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PHYSICS

BOOKS - A2Z PHYSICS (HINGLISH)

GRAVITATION

Gravitational Field And Acceleration Due To Gravity

1. An astronaut experiences weightlessness in a space satellite It is because .

A. the gravitational force is small at that location in space.

B. the gravitational force is large at that location in space.

C. the astronaut experiences no gravity.

D. the gravitational force is infinitely large at that location in space.

Answer: C

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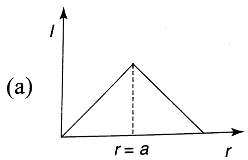
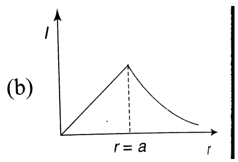
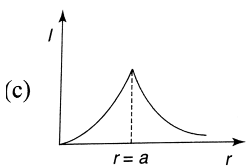
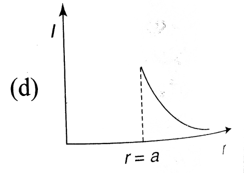
2. Which one of the following plots represents the variation of the gravitational field on a particle with distance r due to a thin spherical shell of raduis R? (r is measured from the centre of the spherical shell).

A. 

B. 

C. 

D. 

Answer: D

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3. At the surface of a certain planet acceleration due to gravity is one - quarter of that on earth If a brass ball is transported to this planet , then which one of the following statements is not correct ? .

A. The mass of the brass ball on this planet is a quarter
B. The weight of the brass ball on this planet is a quarter of the weight as measured on earth.
C. The brass ball has the same mass on the other planet as on earth
D. The brass ball has the same volume on the other planet as on earth

Answer: A

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4. The mass of the moon is $\frac{1}{8}$ of the earth but the gravitational pull is $\frac{1}{6}$ earth It is due to the fact that .

A. The radius of the moon is $\frac{81}{6}$ of the earth

B. The radius of the earth is $\frac{9}{\sqrt{6}}$ of the moon

C. Moon is the satellite of the earth

D. none of these

Answer: B

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5. Which of the following statements is correct ? .

A. Acceleration due to gravity increase with increase altitude

B. Acceleration due to gravity increases with increasing depth.

C. Acceleration due to gravity increases with increasing latitude.

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

Answer: C

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6. 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 the same every where

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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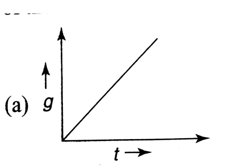
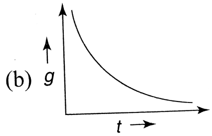
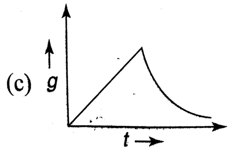
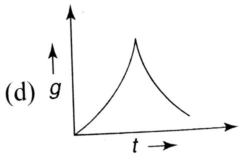
7. Which graph correctly presents the variation of acceleration due to gravity with the distance form the centre of the earth?

A. 

B. 

C. 

D. 

Answer: C

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8. 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?

A. $x = h$

B. $x = 2h$

C. $x = \frac{h}{2}$

D. $x = h^2$

Answer: B

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9. Weight fo a body of a mass m decreases by 1% when it is raised to height h above the earth's surface. If the body is taken to depth h in a mine, change in its weight is

A. 2% decreases

B. 0.5% decreases

C. 1% increases

D. 0.5% increases

Answer: B

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10. Let g be the acceleration due to gravity at the earth's surface and K the rotational kinetic energy of the earth. Suppose the earth's radius decreases by 2%. Keeping all other quantities constant, then

A. g decreases by 2% and K decreased by 4%

B. g decreases by 4% and K increased by 2%

C. g increases by 4% and K increased by 4%

D. g decreases by 4% and K increased by 4%

Answer: C

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11. At what depth below the surface of the earth, acceleration due to gravity g will be half its value 1600km above the surface of the earth

A. $4.2 \times 10^6 m$

B. $3.91 \times 10^6 m$

C. $1.59 \times 10^6 m$

D. none of these

Answer: A

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12. Cosider earth to be a homogeneous sphere. Scientist A goes deep down in a mine and scientist B goes high up in a bollon. The value of g measured by

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

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

C. Each decreases at same rates

D. Each decreases at different rates

Answer: D

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13. If a planet consits of a satellite whose mass and radius were both half that of the earth, the acceleration due to gravity at its surface would be (g on earth=$9.8 m/\sec^2$)

A. $4.9 m/\sec^2$

B. $8.9 m/\sec^2$

C. $19.6 m/\sec^2$

D. $29.4m/\sec^2$

Answer: C

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14. Acceleration due to gravity on moon is $1/6$ of the acceleration due to gravity on earth. If the ratio of densities of earth (ρ_e) and moon (ρ_m) is $\left(\frac{\rho_e}{\rho_m}\right) = \frac{5}{3}$ then radius of moon (R_m) in terms of R_e will be

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

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

C. $\frac{7}{18}R_e$

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

Answer: A

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15. The moon's radius is $1/4$ that of the earth and its mass $1/80$ times that of the earth. If generates the acceleration due to gravity on the surface of the earth, that on the surface of the moon is

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

B. $\frac{g}{5}$

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

D. $\frac{g}{8}$

Answer: B

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16. Mass of moon is $7.34 \times 10^{22} kg$. If the acceleration due gravity on the moon is $1.4 m / s^2$, the radius of the moon $(G = 6.667 \times 10^{-11} Nm^2 / kg^2)$

A. $0.56 \times 10^4 m$

B. $1.87 \times 10^6 m$

C. $1.92 \times 10^6 m$

D. $1.01 \times 10^8 m$

Answer: B

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

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

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

C. $g_1 : g_2 = R_1 \rho_2^2 : R_2 \rho_1$

D. $g_1 : g_2 = R_1 \rho_1^2 : R_2 \rho_2$

Answer: D

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18. The height of the point vertically above the earth's surface, at which acceleration due to gravity becomes 1% of its value at the surface is (Radius of the earth =R)

A. $8R$

B. $9R$

C. $10R$

D. $20R$

Answer: B

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19. The depth at which the effective value of acceleration due to gravity is $\frac{g}{4}$ is (R=radius of the earth)

A. R

B. $\frac{3R}{4}$

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

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

Answer: B

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20. The depth at which the value of acceleration due to gravity is $\frac{1}{n}$ times the value at the surface, is (R=radius of the earth)

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

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

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

D. $R\left(\frac{n}{n+1}\right)$

Answer: B

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21. A spherical planet far out in space has a mass M_0 and diameter D_0. A particle of mass m falling freely near the surface of this planet will experience an accelertion due to gravity which is equal to

A. GM_0 / D_0^2

B. $4mGM_0 / D_0^2$

C. $4GM_0 / D_0^2$

D. GmM_0 / D_0^2

Answer: C

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22. A planet has mass $1/10$ of that of earth, while radius is $1/3$ that of earth. If a person can throw a stone on earth surface height of 90m, then he will be able to throw the stone on that planet to a height

A. $90m$

B. $40m$

C. $100m$

D. $45m$

Answer: C

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23. The acceleration of a body due to the attraction of the earth (radius R) at a distance 2R form the surface of the earth is (g=acceleration due to gravity at the surface of the earth)

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

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

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

D. g

Answer: A

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24. At surface of earth weight of a person is 72N then his weight at height $R/2$ from surface of earth is (R=radius of earth)

A. $28N$

B. $16N$

C. $32N$

D. $72N$

Answer: C

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25. Assuming earth to be a sphere of a uniform density, what is the value of gravitational acceleration in mine 100km below the earth's surface (Given $R = 6400km$)

A. $9.66m/s^2$

B. $7.64m/s^2$

C. $5.06m/s^2$

D. $3.10m/s^2$

Answer: A

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26. The acceleration due to gravity g and density of the earth ρ are related by which of the following relations? (where G is the gravitational constant and R_E is the radius of the earth)

A. $\rho = \dfrac{4\pi G R_E}{3g}$

B. $\rho = \dfrac{3g}{4\pi G R_E}$

C. $\rho = \dfrac{3g}{4\pi g R_E}$

D. $\rho = \dfrac{4\pi g R_E}{3G}$

Answer: B

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27. 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 2%

B. increase by 1%

C. decrease by 1%

D. decrease by $\frac{1}{2}\%$

Answer: A

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28. The mass of the moon is $\frac{1}{8}$ of the earth but the gravitational pull is $\frac{1}{6}$ earth It is due to the fact that .

A. moon is the satellite of the earth

B. the radius of the earth is $\frac{8}{6}$ of the moon

C. the radius of the earth is $\left(\sqrt{8/6}\right)$ of the moon

D. the radius of the moon is $(6/8)$ of the earth

Answer: C

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29. A body hanging from a spring strethces it by 1cm at the earth's surface. How much will the same body stretch the spring at a place 16400km above the earth's surface? (Radius of the earth 6400km)

A. $1.28m$

B. $0.64m$

C. $3.6m$

D. $0.12m$

Answer: B

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

A. $125N$

B. $150N$

C. $175N$

D. $250N$

Answer: A

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31. At surface of earth weight of a person is 72N then his weight at height $R/2$ from surface of earth is (R=radius of earth)

A. $16N$

B. $28N$

C. $32N$

D. $72N$

Answer: C

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32. The acceleration due to gravity g and density of the pols and the equator is g_p and g_e respectively. If the earth is a sphere of radius R_E and rotating about its axis with angular speed ω and $g_p - g_e$ given by

A. $\dfrac{\omega^2}{R_E}$

B. $\dfrac{\omega^2}{R_E^2}$

C. $\omega^2 R_E^2$

D. $\omega^2 R_E$

Answer: D

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33. 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:

A. $6N$

B. $20N$

C. $40N$

D. $80N$

Answer: D

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34. Infinite bodies, each of mass 3kg are situated at distance 1m,2m,4m,8m...respectively on x-axis. The resultant intensity of gravitational field at the origin will be

A. G

B. $2G$

C. $3G$

D. $4G$

Answer: D

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Gravitational Potential Energyand Escape Velocity

1. There is no atomosphere on moon because

A. it is closer to earth

B. it revolves round the earth

C. it get light from the sun

D. the escape velocity of the gas molecules is less than their root mean square velocity here

Answer: D

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2. A projectile is launched from the surface of earth with a velocity less than the escape velocity. Its total mechanical energy is

