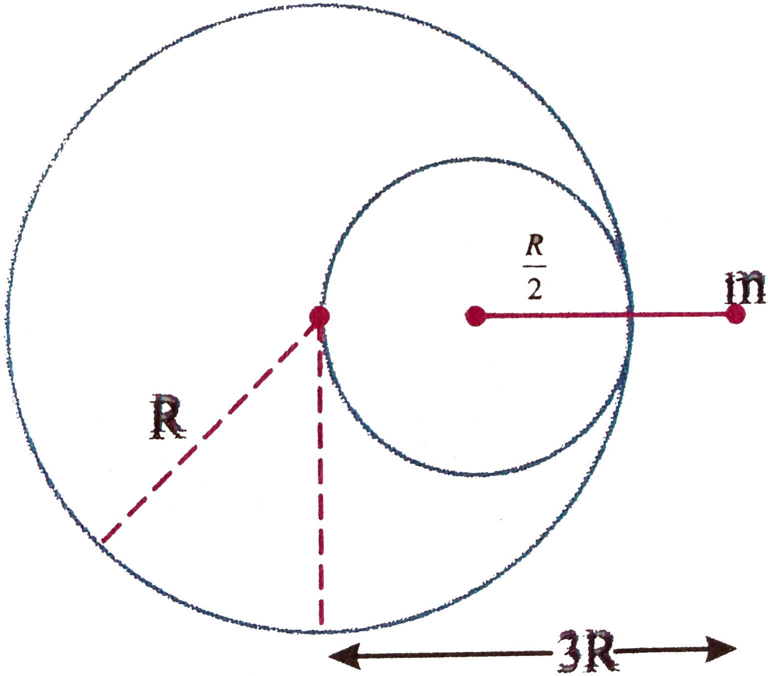
PHYSICS

BOOKS - DC PANDEY ENGLISH

GRAVITATION

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



A. $\frac{9}{50}$

B. $\frac{41}{50}$

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

D. $\frac{22}{25}$

Answer: B

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Comprehension Type Questions

1. If a smooth tunnel is dug across a diameter of earth and a particle is released from the surface of earth, the particle oscillate simple harmonically along it

Time period of the particle is not equal to

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

B. $\frac{2\pi}{\sqrt{GM}}R^{3/2}$

C. 84.6 min

D. None of these

Answer: D

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D Matrix Matching Type Questions

1. On the surface of earth acceleration due to gravity is g and gravitational potential is V. Match the following.

Table-1	Table-2
(A) At height $h = R$, value of g	(P) decreases by a factor 1/4
(B) At depth $h = R/2$, value of g	(Q) decreases by a factor 1/2
(C) At height $h = R$, value of V	(R) increases by a factor 11/8
(D) at depth $h = R/2$, value of V	(S) increases by a factor 2
	(T) None

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E Integer Type Questions

1. The orbital angular momentum of a satellite revolving at a distance r from the centre is L, If the distance is increased to 16r, then the new angular momentum will be

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Others

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

A. $-8Gm$

B. $-3Gm$

C. $-4Gm$

D. $-2Gm$

Answer: D

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2. A body starts from rest from a point distant r_0 from the centre of the earth. It reaches the surface of the earth whose radius is R. The velocity acquired by the body is

A. $GM\left(\frac{1}{R}-\frac{1}{R_0}\right)$

B. $2GM\left(\frac{1}{R}-\frac{1}{R_0}\right)$

C. $\sqrt{2GM\left(\frac{1}{R}-\frac{1}{R_0}\right)}$

D. $2GM\sqrt{\left(\frac{1}{R}-\frac{1}{R_0}\right)}$

Answer: C

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

A. increases

B. decreases

C. remains same

D. it will depend on the mass of shell

Answer: B

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4. A satellite revolves in the geostationary orbit but in a direction east to west. The time interval between its successive passing about a point on the equator is:

A. 4h

B. 6h

C. 12h

D. 24h

Answer: C

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5. Two point masses of mass $4m$ and m respectively separated by d distance are revolving under mutual force of attraction. Ration of their kinetic energies will be:

A. $1:4$

B. $4:1$

C. $1:1$

D. $1:16$

Answer: A

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6. A planet revolves about the sun in elliptical orbit. The arial velocity $\left(\frac{dA}{dt}\right)$ of the planet is $4.0 \times 10^{16} m^2 / s$. The least distance between planet and the sun is $2 \times 10^{12} m$. Then the maximum speed of the planet in km / s is -

A. 10

B. 20

C. 40

D. 80

Answer: C

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7. Binding energy of a particle on the surface of earth is E. Kinetic energy grater than E is given to this particle. Then total energy of particle will become

A. zero

B. infinite

C. > 0

D. < 0

Answer: C

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

A. its kinetic energy increases

B. its kinetic energy decreases

C. its angular momentum about the earth decreases

D. its period of revolution around the earth increases

Answer: A

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9. A particle of mass m is placed at the centre of a uniform shell of mass 3m and radius R. The gravitational potential on the surface of the shell is

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

B. $-\frac{3GM}{R}$

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

D. zero

Answer: B

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10. A particle on earth's surface is given a velocity euqal to its escape velocity. Its total mechanical energy with zero potential energy reference at infinite separation will be:

A. negative

B. positive

C. zero

D. infinite

Answer: C

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

A. $2R$

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

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

D. $4R$

Answer: B

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12. Two earth-satellite are revolving in the same circular orbit round the centre of the earth. They must have the same

A. mass

B. angular momentum

C. kinetic enrgy

D. velocity

Answer: D

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13. A hole is drilled from the surface of earth to its centre. A particle is dropped from rest in the surface of earth in terms of its escape velocity on the surface of earth v_e is :

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

B. v_e

C. $\sqrt{2}v_e$

D. $\dfrac{v_e}{\sqrt{2}}$

Answer: D

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

A. $5.0 \times 10^{-12} J$

B. $2.25 \times 10^{-10} J$

C. $4.0 \times x10^{-11} J$

D. $6.0 \times 10^{-15} J$

Answer: A

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15. A planet has a mass of eight time the mass of earth and denisity is also equal to eight times a the average density of the earth. If g be the acceleration due to earth's gravity on its surface, then acceleration due to gravity on planet's surface will be

A. 2g

B. 4g

C. 8g

D. 16g

Answer: C

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16. The work done in slowly lifting a body from earth's surface to a height R (radius of earth) is equal to two times the work done in lifting the same body from earth's surface to a height h. Here h is equal to

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

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

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

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

Answer: B

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17. The magnitude of gravitational potential energy of the moon earth system is U with zero potential energy at infinite separation. The kinetic energy of the moon with respect to the earth is K.

A. $K = 2U$

B. $K = \frac{U}{2}$

C. $K = U$

D. $K = 4U$

Answer: B

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18. 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.

A. $\frac{\sqrt{3}}{4}\frac{GM^2}{R^2}$

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

C. $\frac{\sqrt{3}GM^2}{R^2}$

D. $\frac{\sqrt{3}}{2}\frac{GM^2}{R^2}$

Answer: A

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19. Consider a thin uniform spherical layer of mass M and radius R. The potential energy of gravitational interaction of matter forming this shell is :

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

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

C. $-\frac{3}{5}\frac{GM^2}{R}$

D. $-\frac{GM^2}{4R}$

Answer: B

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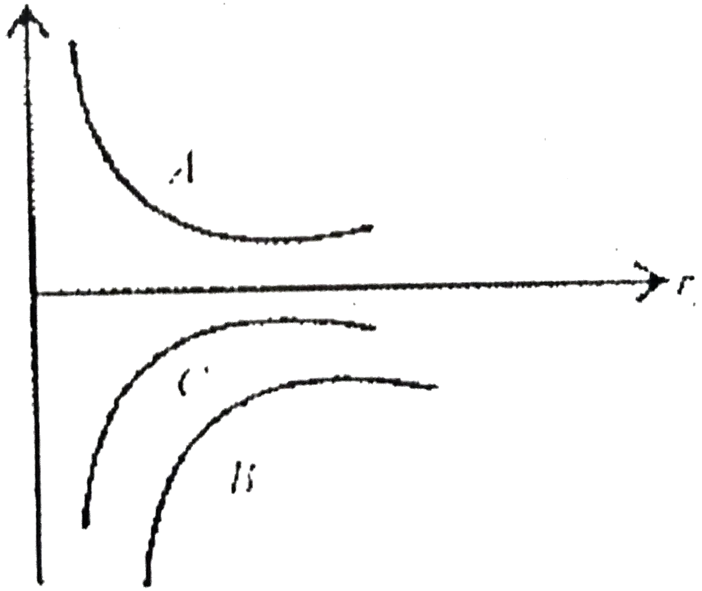
20. Figure shows the variation of energy with the orbit radius r of a satellite in a circular motion. Mark the correct statement.



A. C shows the total energy, B the kinetic energy and A the potential energy of the satellite

B. A shows the kinetic energy, B the total energy and C the potential energy of the satellite

C. A and B are the kinetic and potential energies and C the total energy of the satellite

D. C and A are the kinetic and potential energies respectively and B the total energy of the satellite

Answer: C

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21. If the radius of the earth were increased by a factor of 2 keeping the mass constant, by what factor would its density have to be changed to keep g the same?

