of acceleration due to gravity be half its value at the surface of the Earth?

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21. Why does a body lose weight at the centre of the earth?

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22. If the Earth stops rotating about its polar axis, what will be the effect on the value of acceleration due to gravity 'g' ? Will this effect be same at all places?

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23. Why we are not thrown off the surface of Earth by centrifugal force?

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24. Why is gravitational potential energy negative?

Watch Video Solution

25. What is the maximum value of gravitational potential energy and where?

Watch Video Solution

26. What is the relation between gravitational intensity and gravitational potential at a point?

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27. Where is the gravitational field zero and where is the gravitational potential zero, in case of Earth?

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28. The gravitational potential energy of a body at a distance r from the centre of the Earth is U where $r > R$ (radius of Earth). What is the weight of body at the point ?

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29. What is the workdone in bringins a body of mass m from infinity to the surface of Earth of radius R and mass m?

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30. What are the SI units of gravitational intansity and gravitational potential?

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31. What is the value of gravitational intensity at the surface of Earth and at the Earth's centre?

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32. A point mass m is a distance x from the centre of mass M and radius R on its axis. Find the gravitational force between the two. What will this force be if $x > > R$ and $x < < R$? For what value of x is the force maximum?

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33. Choose the correct alternative :

(a) If the gravitational potential energy of two mass points infinite distance away is taken to be zero, the gravitational potential energy of a galaxy is (positive /negative/zero).

(b) The universe on the large is shaped by (gravitational/electromagentic) forces, on the atomic scale by (gravitational/electromagnetic) forces, on the nuclear scale by (gravitational/electromagnetic/strongnuclear) forces.

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34. From where does a satellite revolving around a planet get the required centrepetal force?

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35. The Earth is acted upon by the gravitational force of attraction due to the sun. They why does the Earth not fall towards sun?

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36. An artifical satellite revolves in the orbit around the Earth without using any fuel. But an aeroplane requires fuel to fly at a centain height. Why ?

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37. Can we determine the gravitational mass of a body inside an artificial satellite?

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38. An artificial satellite is revolving around the Earth at a height $400km$ from the Earth's surface . If a packet is released from the satellite, what will happen ti it? Will it reach the Earth?

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39. A satellite revolving around Earth loses height. How will its time period be changed?

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40. Two artificial satellites one close to the surface and the other away, are revolving around the earth. Which one has larger speed?

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41. Should the speed of two artificial satellites of the earth having the different masses but the same orbital radius be the same?

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42. Which has longer period of revolution, a satellite revolving close or away from the surface of earth?

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43. The astronauts in a satellite orbiting the Earth feel weightlessness. Does the weightlessness depend upon the distance of the satellite from the Earth ? If so how ? Explain your answer.

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44. What is the sense of roatation of stationary satellite around the Earth ?

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45. Assertion: The time period of geostationary satellite is 24 hrs.

Reason: Geostationary satellite must have the same time period as the time taken by the earth to complete on revolution about its axis.

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46. If a satellites is revolving close to a planet of density ρ with period T, show that the quantity ρT^2 is a universal constant.

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47. Two satellites A and B are orbiting around the earth in ciruclar orbits of the same radius. The mass of A is 16 times that of B. Then the raito of the period of revolution of B to that of A is

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48. If the Earth's satellite is put into an orbit at a height where resistance due to atmosphere, can not be neglected, how will motion of satellite be affected?

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49. Does a rocket really need the escape speed of $11.2 km / s$ initially to escape from the Earth?

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50. For a satellite, escape speed is $11 kms^{-1}$. If the satellite is launched at an angle of 60° with the vertical, what will be the escape speed?

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51. What is the escape velocity of the object, if.the magnitude of the potential energy per unit mass of the object at the surface of earth is E?

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52. Show that Moon would depart for even if its speed were incresed by $42\ \%$.

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53. A satellite of small mass burns during its descent and not during ascent. Why ?

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54. Assertion: A person sitting in an artificial satellite revolving around the earth feels weightless.

Reason: There is no gravitational force on the satellite.

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55. Lighter gases like H_2, He, etc. are rare in the atmosphere of the earth. Why?

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VERY SHORT ANS. QUESTIONS II.

1. Which of the following observations point to the equivalence of inertial and gravitational mass

(a) Two spheres of difference masses dropped from the top of a long evacuated reach the bottom of the tube at the same time.

(b) The time-period of a simple pendulum is independent on its mass.

(c) The gravitational force on a particle inside a hollow under isolated is zero.

(d)For a mass in a closed cabin that is falling freely under gravity, gravity 'disappears'.

(e) An astronomer inside a spaceship orbiting around the Earth fells weightless.

(f) Planets orbiting around the sun obey kepler's third law (approximately).

(g) The gravitational force on a body due to the Earth is equal and opposite to the gravitational force on the Earth due to the body.

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VERY SHORT ANS. QUESTIONS III.

1. Why the value of acceleration due to gravity is more at the poles than at the equator?

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VERY SHORT ANS. QUESTIONS IV.

1. Under what condition, the gravitational potential energy of a body will be zero?

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VERY SHORT ANS. QUESTIONS V.

1. The centripetal force on a satellite revolving around the Earth is F. What is the gravitational force due to Earth on it ? Net force?

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SHORT ANSWER QUESTIONS I.

1. 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.

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SHORT ANSWER QUESTIONS

1. If the Earth be one third its present distance from the sun, how many days will the present one year on the surface of Earth will change?

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2. The largest and the shortest distance of the earth from the sun are r_1 and r_2, its distance from the sun when it is at the perpendicular to the major axis of the orbit drawn from the sun

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3. Assertion: Generally the path of projectile form the earth is parabolic but it is elliptical for projection going to a very large height.

Reason: The path of projectile is independent of the gravitational force of earth.

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4. Do the forces of friction and other contact fores aries due to gravitational attraction ? If not, what is the origin of these force?

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5. The mass of moon 1% of mass of earth. The ratio of gravitational pull of earth on moon and that of moon on earth will be

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Watch Video Solution

6. Gravitational force acts on all objects in properties to their masses. Why then, a heavy object does not fall faster than a light object?

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7. According to Newton's law of gravitational, every particle of matter attracts every other particle. But bodies on the surface of Earth never move towards each other on account of this force of attraction. Why ?

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8. Gravitational force between two point masses m and M separated by a distance r is F. Now if a point mass $3m$ is placed next to m,

what will be that a. force on M due to m, b total on M?

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9. Does the graviatational force of attraction of the Earth on a body become zero at some height above the earth? Explain.

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10. A mass M is broken into two parts of masses m_1 and m_2. How are m_1 and m_2 related so that force of gravitational attraction between the two parts is maximum?

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11. Distinguish between mass and weight.

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12. If a person goes to a height equal to radius of Earth from its sutface. What would be this weight relative to that on the Earth.

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13. The change in the value of 'g' at a height 'h' above the surface of the earth is the same as at a depth 'd' below the surface of earth. When both 'd' and 'h' are much smaller then the radius of earth, then which one of the following is correct?

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14. What will be the effect on the time period of a simple pendulum, on taking it, to a mountain?

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15. Suppose a holes is drilled completed through the earth along a dimeter. Mass and radius of Earth are M and R. What is the force acting on a body of mass m at a distance r from the centre of Earth?

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16. Is the value of g same every where on the surface of Earth ? How has it been decided?

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17. How will the value of g be effected if

(i) the rotatio of the Earth about its polar axis stops and

(ii) the rotational speed of the Earth about its polar axis is doubled?

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18. When a clock controlled by a pendulum is taken from planis to mountain, it becomes slow but a wrist watch controlled by a spring remains unaffected. Why ?

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19. 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)

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20. A particle is projected vertivally upwards from the surface of earth $(radius R_e)$ with a kinetic energy equal to half of the minimum value needed for it to escape. The height to which it rises above the surface of earth is .....

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21. The distance between earth and moon is about $3.8 \times 10^5 km$. At what point or points will the gravitational field strength of earth-moon system be zero? Given mass of earth is 81 times the moon's mass.

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22. Is the potential energy of a system of bodies positive or negative ? Give reason in support of your answer.

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23. does speed of satellite remain constant in an orbit ? Explain.

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24. What is the tota, energy of a satellite revolving around Earth ?

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25. What is binding energy of a satellite?

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26. The gravitational potential energy of a body at a distance r from the centre of the Earth is U where $r > R$ (radius of Earth). What is the weight of body at the point ?

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27. A satellite with kinetic energy E_k is revolving round the earth in a circular orbit. How much more kinetic energy should be given to it so

that it may just escape into outer space

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28. 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

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29. it possible to put an artifical1 satellite into orbit in such a way that it will always remain directly over New Delhi.

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30. An artificial satellite is moving in a circular orbit around the earth with a speed equal to half the magnitude of escape velocity from the

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 onto the earth, find the speed with which it hits the surface of the earth.

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31. Assertion : An astronaut in an orbiting space station above the earth experience weightlessness.

Reason : An object moving around the earth under the infuence of earth's gravitational force is in a state of 'free fall'

Watch Video Solution

32. There is no atomosphere on moon because

Watch Video Solution

33. The garvitational force exerted by the sun on the Moon is greater than that exerted by the Earth on the Moon. Why then does not the Moon escape from the Earth, during solar esclipe?

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34. Assertion : On satellites we feel weightlessness. Moon is also a satellite of earth. But we do not feel weightlessness on moon.

Reason : Mass of moon is considerable.

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35. What do you understand by gravity and acceleration due to gravity. Establish a relation between g and G.

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36. Explain how the knowledge of g helps us to find

(i) mass of earth and

(ii)mean density of earth?

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37. Explain gravitational potential at a point and gravitational potential energy of a body in a gravitational field. Establish a relation between them.

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38. Assertion: The ratio of intertial mass to gravitational mass is equal to one.

Reason: The inertial mass and gravitational mass of a body are equivalent.

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39. PRINCIPLE OF LAUNCHING A SATELLITE

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40. What do you underestand by orbital velocity ? Derive an expression for the orbital velocity of a satellite.

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41. What do you understand by geostationary and polar satellite ? Discuss their important uses.

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42. What do you undersatnd by 'Escape velocity' ? Derive an expression for it in terms of parametes of given planet.

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43. Explain the reason of weightlessness inside a satellite.

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44. The difference in the lengths of a mean solar day and a sidereal day is about

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45. Two identical heavy sphers are separated by a distance 10 times their radius. Will an object planed at the mid point of the line joining

their centres be in stable equilibrium or unstable equilibrium ? Give reason for your answer.

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46. Show the nature of the following graph for a satellite orbiting the earth.

(a) KE vs orbitial radius R (b) PE vs orbital radius r (c) TE vs orbital radius R.

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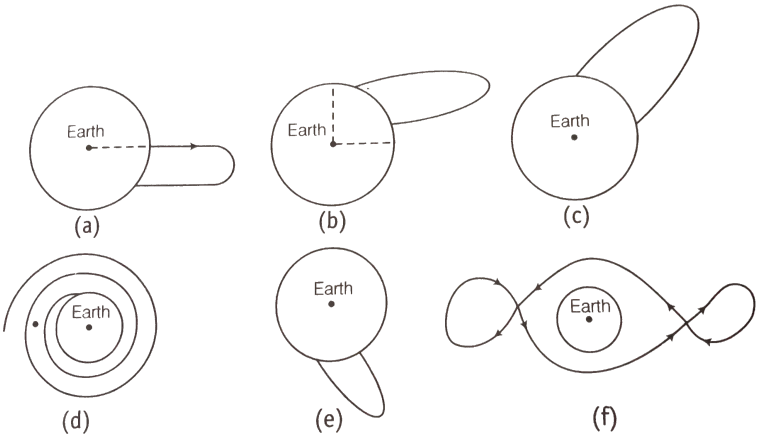
47. Shown are several cuves (fig. (a), (b), (c), (d), (e), (f)]. Explain with reason, which ones amongst them can be possible trajectories

traced by a projectile (neglect air friction).



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48. A particle of mass 'm' is raised to a height $h = R$ from the surface of earth. Find increase in potential energy. $R =$ radius of earth. $g =$ acceleration due to gravity on the surface of earth.

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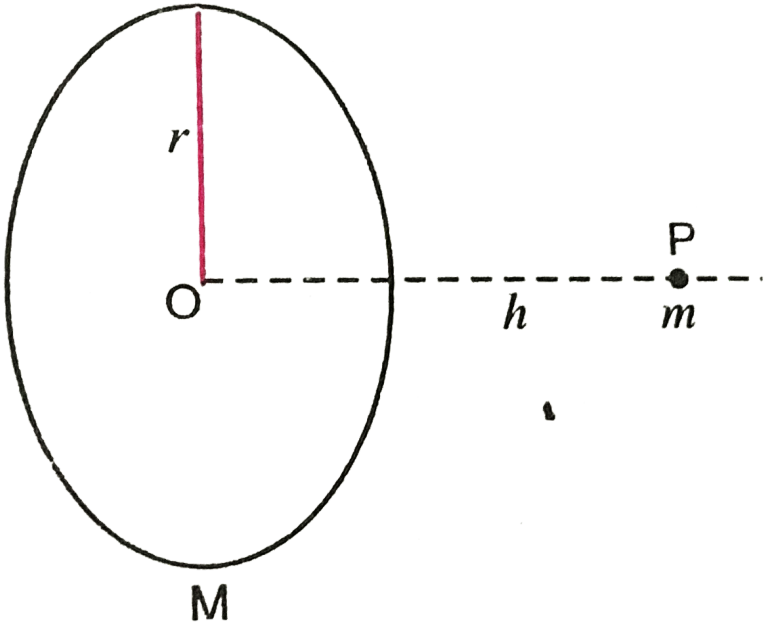
49. A mass m is placed at P a distance h along the normal through the centre O of a thin circular ring of mass M and radius r Fig.

If the mass is removed futher away such that OP becomes $2h$, by what factor the force of gravitational will decrease, if $h = r$?



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SHORT ANSWER QUESTIONS II.

1. What are the main features of gravitational force?

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SHORT ANSWER QUESTIONS III.

1. Distinguish between g and G.

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SHORT ANSWER QUESTIONS IV.

1. A planet whose size is the same and mass 4 times as that of Earth, find the amount of energy needed to lift a $2kg$ mass vertically upwards through $2m$ distance on the planet. The value of g on the surface of Earth is $10ms^{-2}$.

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SHORT ANSWER QUESTIONS V.

1. 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.

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LONG ANSWER QUESTIONS

1. Explain kepler's laws of planetary motion and deduce newton's law of gravitational from them.

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2. State kepler's laws of planetary motion and explain the deduction of Kepler's second law and their law of planetary motion.

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3. Explain Newton's law of gravitational. Denfine gravitational constant, and gives its dimesional formula. Give the evidences in support of the Newton's law of gravitational.

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4. Discuss the variation of g with height and depth.

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5. What do you understand by 'g'. Discuss the variation of g with rotation of earth after establishing a relation for the same.

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6. What is a geostationary statellite? What are the basic requirements for such a satellite?

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7. A star like the sun has serveral bodies moving around it at different distance. Consider that all of them are moving in circular orbits. Let r be the distance of the body from the centre of the star and let its linear velocity be v, angular velocity ω, kinetic energy K, gravitational potential energy U, total energy E and angular momentum L. As the radius r of the orbit increase, determine which of the above quantities increase and which ones decrease.