A. positive

B. negative

C. zero

D. dependes upon initial velocity

Answer: B

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3. The intensity of gravitational field at a point situated at a distance of 8000km form the centre of the earth is $6 / kg$. The gravitational potential at that point is -(in joule /kg)

A. 8×10^6

B. 2.4×10^3

C. 4.8×10^7

D. 6.4×10^{14}

Answer: C

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4. A body of mass m kg starts falling from a point 2R above the earth's surface. Its kinetic energy when its has fallen to a point 'R' above the earth's surface [R Radius of earth M-mass of earth, G-gravitational constant]

A. $\frac{1}{2}\frac{GMm}{R}$

B. $\frac{1}{6}\frac{GMm}{R}$

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

D. $\frac{1}{3}\frac{GMm}{R}$

Answer: B

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

A. $11km/s$

B. $11\sqrt{3}km/s$

C. $\frac{11}{\sqrt{3}}km/s$

D. $33km / s$

Answer: A

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6. A body of mass m is situated at a distance $4R_e$ above the earth's surface, where R_e is the radius of earth. How much minimum energy be given to the body so that may escape

A. mgR_e

B. $2mgR_e$

C. $\dfrac{mgR_e}{5}$

D. $\dfrac{mgR_e}{16}$

Answer: C

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7. Assuming earth as a uniform sphere of radius R, if we project a body along the smooth diametrical chute form the centre of earth with a speed v such that it will just reach the earth's surface then v is equal to :

A. $\sqrt{gR}$

B. $\sqrt{2gR}$

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

D. none of these

Answer: A

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8. In the above question, escape speed from the centre of earth is :

A. $\sqrt{2gR}$

B. $\sqrt{gR}$

C. $\sqrt{3gR}$

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

Answer: C

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9. Let the minimum external work done in shifting a particle from centre of earth to earth's surface be W_1 and that from surface of earth to infinity be W_2 . Then $\frac{W_1}{W_2}$ is equal to

A. $1:1$

B. $1:2$

C. $2:1$

D. $1:3$

Answer: B

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10. The escape velocity form the centre of a unifrom ring of mass M and radius R is :

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

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

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

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

Answer: A

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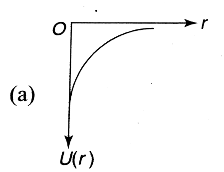
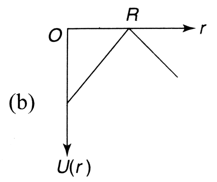
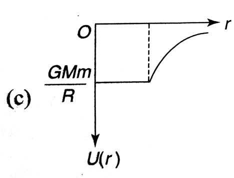
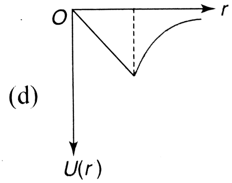
11. A shell of mass M and radius R has point mass m placed at a distance r from its centre. The gravitational potential energy U(r) vs r will be

A. 

B. 

C. 

D. 

Answer: C

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12. A projectile is launched from the surface of earth with a velocity less than the escape velocity. Its total mechanical energy is

A. positive

B. negative

C. zero

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

Answer: B

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13. The gravitational potential energy of body of mass 'm' at the earth's surface mgR_e. Its gravitational potential energy at a height R_e

fromt the earth's surface will be (here R_e is the radius of the earth)

A. $-2mgR_e$

B. $2mgR_e$

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

D. $-\frac{1}{2}mgR_e$

Answer: D

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14. 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. $R / \left(\frac{gR}{2V^2} - 1\right)$

B. $R\left(\frac{gR}{2V^2} - 1\right)$

C. $R / \left(\frac{2gR}{V^2} - 1\right)$

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

Answer: C

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15. A body of mass m kg starts falling from a point 2R above the earth's surface. Its kinetic energy when its has fallen to a point 'R' above the earth's surface [R-Radius of earth M-mass of earth, G-gravitational constant]

A. $\frac{1}{2}\frac{GMm}{R}$

B. $\frac{1}{6}\frac{GMm}{R}$

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

D. $\frac{1}{3}\frac{GMm}{R}$

Answer: B

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16. Maximum height reached by a rocket fired with a speed equal to 50% of the escape velocity from earth's surface is:

A. $R/2$

B. $16R/9$

C. $R/3$

D. $R/8$

Answer: C

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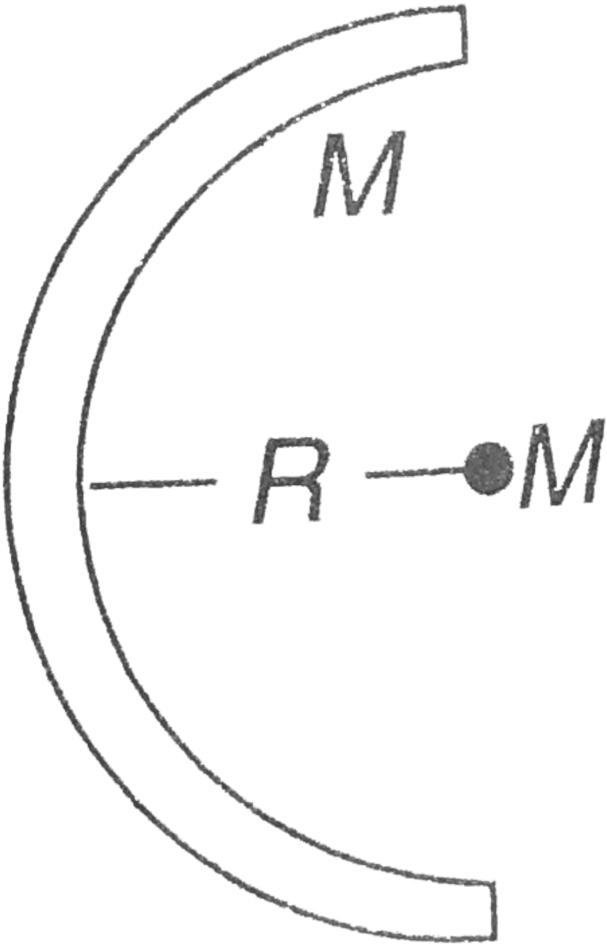
17. The potential energy of interaction between the semi-circular ring of mass M and radius R, and the particle of mass M placed at the centre of curvature of the semi-circular arc is:



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

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

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

D. none of these

Answer: A

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18. Two oppositely rotating satellities of same are launched in the same orbit round the earth. The collide idealistically. What is the ratio of gravitational potential energy before and after collistion?

A. 2

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

C. $\sqrt{2}$

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

Answer: B

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

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

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

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

Answer: C

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20. Four particles each of mass m are kept at the four vertices of a square of side 'a' . Find gravitational potential energy of this system.

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

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

Answer: B

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21. 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. $-2\sqrt{2}\frac{Gm}{l}$

B. $-3\sqrt{2}\frac{Gm}{l}$

C. $-2\frac{Gm}{l}$

D. $-4\sqrt{2}\frac{Gm}{l}$

Answer: D

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22. 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. $mgR_E\dfrac{n}{(n-1)}$

B. mgR_E

C. $(mgR_E)\dfrac{n}{(n+1)}$

D. $\dfrac{mgR_E}{n}$

Answer: C

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

A. $-\dfrac{Gm}{R}$

B. $-\dfrac{3Gm}{R}$

C. $-\dfrac{4Gm}{R}$

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

Answer: C

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24. Two spheres each of mass M and radius R are separated by a distance of r. The gravitational potential at the midpoint of the line joining the centres of the spheres is

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

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

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

D. $-\frac{4GM}{r}$

Answer: D

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25. The mass of the earth is $6 \times 10^{24} kg$ and that of the moon is $7.4 \times 10^{22} kg$. The potential energy of the system is $-7.79 \times 10^{28} J$. The mean distance between the earth and moon is

$\left(G = 6.67 \times 10^{-11} Nm^2 kg^{-2}\right)$

A. $3.8 \times 10^8 m$

B. $3.37 \times 10^6 m$

C. $7.6 \times 10^4 m$

D. $1.9 \times 10^2 m$

Answer: A

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

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

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

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

Answer: A

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27. 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.

A. (i) and (ii)

B. (ii) and (iv)

C. (i) and (iii)

D. (iii) and (iv)

Answer: B

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28. The escapoe 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

A. $11.2 kms^{-1}$

B. $22.4\sqrt{2} kms^{-1}$

C. $\frac{22.4}{\sqrt{2}} kms^{-1}$

D. $22.4\sqrt{3} kms^{-1}$

Answer: B

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29. The escape velocity for a body of mass $1kg$ from the earth surface is $11.2 kms^{-1}$. The escape velocity for a body of mass $100kg$ would be

A. $11.2 \times 10^{-2} kms^{-1}$

B. $111 kms^{-1}$

C. $11.2 kms^{-1}$

D. $11.2 \times 10^{-2} kms^{-1}$

Answer: C

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30. The mass of a planet is six times that of the earth. The radius of the planet is twice that of the earth. It's the escape velocity from the earth is v, then the escape velocity from the planet is:

A. $\sqrt{3}v$

B. $\sqrt{2}v$

C. $\sqrt{5}v$

D. $\sqrt{12}v$

Answer: A

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31. If v_e is escape velocity and v_0, is orbital velocity of satellite for orbit close to the earth's surface. Then are related by

A. $v_0 = \sqrt{2}v_e$

B. $n_0 = n_e$

C. $v_e = \frac{v_0}{2}$

D. $v_e = \sqrt{2}v_0$

Answer: D

Watch Video Solution

32. 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 or the earth changes in direction, but its magnitude remains constant.

C. The total mechanical energy of S varies perodically will time.

D. The linear momentum S remains constant in magnitude

Answer: A

Watch Video Solution

Motion Of Satellite

1. In a satellite if the time of revolution is T, then kinetic energy is proportional to

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

B. $\frac{1}{T^2}$

C. $\frac{1}{T^3}$

D. $T^{2/3}$

Answer: D

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

A. A satellite cannot 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 use just one geostationary satellite for global communication around the globe

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

Answer: B

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3. A satellite is moved from one circular orbit around the earth, to another of lesser radius. Which of the following statement is true?