A. $\frac{1}{8}$

B. 4

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

D. $\frac{1}{4}$

Answer: C

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22. A satellite of mass m moves along an elliptical path arouned the earth. The areal velocity of the satellite is proportional to

A. m

B. m^{-1}

C. m^0

D. $m^{1/2}$

Answer: C

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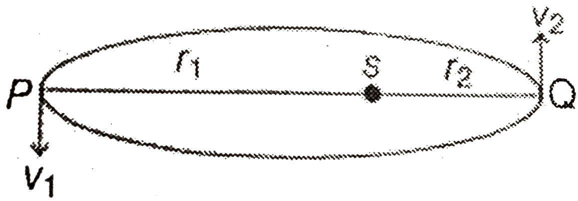
23. A planet is moving in an elliptical path around the sun as shown in figure. Speed of planet in positions P and Q are V_1 and V_2 respectively with $SP = r_1$ and $SQ = r_2$, then v_1 / v_2 is equal to



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

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

C. $\left(\frac{r_2}{r_1}\right)^2$

D. $\left(\frac{r_1}{r_2}\right)^2$

Answer: B

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24. The period of revolution of an earth satellite close to surface of earth is 90min. The time period of aother satellite in an orbit at a distance of three times the radius of earth from its surface will be

A. $90\sqrt{8}$ min

B. 360 min

C. 720 min

D. 270 min

Answer: C

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25. The acceleration due to gravity on the moon is only one sixth that of earth.It the earth and moon are assume to have the same density, the ratio of the radii of moon and earth will be

A. $\frac{1}{6}$

B. $\frac{1}{(6)^{1/3}}$

C. $\frac{1}{36}$

D. $\frac{1}{(6)^{2/3}}$

Answer: A

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26. The acceleration due to gravity near the surface of a planet of radius R and density d is proportional to

A. $R^{1/2}$

B. $R^{3/2}$

C. $R^{-1/2}$

D. R^{0}

Answer: D

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27. A geo-stationary satellite orbits around the earth in a circular orbit of radius 36000 km. Then, the time period of a spy satellite orbiting a few hundred kilometers above the earth's surface (R_("Earth") = 6400 " km")`

will approximately be

A. $1/2h$

B. $1h$

C. $2h$

D. $4h$

Answer: C

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

A. $4J/kg$

B. $7J/kg$

C. $-3J/kg$

D. $-7J/kg$

Answer: D

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29. If the angular velocity of a planet about its own axis is halved, the distance of geostationary satellite of this planet from the centre of the centre of the planet will become

A. $(2)^{1/2}$ times

B. $(2)^{3/2}$times

C. $(2)^{2/3}$ times

D. 4 times

Answer: C

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30. A planet of mass m is in an elliptical orbit about the sun with an orbital period T. If A be the area of orbit, then its angular momentum would be

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

B. mAT

C. $\frac{mA}{2T}$

D. 2nAT

Answer: A

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31. If the radius of the earth were to shrink by one percent its mass remaining the same, the acceleration due to greavity on the earth's surface would

A. decreases

B. remain unchanged

C. increases

D. it will depend on the mass of earth

Answer: C

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32. If g be the acceleration due to gravity of the earth's surface, the gain is the potential energy of an object of mass m raised from the surface of the earth to a height equal to the radius R of the earth is

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

B. 2mgR

C. ngR

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

Answer: A

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33. A simple pendulum has a time period T_1 when on the earth's surface and T_2 when taken to a height R above the earth's surface, where R is the radius of the earth. The value of $\frac{T_2}{T_1}$ is

A. 1

B. $\sqrt{2}$

C. 4

D. 2

Answer: D

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34. If the distance between the earth and the sun were reduced to half its present value, then the number of days in one year would have been

A. 64.5

B. 129

C. 182.5

D. 730

Answer: B

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35. A satellite S is moving in an elliptical orbit around the earth. The mass of the satellite is very small as comapred to the mass of the earth. Then,

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 changes in direction, but its magnitude remain constant

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

D. the linear momentum of S remain constant in magnitude

Answer: A

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

A. increases continuously

B. decreases continuously

C. first increases then decreases

D. first decreases then increases

Answer: C

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37. A body of mass m is kept at a small height h above the ground. If the radius of the earth is R and its mass is M, the potential energy of the body and earth system (with $h = \infty$ being the reference position) is

A. $\frac{GMm}{R} + mgh$

B. $\frac{-GMm}{R} + mgh$

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

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

Answer: B

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38. The ratio of energy required to raise a satellite to a height h above the earth surface to that required to put it into the orbit is

A. $1:1$

B. $8:1$

C. $4:1$

D. $2:3$

Answer: D

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39. The gravitational field due to a mass distribution is $E=\frac{A}{x^2}$ in x-direction. Here, A is a constant, Taking the gravitational potential to be zero at infinity, potential at x is

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

B. $\frac{2A}{x^3}$

C. $\frac{A}{x}$

D. $\frac{A}{2x^2}$

Answer: C

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40. A uniform ring of mass m and radius a is placed directly above a uniform sphere of mass M and of equal radius. The centre of the ring is at distance $\sqrt{3}a$ from the centre of the sphere. Find the gravitational force exerted by the sphere on the ring.

A. $\dfrac{8GM^2}{R^2}$

B. $\dfrac{2GM^2}{\sqrt{3}R^2}$

C. $\dfrac{3GM^2}{2R^2}$

D. $\dfrac{\sqrt{3}}{2}\dfrac{GM^2}{R^2}$

Answer: D

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41. The gravitational field in a in region is given by $\overrightarrow{g} = \left(4\hat{i} + \overrightarrow{j}\right)N/kg$. What done by this field is zero when the particle is moved along the line :

A. $y + 4x = 2$

B. $4y + x = 6$

C. $x + y = 5$

D. All of these

Answer: A

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

A. the particle will execute simple harmonic motion inside the shell

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

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

D. None of the above

Answer: D

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43. A particle is fired upword with a speed of $20km/s$. The speed with which it will move in interstellar space is

A. $8.8km/s$

B. $16.5km/s$

C. $4.6km/s$

D. $10km/s$

Answer: B

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44. Two bodies of masses m_1 and m_2 are initially at rest placed infinite distance apart. They are then allowed to move towards each other under mutual gravitational attraction. Their relative velocity when they are r distance apart is

A. $\sqrt{\dfrac{2G(m_1+m_2)}{r}}$

B. $\sqrt{\dfrac{2Gm_1m_2}{(m_1+m_2)r}}$

C. $\sqrt{\dfrac{G(m_1+m_2)}{r}}$

D. $\sqrt{\dfrac{Gm_1m_2}{(m_1+m_2)r}}$

Answer: A

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45. If the period of revolution of an artificial satellite just above the earth's surface is T and the density of earth is p, then pT^2 is

A. a universal constant whose value is $\dfrac{3\pi}{G}$

B. a universal constant whose value is $\frac{3\pi}{2G}$

C. proportional to radius of earth R

D. proportional to square of the radius of earth R^2 Here, G=universal gravitational constant

Answer: A

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46. A satellite is revolving round the earth with orbital speed v_o. If it stops suddenly, the speed with which it will strike the surface of earth would be (v_e = escape velocity of a particle on earth's surface)

A. $\frac{v_e^2}{v_0}$

B. v_0

C. $\sqrt{v_e^2 - v_0^2}$

D. $\sqrt{v_e^2 - 2v_0^2}$

Answer: D

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47. The ratio of energy required to raise a satellite to a height h above the earth surface to that required to put it into the orbit is

A. h:R

B. R:2h

C. 2h:R

D. R:h

Answer: C

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48. A spherical hole is made in a solid sphere of radius R. The mass of the sphere before hollowing was M. The gravitational field at the centre of the hole due to the remaining mass is -

A. zero

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

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

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

Answer: C

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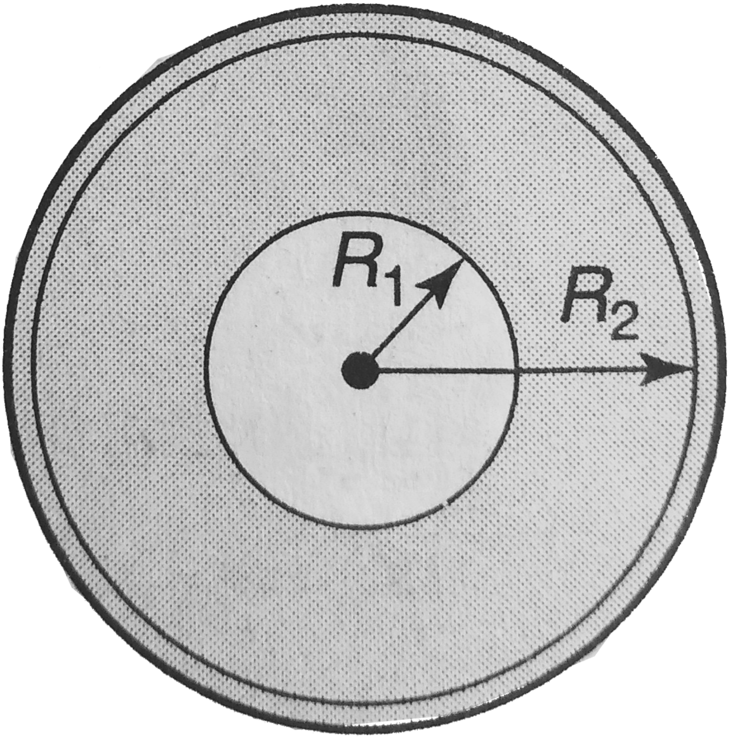
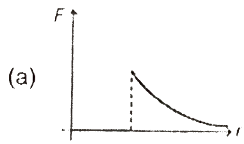
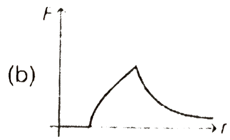
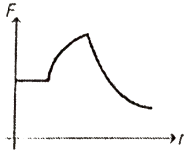
49. A sphare of mass M and $radius R_2$ has a concentric cavity of radius R_1 as shown in figure The force F exerted by the sphere on a particle of mass m located at a distance r from the centre of sphere veries as

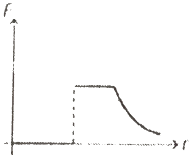
$(0 \leq r \leq \infty)$.