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8. Six point masses of mass m each are at the vertices of a regular hexagon of side l. Calculate the force on any of the masses.

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9. A satellite is to be placed in equatorial geostationary orbit around earth for communication.

(a) Calculate height of such a satellite.

(b) Find out the minimum number of satellites that are needed to cover entire earth so that at least one satellites is visible from any point on the equator.

$[M = 6 \times 10^{24} kg, R = 6400 km, T = 24 h, G = 6.67 \times 10^{-11} SI units]$

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10. Earth's orbit is an ellipse with ecentricity 0.0167. Thus earth's distance from the sun and speed as it moves around the sun varies from day to day. This means that the length of the solar day is not constant through the year. Assume that earth's spin axis is normal to its orbital plane and find out the lenght of the shortest and the

longest day. A day should be taken from noon. Does this explain variation of lenght of the day during the year?

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11. A satellite is in an elliptical orbit around the earth with aphelion of $6R$ and perihelion of $2R$ where $R = 6400km$ is the radius of the earth. Find accentricity of the orbit. Find the velocity of the satellite at apogee and perigee. What should be done if this satellite has to be transferred to a circular orbit of radius $6R$? $\left[G = 6.67 \times 10^{-11} SI \text{ units and } M = 6 \times 10^{24} kg\right]$

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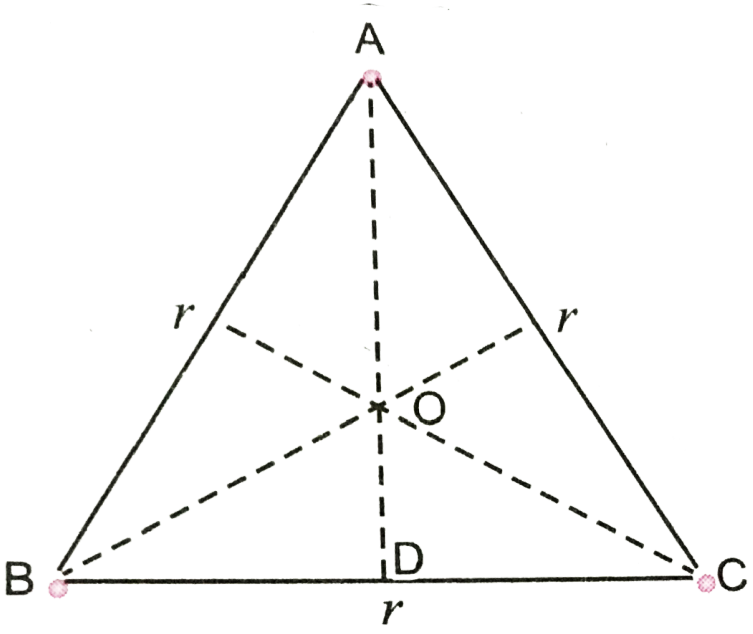
ADVANCED PROBLEMS FOR COMPETITIONS

1. There are three identical point mass bodies each of mass m locted at the vertices of an equilateral triangle with side r. They are exerting gravitational force of attraction on each other, which can be given by Newton's law of gravitaiton. Each mass body produces its gravitational field in the surrounding region. the magnitude of gravitational field at a point due to a point mass body is the measure of gravitaitonal intensity at that point. The gravitational potential at a point in a gravitational field is the amount of workdone in bringing a unit mass body infinity to the given point without acceleration.



Answer the following questions :

At what speed must they move if they all revolve under the influence of one another's gravitation in a circular orbit circumsribing the triangle still preserving the equilateral triangle

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2. Show that the object lying at the equator will fly off the surface of earth, if the speed of rotation of the earth increase seventeen times its present speed.

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3. A spherical cavity is made inside a sphere of density, d. Its centre lies at a distance l, from the centre of sphere, show that the gravitational strength, I, of the field inside the cavity is $= (4/3) \times \pi Gld.$

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4. If the radius of the earth decreases by 1% without changing its mass, will the acceleration due to gravity at the surface of the earth increase or decrease? If so, by what percent?

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5. On a planet whose size is the same and mass four times as that of our earth, find the amount of work done to lift $3kg$ mass vertically upwards through $3m$ distance on the planet. The value of g on the surface of earth is $10ms^{-2}$

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6. An artificial satellite is moving in a circular orbit around the earth with a speed equal to half the magnitude of escape velocity from the

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 onto the earth, find the speed with which it hits the surface of the earth.

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7. Mass M, of a planet earth is uniformly distributed over a spherical volume of radius R. Calculate the energy needed to deassemble the planet against the gravitational pull ammongst its consituent particles. Given

$mR = 2.5 \times 10^{31} kgm$ and $g = 10 ks^{-2}$.

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8. Determine the speed with which the earth would have to rotate on its axis , so that a person on the equator would weigh $\frac{3}{5}$ th as much as the person. Take $R = 6400km$.

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9. The escape speed of a body on the earth's surface is $11.2kms^{-1}$. A body is projected with thrice of this speed. The speed of the body when it escape the gravitational pull of earth is

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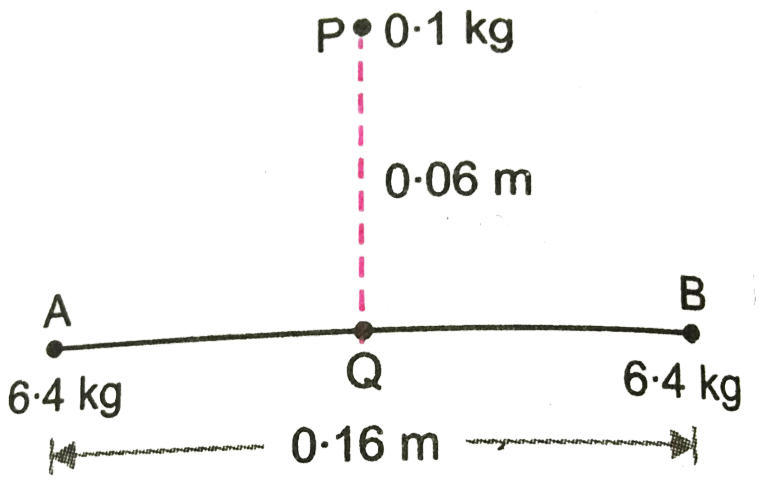
10. Two equal masses of $6.40kg$ are separted by a distance of $0.16m$. A small body is released from a point P, equidistant from the two masses and at a distance of $0.06m$ from the line joining them. Fig.

(a) Calculate the velocity of this body when it passes through Q.

(b) Calculate the acceleration of this body at P and Q if its mass is

$0.1kg$.

Use $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$



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11. Distance between the centres of two stars is 10α. The masses of these stars are M and 16M and their radii a and 2a, respectively. A body of mass m is fired straight form the surface of the larger star towards the smaller star. What should be its minimum inital speed to

reach the surface of the smaller star? Obtain the expression in terms of G,M and a.

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12. The masses and radii of the Earth and the Moon are M_1, R_1 and M_2, R_2 respectively. Their centres are at a distance d apart. The minimum speed with which a particel of mass m should be projected from a point midway between the two centres so as to escape to infinity is .....

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13. A satellite of mass $10kg$ is placed initially in a temporary orbit $800km$ above the surface of earth. The satellite is to be placed now in a permanent orbit at $2000km$ above the surface of earth. Find the amount of workdone to move the satellite from temporary to

permanent orbit. The radius of the earth is $6400km$ and $g = 10ms^{-2}$.

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14. A non-homogenous sphere of radius R has the following density variation.

$\rho = \rho_0, r \leq r/3,$

$\rho = \rho_0/2, \frac{R}{3} < r \leq 3\frac{R}{4},$

$\rho = \frac{\rho_0}{8}, (3R)/(4) < r \leq R,$

What is the gravitational field due to sphere at distance $2R$ from center?

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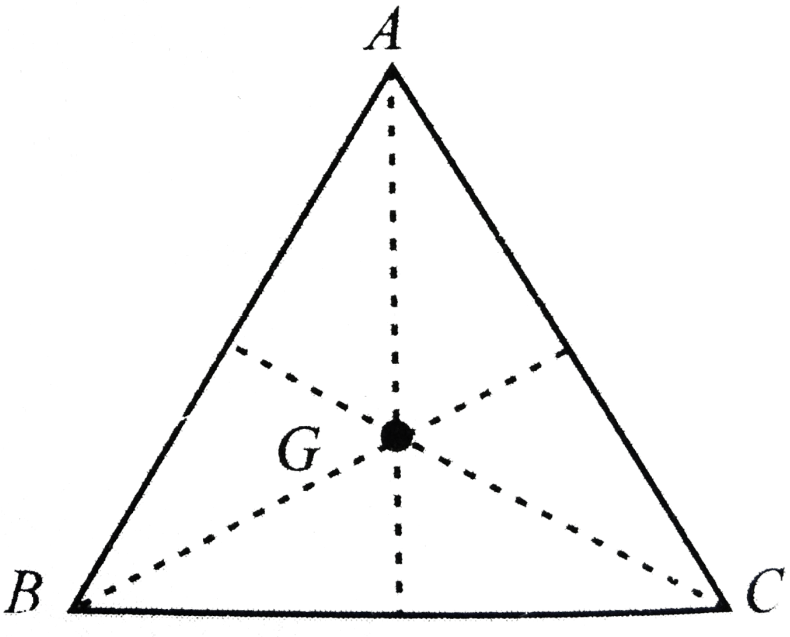
15. Three equal masses of mkg each are fixed at the vertices of an equilateral triangle ABC.

a. What is the force acting on a mass $2m$ placed at the centroid G of the triangle?

b. What is the force if the mass at the vertex A is doubled? Take $AG = BG = CG = 1m$



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NCERT

1. Answer the following: (a) You can shield a charge from electrical forces by putting it inside a hollow conductor. Can you shield a body from the gravitational influence of nearby matter by putting it inside a hollow sphere or by some other means? (b) An astronaut inside a small spaceship orbiting around the Earth cannot detect gravity. If the space station orbiting around the Earth has a large size, can he hope to detect gravity? (c) If you compare the gravitational force on the Earth due to the Sun to that due to the Moon, you would find that the Sun's pull is greater than the Moon's pull. (You can check this yourself using the data available in the succeeding exercises). However, the tidal effect of the Moon's pull is greater than the tidal effect of Sun. Why?

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2. Choose the correct alternative

(a)Acceleration due to gravity increase/decrease with increasing

altitude.

(b) Acceleration due to gravity increase/decrease with increasing depth (assume the earth to be a sphere of uniform density).

(c) Acceleration due to gravity is independer of mass of the earth/mass of the body.

(d) The formula $-GMm\left(\frac{1}{r_2}-\frac{1}{r_1}\right)$ is more/less accurate than the formula $mg(r_2-r_1)$ for the difference of potential energy between two points r_2 and r_1 distance away from the centre of earth.

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3. Suppose there existed a planet that went around the sun twice as fast as the earth. What would by its orbital size?

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4. One of the satellite of jupiter, has an orbital period of 1.769 days and the radius of the orbit is $4.22 \times 10^8 m$. Show that mass of jupiter is about one thousandth times that of the radius of the sun. (Take 1 year $= 365.15$ mean solar day).

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5. 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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6. Choose the correct alternative :

(a) If the zero of the potential energy is at infinity, the total energy of

an orbiting satellite is negative of its kinetic/potential energy.

(b) The energy required to rocket an orbiting satellite out of Earth's gravitational influence is more/less than the energy required to project a sationary object at the same height (as the satellite) out of Earth's influence.

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7. The escape velocity of a body form the earth depends on

(i) the mass of the body.

(ii) the location from where it is projected.

(iii) the direction of projection.

(iv) the height of the location form where the body is launched.

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8. A comet orbits the Sun in a highly elliptical orbit. Does the comet have a constant (a) linear speed (b) angular speed (c) angular momentum (d) kinetic energy (e) potential energy (f) total energy throughout its orbit? Neglect any mass loss of the comet when it comes very close to the Sun.

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9. Which of the following symptoms is likely to afflict an astronaut in space (a) swollen feet, (b) swollen face, (c) headache, (d) orientational problem.

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10. The gravitation intensity at the centre C of the drumhead defined by a hemispherical shell has the direction indicated by the arrow [see

Fig. 8.46]

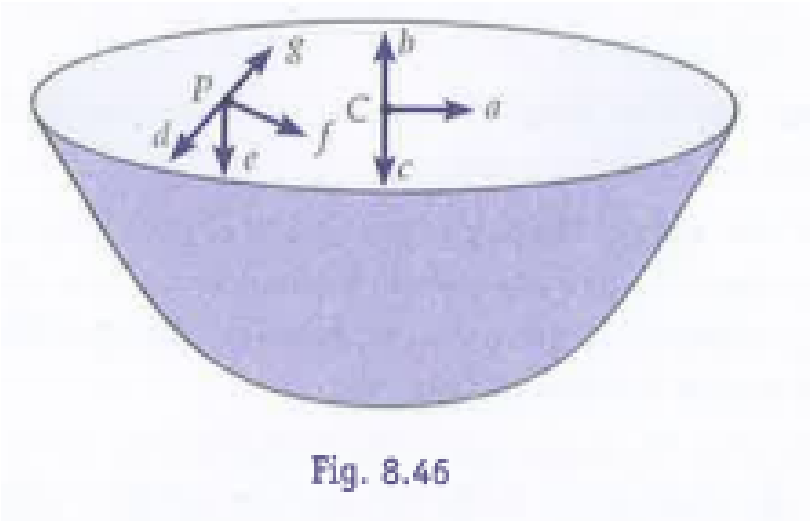

Fig. 8.46

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11. For the above problem, the direction of the gravitational intensity at an arbitrary point P is indicated by the arrow (i) d, (ii), e, (iii) f (iv) g.

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12. How far from Earth must a body be along a line joining the sun to the earth so that resultage gravitational pull on the body due to

Earth and sun is zero ? Distance between sun and the Earth is $1.5 \times 10^8 km$. Mass of sun $= 3.25 \times 10^5$ times mass of Earth.

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13. Estimate the mass of the sun, assuming the orbit of Earth around the sun to be a circle. The distance between the sun and the Earth is $1.49 \times 10^{11} m$, and $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

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14. A saturn year is 29.5 times the earth year. How far is the saturn from the sun if the earth is 1.5×10^8 away from the sun?

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15. A body weighs $64N$ on the surface of Earth. What is the gravitational force on it due to the earth, at a height equal to half the radius of Earth ? Acceleration due to gravity on the surface of Earth is $10ms^{-2}$.

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16. A body weighs 250N on the surface of the earth. How much will it weighs half way down to the centre of the earth?

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17. A rocket is fired vertically upwards with a speed of $v\left(=5kms^{-1}\right)$ from the surface of earth. It goes up to a height h before returning to earth. At height h a body is thrown from the rocket with speed v_0 in such away so that the body becomes a satellite of earth. Let the mass of the earth, $M=6\times10^{24}kg$, mean radius of the earth,

$R = 6.4 \times 10^6 m, G = 6.67 \times 10^{-11} Nm^2 kg^{-2}, g = 9.8 ms^{-2}$.