A. The kinetic energy of satellite increases and the gravitational potential energy of satellite -earth system increases,

B. The kinetic energy of satellite increases and the gravitational potential energy of satellite -earth system decreases,

C. The kinetic energy of satellite decreases and the gravitational potential energy of satellite -earth system decreases,

D. The kinetic energy of satellite decreases and the gravitational potential energy of satellite -earth system increases,

Answer: B

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4. Which of the following statement is correct regarding a geostationary satellite?

A. A geostationary satellite goes around the earth in east-west direction.

B. A geostatioanry satellite goes around the earth in west-east direction.

C. The time periode of a geostationary satellite is 48 hours

D. The angle between the equatorial plane and the orbital plane of geostationary satellite is 90°

Answer: B

Watch Video Solution

5. The mean radius of the earth is R, its angular speed on its own axis is ω and the acceleration due to gravity at earth's surface is g. The cube of the radius of the orbit of a geo-stationary satellite will be

A. $R^2 g / \omega$

B. $R^2 \omega^2 / g$

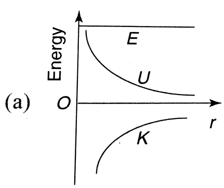
C. Rg / ω^2

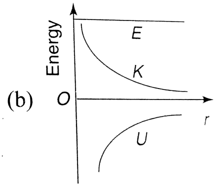
D. $R^2 g / \omega^2$

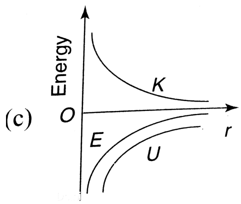
Answer: D

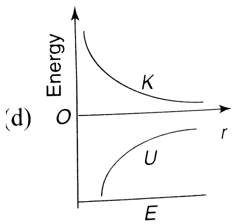
Watch Video Solution

6. The correct graph representing the variation of total energy (E_t), kinetic energy (E_k) and potential energy (U) of a satellite with its distance form the centre of earth is

A. 

B. 

C. 

D. 

Answer: C

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7. A satellite is seen every $6h$ over the equator. It is known that it rotates opposite to that of earth's direction. Then, the angular velocity (in radius per hour) of satellite about the centre of earth will be

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

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

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

D. $\frac{\pi}{8}$

Answer: C

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8. A satellite is seen after every 8 hours over the equator at a place on the earth when its sense of rotation is opposite to the earth. The time interval after which it can be seen at the same place when the sense of rotation of earth and satellite is same will be:

A. $8 hours$

B. $12 hours$

C. $24 hours$

D. $6hours$

Answer: C

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

A. $v_1 = v_2$

B. $v_1 < v_2$

C. $v_{1 > v_2}$

D. $\frac{v_1}{r_1} = \frac{v_2}{r_2}$

Answer: B

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10. The ratio of the K.E. required to the given to the satellite to escape earth's gravitational field to the K.E. required to be given so that the satellite moves in a circular orbit just above earth atmosphere is

A. One

B. Two

C. Half

D. Infinity

Answer: B

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11. The orbital velocity of an satellite in a circular orbit just above the earth's surface is v. For a satellite orbiting at an altitude of half of the earth's radius, the orbital velocity is

A. $\frac{3}{2}v$

B. $\sqrt{\frac{3}{2}v}$

C. $\sqrt{\frac{2}{3}v}$

D. $\frac{2}{3}v$

Answer: C

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12. 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. Increases by 1%

B. Increases by 0.5%

C. decreases by 1%

D. decreases by 0.5%

Answer: B

Watch Video Solution

13. A satellite revolves in elliptical orbit around a planet of mass M. Its time period is T and M is at the centre of the path. The length of the major axis of the path is: (neglect the gravitational effect of other object in space)

A. $2\left[\frac{GMT^2}{4\pi^2}\right]^{1/3}$

B. $\left[\frac{GMT^2}{4\pi^2}\right]^{1/3}$

C. $\frac{1}{2}\left[\frac{GMT^2}{4\pi^2}\right]^{1/3}$

D. none of these

Answer: A

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14. Two identical satellite are at R and $7R$ away from earth surface, the wrong statement is (R=radius of earth)

A. Ratio of total energy will be 4

B. Ratio of kinetic energy will be 4

C. Ratio of potential energy will be 4

D. Ratio of total energy will be 4 but ratio of potential and kinetic energies will be 2

Answer: D

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15. In the following four periods

(i) Time of revolution of a satellite just above the earth's surface (T_{st})

(ii) Period of oscillation of mass inside the tunnel bored along the diameter of the earth (T_{ma})

(iii) Period of simple pendulam having a length equal to the earth's raduis in a unifrom field of $9.8 N/kg (T_{sp})$

(iv) Period of an infinite length simple pendulam in the earth's real gravitational field (T_{is})

A. $T_{st} > T_{ma}$

B. $T_{ma} > T_{st}$

C. $T_{sp} > T_{is}$

D. $T_{st} = T_{ma} = T_{sp} = T_{is}$

Answer: C

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16. 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

A. E_k

B. $2E_k$

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

D. $3E_k$

Answer: A

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17. The little prince (the main charcter of the novel written by Antione de saint-Exupery) lives on the spherical planet named $B-612$, the density of which is $5200kg/m^3$. The little prince noticed that if he quickens his pace, he feels himself ligheter. when he reached the speed of $2m/s$ he became weightless, and began to orbit about the planet as a satellite. what is escape speed on the surface of planet?

A. $2\sqrt{2}m/s$

B. $2m/s$

C. $4\sqrt{2}m / s$

D. $8\sqrt{2}m / s$

Answer: A

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18. A satellite moves estwards very near the surface of the Earth in equitorial plane with speed (v_0). Another satellite moves at the same height with the same speed in the equatorial plane but westwards. If R =radius of the Earth and ω be its angular speed of the Earth about its own axis. Then find the approximate difference in the two time period as observed on the earth.

A. $\dfrac{4\pi\omega R^2}{v_0^2 + R^2\omega^2}$

B. $\dfrac{2\pi\omega R^2}{v_0^2 - R^2\omega^2}$

C. $\dfrac{4\pi\omega R^2}{v_0^2 - R^2\omega^2}$

D. $\dfrac{2\pi\omega R^2}{v_0^2 + R^2\omega^2}$

Answer: C

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19. Two satellites S_1 and S_2 revole round a planet in coplanar circular orbits in the same sanse. Their periods of revolution are 1 hour and 8 hour respectively. The radius of the orbit of $S_1 is 10^4 km,$ When $S_2 is closest \rightarrow S_1$ find

(i) the speed of $S_2 relative \rightarrow$ S_1

$(ii) the angu\underline{a}r speed of$S_2

$as actually observed by an * ronaut is$S_1.`

A. $2\pi \times 10^4 kmph$

B. $\pi \times 10^4 kmph$

C. $\frac{\pi}{2} \times 10^4 kmph$

D. $\frac{\pi}{3} \times 10^4 kmph$

Answer: B

Watch Video Solution

20. The orbital velocity of an satellite in a circular orbit just above the earth's surface is v. For a satellite orbiting at an altitude of half of the earth's radius, the orbital velocity is

A. $(3/2)v$

B. $\sqrt{(3/2)}v$

C. $\sqrt{(2/3)}v$

D. $(2/3)v$

Answer: C

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21. The time period of an artificial satellite in a circular orbit of radius R is 2 days and its orbital velocity is v_0. If time period of another satellite in a circular orbit is 16 days then

A. Its radius of orbit is $4R$ and orbital velocity is v_0

B. Its radius of orbit is $4R$ and orbital velocity is $\frac{v_0}{2}$

C. Its radius of orbit is $2R$ and orbital velocity is n_0

D. Its radius of orbit is $2R$ and orbital velocity is $\frac{v_0}{2}$

Answer: B

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22. The orbit velocity of a satellite at a height R above the surface of Earth is v. The escape velocity from the location is

A. $\sqrt{2}v$

B. $2v$

C. $4v$

D. none of these

Answer: A

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23. 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. $\dfrac{GM_E m}{2R_E}$

B. $\dfrac{GM_E m}{4R_E}$

C. $\dfrac{GM_E m}{8R_E}$

D. $\dfrac{GM_E m}{16R_E}$

Answer: C

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24. in the previous question, the change in potential energy.

A. $\dfrac{GM_E m}{2R_E}$

B. $\dfrac{GM_E m}{4R_E}$

C. $\dfrac{GM_E m}{8R_E}$

D. $\dfrac{GM_E m}{R_E} s$

Answer: B

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25. 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

A. $v = \sqrt{GM\left(\frac{1}{R} - \frac{1}{r}\right)}$

B. $v = \sqrt{GM\left(\frac{1}{2R} - \frac{1}{r}\right)}$

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

D. $v = \sqrt{GM\left(\frac{1}{2R} + \frac{1}{r}\right)}$

Answer: B

Watch Video Solution

26. A satellite is orbiting the earth in a circular orbit of radius r. Its

A. kinetic energy veries as r

B. angular momentum varies as r^{-1}

C. linear momentum varies as r^{2}

D. frequency of revolution varies as $r^{-3/2}$

Answer: D

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27. The time period T of the moon of planet mars (mass M_m) is related to its orbital radius R as (G=gravitational constant)

A. $T^2 = \frac{4\pi^2 R^3}{GM_m}$

B. $T^2 = \frac{4\pi^2 GR^3}{M_m}$

C. $T^2 = \frac{2\pi GR^3}{M_m}$

D. $T^2 = (4\pi M_m GR^3)$

Answer: A

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28. The additional kinetic energy to be provided to a satellite of mass m revolving around a planet of mass M, to transfer it forms a circular orbit of radius R_1 to another of radius $R_2 (R_2 > R_1)$ is

A. $GmM\left(\frac{1}{R_1^2} - \frac{1}{R_2^2}\right)$

B. $GmM\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

C. $2GmM\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

D. $\frac{1}{2}GmM\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

Answer: D

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29. 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)

A. $\dfrac{GM_E m}{4(R_E + h)}$

B. $\dfrac{GM_E m}{2(R_E + h)}$

C. $\dfrac{GM_E m}{(R_E + h)}$

D. $\frac{2GM_Em}{(R_E + h)}$

Answer: B

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30. An artificial satellite moving in a circular orbit around the earth has a total energy E_0. Its potential energy is

A. $-E_0$

B. E_0

C. $2E_0$

D. $-2E_0$

Answer: C

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31. For a satellite moving in a circular orbit around the earth, the ratio of its potential energy to kinetic energy is

A. 1

B. -1

C. 2

D. -2

Answer: D

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32. Two satellites of earth S_1 and S_2 are moving in the same orbit. The mass of S_1 is four times the mass of S_2. Which one of the following statements is true?