A. 

B. 

C. (c) 

D. (d) 

Answer: B

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50. A small planet is revolving around a very massive star in a circular orbit of Radius R with a period of revolution T. If the gravitational force between the planet and the star were proportional to $R^{-5/2}$, then T would be proportional to

A. R^3

B. $R^{7/2}$

C. $R^{3/2}$

D. `R^(15//4

Answer: B

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51. If G is the uciversal gravitational constant and p is the uniform density of a spherical planet. Then shortest possible period o0f rotation around a planet can be

A. $\sqrt{\frac{\pi G}{2p}}$

B. $\sqrt{\frac{3\pi GP}{p}}$

C. $\sqrt{\frac{\pi}{6Gp}}$

D. $\sqrt{\frac{3\pi}{Gp}}$

Answer: D

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52. Speed of a planet in an ellioptical orbit with semimajor axis a about sun of mass M at a distance r from sun is

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

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

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

D. $\sqrt{\frac{GMr}{2a^2}}$

Answer: A

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

A. $\sqrt{2E}$

B. $4E^2$

C. $\sqrt{E}$

D. $\sqrt{E/2}$

Answer: A

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54. 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

A. $\dfrac{r^3\omega}{R}$

B. $\left(\dfrac{r^2}{\omega^3}/(R)\right.$

C. $\dfrac{r^3\omega^3}{R^2}$

D. $\dfrac{r^2\omega^2}{R}$

Answer: C

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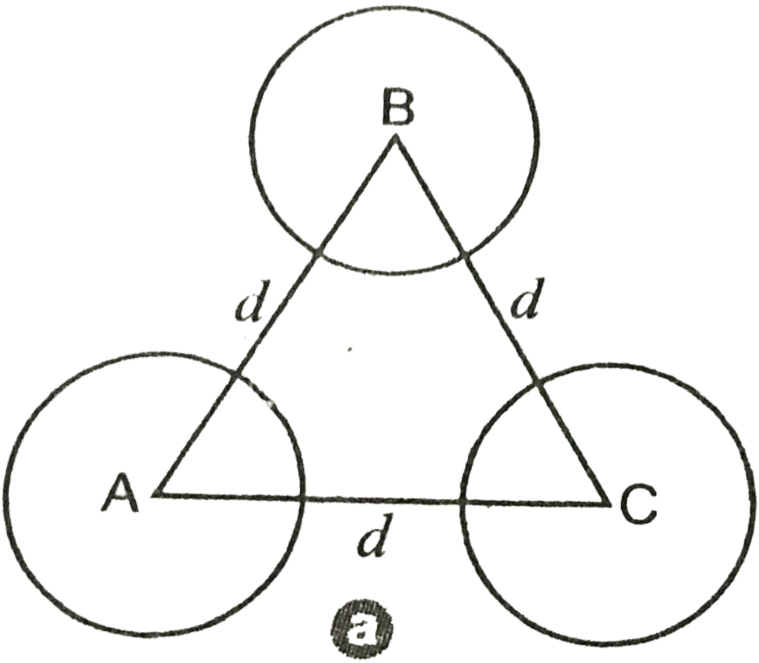
55. Three solid spheres each of mass m and radius R are released from the position shown in Fig. What is the speed of any one sphere at the time of collision?



A. $\sqrt{Gm\left(\frac{1}{d}-\frac{3}{R}\right)}$

B. $\sqrt{Gm\left(\frac{3}{d}-\frac{1}{R}\right)}$

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

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

Answer: D

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56. A satellite is moving in a circular orbit round the earth with a diameter of orbit 2R. At a certain point a rocket fixed to the satellite is fired such that it increases the velocity of the satellite tangentially. The resulting orbit of the satellite would be

A. same as before

B. circular orbit with diameter greater than R

C. elliptical orbit with minimum distance from the centre of eart5h equal to R

D. elliptical orbit with maximum distnace form the centre of earth equal to R

Answer: C

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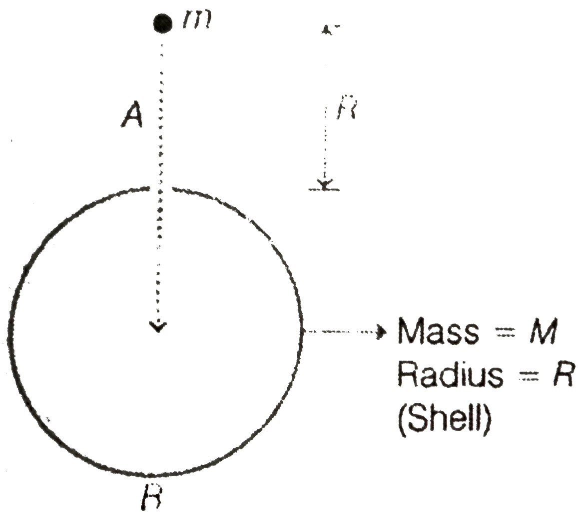
57. A particle of mass m is moved from A to B as show in figure. Then potential energy of the the particle



A. will continuously increases

B. will continuously decreases

C. will first increase and then become constant

D. will first decreases and then become constant

Answer: D

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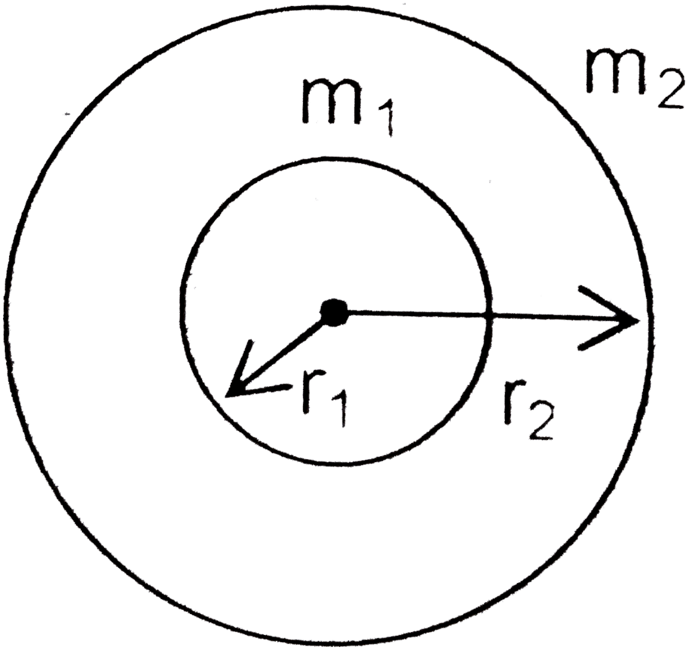
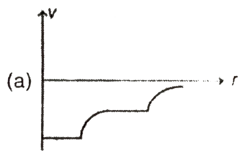
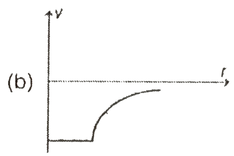
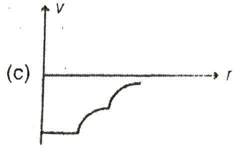
58. Two concentric spherical sheels are as shown in figure. The $V - r$ graph will be as



A. 

B. 

C. 

D. 

Answer: C

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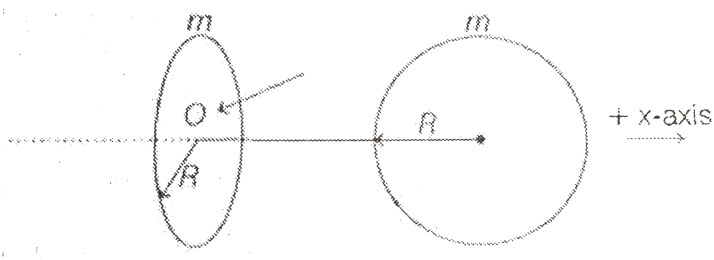
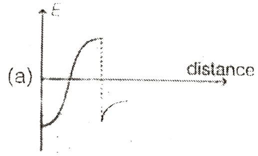
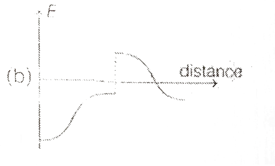
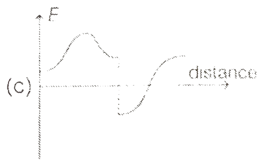
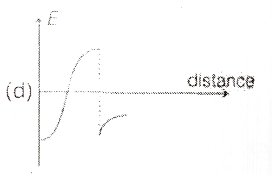
59. One ring of radius R and mass m and one solid sphere of same mass m and same radius R are placed with their centres on positive x-axis. We are moving from some finite distance on negative x-axis towards positive x-axis plane of the ring is perpendicular to x-axis. How will the net gravitational field vary with distance moved on x-axis We move only up to surface of solid sphere. O is the origin.



A. 

B. 

C. 

D. 

Answer: C

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60. A mass is taken from surface to a height h. The change in potential energy in this process is equal to the change in potential energy if it is now taken from that point to infinity. What is the value of h?