Answer the following questions:

The value of h is

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18. The escape speed of a body on the earth's surface is $11.2 kms^{-1}$. A body is projected with thrice of this speed. The speed of the body when it escape the gravitational pull of earth is

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19. A satellite of a mass m orbits the earth at a hight h above the surface of the earth. How much energy must be expended to rocket the satellite out of earth's gravitational influence? (where M_E and R_E be mass and radius of the earth respectively)

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20. Two stars each of mass M and radius R are approaching each other for a head-on collision. They start approaching each other when their separation is $r > > R$. If their speed at this separation are negligible, the speed v with which they collide would be

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21. Two heavy sphere each of mass $100kg$ and radius $0.10m$ are placed $1.0m$ 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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ADDITIONAL EXERCISES

1. A geostationary satellite orbits the Earth at a height of nearly $36,000km$ from the surface of earth. What is the potential due to earth's gravity at the site of tthis satllite ? (Take the potential energy at infinity to be zero). Mass of the Earth $= 6.0 \times 10^{24}kg$, radius $= 6400km, G = 6.67 \times 10^{-11}Nm^2/kg^2$.

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2. A star 2.5 times the mass of the sun and collapsed to a size of the $12km$ rotates with a speed of 1.5 rev.per second. (Extremely compact stars of this kind are known as neutron stars. Centain onserved steller objects called pulsars are believed to belong this category). Will an object placed on its equator remain struck to its surface due to gravity ? (Mass of the sun $= 2 \times 10^{30}kg$).

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3. A space-ship is stationed on Mars. How much energy must be expended on the spaceship to rocket it out of the solar system ? Mass of the spaceship $= 1000kg$, Mass of the sun $= 2 \times 10^{30}kg$. Mass of the Mars $= 6.4 \times 10^{23}kg$, Radius of Mars $= 3395km$. Radius of the orbit Mars $= 2.28 \times 10^{11}m$, $G = 6.67 \times 10^{-11}Nm^2kg^{-2}$.

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4. A rocket of mass m is field vertically from the surface of Mars of mass M, radius R with a sped v. If $20\,\%$ of its initial energy is lost due to Martain atmosheric resistance, how far will the rocket go from the surface of Mars before returing to it? Let G be the gravational constant.

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VERY SHORT ANSWER QUESTIONS

1. Moelcules in air in the atmosphere are attracted by gravitational force of the earth. Explain why all of them do not fall into the earth just like an apple falling from a tree.

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2. Give one example each of central and non-central force.

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3. Draw areal velocity time graph for Mars.

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4. What is the direction of areal velocity of the earth around the sun?

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5. How is the gravitational force between two point masses affected when they are dipped in water keeping the separation between them the same ?

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6. Is it possible for a body to have inertia but no weight?

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7. We can shield a charge from electric fields by putting it inside a hollow conductor. Can we shield a body from the gravitational

influence of nearby matter by putting it inside a hollw sphere or by some other means ?

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8. An astronaut inside a small spaceship orbitting around the earth cannot detect gravity. If the space station orbtitting around the earth has a large size, can he hope to detect gravity ?

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9. 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).

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10. Out of aphelion and perihelion, where is the speed of the earth more and why ?

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11. What is the angle between the equatorial plane and the orbital plane of (a) Polar satellitee ? (b) Geostationary satellite?

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QUESTIONS

1. A mass m is at a distance a from one end of a uniform rod of length l and mass M. Find the gravitational force on the mass due to

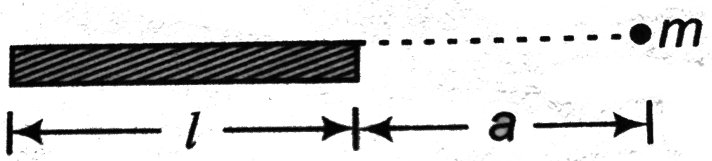

Fig. 13.12

the rod.

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2. If the radius of the earth decreases by 1% without changing its mass, will the acceleration due to gravity at the surface of the earth increase or decrease? If so, by what percent?

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3. A missile is fired radially from the surface of earth (radius $6.4 \times 10^6 m$) at a satellite, orbiting the earth. The satellite appears stationary vertically upwards from the point where the missile is

launched. Its distance from the centre of the earth is $25.4 \times 10^6 m$. Will the missile actually hit the satellite?

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4. At noon, the sun and the earth pull the objects on the earth's surface in opposite directions. At midnight, the sun and the earth pull these objects in same direction. Is the weight of an object as measured by a spring balance on the earth's surface , more at midnight as compared to its weight as noon?

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5. The largest and the shorest distance of earth from the sun $1.1AU$ and $0.92AU$. What is its distance from the sun when it is perpendicular to the major axis of the orbit drawn from the sun ?

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6. Explain the use of multistage rockets in launching a satellite.

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7. Assertion: A person sitting in an artificial satellite revolving around the earth feels weightless.

Reason: There is no gravitational force on the satellite.

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8. Can a satellite move in a stable orbit in a plane not passing through the earth's centre ? Explain.

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9. Among the known types of forces in nature, the gravitational force is the weaknest. Why then does it play a dominant role for motion of bodies on the terrestrial astronomical and cosmological scale?

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10. All planets are spherical, why are they not cubical or cylindrical?

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11. A mass m is at a distance a from one end of a uniform rod of length l and mass M. Find the gravitational force on the mass due to

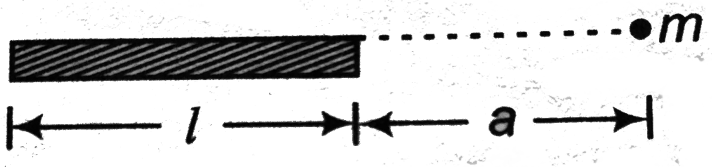

Fig. 13.12

the rod.

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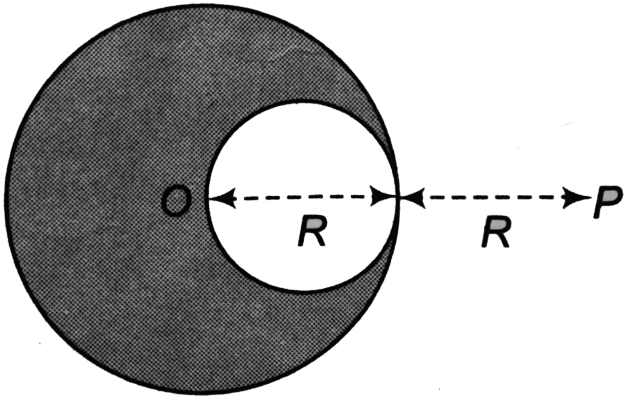
12. A solid sphere of uniform density and radius R applies a gravitational force of attraction equal to F_1 on a particle placed at P , distance $2R$ from the centre O of the sphere. A spherical cavity of radius $R/2$ is now made in the sphere as shown in figure. The particle with cavity now applies a gravitational force F_2 on same particle placed at P. The radio F_2/F_1 will be



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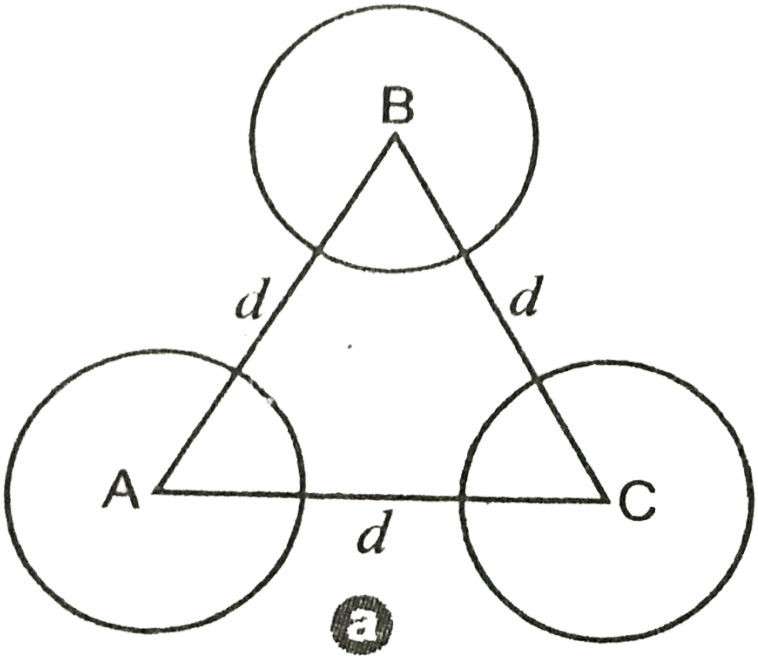
13. Three solid spheres each of mass m and radius R are released from the position shown in Fig. What is the speed of any one sphere at the time of collision?



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14. Find the intensity of gravitational field at a point lying at a distance x from the centre on the axis of a ring of radius a and mass

M.

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VALUE BASED QUESTIONS

1. According to Newton's law of gravitational, everybody in this universe attracts every other body with a force, which is directly proportional to the product of their masses and is inversely proportional to the square of the distance between their centres, i.e., $F \propto \frac{m_1 m_2}{r^2}$ or $F = \frac{G m_1 m_2}{r^2}$

where G is universal gravitational constant $= 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

(i) What is the value of G on the surface of moon?

(ii) How is the gravitational force between two bodies affected when distance between them is halved?

(iii) What values of like do you learn from this law?

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2. Everybody, when free, falls towards the centre of earth with an acceleration $= g$, which is called acceleration due to gravity. The value of g on the surface of earth is, $g = \frac{GM}{R^2} = 9.8m/s^2$. It is a vector, directed always the centre of earth. The value of g does not depend upon shape, size or mass of the body. Rether, it depends on mass and size of earth (or planet due to which there is a gravity pull). Read the above passesge and answer the following questions :

(i) A piece of stone and a feather are dropped together in space from the same height. which one will strike the ground first ? (ii) The mass of a planet is $\frac{1}{8}th$ the mass of earth and its diameter is $\frac{5}{6}$ the diameter of earth. What is the value of 'g' on the surface of this planet.

(iii) What does the concept of free fall imply in day to day life?

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3. Whenever a body is thrown vertically upwards with a certain velocity, the upwards motion is opposed by gravitational pull of earth and resisatnce of air. The velocity of the body goes on decreasing at a constant rate $(= -g)$.As soon as upward velocity of body becomes zero, it cannot rise any more. The height it has attained is the maximum height. The body then begins to fall downwards with an acceleration $= g$.

Read the above passege and answer the following questions :

(i) A body is thrown upwards with a velocity of $19.6m/s$. What is the maximum height attained?

(ii) With what velocity will the body hit the ground?

(iii) What are the implications of this study in day to day life ?

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4. The escape velocity of a body from the surface of earth is the minimum velocity of projection of the body from the surface, which would take the body just beyound the gravitational field of earth.

Once the body crosses the gravitational field of earth, it will never return to earth on its own. The body is said to have esacped. If M is mass of earth and R is radius of earth, then esacpe velocity, $V_e = \sqrt{\frac{2GM}{R}} = \sqrt{2gR}$. The value of V_e does not depend upon mass of the body.

Read the above passega and answer the following questions :

(i) What is the escape velocity from the surface of earth for a body of mass $2kg$ and for another body of mass $20kg$? Is the energy required in the two cases same ?

(ii) What value of life do you learn from this study ?

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5. While studying the theory of planetary motion, kepler established three laws. According to kepler's second law, the line joining a planet to the sun sweeps out equal areas in equal intervals of time, i.e., the areal velocity of the planet around the sun is constant. This led him to conlude from the sun.

Read the above passege and answer the following questions :

(i) What is the basis of kepler's second law?

(ii) Mercury is closer to the sun than the earth. Will time period of mercury be less or more than one year ? Why ?

(iii) What value of life do you learn from kepler's second law?

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CURIOSITY QUESTION

1. What are the medical problems an astronaut will face when in space for long time while orbiting around a planet in a satellite.

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MULTIPLE CHOICE QUESTIONS

1. Two satellite of mass m and $9m$ are orbiting a planet in orbits of radius R. Their periods of revolution will be in the ratio of

A. $9:1$

B. $3:1$

C. $1:1$

D. $1:3$

Answer: C

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2. The value of g at a particular point is $10ms^{-2}$. Suppose the earth shrinks uniformly to half of 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 the earth does not change) will now be

A. $4.9m/s^2$

B. $3.1m/s^2$

C. $9.8m/s^2$

D. $19.6m/s^2$

Answer: C

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3. 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. S_1 and S_2

B. S_1 and S_4

C. S_2 and S_3

D. S_2 and S_4

Answer: D

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4. 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 :

A. $R/\sqrt{2}$

B. $R/2$

C. $R/\sqrt{2}$

D. $2R$

Answer: D

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

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

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

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

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

Answer: A

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6. A man standing on an international space sattion, which is orbiting earth at an altitude $520km$ with a constant speed $7.6km/s$. If the man's weight is $50kg$, this acceleration is (radius of earth is $6400km$ and value of g on earth is $9.8m/s^2$).

A. $4.6ms^{-2}$

B. $7.6ms^{-2}$

C. $8.4ms^{-2}$

D. $10ms^{-2}$

Answer: C

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7. The acceleration due to gravity at a height $1km$ above the earth is the same as at a depth d below the surface of earth. Then :

A. $10km$

B. $7.5km$

C. $5km$

D. $2.5km$

Answer: A

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8. 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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9. The time period of a sceond's pendulum in a satellite is

A. zero

B. 2

C. infinity

D. depends on the mass of body

Answer: C

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10. Statement-1 : The escape velocity from the earth is v_e. The esacpe velocity from a planet whose radius is twice that of the earth and

mean density is same as that of the earth is $2v_e$.

Statement-2 : $v_e = \sqrt{gR}$

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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11. 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. be similarly true.

B. not be true because the force between earth and mecury 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 force.

Answer: C

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12. 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: A

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13. 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 satellites run out.

B. the laws of gravitational perdict a trajectory spiralling inwards.

C. of various forces causing the speed of satellite and hence height to gradually decrease.

D. of collisions with other satellites.

Answer: C

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14. 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 the total gravitational force on it is central.

C. os not elliptical but will necessarily be a closed curve.

D. deviates considerably from being elliptical due to influence of plants other than earth.

Answer: B

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15. 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 very small masses compared to sun.

B. will move in an irregular way because of their small masses and will drift away into outer space.

C. will 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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16. Choose the wrong option.

A. inertial mass is a measure of difficulty of accelerating a body by an external force whereas the gravitational mass is relevent in determining the gravitational force on it by an external mass.

B. That the gravitational mass and intertial 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 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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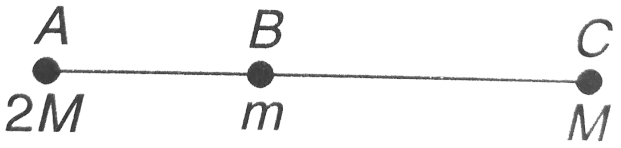
17. particles of masses 2M m and M are resectively at points A , B and C with $AB = \frac{1}{2}(BC)$ m is much - much smaller than M and at time $t = 0$ they are all at rest as given in figure . As subsequent times before any collision takes palce .



A. m will remains at 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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18. If the law of gravitational, instead of being inverse-square law, becomes an inverse-cube law

A. planets will not have elliptic 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 appoximately perabolic.

D. there will be no gravitational force inside a spherical shell of uniform density.

Answer: A::B::C

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19. If the mass of the sun were ten times smaller and the universal gravitational constant were ten times larger in magnitude, which of the following is not correct?

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 muck faster.