A. The potential energies of earth and satellite in the two cases are equal

B. S_1 and S_2 are moving with the same period

C. The kinetic energy of two satellites are equal

D. The time period of S_1 is four times that S_2.

Answer: B

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33. The orbit of geostationary satellite is circular, the time period of satellite depeds on (i) mass of the satellite, (ii) mass of earth, (iii) readius of the orbit and (iv) height of the satellite from the surface of the earth

A. (i) only

B. (i) and (ii)

C. (i), (ii) and (iii)

D. (ii), (iii) and (iv)

Answer: D

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Problems Based On Mixed Concepts

1. A body is fired with a velocity of magnitude $\sqrt{gR} < V\sqrt{2gR}$ at an angle of 30° with the radius vector of earth. If at the highest point the speed of the body is $V/4$, the maximum height attained by the body is equal to:

A. $V^{2}/8g$

B. R

C. $\sqrt{2}R$

D. none of these

Answer: A

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2. The gravitational field intensity at a point $10,000km$ from the centre of the earth is

$4.8 Nkg^{-1}$. The gravitational potential at that point is

A. $-4.8 \times 10^{-7} Jkg^{-1}$

B. $-2.4 \times 10^{7} Jkg^{-1}$

C. $4.8 \times 10^{6} Jkg^{-1}$

D. $3.6 \times 10^{6} Jkg^{-1}$

Answer: A

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3. A small body of superdense material, whose mass is twice the mass of the earth but whose size is very small compared to the size of the earth, starts form rest at a height $H < < R$ above the earth's surface, and reaches the earth's surface in time t. then t is equal to

A. $\sqrt{2H / g}$

B. $\sqrt{H / g}$

C. $\sqrt{2H / 3g}$

D. $\sqrt{4H / 3g}$

Answer: A

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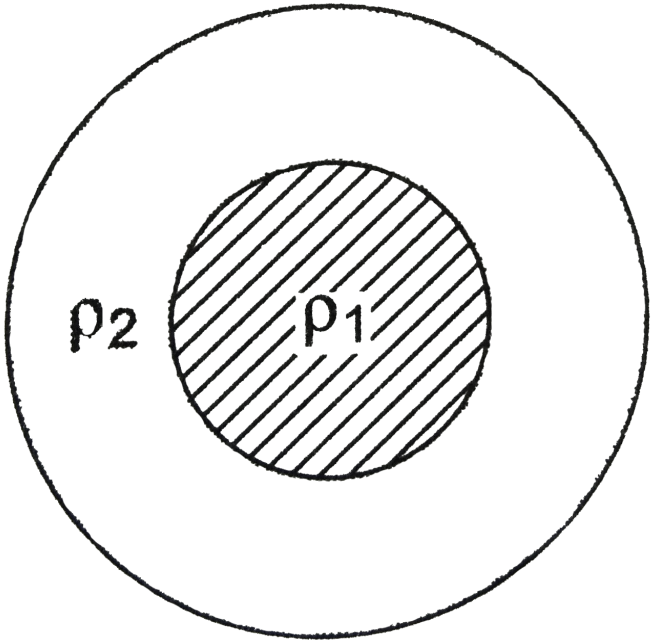
4. The density of the core a planet is ρ_1 and that of the outer shell is ρ_2. The radii of the core and that of the planet are R and $2R$ respectively. The acceleration due to gravity at the surface of the planet is same as at a depth

R. Find the ratio of $\frac{\rho_1}{\rho_2}$



A. $3/4$

B. $5/3$

C. $7/3$

D. $3/5$

Answer: C

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5. Work done by an external agent in bringing three particles each of mass m at the vertices of an equilateral triangle of length l is

A. $\frac{3Gm^2}{l}$

B. $-\frac{3Gm^2}{l}$

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

D. none of these

Answer: B

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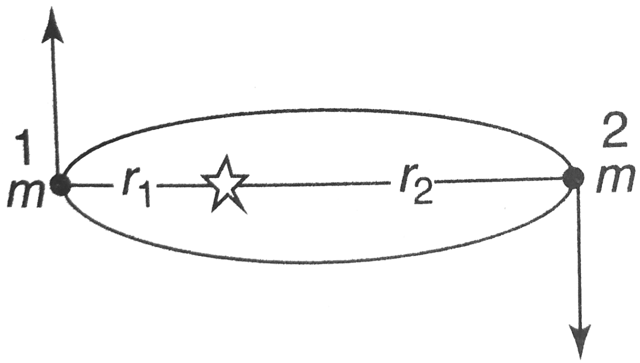
6. The ratio of KE of a planet at the points 1 and 2 is :



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

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

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

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

Answer: B

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7. If radius of the earth contracts to half of its present value without change in its mass, what will be the new duration of the day?

A. $12hr$

B. $6hr$

C. $42min$

D. none of these

Answer: B

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8. Find the escape velocity of particle of mass m which is situated at a radial distance r

(from centre of earth) above the earth's surface. M is the mass earth.

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

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

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

D. none of these

Answer: C

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9. If a particles of mass m is projected with minimum velocity form the surface of a star with kinetic energy $\dfrac{K_1 GMm}{a}$ and potential energy at surface of the star $\dfrac{K_2 GMm}{a}$ towards the star of same mass m and radius a (K_1 and K_2 are constant) to reach the other star. Find the distance between the centre of the two stars:

A. $\dfrac{2a}{(K_2 - K_1)}$

B. $\dfrac{4a}{(K_2 - K_1)}$

C. $\dfrac{2a}{(K_1 - K_2)}$

D. $\dfrac{a}{(K_1 - K_2)}$

Answer: B

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10. The mass of a satellite is $M/81$ and radius is $R/4$ where M and R are the mass and radius of the planet. The distance between the surfaces of planet and its satellite will be atleast greter than:

A. $1.25R$

B. $12.5R$

C. $10.5R$

D. $5R$

Answer: A

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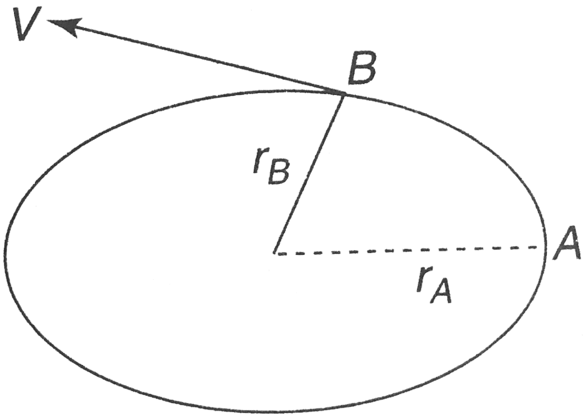
11. The orbital velocity of a satellite at point B with radius r_B and n. The radius of a point A is r_A. If the orbit is increased in radial distance so that r_A becomes $.12r_A$ find the orbital velocity at $(1.2r_A)$:



A. $\dfrac{vr_B}{r_A\sqrt{1.2}}$

B. $\dfrac{vr_A}{1.2r_B}$

C. $\dfrac{vr_B}{1.2r_A}$

D. $\dfrac{vr_A}{r_B\sqrt{2}}$

Answer: A

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12. An asteroid of mass m is approaching earth, initially at a distance $10R_E$ with speed v_i. It hits earth with a speed v_f (R_E and M_E are radius and mass of earth),. Then

A. $v_f^2 = v_i^2 + \frac{2GM}{R_E}\left(1 + \frac{1}{10}\right)$

B. $v_f^2 = v_i^2 + \frac{2Gm_E}{R_E}\left(1 + \frac{1}{10}\right)$

C. $v_f^2 = v_i^2 + \frac{2Gm_E}{R_E}\left(1 - \frac{1}{10}\right)$

D. $v_f^2 = v_i^2 + \frac{2GM}{R_E}\left(1 - \frac{1}{10}\right)$

Answer: C

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13. A projectile rises upto a maximum height of $R/(1-K^2)$ where K is a constant and R is the radius of earth. If the velocity of projectile with which it should be fired upwards form the surface of the earth to reach this height is equal to the product of a coeffiecient and escape velocity then this coeffiecient is equal to:

A. K

B. K^2

C. $K^{3/2}$

D. $K^{1/2}$

Answer: A

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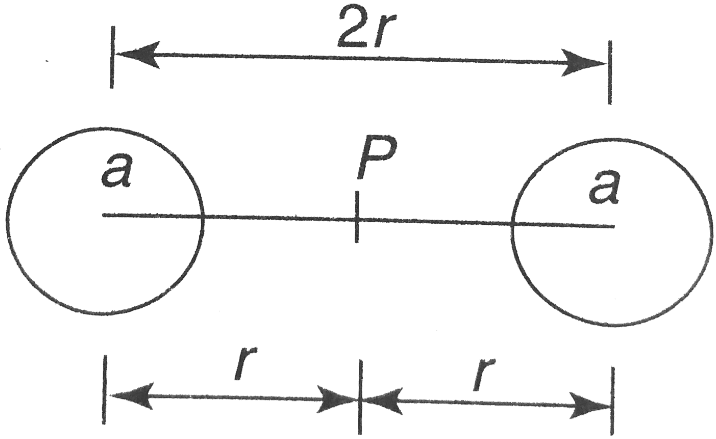
14. A particle is projected from the surface of one star towards other star of same radius a and mass with such a minimum velocity

$K\sqrt{\frac{GM}{a}}$, so that it is attracted towards other star. Find the value of K if two stars are $2r$ distance apart:



A. $\frac{2(r-a)}{[r(2r-a)]^{1/2}}$

B. $\frac{2(r-a)}{[r(r-a)]^{1/2}}$

C. $\frac{r-a}{[r(r-a)]^{1/2}}$

D. $\dfrac{r+a}{\left[r(r-a)\right]^{1/2}}$

Answer: A

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15. Two stars of mass m_1 and m_2 are parts of a binary star system. The radii of their orbits are r_1 and r_2 respectivey, measured from the centre of mass of the system. The magnitude of gravitational force m_1 exerts on m_2 is