A. $h = R$

B. $h = 2R$

C. $h = \frac{3R}{2}$

D. $h = 4R$

Answer: A

Watch Video Solution

61. If radius of a solid sohere is decreases to half, keeping density of sphere unchanged, the slope of E-r graph inside the sphere will

A. remain unchanged

B. become two times

C. become four times

D. remain $\frac{1}{8}$ th

Answer: A

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62. A particle of mass m is moving along the line y-b with constant acceleration a. The areal velocity of the position vector of the particle at time t is $(u = 0)$

A. constant

B. $\dfrac{abt}{2}$

C. $\dfrac{abt}{2m}$

D. $\dfrac{a^2bt}{2m}$

Answer: B

Watch Video Solution

63. A particle of mass m is projected upword with velocity $v = \dfrac{v_e}{2}$ (v_e) escape of the particle is

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

B. $-\frac{GMm}{4R}$

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

D. $-\frac{2GMm}{3R}$

Answer: C

Watch Video Solution

64. Two particles each of mass m are revolving in circular orbits of radius $r = 5R$ in opposite directions with orbital speed v_0. They collide perfectly inelastically and fall to the ground. The speed of combined mass on triking the ground will be

A. $2\sqrt{2}v_0$

B. $\sqrt{2}v_0$

C. $2v_0$

D. v_0

Answer: A

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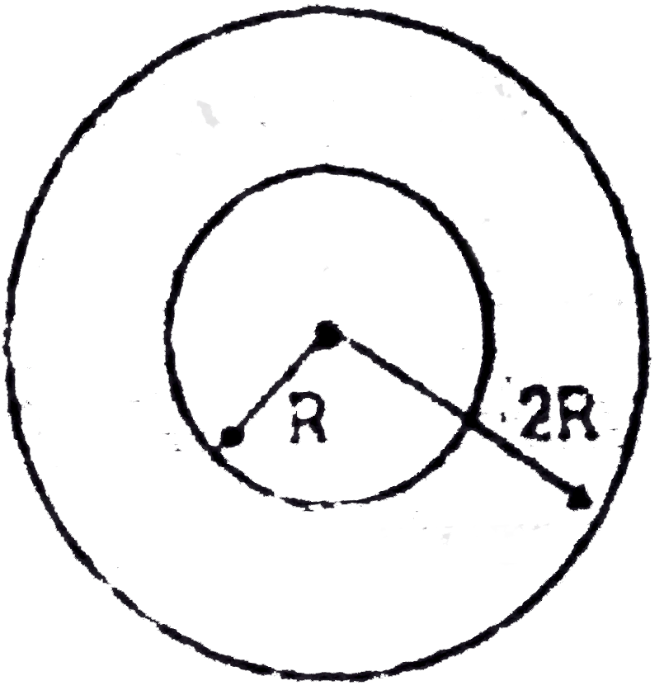

65.

There is a concentric hole of radius R in a solid sphere of radius 2R. Mass of the remaining portional is M. What is the gravitational potential at centre?

A. $-\frac{5G}{7R}$

B. $-\frac{5G}{14R}$

C. $-\frac{3G}{7R}$

D. $-\frac{9G}{14R}$

Answer: D

Watch Video Solution

66. A particle is projected from the surface of earth with velocity equal to its escape velocity , at 45° with horizontal . What is the angle of its velocity with horizontal at height h = R . (Here horizontal at some point means a line parallel to tangent on earth just below that point .)

A. 30°

B. 60°

C. $\cos^{-1}\left(\frac{1}{3}\right)$

D. $\cos^{-1}\left(\frac{1}{4}\right)$

Answer: B

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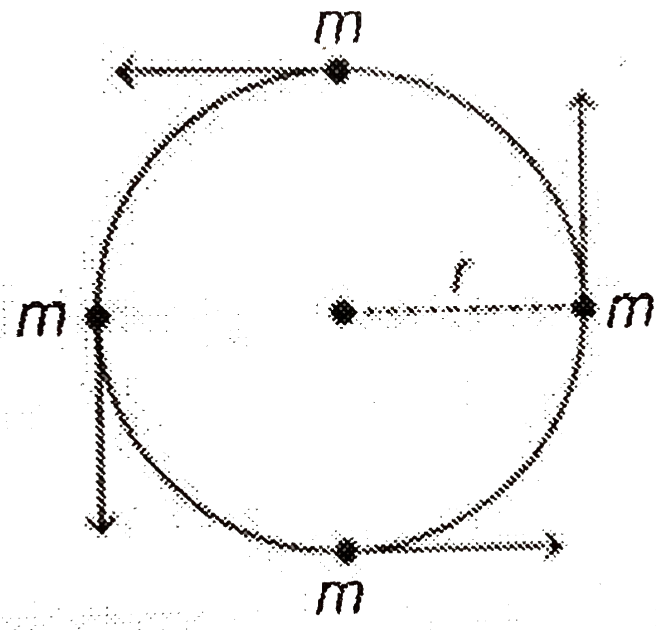
67. Four similar particles of mass m are orbiting in a circle of radius r in the same direction and same speed because of their mutual gravitational attractive force as shown in the figure . Speed of a particle is given by



A. $\sqrt{\frac{Gm}{4r}(1+2\sqrt{2})}$

B. $\sqrt{\frac{Gm}{r}(1+\sqrt{2})}$

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

D. $\sqrt{\frac{Gm}{4r}(2+\sqrt{2})}$

Answer: A

Watch Video Solution

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

A. $3:5$

B. $4:5$

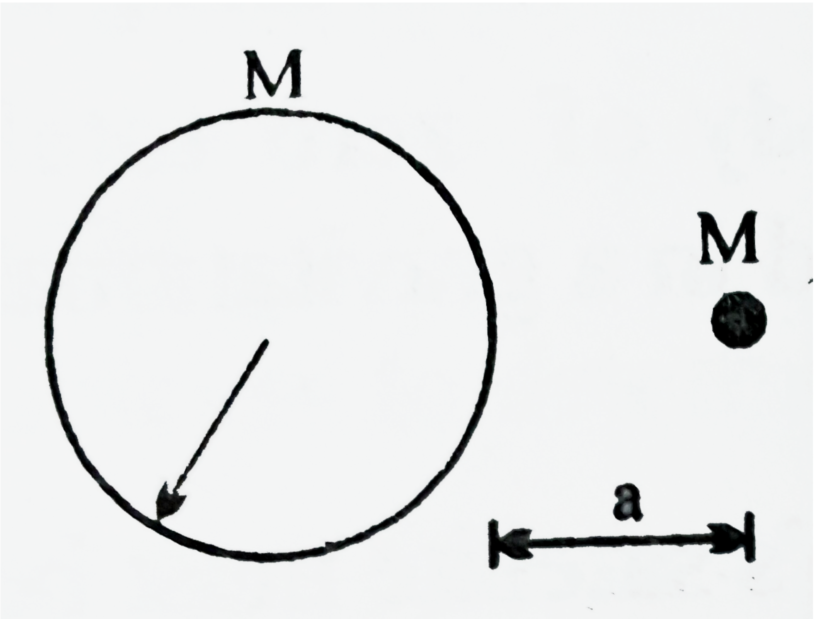
C. $5:3$

D. $5:4$

Answer: C

Watch Video Solution

69. A particle of mass M is at a distance a from surface of a thin spherical shell of equal mass and having radius a.



A. Gravitational field and potential both are zero at centre of the shell

B. Gravitational field is zero not only inside the shell but at a point outside the shell also

C. Inside the shell , gravitational field alone is zero

D. Neither gravitational field nor gravitational potential is zero inside the shell

Answer: D

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70. A projectile is launched from the surface of the earth with a very high speed u at an angle θ with vertical . What is its velocity when it is at the farthest distance from the earth surface . Given that the maximum height reached when it is launched vertically from the earth with a velocity v = $\sqrt{\frac{GM}{R}}$

A. $\frac{u\cos\theta}{2}$

B. $\frac{u\sin\theta}{2}$

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

D. $\sqrt{\frac{GM}{3R}}$

Answer: B

Watch Video Solution

71. A system consists of two stars of equal masses that revolve in a circular orbit about their centre of mass . Orbital speed of each star is v and period is T . Find the mass M of each star . (G is gravitational constant)

A. $\frac{2Gv^3}{\pi T}$

B. $\frac{v^3 T}{\pi G}$

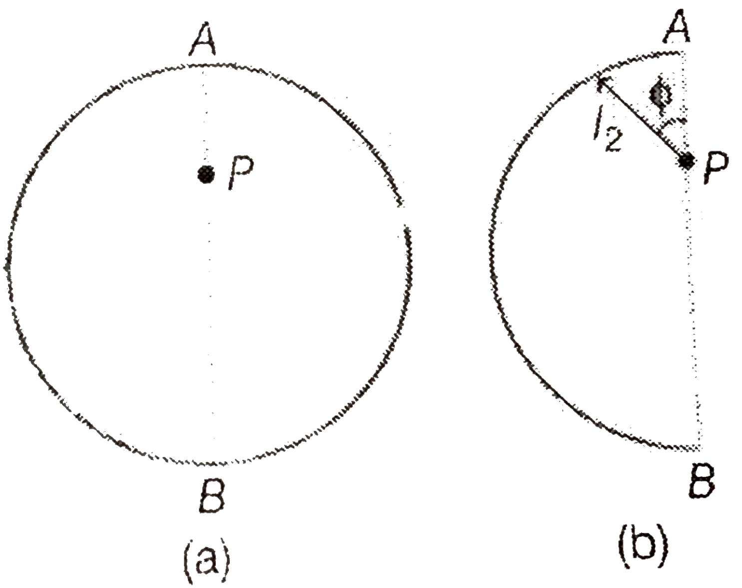
C. $\frac{v^3 T}{2\pi G}$

D. $\frac{2Tv^3}{\pi G}$

Answer: D

Watch Video Solution

72. Figure (a) shows a ring of mass m and figure (b) shows half portion of the same ring . Gravitational field at point P in figure (b) is I_2 in magnitude and makes an angle ϕ with line . AB. Gravitational field at point P in figure (a) is I_1 in magnitude . The ratio of $\frac{I_1}{2I_2}$ is