Answer: A::C::D

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20. If the sun and the planets carried huge amounts of opposite charges

A. all three 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: A::C::D

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21. 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 that happens, for our earth

A. nothing will change.

B. we will become hotter after billions of years.

C. we will be going around but not strictly in closed orbits.

D. after sufficiently long time we will leave the solar system.

Answer: C::D

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22. 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 $F_2 = -F_2 = \frac{r_{12}}{r_{12}^3} G M_0^2 \left(\frac{m_1 m_2}{M_0^2} \right)^n$ 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 of kepler will be valid.

C. only of the third law will become invalid.

D. for n negative, an object ligther than water will sink in water.

Answer: A::C::D

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23. 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 east-west direction.

Answer: A::C

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24. The centre of mass of a body

A. are always at the 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. is close to each other for objects, say of sizes less than $100m$.

Answer: D

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25. The largest and the shortest distance of the earth from the sun are r_1 and r_2, its distance from the sun when it is at the perpendicular to the major axis of the orbit drawn from the sun

A. $\frac{r_1 + r_2}{4}$

B. $\frac{r_1 + r_2}{r_1 - r_2}$

C. $\frac{2r_1 r_2}{r_1 + r_2}$

D. $\frac{r_1 + r_2}{2}$

Answer: C

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26. 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. 1.0%

C. 1.5%

D. 3.0%

Answer: C

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27. A geo-stationary stellite orbits around the earth in a circular orbit of radius 36,000km. Then, the time period of a spy stellite orbitting a few hundred km above the earth's surface $(R_{earth} = 6400km)$ will approximately be

A. $1/2hr$

B. $1hr$

C. $2hr$

D. $4hr$

Answer: C

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28. Two small satellies move in a circular orbits around the earth, at disatnce r and $(r+dr)$ from the centre of the earth. Their time periods of rotation ate T and $T+dT(\Delta r << br, \Delta T << T)$. Then

A. $\Delta T = \frac{3}{2}T\frac{\Delta r}{r}$

B. $\Delta T = \frac{-3}{2}T\frac{\Delta r}{r}$

C. $\Delta T = \frac{2}{3}T\frac{\Delta r}{r}$

D. $\Delta T = T\frac{\Delta r}{r}$

Answer: A

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29. A system of binary stars of mass m_A and m_B are moving in circular orbits of radii r_A and r_B respectively. If T_A and T_B are at the time periods of masses m_A and m_B respectively then

A. $\frac{T_A}{T_B} = \left(\frac{r_A}{r_B}\right)^{1/2}$

B. $T_A > T_B($ if $r_A > r_B)$

C. $T_A > T_B($ if $m_A > m_B)$

D. $T_A = T_B$

Answer: D

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30. 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. 10

B. 13

C. $8\sqrt{3}$

D. $8\sqrt{3}$

Answer: B

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31. A satellite moves in a circle around the earth. The radius of this circle is equal to one half of the radius of the moon's orbit. The satellite completes one revolution is :

A. $1/2$ lunar month

B. $2/3$ lunar month

C. $2^{-3/2}$ lunar month

D. $2^{3/2}$ lunar month

Answer: C

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32. A geostationary satellite orbits around the earth in a circular orbit of radius $3600km$. Then the time period of satellite orbiting $= 2600km$ above the earth's surface $(R_{earth} = 6400km)$ will appoximetely be

A. $1/2hr$

B. $1hr$

C. $3hr$

D. $4hr$

Answer: C

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33. If the distance between the earth and the sun were half its present value, the number of days in a year would have been

A. 64.5

B. 70.24

C. 182.5

D. 730

Answer: B

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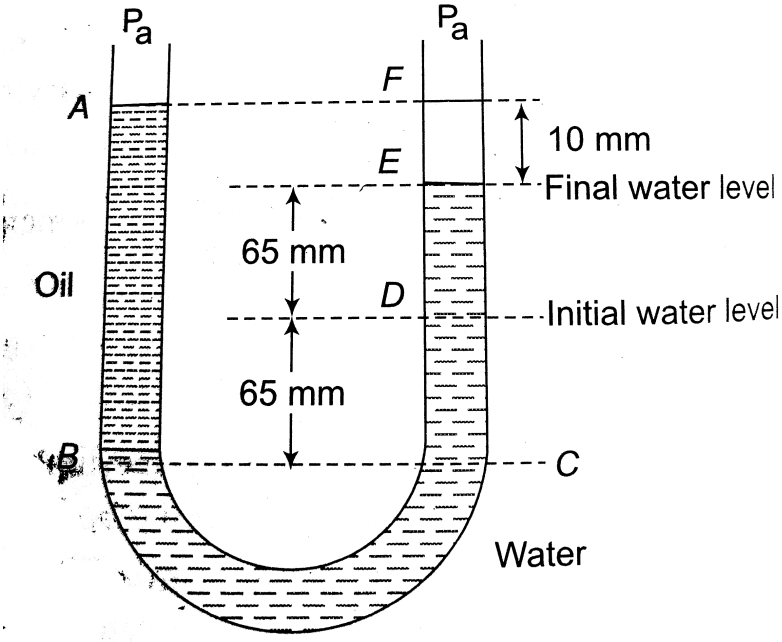
34. A U-tube with both ends open to the atmosphere is partially filled with water. Oil, which is immiscible with water. Is poured into one side until it stands at a distance of $10mm$ above the water level on the other side. Meanwhile the water rises by $65mm$ from its original level (see diagram). The density of the oil is:



A. $650kgm^{-3}$

B. $425kgm^{-3}$

C. $800kgm^{-3}$

D. $928 kgm^{-3}$

Answer: D

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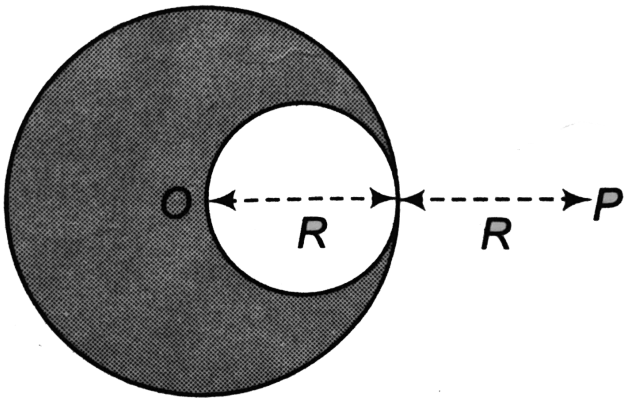
35. A solid sphere of uniform density and radius R applies a gravitational force of attraction equal to F_1 on a particle placed at P , distance $2R$ from the centre O of the sphere. A spherical cavity of radius $R/2$ is now made in the sphere as shown in figure. The particle with cavity now applies a gravitational force F_2 on same

particle placed at P. The radio F_2 / F_1 will be



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

B. $\frac{2F}{3}$

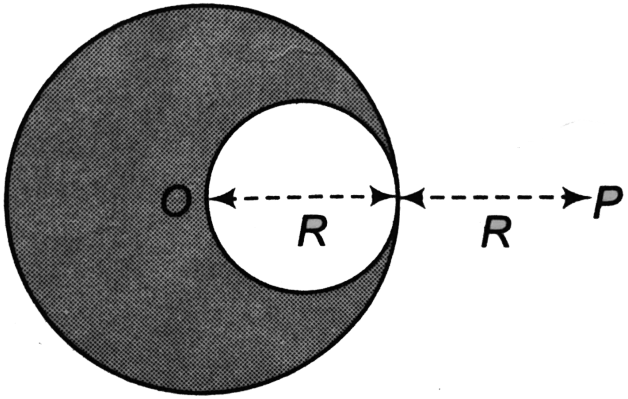
C. $\frac{4F}{3}$

D. $\frac{7F}{9}$

Answer: D

Watch Video Solution

36. A solid sphere of uniform density and radius R applies a gravitational force of attraction equal to F_1 on a particle placed at P, distance $2R$ from the centre O of the sphere. A spherical cavity of radius $R/2$ is now made in the sphere as shown in figure. The particle with cavity now applies a gravitational force F_2 on same particle placed at P. The radio F_2/F_1 will be



A. $3/25$

B. $9/50$

C. $22/25$

D. $41/50$

Answer: D

Watch Video Solution

37. In the above question, if the soild sphere is a large rock, what is the gravitational acceleration at a point on the surface of the rock at a point just above the cavity ?

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

B. $\frac{GM}{2R^2}$

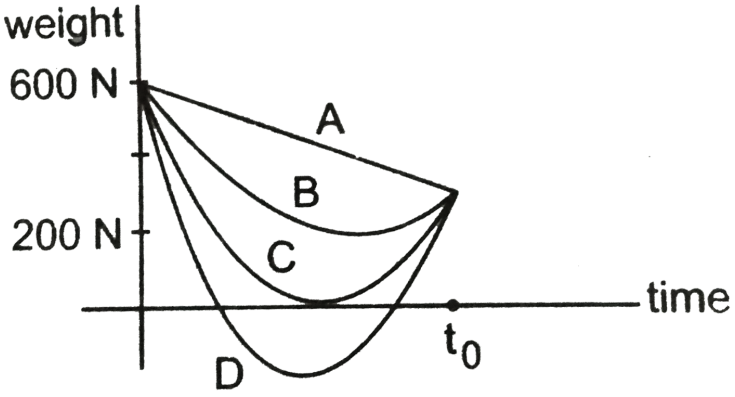
C. $\frac{GM}{8R^2}$

D. $\frac{7GM}{8R^2}$

Answer: B

Watch Video Solution

38. Suppose the acceleration due to gravity at earth's surface is $10ms^{-2}$ and at the surface of Mars it is $4.0ms^{-2}$. A passenger goes from the to the mars in a spaceship with a constant velocity. Neglect all other object in sky. Which part of figure best represent the weight (net gravitational force) of the passenger as a function of time?



A. A

B. B

C. C

D. D

Answer: C

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39. A mass m is at a distance a from one end of a uniform rod of length l and mass M. Find the gravitational force on the mass due to

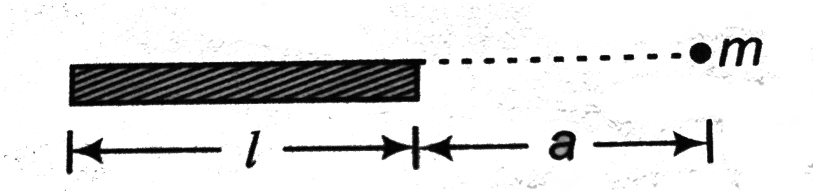

Fig. 13.12

the rod.

A. $\frac{GM^2}{L^2}$

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

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

D. $\frac{4GM^2}{9L^2}$

Answer: B

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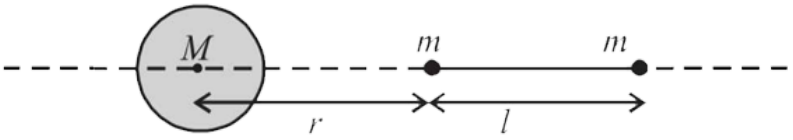
40. A larger spherical mass M is fixed at one position and two identical point masses m are kept on a line passing through the centre of M. The point masses are connected by rigid massless rod of length l and this assembly is free to move along the line connecting them. All three masses interact only 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



A. 3

B. 6

C. 7

D. 9

Answer: C

Watch Video Solution

41. 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.

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

B. $\sqrt{\frac{2\sqrt{2}GM}{r}}$

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

D. $\sqrt{\frac{GM}{r}\frac{2\sqrt{2}+1}{4}}$

Answer: D

Watch Video Solution

42. 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. $2.5R$

B. $4.5R$

C. $7.5R$

D. $1.5R$

Answer: C

Watch Video Solution

43. A body weighs $700gm$ wt on the surface of the earth. How much will it weigh on the surface of a planet whose mass is $\frac{1}{7}$ and radius is half that of the earth

A. $400gm$

B. $300gm$

C. $700gm$

D. $500gm$

Answer: A

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44. Mass remaining constant, the radius of the earth shrinks by 1%. The acceleration due to gravity on the earth's surface would

A. increase by $1\ \%$

B. decrease by $2\ \%$

C. decrease by $1\ \%$

D. increase by $2\ \%$

Answer: B

Watch Video Solution

45. The density of a newly discovered planet is twice that of earth. The acceleration due to gravity at the surface of the planet is equal to that at the surface of the earth. If the radius of the earth is R, the radius of the planet would be

A. $2R$

B. $4R$

C. $R/4$

D. $R/2$

Answer: D

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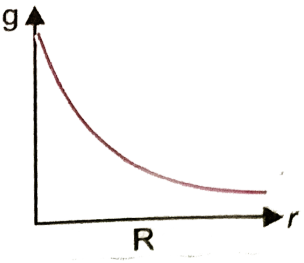
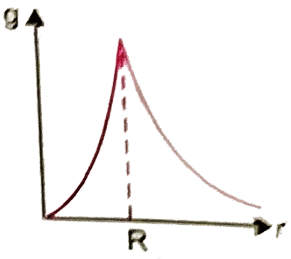
46. The dependence of acceleration due to gravity g on the distance r from the centre of the earth, assumed to br a sphere of radius R of uniform density is as shoen in Fig. below:

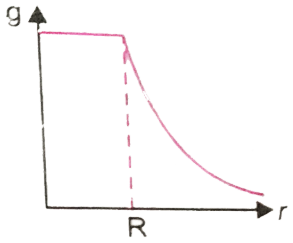
(1)



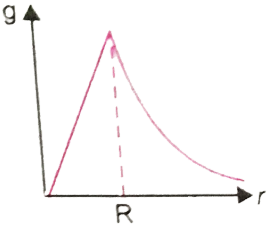
(2)



(3)



(4)



The correct figure is

A. (4)

B. (1)

C. (2)

D. (3)

Answer: A

Watch Video Solution

47. A planet of radius $R = \frac{1}{10} \times (radius of Earth)$ has the same mass density as Earth. Scientists dig a well of depth $\frac{R}{5}$ on it and

lower a wire of the same length and a linear mass density $10^{-3}kgm(\_1)$ into it. If the wire is not touching anywhere, the force applied at the top of the wire by a person holding it inplace is (take the radius of Earth $= 6 \times 10^6 m$ and the acceleration due to gravity on Earth is $10ms^{-2}$

A. $96N$

B. $108N$

C. $120N$

D. $150N$

Answer: B

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48. A particle hanging from a spring stretches it by 1 cm at earth's surface. How much will the same particle stretch the spring at a

place 800 km above the earth's surface/ Radius of the earth=6400 km.

A. $16/50cm$

B. $16/25cm$

C. $24/16cm$

D. $50/16cm$

Answer: B

Watch Video Solution

49. What is the percentage change in the value of g as we shift from equator to pole on the surface of earth ? (Given equatorial radius of earth is greater than polar radius by $21km$ and mean radius of earth is $6300km$).

A. $0.52\ \%$

B. $0.67\,\%$

C. $1.67\,\%$

D. $6.7\,\%$

Answer: B

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50. A body weights 98 N on a spring balance at the north pole. What will be its weight recorded on the same scale if it is shifted to te equator? Use g=$G\frac{M}{R^2} = 9.8\frac{m}{s^2}$ and the radius of the earth R=6400 km.