A. $\dfrac{m_1 m_2 G}{(r_1+r_2)^2}$

B. $\dfrac{m_1 G}{(r_1 + r_2)^2}$

C. $\dfrac{m_2 G}{(r_1 + r_2)^2}$

D. $\dfrac{G(m_1 + m_2)}{(r_1 + r_2)^2}$

Answer: A

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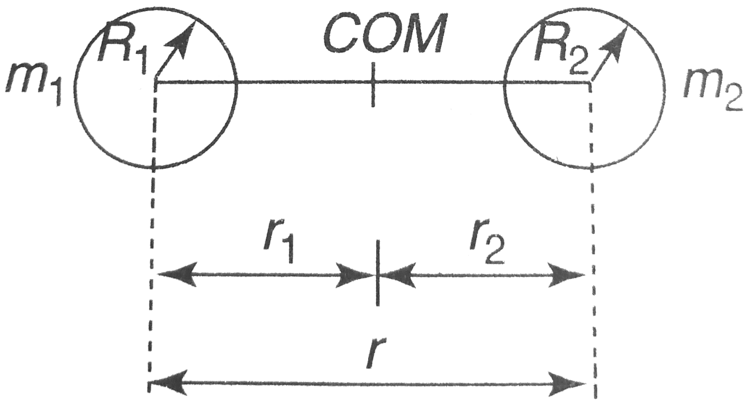
16. Binary stars of comparable masses rotates under the influence of each other's gravity at a distance $\left[\dfrac{2G}{\omega^2}\right]^{1/3}$ where ω is the angular velocity of each of the system. If difference between the masses of two stars is 6 units. Find the ratio of the masses of smaller to bigger star.



A. $4:10$

B. $1:7$

C. $2:8$

D. $3:9$

Answer: B

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17. The ratio of cube of circumferences of the orbit of a satellite to the volume of the earth is $6 \times 10^{10}(g/R)$, where g is the acceleration of gravity. Find the time period of satellite (in secods). R is the radius of earth

A. 2×10^{5}

B. 10^5

C. 4×10^4

D. 10^4

Answer: A

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18. Two planets revolve with same angular velocity about a star. The radius of orbit of outer planet is twice the radius of orbit of the inner planet. If T is time period of the revolution of outer planet, find the time in which inner planet will fall into the star. If it was suddenly stopped.

A. $\sqrt{\frac{23gR}{11}}$

B. $\sqrt{\frac{25gR}{11}}$

C. $\frac{v_a^2}{gR^2} - R$

D. $\frac{v_a^2}{2gR^2} - R$

Answer: B

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19. What would be the projections velocity of a satellite so that intersteller (interspace with no gravitation) velocity of the satellite becomes the orbital velocity when it is in the orbit at height of $10R$ from earth's surface, where R is the radius of the earth?

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

B. $\frac{T\sqrt{2}}{16}$

C. $\frac{T\sqrt{2}}{4}$

D. $\frac{T\sqrt{2}}{32}$

Answer: A

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20. A satellite in equatorial plane is rotating in the direction of earth's rotation with time interval between its two consecutive appearence over head of an observer as time period of rotation of the earth, T_E. What is the time period of the satellite?

A. T_E

B. $2T_E$

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

D. $\frac{2T_E}{3}$

Answer: C

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21. A satellite is orbiting with areal velocity v_a. At what height form the surface of the earth, it is rotating, if the radius of earth is R?

A. $\frac{4v_a^2}{gR^2} - R$

B. $\frac{2v_a^2}{gR^2} - R$

C. $\frac{v_a^2}{gR^2} - R$

D. $\frac{v_a^2}{2gR^2} - R$

Answer: A

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22. 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:

A. $\frac{F_1}{F_2} = \frac{r_1}{r_2}$ if $r_1 > R$ and $r_2 < R$

B. $\frac{F_1}{F_2} = \frac{r_2^2}{r_1^2}$ if $r_! > R$ and $r_2 > R$

C. $\frac{F_1}{F_2} = \frac{r_1^3}{r_2^3}$ if $r_1 < R$ and $r_2 < R$

D. $\frac{F_1}{F_2} = \frac{r_1^2}{r_2^2}$ if $\eta < R$ and $r_2 < R$

Answer: B

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23. A spherical planet has uniform density $\frac{\pi}{2} \times 10^4 kg/m^3$. Find out the minimum period for a satellite in a circular orbit around it in seconds (Use $G = \frac{20}{3} \times 10^{-11} \frac{N - m^2}{kg^2}$).

A. 7500

B. 3000

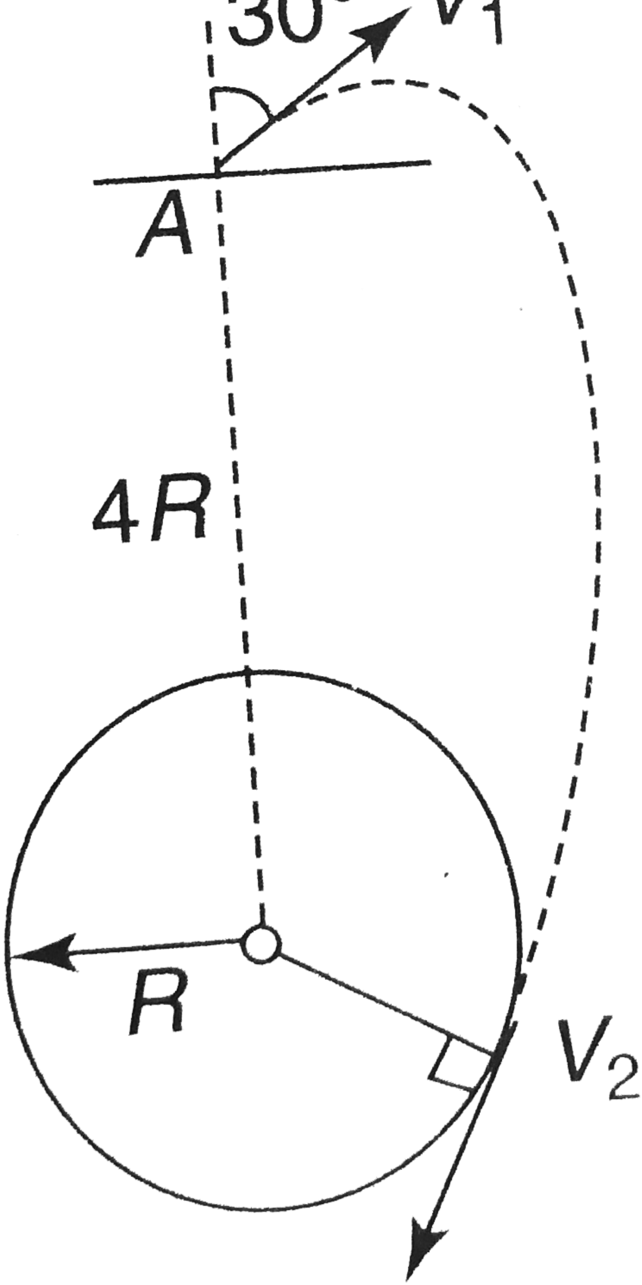
C. 4500

D. 6000

Answer: B

Watch Video Solution

24. A particle is projected from point A, that is at a distance $4R$ form the centre of the earth, with speed V_1 in a direction making 30° with the line joining the centre of the earth and point A, as shown. Consider gravitational interaction only between thesetwo. (Use $\frac{GM}{R} = 6.4 \times 10^7 m^2/s^2$). The speed V_1 if particle pasess grazing the surface of the earth is



30°
V_1
A
4R
R
V_2

A. $2\sqrt{2} \times 10^3 m / s$

B. $4\sqrt{2} \times 10^3 m / s$

C. $4 \times 10^3 m / s$

D. $4\sqrt{3} \times 10^3 m / s$

Answer: B

Watch Video Solution

25. Three identical stars, each of mass M, from an equilateral triangle (stars are positioned at the corners) that rotates around the centre of the triangle. The system is isolated and edge length of the triangle is L. The amount of work done, that is required ot dismantle the system, is:

A. $\dfrac{3GM^2}{L}$

B. $\dfrac{3}{2}\dfrac{GM^2}{L}$

C. $\dfrac{3}{4}\dfrac{GM^2}{L}$

D. $\dfrac{GM^2}{2L}$

Answer: B

Watch Video Solution

26. A satellite can be in a geostationary orbit around earth in an orbit of radius r. If the angular velocity of earth about its axis doubles, a satellite can now be in a geostationary orbit aroun earth radius

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

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

C. $\frac{r}{(4)^{1/3}}$

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

Answer: C

Watch Video Solution

27. 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. $\frac{1}{4}R$

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

Answer: D

Watch Video Solution

28. Imagine a new planet having the same density as that of earth but 3 times bigger than the earth in size. If the acceleration due to gravity on the surface of earth is g and that on the new plane is g , then :

A. $g' = 3g$

B. $g' = 9g$

C. $g' = g/7$

D. $g' = 27g$

Answer: A

Watch Video Solution

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

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

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

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

D. none of these

Answer: B

Watch Video Solution

Assertion Reasoning

1. 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 the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: A

Watch Video Solution

2. Assertion: Geostationary satellite appear fixed from any point on earth.

Reason: The time period of geostationary satellite is 24 hrs

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: A

Watch Video Solution

3. Assertion: The motion of a particle under the central force is always confined to a plane.

Reason: Angular momentum is always conserved in the motion under a central force.

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: A

Watch Video Solution

4. Assertion: There is no effect of rotation of a earth on acceleration due to gravity at poles.

Reason : Rotation of earth is about polar axis.

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: A

Watch Video Solution

5. 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.

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: A

Watch Video Solution

6. Assertion : Gravitational potential of earth at every place body are equal to one.

Reason: Everybody on earth is bound by the attraction of earth.

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: A

Watch Video Solution

7. Assertion : Even when orbit of a satellite is elliptical, its plane of rotation passes through the centre of earth.

Reason: According to law of conservation of angular momentum plane of rotation of satellite always remin same.

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: A

Watch Video Solution

8. 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.