A. sec ϕ

B. cos ϕ

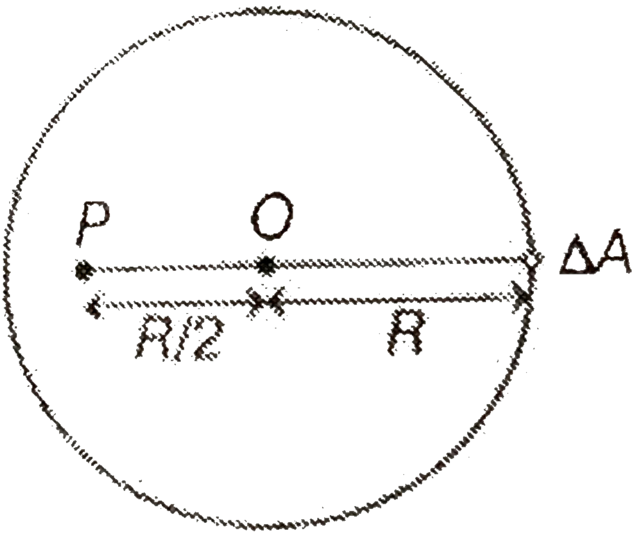
C. tan ϕ

D. sin ϕ

Answer: B

Watch Video Solution

73. A small section of area ΔA is removed from a uniform spherical shell with surface mass density σ and radius R as shown in the figure . Find the magnitude of gravitational field intensity at point P due to the remaining mass .



A. $\dfrac{4\sigma \Delta A G}{9R^2}$

B. $\dfrac{4\sigma \Delta A G}{R^2}$

C. $\frac{\sigma \Delta AG}{R^2}$

D. zero

Answer: A

Watch Video Solution

74. A projectile is projected tangentially from the surface of a planet of radius R. If it is at a height of 3R at the farthest point of its trajectory, then the velocity of projection V_0 is given by (acceleration due to gravity on surface=g)

A. $v_0 = \sqrt{1.5gR}$

B. $v_0 = \sqrt{0.5gR}$

C. $v_0 = \sqrt{1.6gR}$

D. $v_0 = \sqrt{2gR/3}$

Answer: C

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75. A solid sphere of mass M and radius R has a spherical cavity of radius R/2 such that the centre of cavity is at a distance R/2 from the centre of the sphere. A point mass m is placed inside the cavity at a distance R/4 from the centre of sphere. The gravitational force on mass m is

A. $\frac{11GMm}{R^2}$

B. $\frac{14GMm}{R^2}$

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

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

Answer: C

Watch Video Solution

76. Two stars of masses m_1 and m_2 distance r apart, revolve about their centre of mass. The period of revolution is :

A. $2\pi\sqrt{\frac{r^3}{2G(m_1+m_2)}}$

B. $2\pi\sqrt{\frac{r^3(m_1+m_2)}{2Gm_1m_2}}$

C. $2\pi\sqrt{\frac{2r^3}{G(m_1+m_2)}}$

D. $2\pi\sqrt{\frac{r^3}{G(m_1+m_2)}}$

Answer: D

Watch Video Solution

77. A binary star system is revolving in a circular path with angular speed $'\omega'$ and mass of the stars are 'm' and '4m' respectively. Both stars stop suddenly, then the speed of havirer star when the separation between the stars when the seperation between the stars becomes half of initial value is :

A. a. $\sqrt{2\left[\frac{(Gm\omega)^2}{2}\right]^{1/3}}$

B. b. $\sqrt{\frac{2}{5}\left[\frac{(Gm\omega)^2}{5}\right]^{1/3}}$

C. c. $\sqrt{\left[\frac{(Gm\omega)^2}{5}\right]^{1/3}}$

D. d. $\sqrt{2\left[\frac{(Gm\omega)^2}{5}\right]^{1/3}}$

Answer: B

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78. 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. in some parts of the orbit

B. in any part of the orbit

C. in no part of the orbit

D. in one complete revolution

Answer: A::D

Watch Video Solution

79. Two smooth tunnels are dug from one side of earth's surface to the other side, one along a diameter and other along the chord .Now two particle are dropped from one end of each of the tunnels. Both time particles oscillate simple harmonically along the tunnels. Let T_1 and T_2 be the time particle and v1and v2 be the maximum speed along the diameter and along the chord respectively. Then:

A. a. $T_1 = T_2$

B. b. $T_1 > T_2$

C. c. $v_1 = v_2$

D. d. $v_1 > v_2$

Answer: A::D

Watch Video Solution

80. Two objectes of mass m and 4m are at rest at and infinite seperation. They move towards each other under mutual gravitational attraction. If G is the universal gravitational constant. Then at seperation r

A. the total energy of the two objects is zero

B. their relative velocity of approach is $\left(\frac{10GM}{r}\right)^{1/2}$ in magnitude

C. the total kinetic energy of the objects is $\frac{4Gm^2}{r}$

D. net angular momentum of both the particles is zero about any point

Answer: A::B::C::D

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81. Let V and E be the gravitational potential field. Then select the correct alternative(s) :

A. The plot of E against r (distance form centre) is discontinuous for a spherical shell

B. The plot of V against r is continuous for a spherical shell

C. The plot of E against r is discontinuous for a solid sphere

D. The plot of V against r is continuous for a solid sphere

Answer: A::B::D

Watch Video Solution

82. In circular orbit of a satellite

A. orbital speed is $\sqrt{\frac{GM}{r}}$

B. time period $T^2 \propto r^3$

C. kinetic energy is $\frac{GMm}{2r}$

D. potential energy is $-\frac{GMm}{2r}$

Answer: A::B::C

Watch Video Solution

83. Due to a solid sphere, magnitude of

A. gravitational potential is maximum at centre

B. gravitational potential is minimum at centre

C. field strength is maximum at centre

D. field strength is minimum at centre

Answer: A::D

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84. In elliptical orbit of a planet

A. angular momentum about centre of sun is constant

B. potential energy is constant

C. kinetic energy is constant

D. total mechanical energy is constant

Answer: A::D

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85. At the surface of earth, potential energy of a particle is U and potential is V.Change in potential energy and potential at height h=R are suppose ΔU and ΔV.Then

A. $\Delta U = -U/2$

B. $\Delta U = U/2$

C. $\Delta V = V/2$

D. $\Delta V = -V/2$

Answer: A::D

Watch Video Solution

86. satellite revolving in circular orbit suppose V_0 is the orbital speed, T its time period, u its potential energy and K the kinetic energy. Now value of G is decreasesd. Then

A. V_0 will decreases

B. T will decrease

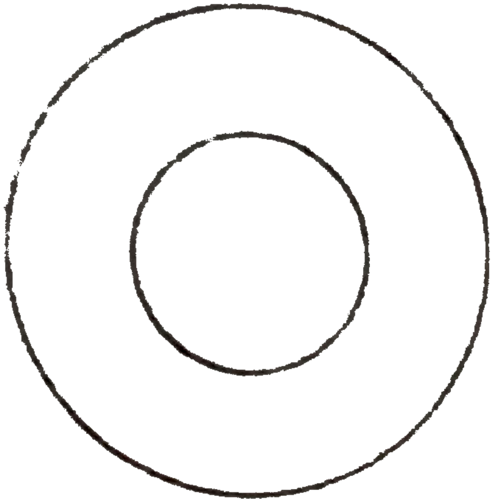
C. U will decrease

D. K will decrease

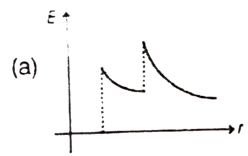
Answer: A::D

Watch Video Solution

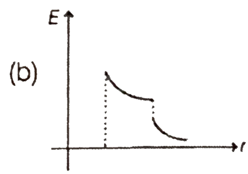
87. Two concentric speherical shells are as shown in figure. The magnitude of gravitational potential (V) and field strength (E) vary with distance (r) from centre as



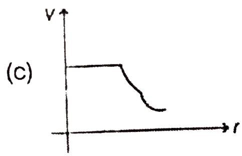
A.

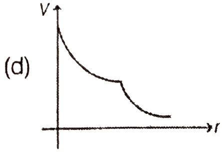


B.



C.



D. 

Answer: A::C

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88. For a satellite to apper satationery to an observer on earth.

A. It must be rotating about the earth's axis

B. It must be rotating in the equatrial plane

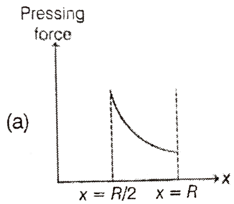
C. It should rotate from west to east

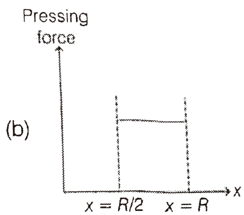
D. Its time period must be 24 hours

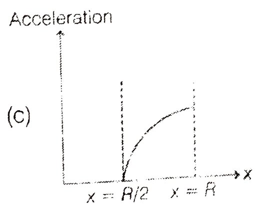
Answer: A::B::C::D

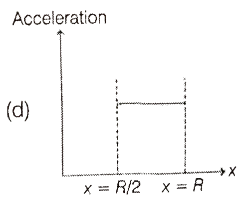
Watch Video Solution

89. A tunnel is dug along a chord of the earth at a perpendicular distance $R/2$ from the earth's centre. The wall of the tunnel may be assumed to be frictionless. A particle is released from one end of the tunnel. The pressing force by the particle on the wall, and the acceleration of the particle vary with x (distance of the particle from the centre) according to

A. 