A. $99.66N$

B. $110N$

C. $97.66N$

D. $106N$

Answer: A

Watch Video Solution

51. The ratio of radii of earth to another planet is $2/3$ and the ratio of their mean densities is $4/5$. If an astronaut can jump to a maximum height of $1.5m$ on the earth, with the same effort, the maximum height he can jump on the planet is

A. $1m$

B. $0.8m$

C. $0.5m$

D. 1.24 m

Answer: B

Watch Video Solution

52. 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 v 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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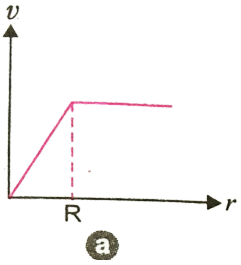
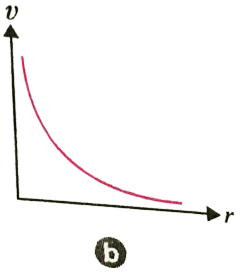
53. A spherically symmetric gravitational system of particles has a mass density$\rho=\begin{cases}\rho_0 & f\ \text{or} \quad r<R\\ 0 & f\ \text{or} \quad r>R\end{cases}$ whereρ_0 is a constant. A test mass can undergo circular motion under the influence of the

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

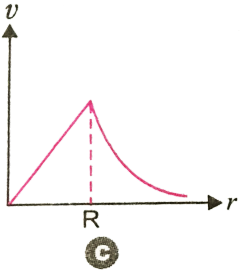
A.



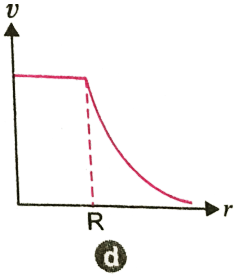
B.



C.



D.



Answer: C

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54. 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. K/x

B. $K/2x$

C. K/x^2

D. $K/2x^2$

Answer: D

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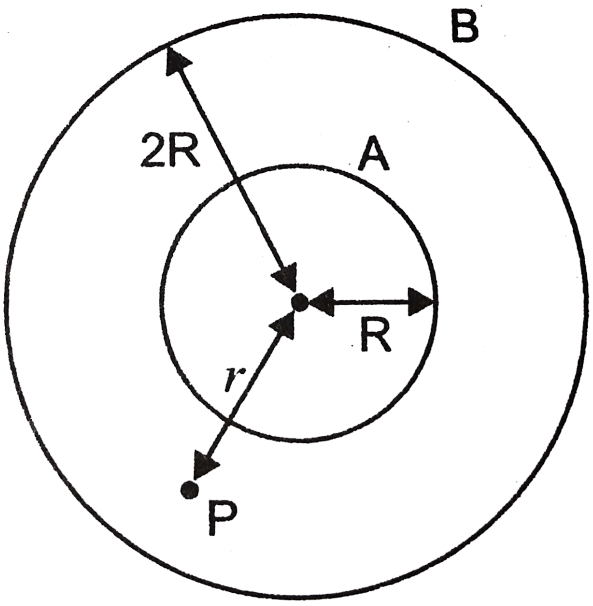
55. Two concentric spherical shells A and B of radii R and $2R$ and mases $4M$, and M, respectively are placed in space as shown in Fig. The gravitational potential at P at a distance $r(R < r < 2R)$from the centre of shells is



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

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

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

D. none of these

Answer: D

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56. At what height from the surface of earth the gravitation potential and the value of g are $-5.4 \times 10^7 Jkg^{-2}$ and $6.0ms^{-2}$ respectively ? Take the radius of earth as $6400km$:

A. $2600km$

B. $1600km$

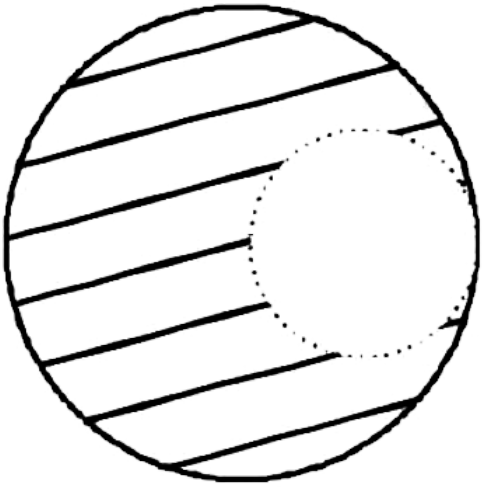
C. $1400km$

D. $2000km$

Answer: A

Watch Video Solution

57. From a solid sphere of mass M and radius R, a spherical portion of radius R/2 is removed, as shown in the figure Taking gravitational potential $V = 0 at r = \infty$, the potential at (G = gravitational constant)



A. $-\frac{2GM}{3R}$

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

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

D. $\frac{-2GM}{R}$

Answer: B

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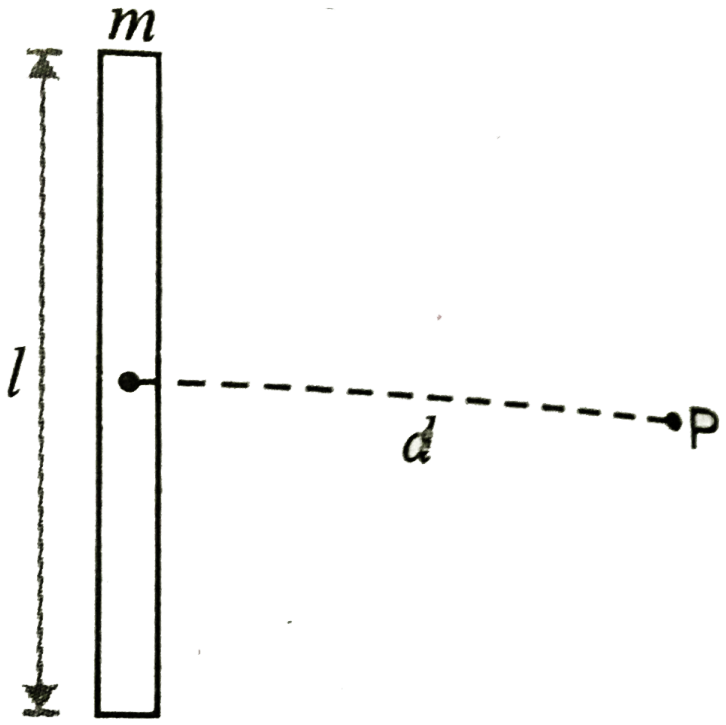
58. A uniform rod of mass m and length l is taken. Find the gravitational field intensity at point P at distance d which is on the perpendicular bisector of the rod as shown in Fig.



A. $\frac{4Gm}{d\sqrt{4d^2+l^2}}$

B. $\frac{2Gm}{d\sqrt{l^2+4d^2}}$

C. $\frac{2\sqrt{2}Gm}{d\sqrt{l^2+4d^2}}$

D. none of the above

Answer: B

Watch Video Solution

59. A point P lies on the axis of a fixed ring of mass M and radius a, at a distance a from its centre C. A small particle starts from P and reaches C under gravitational attraction only. Its speed at C will be.

A. $\sqrt{\frac{2GM}{a}}$

B. $\sqrt{\frac{2GM}{a}\left(1-\frac{1}{\sqrt{2}}\right)}$

C. $\sqrt{\frac{2GM}{a}(\sqrt{2}-1)}$

D. zero

Answer: B

Watch Video Solution

60. Infinite number of masses, each of $1kg$, are placed along the x-axis at $x = \pm 1m, \pm 2m, \pm 4m, \pm 8m, \pm 16m..$ The gravitational of the resultant gravitational potential in term of gravitaitonal constant G at the origin $(x = 0)$ is

A. $G/2$

B. G

C. $2G$

D. $4G$

Answer: D

Watch Video Solution

61. 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

Watch Video Solution

62. 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.

A. $\frac{2GM}{a}$

B. $\frac{3GM}{a}$

C. $\frac{4GM}{a}$

D. $\frac{GM}{a}$

Answer: B

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63. 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. $-2J/kg$

B. $-3J/kg$

C. $-5J/kg$

D. $-7J/kg$

Answer: C

Watch Video Solution

64. 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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65. 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. $\frac{-\sqrt{2}Gm^2}{l}\left(2-\frac{1}{\sqrt{2}}\right)$

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

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

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

Answer: B

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66. A satellite of mass m is in a circular orbit of radius $2R_E$ about the earth. The energy required to transfer it to a circular orbit of radius $4R_E$ is (where M_E and R_E is the mass and radius of the earth respectively)

A. $1.65 \times 10^9 J$

B. $3.13 \times 10^9 J$

C. $6.26 \times 10^9 J$

D. $4.80 \times 10^9 J$

Answer: B

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67. A body is projected vartically upwards from the bottom of a crater of moon of depth $\frac{R}{100}$ where R is the radius of moon with a velocity equal to the escape velocity on the surface of moon. Calculate maximum height attained by the body formt eh surface of the moon.

A. R

B. $85R$

C. $99R$

D. $100R$

Answer: C

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68. A body is released from a point of distance R' from the centre of earth. Its velocity at the time of striking the earth will be $(R' > R_e)$

A. $\sqrt{2gr}$

B. $\sqrt{2g(R+r)}$

C. $R\left[2g\left(\frac{1}{R}-\frac{1}{r}\right)\right]^{1/2}$

D. $\left[2g\left(\frac{1}{r}-\frac{1}{R}\right)\right]^{1/2}$

Answer: C

Watch Video Solution

69. A rocket is launched vertically from the surface of earth with an initial velocity v. How far above the surface of earth it will go? Neglect the air resistance.

A. $\sqrt{2gR}$

B. $u^2/2g$

C. $\left[\frac{2g}{u^2} - \frac{1}{R}\right]$

D. $\left[\frac{2g}{u^2} - \frac{1}{R}\right]^{-1}$

Answer: D

Watch Video Solution

70. If a body is to be projected vertically upwards from earth's surface to reach a height of $10R$ where R is the radius of earth. The velocity required to be si is

A. $\sqrt{\frac{24}{11}gr}$

B. $\sqrt{\frac{22}{11}gr}$

C. $\sqrt{\frac{20}{11}gr}$

D. $\sqrt{\frac{18}{11}gr}$

Answer: C

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71. A body is projected vertically upwards from the surface of a planet of radius R with a velocity equal to hall the escape velocity for that planet. The maximum height attained by the body is

A. $R/2$

B. $R/3$

C. $R/5$

D. $R/4$

Answer: B

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72. 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. $1/2$

B. $\sqrt{2}$

C. $1/\sqrt{2}$

D. $1/3$

Answer: C

Watch Video Solution

73. 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?

A. $\frac{5GmM}{6R}$

B. $\frac{2GmM}{3R}$

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

D. $\frac{GmM}{3R}$

Answer: A

Watch Video Solution

74. A body of mass m is lifted up from the surface of earth to a height three times the radius of the earth R. The change in potential energy of the body is

A. $\frac{1}{4}mgR$

B. $\frac{2}{3}mgR$

C. $\frac{3}{4}mgR$

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

Answer: C

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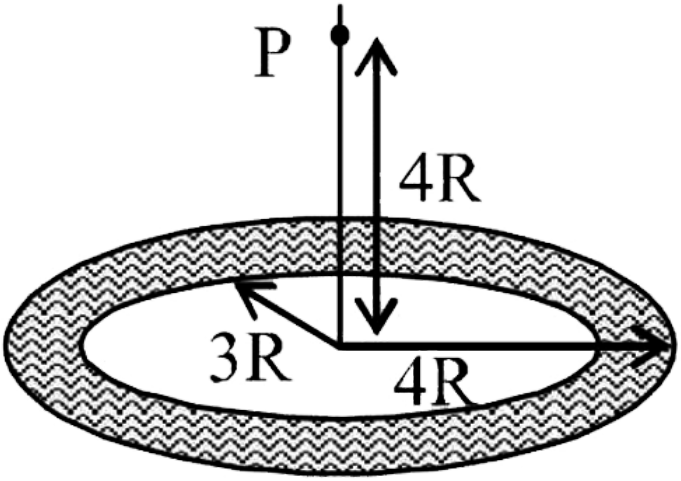
75. A thin uniform disc (see figure) of mass M has outer radius 4R and inner radius 3R. The work required to take a unit mass for point

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

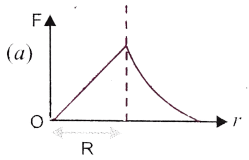
D. $\frac{2GM}{5R}\left(\sqrt{2}-1\right)$

Answer: A

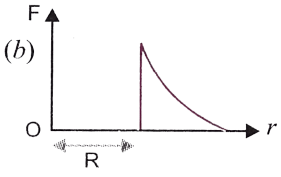
Watch Video Solution

76. 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.



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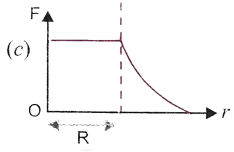

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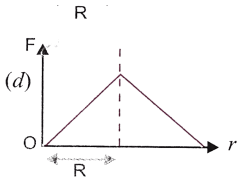

Answer: B

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77. 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. $GMK = 4\pi^2$

B. $K = G$

C. $K = \frac{1}{G}$

D. $GK = 4\pi r^2$

Answer: A

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Watch Video Solution

78. 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^{-n}

B. R^{n}

C. $R^{(n-1)/2}$

D. $R^{(n+1)/2}$

Answer: D

Watch Video Solution

79. Which of the following statement is correct about satellites?

A. A satellite can not move in a stable orbit in a plane passing through the earth's centre

B. Geostationary satellites are launched in the equatorial plane

C. We can just geostationary satellite for global communication around the globle

D. The speed of a satellite increases with an increase in the radius of its orbit.

Answer: B

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80. A rocket is launched normal to the surface of the earth, away from the sun, along the line joining the sun and the earth. The sun is 3×10^5 times heavier than the earth and is at a distance 2.5×10^4 times larger than the radius of the earth. the escape velocity from

earth's gravitational field is $u_e = 11.2ms^{-1}$. The minmum initial velocity $(u_e) = 11.2ms^{-1}$. the minimum initial velocity (u_s) required for the rocket to be able to leave the sun-earth system is closest to (Ignore the rotation of the earth and the presence of any other planet

A. $v_s = 22kms^{-1}$

B. $v_s = 72kms^{-1}$

C. $v_s = 42kms^{-1}$

D. $v_s = 62kms^{-1}$

Answer: C

Watch Video Solution

81. A satellite orbits around the earth in a circular orbit with a speed v and orbital radius r. If it loses some energy, then v and r chsnges as

A. v decreases and r increases

B. both v and r decreases

C. v increases and r decreases

D. both v and r increases

Answer: C

Watch Video Solution

82. A satellite in a force-free space sweeps stationary interplantary dust at a rate $\frac{dM}{dt} = \beta v$, where v is the speed of escaping dust w.r.t. satellite and M is the mass of saetllite at that instant. The acceleration of satellite is

A. $-\beta v^2$

B. $-\beta v^2 / 2M$

C. $-\beta v^2 / M$

D. $-M\beta/v^2$

Answer: C

Watch Video Solution

83. A satellite is moving around the earth's with speed v in a circular orbit of radius r. If the orbit radius is decreases by 1% , its speed will

A. increase by 1%

B. increases by 0.5%

C. decrease by 1%

D. decreases by 0.5%

Answer: B

Watch Video Solution

84. If a satellites is revolving close to a planet of density ρ with period T, show that the quantity ρT^2 is a universal constant.