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct

explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: C

Watch Video Solution

9. 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.

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: B

Watch Video Solution

10. Assertion: When distance between bodies is doubled and also mass of each body is also doubled, gravitational force between them remains the same.

Reason: According to Neweton's law

gravitational, force is directely proportional to mass of bodies and inversely proportional to square of distance between them.

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: A

Watch Video Solution

11. 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.

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: C

Watch Video Solution

12. Assertion: A body becomes weightless at the centre of earth.

Reason: As the distance form centre of earth decreases, acceleration due to gravity increases.

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: C

Watch Video Solution

13. 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 the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct

explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: B

Watch Video Solution

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

Reason: There is no gravitational force on the satellite.

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: C

Watch Video Solution

15. Assertion: The speed of revolution of an artificial satellite revoving very near the earth is $8kms^{-1}$.

Reason: Orbital velocity of a satellite, becomes independent of height of near satellite.

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: A

Watch Video Solution

16. 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 the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: A

Watch Video Solution

1. Potential energy of a satellite having mass m and rotating at a height of $6.4 \times 10^6 m$ from the earth surface is

A. $-0.5mgR_e$

B. $-mgR_e$

C. $-2mgR_e$

D. $4mgR_e$

Answer: A

Watch Video Solution

2. With what velocity should a particle be projected so that its height becomes equal to radius of earth?

A. $\left(\frac{GM}{R}\right)^{1/2}$

B. $\left(\frac{GM}{2R}\right)^{1/2}$

C. $\left(\frac{2GM}{R}\right)^{1/2}$

D. $\left(\frac{4GM}{R}\right)^{1/2}$

Answer: A

Watch Video Solution

3. The period of a satellite in a circular orbit of radius R is T, the period of another satellite in a circular orbit of radius $4R$ is

A. $4T$

B. $T/4$

C. $8T$

D. $T/8$

Answer: C

Watch Video Solution

4. The acceleration due to gravity is g at a point distant r from the centre of earth of radius R. If $r < R$, then

A. $g \propto r$

B. $g \propto r^2$

C. $g \propto r^{-1}$

D. $g \propto r^{-2}$

Answer: A

Watch Video Solution

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

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

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

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

Answer: B

Watch Video Solution

6. The acceleration due to gravity on the planet A is 9 times the acceleration due to gravity on planet B. A man jumps to a height of $2m$ on the surface of A. What is the height of jump by the same person on the planet B?

A. $\frac{2}{3}m$

B. $\frac{2}{9}m$

C. $18m$

D. $6m$

Answer: C

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

gravitational force will now be

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

B. $3F$

C. F

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

Answer: C

Watch Video Solution

8. 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. $\frac{1}{4}R$

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

Answer: D

Watch Video Solution

9. Radius of orbit of satellite of earth is R. Its kinetic energy is proportional to

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

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

C. R

D. $\frac{1}{R^{3/2}}$

Answer: A

Watch Video Solution

10. If the density of a small planet is the same as that of earth while the radius of the planet is 0.2 times that of the earth the gravitational on the surface of that planet is :

A. $0.2g$

B. $0.4g$

C. $2g$

D. $4g$

Answer: A

Watch Video Solution

11. Imagine a new planet having the same density as that of earth but 3 times bigger than the earth in size. If the acceleration due to gravity on the surface of earth is g and that on the new plane is g, then :

A. $g' = 3g$

B. $g' = \frac{g}{9}$

C. $g' = 9g$

D. $g' = 27g$

Answer: A

Watch Video Solution

12. For a satellite moving in an orbit around the earth, ratio of kinetic energy to potential energy is

A. 2

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

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

D. $\sqrt{2}$

Answer: B

Watch Video Solution

13. The earth is assumed to be a sphere of raduis R. A platform is arranged at a height R from the surface of the fv_e, where v_e is its escape velocity from the surface of the earth.

The value of f is

A. $\sqrt{2}$

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

C. $\frac{1}{3}$

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

Answer: B

Watch Video Solution

14. Two satellites of earth S_1 and S_2 are moving in the same orbit. The mass of S_1 is four times the mass of S_2. Which one of the following statements is true?

A. The time period of S_1 is four times that of S_2

B. The potential energies of earth and satellite in the two cases are equal

C. S_1 and S_2 are moving with the speed

D. The kinetic energies of the two satellites are equal

Answer: C

Watch Video Solution

15. A roller coaster is designed such that riders experience "weightlessness" as they go round the top of a hill whose radius of curvature is $20m$. The speed of the car at the top of the hill is between

A. $14m/s$ and $15m/s$

B. $15m/s$ and $16m/s$

C. $16m/s$ and $17m/s$

D. $13m/s$ and $14m/s$

Answer: A

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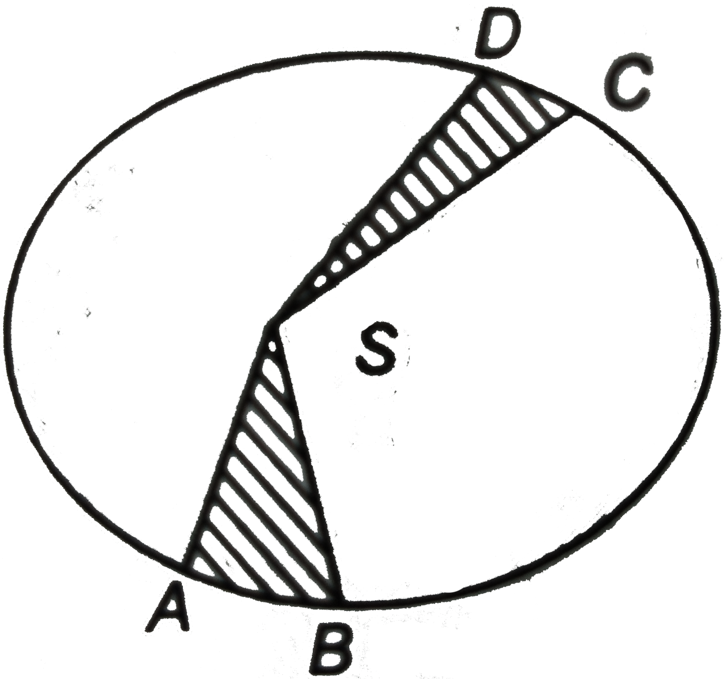
16. The figure represents an elliptical orbit of a planet around sun. The planet takes time T_1 to travel from A to B and it takes time T_2 to travel from C to D. If the area CSD is double

that of area ASB, then



A. $t_1 > t_2$

B. $t_1 = 4t_2$

C. $t_1 = 2t_2$

D. $t_1 = t_2$

Answer: C

Watch Video Solution

17. 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

Watch Video Solution

18. 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. $-\dfrac{3GM}{a}$

B. $-\dfrac{2GM}{a}$

C. $-\dfrac{GM}{a}$

D. $-\dfrac{4GM}{a}$

Answer: A

Watch Video Solution

19. A plenet moving along an elliptical orbit is closest to the sun at a distance r_1 and farthest away at a distance of r_2. If v_1 and v_2

are the linear velocities at these points respectively, then the ratio $\frac{v_1}{v_2}$ is

A. r_2 / r_1

B. $(r_2 / r_1)^2$

C. r_1 / r_2

D. $(r_1 / r_2)^2$

Answer: A

Watch Video Solution

20. A particle of mass m is thrown upwards from the surface of the earth, with a velocity u. The mass and the radius of the earth are, respectively, M and R. G is gravitational constant g is acceleration due to gravity on the surface of earth. The minimum value of u so that the particle does not return back to earth is

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

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

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

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

Answer: A

Watch Video Solution

21. 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

Watch Video Solution

22. The height a which the weight of a body becomes $1/16th$ its weight on the surface of earth (radius R) is

A. $4R$

B. $5R$

C. $15R$

D. $3R$

Answer: D

Watch Video Solution

23. A spherical planet far out in space has a mass M_0 and diameter D_0. A particle of mass m falling freely near the surface of this planet will experience an accelertion due to gravity which is equal to

A. $4GM_pm / D_p^2$

B. $4GM_p / D_p^2$

C. GM_pm / D_p^2

D. GM_p / D_p^2

Answer: B

Watch Video Solution

24. A geostationary satellite is orbiting the earth at a height of $5R$ above the surface of the earth, R being the radius of the earth. The time period of another satellite in hours at a height of $2R$ form the surface of the earth is

A. $\frac{6}{\sqrt{2}}$

B. 5

C. 10

D. $6\sqrt{2}$

Answer: D

Watch Video Solution

25. If v_e is escape velocity and v_0, is orbital velocity of satellite for orbit close to the earth's surface. Then are related by

A. $v_0 = \sqrt{2}v_e$

B. $v_0 = v_e$

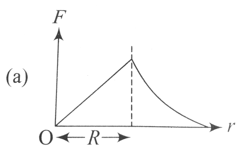
C. $v_e = \sqrt{2v_0}$

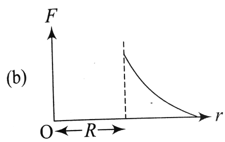
D. $v_e = \sqrt{2}v_0$

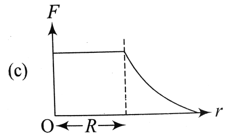
Answer: D

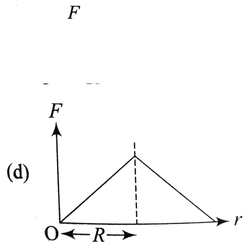
Watch Video Solution

26. Which one of the following plots represents the variation of the gravitational field on a particle with distance r due to a thin spherical shell of raduis R? (r is measured from the centre of the spherical shell).

A. 

B. 

C. 

D. 