B. 

C. 

D. 

Answer: B::C

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90. If a body is projected with a speed lesser than escape velocity, then

A. the body can reach a certain height and may fall down following a straight line path.

B. the body can reach a certain height and may fall down following an approximately parabolic path

C. the body may orbit the earth in a circular orbit

D. the body may orbit the earth in a elliptic orbit

Answer: A::B::C::D

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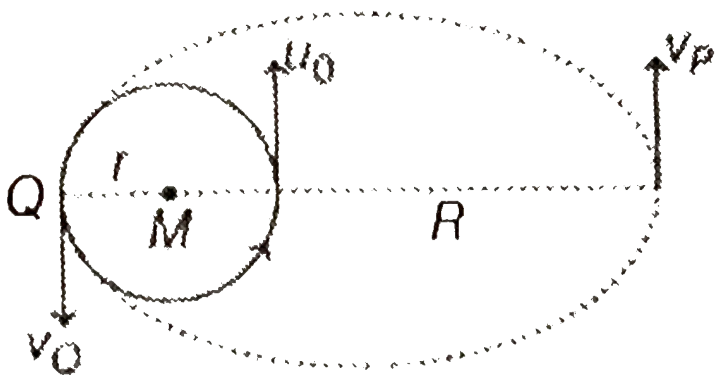
91. A light satellite is initially rotating around a planet in a circular orbit of radius r. Its speed in this circular orbit was u_0. It is put in an elliptical orbit by increasing its speed form u_0 to v_Q (instantaneously). In the elliptical orbit, the satellite reaches the farthest point P, which is at a distance R from the planet. Satellite's speed at farthest point is v_P. At point Q, the speed required by satellite to escape the planet's gravitational pull is v_{esc}



A. a.$v_{\text{esc}} = 2u_0$

B. b.$v_Q = u_0 r\sqrt{\dfrac{2}{R(r+R)}}$

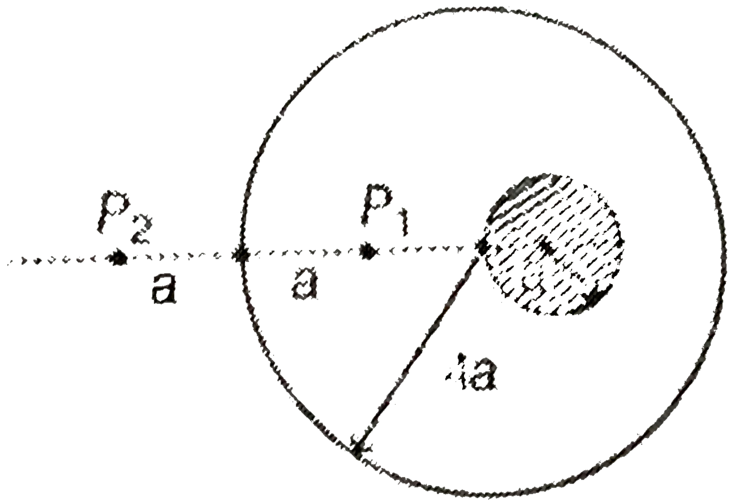
C. c.$v_Q = u_0\sqrt{\dfrac{2R}{(r+R)}}$

D. d.$v_P = u_0 r\sqrt{\dfrac{2}{R(r+R)}}$

Answer: C::D

Watch Video Solution

92. A uniform metal sphere of radius a and mass M is surrounded by a thin uniform spherical shell of equal mass and redius 4a. The centre of the shell falls on the surface of the iner sphere



A. The gravitational field intensity at P_1 is $\dfrac{GM}{16a^2}$

B. The gravitational field intensity at P_2 is $\dfrac{61GM}{900a^2}$

C. The gravitational potential at $P_1 = 0$

D. The gravitational potential at $P_2 = 0$

Answer: A::B

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93. If a smooth tunnel is dug across a diameter of earth and a particle is released from the surface of earth, the particle oscillate simple harmonically along it

Maximum speed of the particle is

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

B. b. $\sqrt{\frac{GM}{R}}$

C. c. $\sqrt{\frac{3GM}{2R}}$

D. d. $\sqrt{\frac{GM}{2R}}$

Answer: B

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94. When a particle is projected from the surface of earth its mechanical energy and angular momentum about center of earth at all time are constant.

Q. A particle of mass m is projected from the surface of earth with velocity v_0 at angle θ with horizontal suppose h be the maximum height of particle from surface of earth and v its speed at that point then v is $v_0 \cos \theta$

A. $v_0 \cos \theta$

B. $> v_0 \cos \theta$

C. $< v_0 \cos \theta$

D. zero

Answer: C

Watch Video Solution

95. When a particle is projected from the surface of earth, its mechanical energy and angular momentum about centre of earth at all time is constant .

A particle mass m is projected from the surface of earth with velocity v_0 at angle θ with horizontal. Suppose h be the maximum height of particle from surface of earth and v its speed at that point then v is

A. $= \dfrac{v_0^2 \sin^2 \theta}{2g}$

B. $> \dfrac{v_0^2 \sin^2 \theta}{2g}$

C. $< \dfrac{v_0^2 \sin^2 \theta}{2g}$

D. can be greater than or less than $\dfrac{v_0^2 \sin^2 \theta}{2g}$

Answer: B

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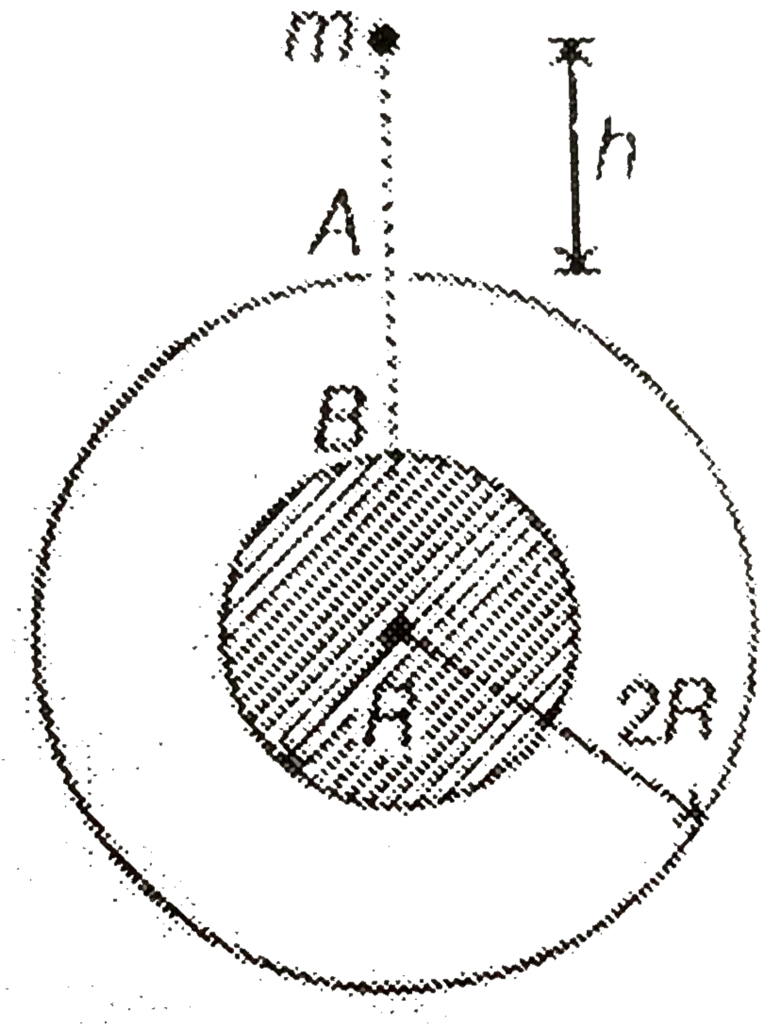
96. A solid sphere of mass M and radius R is surrounded by a spherical shell of same mass M and radius 2R as shown. A small particle of mass m is released from rest from a height $h(< < R)$ above the shell. There is a hole in the shell.