A. $4\pi^2 G$

B. $4\pi^2 / G$

C. $3\pi / G$

D. $1 / G$

Answer: C

Watch Video Solution

85. 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. $3V / 4$

B. $6V$

C. $12V$

D. $3V/2$

Answer: B

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86. 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

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87. Two bodies, each of mass M, are kept fixed with a separation 2L. A particle of mass m is projected from the midpoint of the line joining their cehntres, perpendicualr to the line. The gravitational constant is G. The correct statement (s) is (are)

A. the minimum initial velocity of the mass m to escape the gravitational field of the two bodies is $4\sqrt{GM/L}$

B. the minimum initial velocity of the mass m to escape the gravitational field of the two bodies is $2\sqrt{GM/L}$

C. the minimum initial velocity of the mass m to escape the gravitational field of the two bodies is $\sqrt{2GM/L}$

D. the energy of mass m remains constant.

Answer: B

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Watch Video Solution

88. 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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89. 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. $1:2$

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

C. $1:4$

D. $1:\sqrt{2}$

Answer: B

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90. 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 constant is magnitude

Answer: A

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91. A satellite is revolving in a circular orbit at a height 'h' from the earth's surface (radius of earth R, h ltltR). The minimum increase in its orbital velocity required, So that the satellite could escape from the erth's gravitational field, is close to :(Neglect the effect of atomsphere.)

A. $\sqrt{2gR}$

B. $\sqrt{gR}$

C. $\sqrt{gR/2}$

D. $\sqrt{gR}(\sqrt{2}-1)$

Answer: D

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92. A particle is fired vertically from the surface of the earth with a velocity kv_e, where v_e is the escape velocity and $k < 1$. Neglecting air resistance and assuming earth's radius as R_e. Calculated the height to which it will rise from the surface of the earth.

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

B. $\frac{R}{k^2}$

C. $\frac{1-k^2}{R}$

D. $\frac{k^2}{R}$

Answer: A

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93. 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 compresed to be a black hole?

A. $10^{-9} m$

B. $10^{-6} m$

C. $10^{-2} m$

D. $100 m$

Answer: C

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94. A bullet is fired vertically upwards with a velocity v from the surface of a spherical planet when it reaches its maximum height, its acceleration due to the planet's gravity is $\frac{1}{4}th$ of its value at the surface of the planet. If the escape velocity from the planet is $V_{\text{escape}} = v\sqrt{N}$, then the value of N is : (ignore energy loss due to atmosphere).

A. 1

B. 2

C. 3

D. 4

Answer: B

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95. Which of the following is true for a satellite in an orbit

A. it is a freely falling body

B. it suffers an acceleration

C. it does not require energy for its motion in the orbit

D. its speed is constant

Answer: A::C::D

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96. Which of the following statements are true about acceleration due to gravity

A. g' is zero at the centre of earth

B. g' decreases if earth stops rotating on its axis

C. g' decreases in moving away from centre if $r > R$

D. g' decrease in moving away from centre if $r < R$

Answer: A::C

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97. Which of the following statements are correct about a planet rotating around the sun in an elleptical orbit

A. its areal velocity is constant

B. its angular momentum is constant

C. its mechanical energy is constant

D. its time period of proprtional to r^3

Answer: A::B::C

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98. If two satellites of different masses are revolving in the same orbit, they have the same

A. speed

B. energy

C. time period

D. angular momentum

Answer: A::C

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99. Choose the correct statement / (s)

A. Weight of a body is greater on planes and less on hill tops

B. Weight of a body is greater on poles and less at the equator

C. Weight of a body on the moon is less than that on earth

D. Weight of a body on the moon is same as that at a height. equal to radius of moon from the surface of earth

Answer: A::B::C

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100. The escape velocity of an object projected from the surface of a given planet is independent of

A. mass of the planet

B. the mass of the object

C. the radius of the planet

D. the direction of projection

Answer: B::D

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101. Consider a planet moving in an elliptical orbit round the sun. The work done on the planet by the gravitational force of the sun

A. is zero in some part of the orbit

B. is zero in no part of the motion

C. is zero in any small part of the orbit

D. is zero in one small part of the orbit

Answer: C::D

Watch Video Solution

102. Which of the following stetement (s) is/are tre for a stationary satellite of the earth ?

A. A satellite is stationary in space

B. Its angular speed is equal to that of earth above its own axis

C. Its time period is 24 hours

D. It revolves around the earth from west to east.

Answer: B::C::D

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103. Three point masses are at the corners of an equilateral traingle of side r. Their separations do not change when the system rotates about the centre of the triangle. For this, the time period of rotation must be proportional to

A. $r^{3/2}$

B. r

C. m

D. $m^{-1/2}$

Answer: A::D

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104. Two objects of masses m and $4m$ are at rest at an infinite separation. They move towards each other under mutual gravitational attraction. If G is the universal gravitaitonal constant, then at separation r

A. the total energy of the two objects is zero

B. net angular momentum of both the objects is zero about any point

C. the total $K.E.$ of the objects is $4Gm^2/r$

D. their relative velocity of approach is

$$\left(\frac{8Gm}{r}\right)^{1/2}$$

Answer: A::B::C

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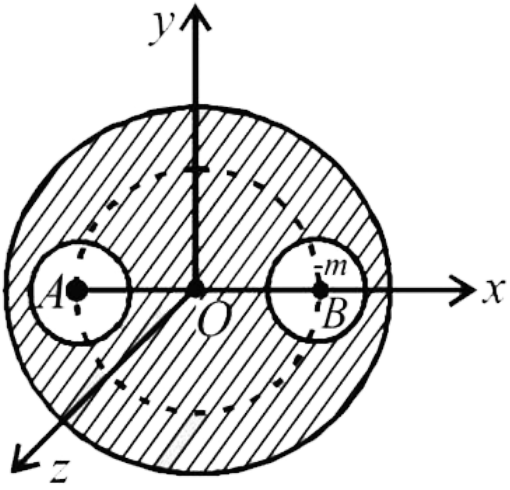
105. A solid sphere of uniform density and radius 4 units is located with its centre at the origin O of coordinates. Two sphere of equal radii 1 unit, with their centres at A(-2,0 ,0) and B(2,0,0) respectively, are taken out of the solid leaving behind spherical cavities as shown if fig Then:



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 circly $y^2 + z^2 = 36$

D. the gravitaitonal potential is the same at all points on the circle $y^2 + z^2 = 4$.

Answer: A::B::D

Watch Video Solution

106. A ring has a total mass M but non-uniformly distributed over its circumference. The radius of the ring is R. A point mass m is placed at the centre of the ring. Workdone in taking away this point mass from ecntre to infinity is

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

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

C. $-\frac{GMm}{2R}$

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

Answer: B

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107. Suppose universal gravitational constant starts to decrease, then

A. length of the day, on earth, will decrease

B. length of the year will decrease

C. earth will follow a spiral path of increasing radius

D. kinetic energy of earth will decrease

Answer: A::C::D

Watch Video Solution

108. Two satelites of a planet have period 32 days and 256 days. If the radius of orbit of former is R, find the orbital radius of the latter.

A. radius of the orbit of the second is $4R$

B. radius of the orbit of the second $8R$

C. total mechanical energy of the second is greater than that of the first

D. kinetic energy of the second in more than that of the first

Answer: A::C

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109. 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. $V_P / V_Q = 1/2$

Answer: B::D

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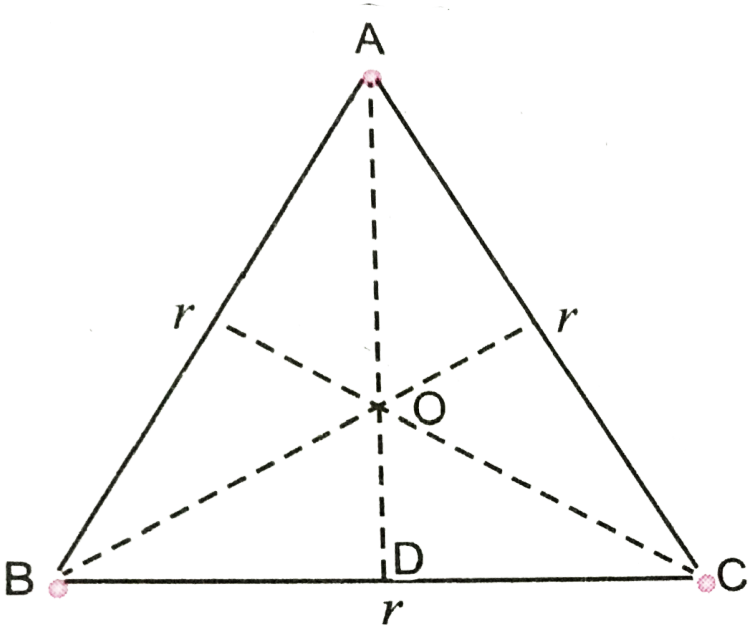
110. There are three identical point mass bodies each of mass m locted at the vertices of an equilateral triangle with side r. They are experting gravitational force of attraction on each other, which can be given by Newton's law of gravitaiton. Each mass body produces its gravitational field in the surrounding region. the magnitude of gravitational field at a point due to a point mass body is the measure

of gravitaitonal intensity at that point. The gravitational potential at a point in a gravitational field is the amount of workdone in bringing a unit mass body infinity to the given point without acceleration.



Answer the following questions :

At what speed must they move if they all revolve under the influence of one another's gravitation in a circular orbit circumsribing the triangle still preserving the equilateral triangle

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

B. $\sqrt{\frac{2Gm}{r}}$

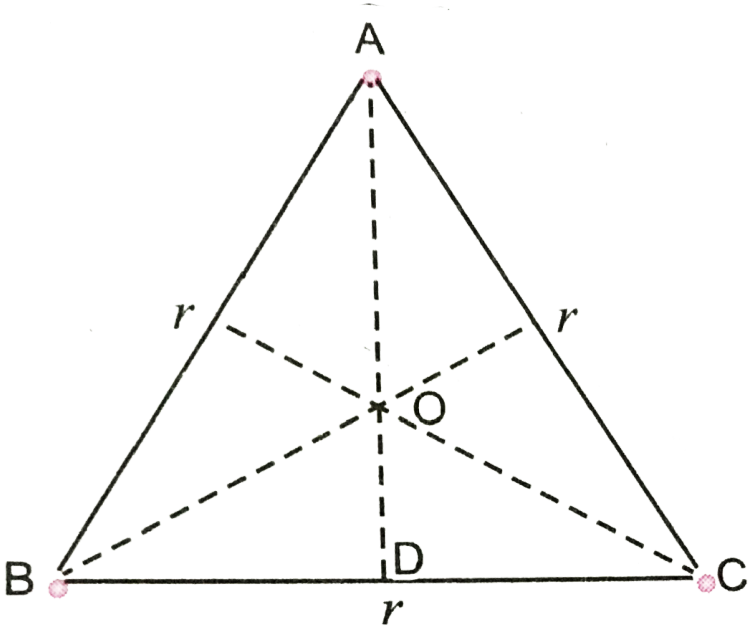
C. $\sqrt{\frac{Gm}{r}}$

D. $\sqrt{\frac{3Gm}{r}}$

Answer: C

Watch Video Solution

111. There are three identical point mass bodies each of mass m locted at the vertices of an equilateral triangle with side r. They are experting gravitational force of attraction on each other, which can be given by Newton's law of gravitaiton. Each mass body produces its gravitational field in the surrounding region. the magnitude of gravitational field at a point due to a point mass body is the measure of gravitaitonal intensity at that point. The gravitational potential at a point in a gravitational field is the amount of workdone in bringing a unit mass body infinity to the given point without acceleration.



Answer the following questions :

Work done in taking one body far away from the other two bodies is

A. $-\frac{Gm^2}{r}$

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

C. $\frac{2Gm^2}{r}$

D. $-\frac{2Gm^2}{r}$

Answer: C

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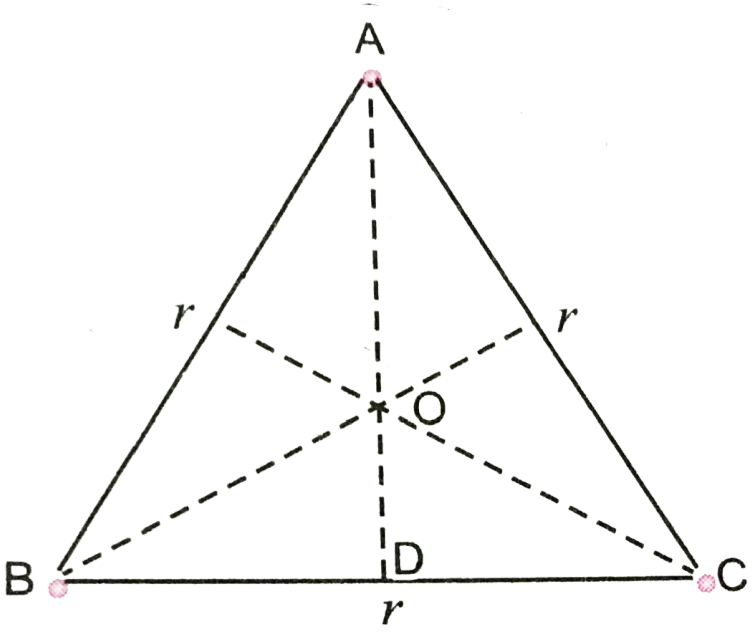
112. There are three identical point mass bodies each of mass m locted at the vertices of an equilateral triangle with side r. They are experting gravitational force of attraction on each other, which can be given by Newton's law of gravitaiton. Each mass body produces its gravitational field in the surrounding region. the magnitude of gravitational field at a point due to a point mass body is the measure of gravitaitonal intensity at that point. The gravitational potential at a point in a gravitational field is the amount of workdone in bringing a unit mass body infinity to the given point without acceleration.



Answer the following questions :

Magnitude of gravitational field at the mid point D of arm BC of triangle ABC is

A. $\frac{Gm^2}{r^2}$

B. $\frac{Gm}{3r^2}$

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

D. $\frac{4Gm}{3r^2}$

Answer: D

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113. A rocket is fired vertically upwards with a speed of $v\left(=5kms^{-1}\right)$ from the surface of earth. It goes up to a height h before returning to earth. At height h a body is thrown from the rocket with speed v_0 in such away so that the body becomes a satellite of earth. Let the mass of the earth, $M=6\times10^{24}kg$, mean radius of the earth, $R=6.4\times10^{6}m, G=6.67\times10^{-11}Nm^{2}kg^{-2}, g=9.8ms^{-2}$.

Answer the following questions:

The value of h is

A. $1.5\times10^{5}m$

B. $3.2\times10^{5}m$

C. $3.2\times10^{6}m$

D. $1.6\times10^{6}m$

Answer: D

Watch Video Solution

114. A rocket is fired vertically upwards with a speed of $v\left(=5kms^{-1}\right)$ from the surface of earth. It goes up to a height h before returning to earth. At height h a body is thrown from the rocket with speed v_0 in such away so that the body becomes a satellite of earth. Let the mass of the earth, $M=6\times10^{24}kg$, mean radius of the earth, $R=6.4\times10^{6}m, G=6.67\times10^{-11}Nm^2kg^{-2}, g=9.8ms^{-2}$.