Answer: B

Watch Video Solution

27. A body of mass m taken form the earth's surface to the height is equal to twice the radius (R) of the earth. The change in potential energy of body will be

A. $mg2R$

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

C. $3mgR$

D. $\frac{1}{3}mgR$

Answer: B

Watch Video Solution

28. Infinite number of bodies, each of mass $2kg$, are situated on x-axis at distance $1m, 2m, 4m, 8m$........ respectively, from the origin. The resulting gravitational potential

the to this system at the origing will be

A. $-G$

B. $-\frac{8}{3}G$

C. $-\frac{4}{3}G$

D. $-4G$

Answer: D

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29. a projectile is fired from the surface of the earth with a velocity of $5ms^{-1}$ and angle θ with the horizontal. Another projectile fired from another planet with a velocity of $3ms^{-1}$ at the same angle follows a trajectory which is identical with the trajectory of the projectile fired from the earth.The value of the acceleration due to gravity on the planet is in ms^{-2} is given $\left(g = 9.8ms^{-2}\right)$

A. 3.5

B. 5.9

C. 16.3

D. 110.8

Answer: A

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30. A black hole is an object whose gravitational field is so strong that even light cannot escape from it. To what approximate radius would earth (mass $= 5.98 \times 10^{24} kg$) have to be compressed to be a black hole?

A. $10^{-9}m$

B. $10^{-6}m$

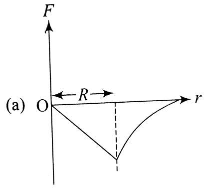
C. $10^{-2}m$

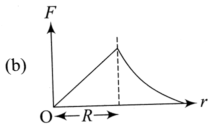
D. $100m$

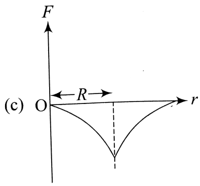
Answer: C

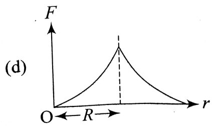
Watch Video Solution

31. Dependence of intensity of gravitational field (E) of earth with distance (r) from centre of earth is correctly represented by

A. 

B. 

C. 

D. 

Answer: A

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32. Kepler's third law states that square of period revolution (T) of a planet around the sun is proportional to third power of average distance i between sun and planet i.e.

$T^2 = Kr^3$

here K is constant

if the mass of sun and planet are M and m respectively then as per Newton's law of gravitational the force of alteaction between them is $F = \frac{GMm}{r^2}$, here G is gravitational constant. The relation between G and K is described as

A. $GK = 4\pi^2$

B. $GMK = 4\pi^2$

C. $K = G$

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

Answer: B

Watch Video Solution

33. 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

34. 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 or the earth changes in direction, but its magnitude remains constant.

C. The total mechanical energy of S varies perodically will time.

D. The linear momentum of S remains costant is magnitude

Answer: A

Watch Video Solution

35. A remote-sensing satellite of earth revolves in a circular orbit at a hight of $0.25 \times 10^6 m$ above the surface of earth. If earth's radius is

$6.38 \times 10^6 m$ and $g = 9.8 ms^{-2}$, then the orbital speed of the satellite is

A. $6.67 kms^{-1}$

B. $7.76 kms^{-1}$

C. $8.56 kms^{-1}$

D. $9.13 kms^{-1}$

Answer: B

Watch Video Solution

36. The ratio of escape velocity at earth (v_e) to the escape velocity at a planet (v_y) whose radius and density are twice

A. $1 : \sqrt{2}$

B. $1 : 2$

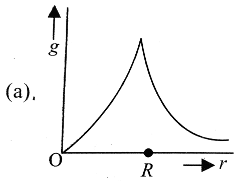
C. $1 : 2\sqrt{2}$

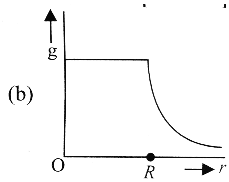
D. $1 : 4$

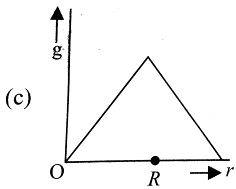
Answer: C

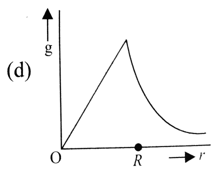
Watch Video Solution

37. Which graph correctley presents the variation of acceleration due to gravity with the distance form the centre of the earth?

A. 

B. 

C. 

D. 

Answer: D

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38. A satellite of mass m is orbiting the earth (of radius R) at a height h from its surface. The total energy of the satellite in terms of g_0, the value of acceleration due to gravity at the earth's surface,

A. $\dfrac{2mg_0R^2}{R+h}$

B. $-\dfrac{2mg_0R^2}{R+h}$

C. $\dfrac{mg_0R^2}{2(R+h)}$

D. $-\dfrac{mg_0R^2}{2(R+h)}$

Answer: D

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39. 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. $d = 1km$

B. $d = \frac{3}{2}km$

C. $d = 2km$

D. $d = \frac{1}{2}km$

Answer: C

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40. Two astronauts are floating in gravitational free space after having lost contanct with their spaceship. The two will:

A. Move towards each other

B. Move away from each other

C. Will becomes stationary

D. Keep floating at the same distance between them

Answer: A

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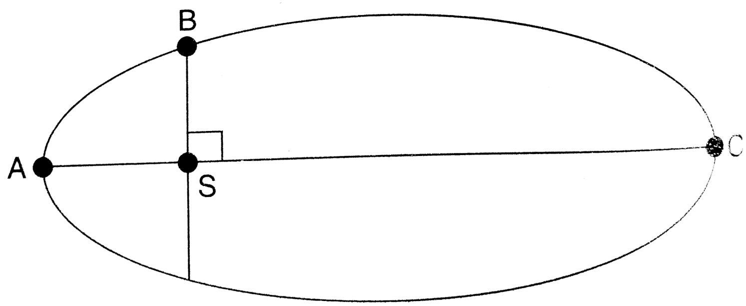
41. The kinetic energies of a planet in an elliptical orbit about the Sun, at positions A, B and C are K_A, K_B and K_C respectively. AC is the major axis and SB is perpendicular to AC at the position of the sun as shown in the figure. Then



A. $K_B > K_A > K_C$

B. $K_A < K_B < K_C$

C. $K_B < K_A < K_C$

D. $K_A > K_B > K_C$

Answer: D

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42. If the massn 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. $'g'$ on the earth will not change

B. rain drops will fall faster

C. time period of a simple pendulam on the earth would decreases

D. walking on the ground would becomes more difficult

Answer: A

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Aiims Questions

1. The escape Velocity from the earth is $11.2 Km / s$. The escape Velocity from a planet having twice the radius and the same mean density as the earth, is :

A. $11.2 km / s$

B. $15.00 km / s$

C. $22.4 km / s$

D. $5.8 km / s$

Answer: C

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

A. $8N$

B. $80N$

C. $40N$

D. $20N$

Answer: A

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3. 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. 1.0%

B. 3.0%

C. 1.5%

D. 0.7%

Answer: C

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4. The velocity with which a projectile must be fired so that it escape earth's gravitational does not depend on

A. mass of the earth

B. radius of the projectile's orbit

C. mass of the projectile

D. gravitational constant

Answer: C

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

A. $4min$

B. $1min$

C. $15min$

D. $56min$

Answer: A

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6. The condition for a uniform spherical mass m of a radius r to be a black hole is [G

=gravitational constant and g=acceleration due to gravity]

A. $\left(\frac{2Gm}{r}\right)^{1/2} \leq c$

B. $\left(\frac{2Gm}{r}\right)^{1/2} \geq c$

C. $\left(\frac{2gm}{r}\right)^{1/2} = c$

D. $\left(\frac{gm}{r}\right)^{1/2} \geq c$

Answer: B

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7. The motion of planets in the solar system is an exmaple of the conservation of

A. mass

B. linear momentum

C. energy

D. angular momentum

Answer: D

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8. Two masses m_1 and m_2 at an infinite distance from each other are initially at rest, start interacting gravitationally. Find their velocity of approach when they are at a distance r apart.

A. $\left[2G\frac{(m_1 - m_2)}{r}\right]^{1/2}$

B. $\left[\frac{r}{2G(m_1 - m_2)}\right]^{1/2}$

C. $\left[\frac{2G}{r}(m_1 + m_2)\right]^{1/2}$

D. $\left[\frac{2G}{r}m_1 m_2\right]^{1/2}$

Answer: C

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9. Acceleration due to gravity on moon is $1/6$ of the acceleration due to gravity on earth. If the ratio of densities of earth (ρ_e) and moon (ρ_m) is $\left(\frac{\rho_e}{\rho_m}\right)=\frac{5}{3}$ then radius of moon (R_m) in terms of R_e will be

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

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

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

D. $/\left(2\sqrt{3}\right)R_e$

Answer: A

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10. The gravitational potential energy of body of mass 'm' at the earth's surface -mgR_e. Its gravitational potential energy at a height R_e from the earth's surface will be (here R_e is the radius of the earth)

A. $-2mgR_e$

B. $2mgR_e$

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

D. $-\frac{1}{2}mgR_e$

Answer: D

Watch Video Solution

11. The orbital velocity of an satellite in a circular orbit just above the earth's surface is v. For a satellite orbiting at an altitude of half of the earth's radius, the orbital velocity is

A. $\frac{3}{2}v$

B. $\sqrt{\frac{3}{2}}v$

C. $\sqrt{\frac{2}{3}}v$

D. $\frac{2}{3}v$

Answer: C

Watch Video Solution

12. Given raduis of earth $'R'$ and length of a day $'T'$ the height of a geostationary satellite is [G-Gravitational constant M-mass of earth]

A. $\left(\frac{4\pi^2 GM}{T^2}\right)^{1/3}$

B. $\left(\frac{4\pi^2 GM}{R^2}\right)^{1/3} - R$

C. $\left(\frac{GMT^2}{4\pi^2}\right)^{1/3} - R$

D. $\left(\frac{GMT^2}{4\pi^2}\right)^{1/3} + R$

Answer: C

Watch Video Solution

13. The ratio of the K.E. required to the given to the satellite to escape earth's gravitational field to the K.E. required to be given so that the satellite moves in a circular orbit just above earth atmosphere is

A. 1

B. 2

C. $1/2$

D. ∞

Answer: B

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14. A communication satellite of mass $500 kg$ revolves around the earth in a circular orbit of radius $4.0 \times 10^7 m$ in the equatorial plane of the earth in the direction from west to east. The magnitude of angular momentum of the satellite is

A. ~$1.3 \times 10^{14} m^2 s^{-1}$

B. ~$0.58 \times 10^{14} m^2 s^{-1}$

C. ~$2.58 \times 10^{14} m^2 s^{-1}$

D. ~$0.13 \times 10^{14} m^2 s^{-1}$

Answer: B

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

B. $mmgR$

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

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

Answer: D

Watch Video Solution

16. Assertion: The length of the day is slowly increasing.

Reason: The dominant effect causing a slowdown in the rotation of the earth is the gravitational pull of other planets in the solar system.