At what time will it enter the hole at A

A. $2\sqrt{\frac{hR^2}{GM}}$

B. $\sqrt{\dfrac{2hR^2}{GM}}$

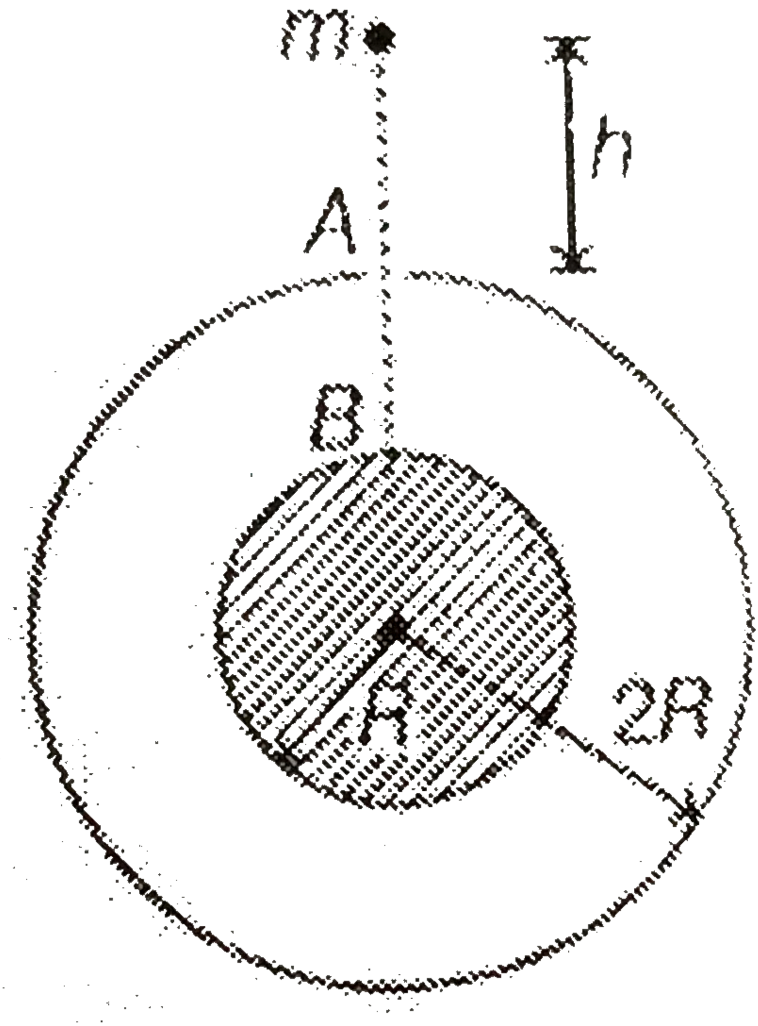
C. $\sqrt{\dfrac{hR^2}{GM}}$

D. None of these

Answer: A

Watch Video Solution

97. A solid sphere of mass M and radius R is surrounded by a spherical shell of same mass M and radius 2R as shown. A small particle of mass m is released from rest from a height $h(< < R)$ above the shell. There is a hole in the shell.



What time will it take to move from A to B?

A. $= \dfrac{R^2}{\sqrt{GMh}}$

B. $> \dfrac{R^2}{\sqrt{GMh}}$

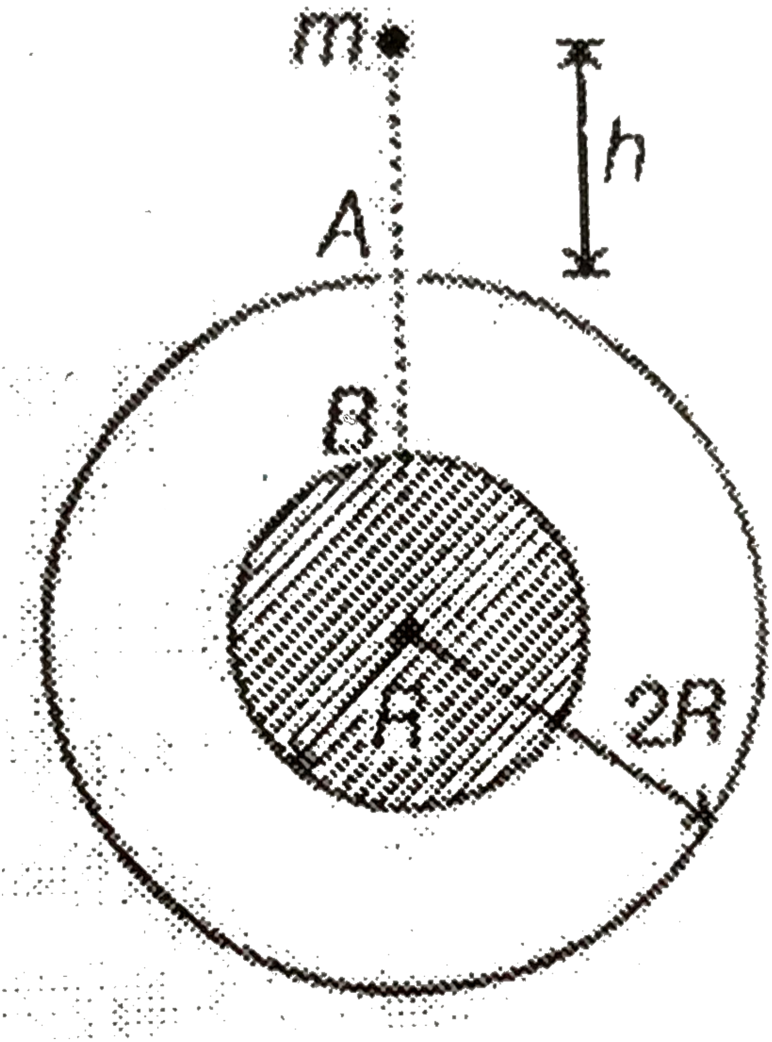
C. $< \dfrac{R^2}{\sqrt{GMh}}$

D. None of these

Answer: C

Watch Video Solution

98. A solid sphere of mass M and radius R is surrounded by a spherical shell of same mass M and radius 2R as shown. A small particle of mass m is released from rest from a height $h(< \ < R)$ above the shell. There is a hole in the shell.



What speed will it collide at B?

A. $\sqrt{\dfrac{2GM}{R}}$

B. $\sqrt{\dfrac{GM}{2R}}$

C. $\sqrt{\dfrac{3GM}{2R}}$

D. $\sqrt{\frac{GM}{R}}$

Answer: D

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99. A planet is revolving round the sun is elliptical orbit. Velocity at perigee position (nearest) is v_1 and at apogee position (farthest) is v_2. Both these velocities are perpendicular to the line joining centre of sun and planet. r_1 is the minimum distance and r_2 the maximum distance. When the planet is at perigee position, it wants to revolve in a circular orbit by itselff. For this, value of G

A. a.should increase

B. b.should decrease

C. c. will not depends on the value of G

D. d. data is insufficient

Answer: A

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100. A planet is revolving round the sun is elliptical orbit. Velocity at perigee position (nearest) is v_1 and at apogee position (farthest) is v_2. Both these velocities are perpendicular to the line joining centre of sun and planet. r_1 is the minimum distance and r_2 the maximum distance.

At apogee position suppose speed of planet is slightly decreased from v_2, then what will happen to minimum distance r_1 and maximum distance r_2 in the subsequent motion.

A. r_1 and r_2 both will decrease

B. r_1 and r_2 both will increase

C. r_2 will remain as it is while r_1 will increase

D. r_2 will remain as it is while r_1 will decrease

Answer: D

Watch Video Solution

101. Three equal masses each of mass 'm' are placed at the three-corner of an equilateral triangle of side 'a'

If a fourth particle of equal mass is placed at the centre of triangle, then net force acting on it, is equal to

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

B. $\frac{4Gm^2}{3a^2}$

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

D. zero

Answer: D

Watch Video Solution

102. Three equal masses each of mass 'm' are palced at the three corners of an equilateral of side a

If a fourth particle of equal mass is placed at the centre of triangle then net force acting on it is equal to .

A. $\dfrac{Gm^2}{a^2}$

B. $\dfrac{4Gm^2}{3a^2}$

C. $\dfrac{3Gm^2}{a^2}$

D. zero

Answer: B

Watch Video Solution

103. Three equal masses each of mass 'm' are palced at the three corners of an equilateral of side a

If a fourth particle of equal mass is placed at the centre of triangle then net force acting on it is equal to .

A. $\dfrac{3Gm^2}{a}$

B. $\dfrac{3Gm^2}{2a}$

C. $\dfrac{4Gm^2}{3a}$

D. $zero$

Answer: B

Watch Video Solution

104. Three equal masses each of mass 'm' are placed at the three-corner of an equilateral triangle of side 'a'

In the above system, if two particles are kept fixed and third particle is released, then speed of the particle when it reaches to the mid point of the side connectiong other two masses is

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

B. b.$\sqrt{\frac{4GM}{a}}$

C. c.$\sqrt{\frac{GM}{a}}$

D. d.$\sqrt{\frac{GM}{2a}}$

Answer: B

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105. An artificial satellite is moving in circular orbit around the earth with speed equal to half the magnitude of escape velocity from the surface of earth. R is the radius of earth and g is acceleration due to gravity at the surface of earth $(R = 6400 km)$

Then the distance of satelite from the surface of earth is .

A. 3200 km

B. 6400 km

C. 12800 km

D. 4800 km

Answer: B

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106. 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 surface of earth. R is the radius of earth and g is acceleration due to gravity at the surface of earth. (R=6400 km).

The time period of revolution of satellite in the given orbit is

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

B. $2\pi\sqrt{\frac{4R}{g}}$

C. $2\pi\sqrt{\frac{8R}{g}}$

D. $2\pi\sqrt{\frac{6R}{g}}$

Answer: C

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107. 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.

A. $\sqrt{gR}$

B. $\sqrt{1.5gR}$

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

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

Answer: A

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108. A pair of stars rotates about a common centre of mass. One of the stars has a mass M and the other has mass m such that =2m. The distance between the centres of the stars is d (d being large compare to the size of eithe star).

The period of rotation of the stars about their common centre of mass (in terms of d,m,G) is

A. $\sqrt{\frac{4\pi^2}{Gm}d^3}$

B. $\sqrt{\frac{8\pi^2}{Gm}d^3}$

C. $\sqrt{\frac{2\pi^2}{3Gm}d^3}$

D. $\sqrt{\frac{4\pi^2}{3Gm}d^3}$

Answer: D

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109. A pair of stars rotates about their centre of mass One of the stars has a mass M and the other has mass m such that $M = 2m$ The distance between the centres of the stars is d (d being large compared to the size of either star) .

The ratio of the angular momentum of the two stars about their common centre of mass (L_m / L_m) is .

A. 1

B. 2

C. 4

D. 9

Answer: B

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110. A pair of stars rotates about their centre of mass One of the stars has a mass M and the other has mass m such that $M = 2m$ The distance between the centres of the stars is d (d being large compared to the size of either star) .