Answer the following questions:

Time period of revollution of satellite around the earth is

A. $3550s$

B. $7100s$

C. $5330s$

D. $8880s$

Answer: B

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115. A rocket is fired vertically upwards with a speed of $v\left(=5kms^{-1}\right)$ from the surface of earth. It goes up to a height h before returning to earth. At height h a body is thrown from the rocket with speed v_0 in such away so that the body becomes a satellite of earth. Let the mass of the earth, $M=6\times10^{24}kg$, mean radius of the earth, $R=6.4\times10^{6}m$, $G=6.67\times10^{-11}Nm^{2}kg^{-2}$, $g=9.8ms^{-2}$.

Answer the following questions:

The energy to be spent in taking the satellite out of the gravitational field of the earth is (mass of the satellite is $200kg$)

A. $5.0\times10^{9}J$

B. $10.0 \times 10^9 J$

C. $2.5 \times 10^{10} J$

D. $5.0 \times 10^{10} J$

Answer: A

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116. A rocket is fired vertically upwards with a speed of $v\left(=5kms^{-1}\right)$ from the surface of earth. It goes up to a height h before returning to earth. At height h a body is thrown from the rocket with speed v_0 in such away so that the body becomes a satellite of earth. Let the mass of the earth, $M = 6 \times 10^{24} kg$, mean radius of the earth, $R = 6.4 \times 10^6 m$, $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$, $g = 9.8 ms^{-2}$.

Answer the following questions:

If this satellite is to be taken at double of the present height from the surface of the earth, then the new time period of revolution is

A. $9330s$

B. $20080s$

C. $11000s$

D. $29400s$

Answer: A

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FILL IN THE BLANKS

1. According to kepler, the line joining a planet to the sun sweeps out.....in equal intervals of time.

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2. Gravity is .....a sapecial case of ..... and is also called..... .

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3. The amount of work done in brinding a body of unit mass infinity to a point without acceleration is called ..... .

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4. Potential energy of a body is zero when that body is at ..... With respect to another body.

Watch Video Solution

5. One newton force is .....produce an acceleration of.....in a body of..... .

Watch Video Solution

6. A geostationary satellite should be at a height nearly..... km above the equator of earth.

Watch Video Solution

7. Escape velocity of sun is..... m/s.

Watch Video Solution

8. The value of acceleration due to gravity is.....every where on the surface of earth.

Watch Video Solution

9. If garvity suddely disappears, all bodies on earth will.....their weights.

Watch Video Solution

10. Mass of a body is more.....than its weight.

Watch Video Solution

11. The sense of rotation of stationary satellite around the earth is.....to..... .

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PROBLEMS FOR PRACTIVE A

1. The distance of planet Jupiter from the Sun is 5.2 times that of the earth. Find the period of revolution of Jupiter around the Sun.

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PROBLEMS FOR PRACTIVE

1. Two satelites of a planet have period 32 days and 256 days. If the radius of orbit of former is R, find the orbital radius of the latter.

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2. A geostationary satellite is orbiting the Earth at a height of $6R$ above the surface of Earth, where R is the radius of the Earth. The time period of another satellites is $6\sqrt{2}h$. Find its height from the surface of Earth.

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3. A geo-stationary stellite orbits around the earth in a circular orbit of radius 36,000km. Then, the time period of a spy stellite orbitting a few hundred km above the earth's surface $(R_{earth} = 6400km)$ will approximately be

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4. If the distance between the earth and the sun were half its present value, the number of days in a year would have been

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5. How fast (in $m^2 s^{-1}$) is area swept out by (a) the radius from sun to earth ? (b) the radius from the sun to earth $= 1.496 \times 10^{11} m$,

Distance of earth to moon $= 3.845 \times 10^8 m$ and period of revolution of moon $= 27\frac{1}{3}$ days.

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6. Estimate the mass of the sun, assuning the orbit of Earth round the sun to be a circule. The disatnce between the sun and the Earth is $1.49 \times 10^{11} m$, and $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

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7. A spherical mass of $20kg$ lying on the surface of the Earth is attracted by another spherical mass of $150kg$ with a force equal to $0.23mgf$. The centres of the two masses are $30cm$ apart. Calculate the mass of the Earth. Radius of the Earth is $6 \times 10^6 m$.

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8. There is a point between the earth and the moon, where the gravitational force on a space ship due to earth and moon together is zero. Find the distance of that point from the earth Given the disatnce between earth and moon is $3.845x10^8m$ and the moon has $1.2\,\%$ of the mass of the earth.

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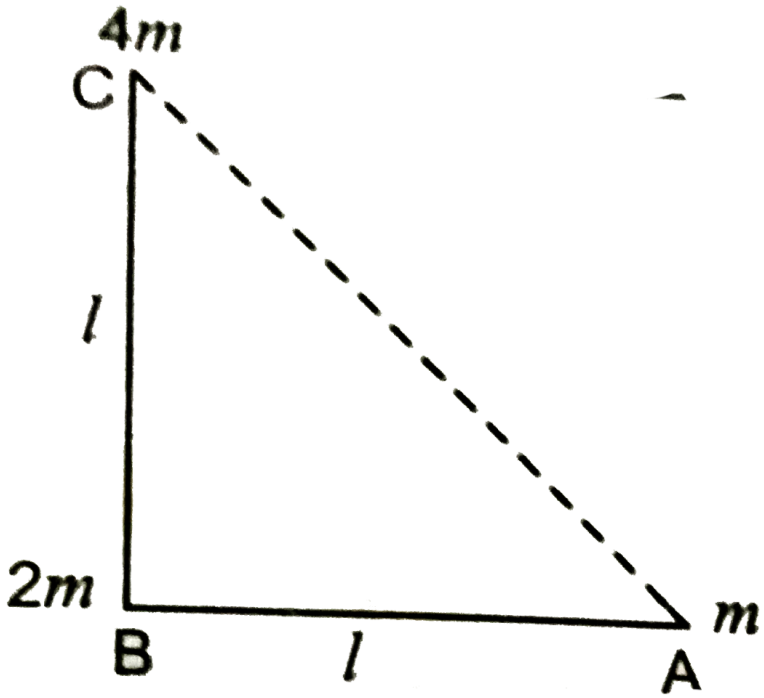
9. Three point mass bodies of masses m, $2m$ and $4m$ are placed at A, B and C as shown in fig. where $AB = BC = l$.



Find the magnitude of the resulatant gravitational pull on body at A due to bodies at B and C.

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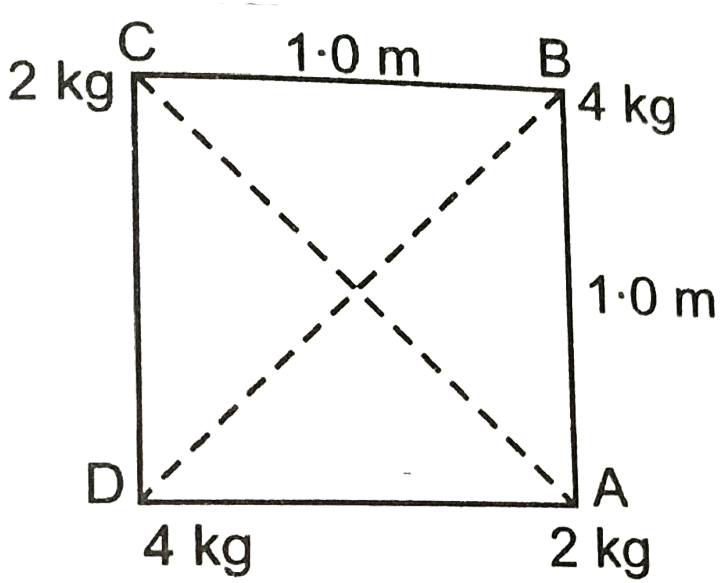
10. Four point mass bodies of masses as shown in Fig. are placed at the vertices of a square $ABCD$, gravitational force on the body at A

. Given, $G = 6.6 \times 10^{-11} Nm^2 kg^{-2}$



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11. If the radius of the Earth shrinks by 2%, mass remaing same, then how would the have of acceleration due to gravity change?

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12. A body weighs $54kgf$ on the surface of Earth. How much will it weigh on the surface of mers whose mass is $1/9$ and the redius is $1/2$ of that of earth?

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13. The weight of a person on the Earth is $80kg$. What will be his weight on the Moon ? Mass of the Moon $= 7.34 \times 10^{22}kg$, radius $= 1.75 \times 10^{6}m$ and gravitational constant $= 6.67 \times 10^{-11}Nm^{2}kg^{-2}$. What will be the mass of the person at the Moon and acceleration due to gravity there ? If this person can jump $2m$ high on the Earth, how much high can he jump at the Moon ?

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14. If the Earth were made of lead of relative density 11.4, then find the value of acceleration due to gravity on the surface of Earth ? Radius of the Earth is $6400km$ and $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

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15. A spherical mass of $20kg$ lying on the surface of the Earth is attracted by another spherical mass of $150kg$ with a force equal to $0.23mgf$. The centres o fthe two masses are $30cm$ apart. Calculate the mass of the Earth. Radius of the Earth is $6 \times 10^6 m$.

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16. The radius of earth is about $6400Km$ and that of mars is about $3200km$ The mass of the earth is about 10times the mass of mars. An object weight $200N$ on earth 's surface, then its weight on the surface of mars will be:

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17. The value of acceleration due to gravity at the surface of the earth is $9.8ms^{-2}$ and the mean radius is about $6.4 \times 10^6 m$. Assuming that we could get more soil some where, estimate how thick would an added uniform outer layer on the earth have to have the value of acceleration due to gravity $10ms^{-2}$ exactly ?

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18. How much above the surface of earth does the accelration due to gravity reduces by $64\,\%$ of its value on the earth. Radius of earth $= 6400km$.

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19. How much above the surface of earth does the accelration due to gravity reduces by $64\,\%$ of its value on the earth. Radius of earth $= 6400km.$

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20. A particle hanging from a spring stretches it by 1 cm at earth's surface. How much will the same particle stretch the spring at a place 800 km above the earth's surface/ Radius of the earth=6400 km.

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21. Assuming the Earth to be a sphere of uniform mass density, how much would a body weight half way down to the centre of the Earth, if it weighed $300N$ on the surface of Earth.

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22. Compare the weights of a body when it is

(i) $200km$ above the surface of the Earth and

(ii) $200km$ below the surface of Earth. Radius of the Earth is $6400km$.

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23. The acceleration due to gravity at a height $1km$ above the earth is the same as at a depth d below the surface of earth. Then :

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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 body of mass $10kg$ is taken from equator to pole of the Earth. Calculate the change in its weight, if the radius of the Earth is $6.38 \times 10^6 m$, time period of Earth's rotation about its polar axis is 24 hours.

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26. At what rate should the earth rotate so that the apparent g at the equator becomes zero? What will be the length of the day in this situation?

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27. Calculate the value of acceleration due to gravity at a place of lititude 30°. Radius of the Earth $6.4 \times 10^6 m$.The value of

acceleration due to gravity on Earth is $9.8m/s^2$.

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28. How far from Earth must a body be along a line joining the sun to the earth so that resultage gravitational pull on the body due to Earth and sun is zero ? Distance between sun and the Earth is $1.5 \times 10^8 km$. Mass of sun $= 3.25 \times 10^5$ times mass of Earth.

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29. calculate the gravitaional intensity and graviational potential at a location which is from the surface of the Earth at a height 4 times the radius of the surface. $R_e = 6400km$,

$G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$, $M_e = 6 \times 10^{24} kg$.

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30. Two masses of $500kg$ each are placed at two points A and B, distance $5m$ apart. There is a point P such that $AP = 3m$ and $BP = 4m$. Find (i) the magnitude of gravitational intensity at P and (ii) gravitational potential at P.

Given $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

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31. 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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32. A satellite of a mass m orbits the earth at a hight h above the surface of the earth. How much energy must be expended to rocket

the satellite out of earth's gravitational influence? (where M_E and R_E be mass and radius of the earth respectively)

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33. Calculate the gravitational potential energy of a body of mass $30kg$, at a height of $4R$ from the surface of Earth, where $R\left(=6.4\times10^6m\right)$ is the radius of the Earth. Mass of the Earth $=6.0\times10^{24}kg, G=6.67\times10^{-11}Nm^2kg^{-2}$.

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34. In the solar system, the Sun is in the focus of the system for Sun-earth binding system. Then the binding energy for the system will be [given that radius of the earth's orbit round the Sun is $1.5\times10^{11}m$ and mass of the earth $=6\times10^{24}kg$]

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35. 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?

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36. The orbit of a geostationary satellite is concentric and coplanar with the equator of Earth and rotates along the direction of rotation of Earth. Calculate the height and speed. Take mass of Earth $= 6 \times 10^{-11} Nm^2 kg^{-2}$. Given $\pi^2 = 10$.

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37. An Earth's satellite makes a circule around the Earth in 100 minutes. Calculate the height of the satellite above the Earth's

surface. Given the radius of the Earth is $6400km$ $g = 10ms^{-2}$. Use $\pi^2 = 10$.

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38. The radius of a planet is R. A satellite revolves around it in a circle of radius r with angular velocity ω_0. The acceleration due to the gravity on planet's surface is

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39. The escape speed of a body on the earth's surface is $11.2kms^{-1}$. A body is projected with thrice of this speed. The speed of the body when it escape the gravitational pull of earth is

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40. A body is projected vertically upwards from the surface of the Earth so as to reach a height equal to the radius of the Earth. Neglecting resistance due to it, calculate the initial speed which should be imparted to the body. Mass of Earth $= 5.98 \times 10^{24} kg$, Radius of Earth $= 6400 km, G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

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41. A spaceship is launched into a circular orbit close to the earth's surface . What additional velocity has now to be imparted to the spaceship in the orbit to overcome the gravitational pull. Radius of earth $= 6400 km, g = 9.8 m/s^2$.

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42. The mass of the earth is $6.0 \times 10^{24} kg$ and its radius is $6.4 \times 10^6 m$. How much work will be done in taking a $10 kg$ body from

the surface of the Earth to infinity ? What will be the gravitational potential energy of the body on the Earth's surafce ?

$G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

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43. A body of mass $50kg$ falls on the earth from infinity. What will be its velocity on reaching the earth? What will be its KE? Take radius of the earth $= 6.4 \times 10^6 m$, $g = 10ms^{-2}$. Air friction is neglected.

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44. Find the work done to bring 4 particle each of mass 100 gram from distances to the vertices of a square of side $20cm$.

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45. Two masses, $800kg$ and $600kg$ are at a distance $0.25m$ apart. The magnitude of total force experienced by a body of mass $1kg$ placed at a point distance $0.2m$ from the $800kg$ mass and $0.15m$ from the $600kg$ mass :

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46. Infinite number of masses, each of mass m, are placed along a straight line at distance of r, $2r$, $4r$, $8r$, etc. from reference point O. Find the

(i) gravitational field intensity and

(ii) gravitational potential at point O.

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47. In an imaginary planetary systam, the centrel star has the same mass as our sun, but is much brighter so that only a planet twice the

distance between the Earth and sun can support life. According to bilogical evolution (including aging processes etc.) on that planet similar to ours, what would be the average life span of a 'human' on that planet in terms of its natural life ? The average life span of a human on the Earth may be taken to be 70 years.