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: C

Watch Video Solution

17. Assertion: The value of acceleration due to gravity does not depends upon mass of the body on which force is applied.

Reason: Acceleration due to gravity is a constant quantity.

A. If both the assertion and reason are true and reason is a true explanation of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explanation of the assertion.

C. If the assertion is true but reason false.

D. If both the assertion and reason are false.

Answer: C

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18. Assertion: Two different planets have same escape velocity.

Reason: Value of escape velocity is a universal constant.

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: D

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19. Assertion: The centre of gravity of a body coincides with its centre of mass only if the gravitational field does not vary form one part of the body to the other.

Reason: Centre of gravity is independent of the gravitational field.

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: C

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20. Assertion: The speed of revolution of an artificial satellite revoving very near the earth is $8kms^{-1}$.

Reason: Orbital velocity of a satellite, becomes independent of height near earth.

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: A

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21. Assertion: Kepler's second law can be understood by conservation of angular momentum principle.

Reason: Kepler's second law is related with areal velocity which can further be proved to be used on coservation of angular momentum as $(dA/dt) = (r^2\omega)/2.$

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: A

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Chapter Test

1. A satellite of the earth is revolving in a circular orbit with a uniform speed v. If the gravitational force suddenly disappears, the satellite will

A. Continue to move with velocity v along the original orbit

B. Move with a velocity v tangentially to the original orbit

C. Fall down with increases velocity

D. Ultimately come to rest somewhere on the original orbit

Answer: B

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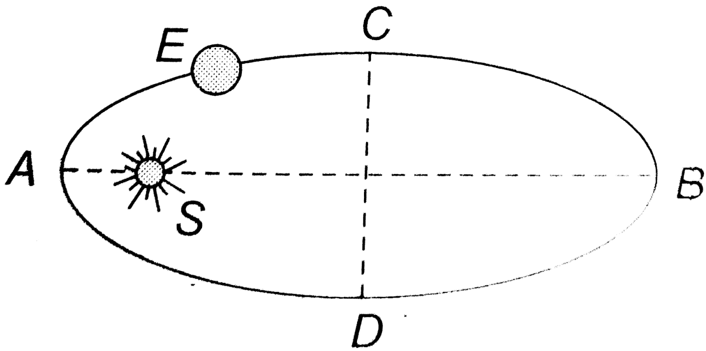
2. The earth E moves in an elliptical orbit with the sun S at one of the foci as shown in figure. Its speed of motion will be maximum at the point



A. C

B. A

C. B

D. D

Answer: B

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3. Different points in the earth are at slightly different distance from the sun and hence experience different force due to gravitation. For a rigid body, we know that if various forces act at various points in it, the resultant motion is as if a net force acts on the CM (centre of mass) causing translation and a net torque at the CM causing rotation around an axis through the CM. for the earth-sun system (approximating the earth as a uniform density sphere).

A. the torque is zero

B. the torque 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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4. 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. $200gmwt$

B. $400gmwt$

C. $50gmwt$

D. $300gmwt$

Answer: B

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5. If the mass of a planet is 10% less than that of the earth and the radius is 20% greater than that of the earth, the acceleration due to gravity on the planet will be

A. $\frac{5}{8}$ times that on the surface of the earth

B. $\frac{3}{4}$ times that on the surface of the earth

C. $\frac{1}{2}$ times that on the surface of the earth

D. $\frac{9}{10}$ times that on the surface of the earth

Answer: A

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6. 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 $R = 6400km$.

A. $\sqrt{\frac{g}{3R}}$

B. $\sqrt{\frac{2g}{3R}}$

C. $\sqrt{\frac{2g}{5R}}$

D. $\sqrt{\frac{2g}{7R}}$

Answer: C

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7. In order to shift a body of mass m from a circular orbit of radius $3R$ to a higher orbit of radius $5R$ around the earth, the work done is

A. $\frac{3GMm}{5R}$

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

C. $\frac{2}{15}\frac{GMm}{R}$

D. $\frac{GMm}{5R}$

Answer: C

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8. A tunnel is dug along a diameter of the earth. Find the force on a particle of mass m placed in the tunnel at a distance x from the centre.

A. $\dfrac{GM_e m}{R_e^3} r$

B. $\dfrac{GM_e m}{R_e^3 r}$

C. $\dfrac{GM_e m R_e^3}{r}$

D. $\dfrac{GM_e m}{R_e^2} r$

Answer: A

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9. The value of g at a certain height h above the free surface of the earth is $x/4$ where x is the value of g at the surface of the earth. The height h is

A. R

B. $2R$

C. $3R$

D. $4R$

Answer: A

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10. Suppose that the acceleration of a free fall at the surface of a distant planet was found to be equal to that at the surface of the earth. If the diameter of the planet were twice the diameter of the earth, then the ratio of mean density of the planet to that of the earth would be

A. $4:1$

B. $2:1$

C. $1:1$

D. $1:2$

Answer: D

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11. 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. $\dfrac{Gm^2}{r^2}$

B. $\dfrac{Gm^2}{4r^2}$

C. $\sqrt{2}\dfrac{Gm^2}{4r^2}$

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

Answer: D

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12. A body of mass m rises to a height $h = R/5$ from the earth's surface where R is earth's radius. If g is acceleration due to gravity at the earth's surface, the increase in potential energy is

A. mgh

B. $\frac{4}{5}mgh$

C. $\frac{5}{6}mgh$

D. $\frac{6}{7}mgh$

Answer: C

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13. A man weighs $80kg$ on the surface of earth of radius r. At what height above the surface of earth his weight will be $40kg$?

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

B. $\sqrt{2}R$

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

D. $\left(\sqrt{2}+1\right)R$

Answer: C

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14. The gravitational potential energy of an isolated system of three particles, each of mass m, at the three corners of an equilateral triangle of side l is

A. $-\dfrac{Gm^2}{l}$

B. $-\dfrac{Gm^2}{2l}$

C. $-\dfrac{2Gm^2}{l}$

D. $-\dfrac{3Gm^2}{l}$

Answer: D

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15. Consider two solid uniform spherical objects of the same density ρ. One has radius R and the other has radius $2R$. They are in outer space where the gravitational fields from other objects are negligible. If they are arranged with their surface touching, what is the contact force between the objects due to their traditional attraction?

A. $G\pi^2\rho^4$

B. $\frac{128}{81}G\pi^2R^2\rho^2$

C. $\frac{128}{81} G\pi^2$

D. $\frac{128}{87} \pi R^2 G$

Answer: B

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

A. $2GM\sqrt{\frac{1}{R}-\frac{1}{r_0}}$

B. $\sqrt{2GM\left(\frac{1}{R}-\frac{1}{r_0}\right)}$

C. $GM\sqrt{\frac{1}{R}-\frac{1}{r_0}}$

D. $\sqrt{GM\left(\frac{1}{R}-\frac{1}{r_0}\right)}$

Answer: B

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17. If the radius of the earth decreases by 10%, the mass remaining unchanged, what will happen to the acceleration due to gravity?

A. Decreases by $19\,\%$

B. Increases by $19\,\%$

C. Decreases more than $19\,\%$

D. Increases more than $19\,\%$

Answer: D

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

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

D. R^{-n}

Answer: B

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

A. gx

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

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

D. $\left(\frac{gR^2}{R+x}\right)^{1/2}$

Answer: D

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20. 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 $= 6400 km$, $g = 9.8 m/s^2$.

A. $11.2km/s$

B. $8km/\sec$

C. $3.2km/\sec$

D. $1.414 \times 8km/\sec$

Answer: C

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21. A satellite of mass m is orbiting around the earth at a height h above the surface of the earth. Mass of the earth is M and its radius is

R. The angular momentum of the satellite is independent of :

A. m

B. M

C. h

D. none of these

Answer: D

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22. Two concentric shells have masses M and m and their radii are R and r, respectively, where $R > r$. What is the gravitational potential at their common centre?

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

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

C. $-G\left[\frac{M}{R}-\frac{m}{r}\right]$

D. $-G\left[\frac{M}{R}+\frac{m}{r}\right]$

Answer: D

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23. The escape velocity corresponding to a planet of mass M and radius R is $50kms^{-1}$. If the planet's mass and radius were $4M$ and R, respectively, then the corresponding escape velocity would be

A. $100km/\sec$

B. $50km/\sec$

C. $200km/\sec$

D. $25km/\sec$

Answer: A

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24. A planet is revolving around the Sun in an elliptical orbit. Its closest distance from the Sun is r and farthest distance is R. If the orbital velocity of the planet closest to the Sun is v, then what is the velocity at the farthest point?

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

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

C. $v\sqrt{\frac{r}{R}}$

D. $v\sqrt{\frac{R}{r}}$

Answer: A

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

A. $GMm/12R^2$

B. $GMm/3R^2$

C. $GMm/8R$

D. $GMm/6R$

Answer: D

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26. A particle of mass 10g is kept on the surface of a uniform sphere of masss 100kg and radius 10cm. Find the work to be done against the gravitational force between them to take the particel far away from the sphere (you may take $G = 6.67 \times 10^{-11} N \frac{m^2}{k} g^2$)

A. $6.67 \times 10^{-9} J$

B. $6.67 \times 10^{-10} J$

C. $13.34 \times 10^{-10} J$

D. $3.33 \times 10^{-10} J$

Answer: B

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27. Assertion: The gravitational force on a particle inside a spherical shell is zero.

Reason: The shell shields other bodies outside it form exerting gravitational forces on a particle inside.

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct

explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: B

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28. Assertion: The total energy of a satellite is negative.

Reason: Gravitational potential energy of an object is negative.

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: A

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29. Assertion: When distance between bodies is doubled and also mass of each body is also doubled, gravitational force between them remains the same.

Reason: According to Neweton's law

gravitational, force is directely proportional to mass of bodies and inversely proportional to square of distance between them.

A. If both the assertion and reason are true and reason is a true explantion of the assertion.

B. If both the assertion and reason are true but the reason is not true the correct explantion of the assertion.

C. If the assertion is true but reason false

D. If both the assertion and reason are false.

Answer: C

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