The ratio of kinetic energies of the two stars (K_m / K_M) is .

A. 1

B. 2

C. 4

D. 9

Answer: B

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111. Consider a spherical planet of radius R . Its density varies with the distance of its centre t as $\rho = A - Br$, where A and B are positive constants. Now answer the following questions.

Acceleration due to gravity at a distance $r(r < R)$ from its centre is

A. $\frac{4}{3}\pi Gr(A - Br)$

B. $(4)\pi Gr(A - Br)$

C. $\frac{4}{3}\pi Gr\left(A - \frac{3}{4}Br\right)$

D. $\frac{4}{3}\pi Gr\left(A - \frac{3}{2}Br\right)$

Answer: C

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112. Consider a spherical planet of radius R . Its density varies with the distance of its centre t as $\rho = A - Br$, where A and B are positive constants. Now answer the following questions.

Acceleration due to gravity at a distance $r(r < R)$ from its centre is

A. a.$\frac{2}{3}\pi GA^2(R^2 - r^2)$

B. b.$\frac{1}{3}\pi GA^2(R^2 - r^2)$

C. c.$\frac{3}{2}\pi GA^2(R^2 - r^2)$

D. d.$\frac{4}{3}\pi GA^2(R^2 - r^2)$

Answer: A

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113. A particle is projected from the surface of earth of mass M and radius R with speed v. Suppose it travels a distance $x(< < R)$ when its speed becomes v to $v/2$ and $y(< < R)$ when speed changes from $v/2$ to 0. Similarly, the corresponding times are suppose t_1 and t_2. Then

	Column-I		Column-II
(A)	x/y	(p)	$= 1$
(B)	t_1/t_2	(r)	> 1
		(r)	< 1

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114. In elliptical orbit of a planet, as the planet moves from apogee position to perigee position to perigee position, match the following columns

	Column-I		Column-II
(A)	Speed of planet	(p)	Remains same
(B)	Distance of planet from centre of sun	(q)	Decreases
(C)	Potential energy	(r)	Increase
(D)	Angular momentum about centre of sun	(s)	Cannot say

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115. Match the following

	Table-1		Table-2
(A)	Newton's law of Gravitation	(P)	Law of conservation of angular momentum
(B)	Kepler's second law	(Q)	$T^2 \propto r^{3/2}$
(C)	Kepler's first law	(R)	Inverse square law
(D)	Kepler's third law	(S)	Orbit of planet is elliptical

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116. Let V and E denote the gravitational potential and gravitational field at a point. Then, match the following columns

	Column-I		Column-II
(A)	$E = 0, V = 0$	(p)	At centre of spherical shell
(B)	$E \neq 0, V = 0$	(q)	At centre of solid sphere
(C)	$V \neq 0, E = 0$	(r)	At centre of circular ring
(D)	$V \neq 0, E \neq 0$	(s)	At cetre of two point masses of equal magnitude
		(t)	None

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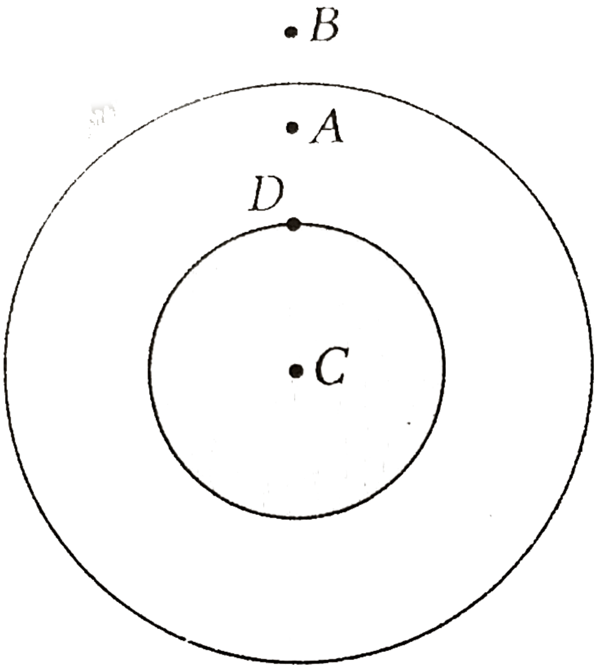
117. Two concentric spherical shells are as shown in figure. Match the following columns



	Column-I		Column-II
(A)	Potential at A	(p)	greater than B
(B)	Gravitational field at A	(q)	less than B
(C)	As one moves from C to D	(r)	Potential remains constant
(D)	As one moves from D to A	(s)	Gravitational field decreases
		(t)	None

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118. Match the following

Table-1	Table-2
(A) Kinetic energy of a particle in gravitational field is increasing	(P) work done by gravitational force should be positive
(B) Potential energy of a particle in gravitational field is increasing	(Q) work done by external force should be non zero
(C) Mechanical energy of a particle in gravitational field is increasing	(R) work done by gravitational force should be negative
	(S) Cannot say anything

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119. Match the following

Table-1	Table-2
(A) Time period of an earth satellite in circular orbit	(P) Independent of mass of satellite
(B) Orbital velocity of satellite	(Q) Independent of radius of orbit
(C) Mechanical energy of satellite	(R) Independent of mass of earth
	(S) None

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120. If earth decreases its rotational speed without changing other factors. Match the following.

Table-1	Table-2
(A) Value of g at pole	(P) will remain same
(B) Value of g at equator	(Q) will increase
(C) Distance of geostationary satellite	(R) will decrease
(D) Energy of geostationary satellite	(S) Cannot say

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121. Match the following columns. (for a satellite in circular orbit)

	Column-I		Column-II
(A)	Kinetic energy	(p)	$-\frac{GMm}{2r}$
(B)	Potential energy	(q)	$\sqrt{\frac{GM}{r}}$
(C)	Total energy	(r)	$-\frac{GMm}{r}$
(D)	Orbital speed	(s)	$\frac{GMm}{2r}$

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122. The diameters of two planets are in the ratio $4:1$ and their mean densities in the ratio $1:2$ The acceleration due to gravity on the particles wil be in ratio.

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123. A mass is taken to a height R from the surface of earth and then is given horizontal velocity v. The minimum value of v so that mass escapes to infinity is $\sqrt{\frac{GM}{nR}}$. Find the value of n.

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124. The density of the core of a planet is x and that of outer shell is y. The radii of the core and that of the planet are R and 2R. The acceleration due to gravity at the surface of planet is same as at a depth R. The ratio of x and y is n/3. Find the value of n.

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125. Energy required to launch a satellite of mass m from earth's surface in a circular orbit at an altitude of 2R (R=radius of th earth) is $\frac{5}{n}$ mgR. Find value of n.

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126. A body is projected vertically upwards from the surface of earth with a velocity equal to half the escape velocity. If R be the radius of earth, maximum height attained by the body from the surface of earth is $\frac{R}{n}$. Find the value of n.

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127. Pertaining to two planets, the ratio of escape velocities from respective surfaces is $1:2$, the ratio of the time period of the same simple pendulum at their respective surfaces is $2:1$ (in same order). Then the ratio of their average densities is

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128. Two particles of equal masses m go round a circle of radius R under the action of their mutual gravitational attraction. The speed of each particle is $v = \sqrt{\frac{Gm}{nR}}$. Find the value of n.

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129. Energy of a satellite in circular orbit is E_0. The energy required to move the satellite to a circular orbit of 3 time the radius of the initial orbit is $\frac{x}{3}E_0$. Find the value of x.

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130. 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. The height of the satellite above the surface of the earth is x R. Find the value of x.

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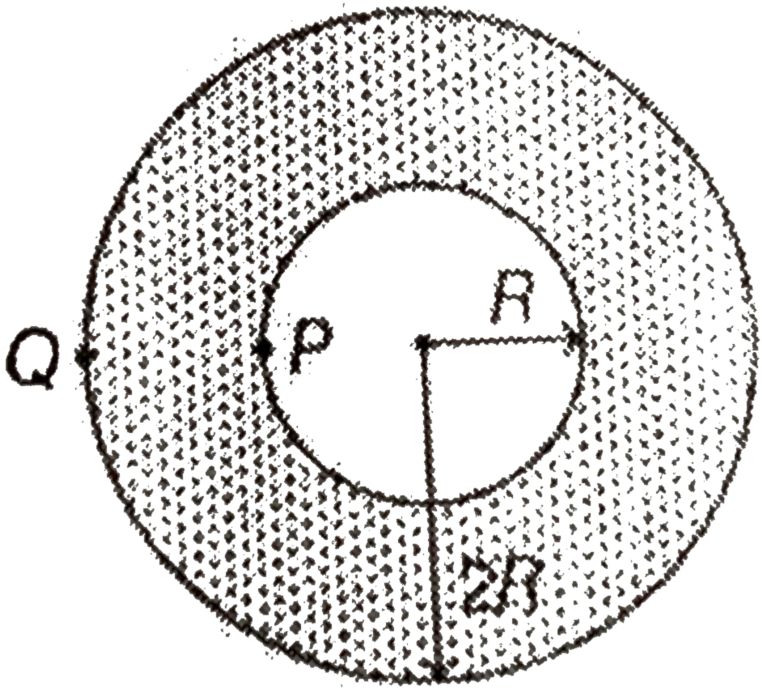
131. A solid sphere of radius R and mass density ρ is surrounded by another outer sphere of density 2ρ. Let E_P is gravitational field at P and E_Q is at Q. If the ratio of $E_Q / E_P = 3k/4$. Find the value of k.



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