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PROBLEMS FOR PRACTIVE B

1. A rocket is fired the Earth towards the Moon. At what distance from the Moon is the gravitational force on the rocket is zero. Mass of Earth is $6 \times 10^{24} kg$, mass of moon is $7.4 \times 10^{22} kg$ and distance between moon and earth is $3.8 \times 10^{8} m$. Neglect the effect of the sun and other planes.

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PROBLEMS FOR PRACTIVE C

1. If the radius of the earth be increased by a factor of 5, by what factor its density be changed to keep the value of g of the same?

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PROBLEMS FOR PRACTIVE D

1. Assuming the earth to be a sphere of uniform density, how much could a body weight at a height eqaul to radius of earth when it weight $250N$ on the surface of earth.

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PROBLEMS FOR PRACTIVE E

1. How much above the surface of earth does the accelration due to gravity reduces by $64\,\%$ of its value on the earth. Radius of earth $= 6400km.$

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PROBLEMS FOR PRACTIVE F

1. Calculate the value of acceleration due to gravity at a place of latitude 30°. Radius of the Earth $6.4 \times 10^6 m$.The value of acceleration due to gravity on Earth is $9.8m/s^2$.

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PROBLEMS FOR PRACTIVE G

1. Two bodies of masses $100kg$ and $1000kg$ are at a distance $1.00m$ apart. Calculate the gravitaional field line joining them. $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

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PROBLEMS FOR PRACTIVE H

1. A particle of mass 'm' is raised to a height $h = R$ from the surface of earth. Find increase in potential energy. $R =$ radius of earth. $g =$ acceleration due to gravity on the surface of earth.

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PROBLEMS FOR PRACTIVE I

1. 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 $G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

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PROBLEMS FOR PRACTIVE J

1. Calculate the minimum speed required by a rocket to pull out of the gravitational force of Mars. Given that the earth has a mass 9 times and radius twice of the planet Mars. Escape speed on the surface of earth is $11.2 kms^{-1}$.

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PROBLEMS FOR PRACTIVE K

1. In a two stage launch of a satllite, the first stage bringe the satlilte to a height of $500km$ and the second stage given it the necessary critical speed to put it in circular orbit around the Earth. Which stage requires more expenditude of fuel?

(Neglect damping due to air resistance, especially in the first stage).

Mass of the Earth $= 6.0 \times 10^{24} kg$,radius of Earth $= 6400km, G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$.

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NCRET MULTIPLE CHOICE QUESTIONS -I

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 everywhere.

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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MULTIPLE CHOICE QUESTIONS -II

1. 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. Acceleration due to gravity is independent of mass of the earth.

Answer: A::C

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FOCUS Multiple Choice questions I.

1. 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. $24h$

B. $6/2.5h$

C. $2.5/6h$

D. $6\sqrt{2}h$

Answer: D

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Multiple Choice questions II.

1. Two masses, $800kg$ and $600kg$ are at a distance $0.25m$ apart. The magnitude of total force experienced by a body of mass $1kg$ placed

at a point distance $0.2m$ from the $800kg$ mass $0.15m$ from the $600kg$ mass :

A. $3.4 \times 10^{-6}N$

B. $2.22 \times 10^{-6}N$

C. $3.22 \times 10^{-6}N$

D. $2.22 \times 10^{-8}N$

Answer: B

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2. In case of earth

A. potential is minimum at the centre

B. potential is zero, both at centre and infinity

C. fields is zero both at centre and infinity

D. potential is same, both at centre and infinity but not zero

Answer: A::B

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Multiple Choice questions III.

1. Two car moving in opposite directions approach each other with speed of $22m/s$ and $16.5m/s$ respectively. The driver of the first car blows a horn having a frequency $400Hz$. The frequency heard by the driver of the second car is [velocity of sound $340m/s$].

A. $350Hz$

B. $361Hz$

C. $411Hz$

D. $448Hz$

Answer: D

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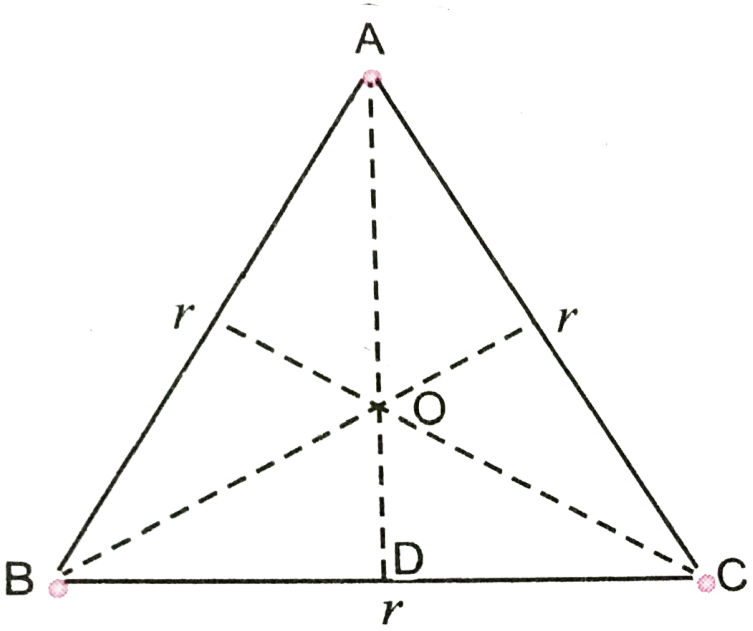
2. There are three identical point mass bodies each of mass m locted at the vertices of an equilateral triangle with side r. They are experting gravitational force of attraction on each other, which can be given by Newton's law of gravitaiton. Each mass body produces its gravitational field in the surrounding region. the magnitude of gravitational field at a point due to a point mass body is the measure of gravitaitonal intensity at that point. The gravitational potential at a point in a gravitational field is the amount of workdone in bringing a unit mass body infinity to the given point without acceleration.



Answer the following questions :

The magnitude of the gravitational force on one body due to other two bodies is

A. $\frac{Gm^2}{r^2}$

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

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

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

Answer: D

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Multiple Choice questions IV.

1. (1) Centre of gravity (C.G.) of a body is the point at which the weight of the body acts,

(2) Centre of mass coincides with the centre of gravity if the earth is assumed to have infinitely large radius,

(3) To evaluate the gravitational field intensity due to any body at an external point, the entire mass of the body can be cosidered to be concentrated at its C.G..,

(4) The radius of gyration of any body rotating about ab axis is the length of the perpendicular dropped from thr C.G. the body to the axis. which one of the following paires of statements is correct ?

A. (4) and (1)

B. (1) and (2)

C. (2) and (3)

D. (3) and (4)

Answer: A

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Multiple Choice questions V.

1. 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. $6.67 km / s$

B. $7.76 km / s$

C. $8.56 km / s$

D. $9.13 km / s$

Answer: B

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Integer Type Questions

1. 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

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2. The earth takes 24 hours to rotate once about its axis. How much time (in min) does the sun take to shift by 1° when viewed from the earth?

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3. A man can jump $1.5m$ high on earth. He can jump on a planet to a height of $3 \times x$ metre. The density of planet is one quarter that of the earth and whose radius is one third of the earth. What is the value of x?

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4. A body of mass $100kg$ falls on the earth from infinity. Its total energy on reaching the earth is $6.27 \times 10^{n} J$. What is the value of n? Given, radius of earth is $6400km$ and $g = 9.8m/s^{2}$. Air friction is neglected.

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5. Two saetllites S_1 and S_2 revolve around a planet in coplaner circular orbit in the same sense. Their periods of revolutions are 1 hour and 8 hours respectively. The radius of orbit of S_1 is $10^4 km$. When S_2 is closed to S_1, the speed of S_2 relative to S_1 is $\pi \times 10^n km/h$. what is the value of n?

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6. The ratio of the radius of the earth to that of moon is 10. The ratio of acceleration due to gravity on the earth and on the moon is 6. What is the ratio (in intergral value) of the escape velocity from the earth's surface to that from the moon?

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7. A particle is projected vertivally upwards from the surface of earth $(radius R_e)$ with a kinetic energy equal to half of the minimum value needed for it to escape. The height to which it rises above the surface of earth is .....

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Assertion-Reason Type Questions

1. Assertion: For the plantes orbiting around the sun, angular speed, linear speed, K.E. changes with time, but angular momentum remains constant.

Reason: No torque is acting on the rotating planet. So its angular momentum is constant.

A. If both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not a correct explanation of the Asseration.

C. If Assertion is true but the Reason is false.

D. If both Assertion and Reason are false.

Answer: A

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2. Assertion : The difference in g at the poles and the equator of the earth is directly proportional to the square of its angular velocity.

Reason : The value of g is minimum at the equator and maximum at poles.

A. If both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not a correct explanation of the Asseration.

C. If Assertion is true but the Reason is false.

D. If both Assertion and Reason are false.

Answer: B

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3. Why is the weight of an object on the Moon $(1/6)$th its weight on the Earth?

A. If both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not a correct explanation of the Asseration.

C. If Assertion is true but the Reason is false.

D. If both Assertion and Reason are false.

Answer: A

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4. Assertion : An astronaut in an orbiting space station above the earth experience weightlessness.

Reason : An object moving around the earth under the infuence of earth's gravitational force is in a state of 'free fall'

A. If both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not a correct explanation of the Asseration.

C. If Assertion is true but the Reason is false.

D. If both Assertion and Reason are false.

Answer: A

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5. Assertion : If a pendulum falls freely, then its time period becomes infinite.

Reason : Free falling body has acceleration, equal to 'g'.

A. If both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not a correct explanation of the Asseration.

C. If Assertion is true but the Reason is false.

D. If both Assertion and Reason are false.

Answer: B

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6. If the ice at the poles melts and flows towards the equator, how will it affect the duration of day-night?

A. If both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not a correct explanation of the Asseration.

C. If Assertion is true but the Reason is false.

D. If both Assertion and Reason are false.

Answer: D

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7. Assertion : The gravitational attraction of moon is much less than that of earth.

Reason : Gravitational force of a given mass (M) depends upon M/r^2, which is smaller for moon.

A. If both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not a correct explanation of the Asseration.

C. If Assertion is true but the Reason is false.

D. If both Assertion and Reason are false.

Answer: A

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8. The earth is continuously pulling the Moon towards its centre. Why the moon does not fall on to the earth?

A. If both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not a correct explanation of the Asseration.

C. If Assertion is true but the Reason is false.

D. If both Assertion and Reason are false.

Answer: C

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9. Assertion: The time period of revolution of a satellite close to surface of earth is smaller then that revolving away from surface of

earth.

Reason: The square of time period of revolution of a satellite is directely proportioanl to cube of its orbital radius.

A. If both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not a correct explanation of the Asseration.

C. If Assertion is true but the Reason is false.

D. If both Assertion and Reason are false.

Answer: A

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10. Assertion : We can not move even a finger without disturbing all the stars.

Reason : Every body in this universe attracts every other body with a force which is unversely proportional to the square of distance between them.

A. If both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not a correct explanation of the Asseration.

C. If Assertion is true but the Reason is false.

D. If both Assertion and Reason are false.

Answer: A

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11. Assertion: Space rockets are usually lauched in the the equitorial line from west to east.

Reason: The acceleration due to gravity is minimum at the equatore.

A. If both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not a correct explanation of the Asseration.

C. If Assertion is true but the Reason is false.

D. If both Assertion and Reason are false.

Answer: C

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12. If the distance between the earth and the sun were half its present value, the number of days in a year would have been

A. If both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not a correct explanation of the Asseration.

C. If Assertion is true but the Reason is false.

D. If both Assertion and Reason are false.

Answer: A

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13. Statement-1 : A body released from a height equal to the radius (R) of the earth. The velocity of the body when it strikes the surface of the earth will be $\sqrt{2gR}$.

Statement -2 : As $v^2 = u^2 + 2$ as.

A. Statement -1 is true , Statement -2 is true , Statement-2 is a correct explanation of Statement -1.

B. Statement -1 is true , Statement-2 is true , Statement-2 is a correct explanation of Statement-1.

C. Statement-1 is true , Statement-2 is false.

D. Statement-1 is false , Statement-2 is true.

Answer: D

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14. Statement-1 : An artificial satellie moving in a circular orbit around the earth has a total energy (i.e., sum of potential energy and kinetic energy)

E_0. Its potential energy is $-E_0$.

Statement-2 : Potential energy of the body at a point in a gravitaitonal field of earth is $-\frac{GMm}{R}$.

A. Statement -1 is true , Statement -2 is true , Statement-2 is a correct explanation of Statement -1.

B. Statement -1 is true , Statement-2 is true , Statement-2 is a correct explanation of Statement-1.

C. Statement-1 is true , Statement-2 is false.

D. Statement-1 is false , Statement-2 is true.

Answer: D

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15. Statement-1 : Two soild sphere of radius r and $2r$, made of same material, are kept in contact. The mutual grvitational force to attraction between them is proportional to $1/r^4$.

Statement-2 : Gravitational attraction between two point mass bodies varies inversely as the square of the distance between them.

A. Statement -1 is true , Statement -2 is true , Statement-2 is a correct explanation of Statement -1.

B. Statement -1 is true , Statement-2 is true , Statement-2 is a correct explanation of Statement-1.

C. Statement-1 is true , Statement-2 is false.

D. Statement-1 is false , Statement-2 is true.

Answer: D

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16. Statement-1 : If body the mass and raiuds of the earth decrease by 1% , the value of acceleration due to gravity will increase by 2% .

Statement-2 : $g = GM/R^2$.

A. Statement -1 is true , Statement -2 is true , Statement-2 is a correct explanation of Statement -1.

B. Statement -1 is true , Statement-2 is true , Statement-2 is a correct explanation of Statement-1.

C. Statement-1 is true , Statement-2 is false.

D. Statement-1 is false , Statement-2 is true.

Answer: D

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17. Statement-1 : Two satellites of mass $3M$ and M orbit the earth in circular orbits of radii r and $3r$ respectively. The ratio of their speeds is $\sqrt{3}:1$.

Statement-2 : Orbital velocity of satellite is

$$v = \sqrt{\frac{GM}{r}}$$

A. Statement -1 is true , Statement -2 is true , Statement-2 is a correct explanation of Statement -1.

B. Statement -1 is true , Statement-2 is true , Statement-2 is a correct explanation of Statement-1.

C. Statement-1 is true , Statement-2 is false.

D. Statement-1 is false , Statement-2 is true.

Answer: A

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18. Statement-1 : Th escape valocity from the earth is v_e. Th esacpe velocity from a planet whose radius to twice that of the earth and mean density is same as that of the earth is $2v_e$.

Statement-2 : $v_e = \sqrt{gR}$

A. Statement -1 is true , Statement -2 is true , Statement-2 is a correct explanation of Statement -1.

B. Statement -1 is true , Statement-2 is true , Statement-2 is a correct explanation of Statement-1.

C. Statement-1 is true , Statement-2 is false.

D. Statement-1 is false , Statement-2 is true.

Answer: C

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19. Statement-1 : A body weight W newton on the surface of the earth. Its weight at a height equal to half the radius of the earth will be $2W/5$.

Statement-2 : $g' = g.\dfrac{R^2}{(R+h)^2}$

A. Statement -1 is true , Statement -2 is true , Statement-2 is a correct explanation of Statement -1.

B. Statement -1 is true , Statement-2 is true , Statement-2 is a correct explanation of Statement-1.

C. Statement-1 is true , Statement-2 is false.

D. Statement-1 is false , Statement-2 is true.

Answer: D

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