PHYSICS

BOOKS - CENGAGE PHYSICS (HINGLISH)

GRAVITATION

Question Bank

1. A body weighs W newton at the surface of the earth. Its weight at a height equal to half

the radius of the earth will be $\frac{kW}{9}$. Find k.

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2. The radii of two planets are R and $2R$, respectively, and their densities are ρ and $\frac{\rho}{2}$, respectively. The ratio of acceleration due to gravity at their surfaces is $\frac{a}{h}$. Find $(a+b)$.

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3. A body weighs 63 N on the surface of the earth. What is the gravitational force on it due to the earth at a height equal to half the radius of the earth ?

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4. A geostationary satellite orbits the earth at a height of nearly $36000km$ from the surface of the earth. If the magnitude of potential đue to earth's gravity at the site of the satellite is

$\left(x \times 10^6 r\right) Jkg^{-1}$, then find the x. [Mass of the carth $= 6 \times 10^{24} kg$ and $radius = 6400 km$ (approximately)]

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5. A satellite moves in an elliptical orbit about a planet. The maximum and minimum velocities of the satellite are 3×10^4 m / s and $1 \times 10^3 \frac{m}{s}$, respectively. If the minimum. distance of the satellite from the planet is $\frac{m}{n} \times 10^3$ km then find $(m - n)$. (The

maximum distance of the satellite from the planet is 4×10^4 km.

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6. Assuming the radius of the earth to be $6.38 \times 10^8 cm$, the gravitational constant to be $6.67 \times 10^{-8} cm^3 g^{-1} s^{-2}$, acceleration due to gravity on the surface to be $980 c \frac{m}{s^2}$, find the mean density (in $\frac{g}{(cm)^3}$) of the earth.

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7. The distance between earth and moon is d and the mass of earth is 81 times that of the moon. If the location of. neutral point from the centre of the earth on the line joining the centres of the earth and moon is $\frac{nd}{10}$, then find n.

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8. If a new planet is discovered rotating around the sun with the orbital radius double

that of the earth, then what will be its time period (in earth's 'days). (Take $\sqrt{2} = 1.4$)

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9. Assuming the earth to be a sphere of radius R, if g_{30° is the value of acceleration due to gravity at latitude of 30° and g at the equator, the value of $g - g_{3e^\circ}$ is $\frac{p}{q}\omega^2 R$, then find $(p+q)$.

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10. Two satellites A and B have ratio of masses as $3:1$ in circular orbits of radii r and $4r$. The ratio of total mechanical energy of A to B is $\frac{m}{n}$. Find $(m+n)$.

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11. A satellite S moves around a planet P in an elliptical orbit as shown in the figure. The ratio of the speed of the satellite at point a to that at point b is $\frac{x}{y}$, Find $(x-y)$.

'(##CEN_KSR_PHY_JEE_C10_011_Q01##)'

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12. The maximum and minimum distances of a comet from the sun are $8 \times 10^{12} m$ and $1.6 \times 10^{12} m$, respectively. If its velocity whien it is nearest to the sun is 60 m / s, then what will be its velocity (in m / s). when it is farthest from the sun?

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13. The escape velocity of a body from the earth's surface is v. If the escape velocity of the same body from a height equal to $7R$ from the earth's surface is $v_e\ m\sqrt{n}$, then find mn.

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14. If the potential energy of a $3kg$ body at the surface of a planet is $-54J$, then its escape velocity (in m / s) will be Escape-velocity of a $1kg$ body on a planet is 100 m / s. The

magnitude of potential energy (in'joule) of the body at that planet is

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

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16. If the height at which the weight of a body becomes $\left(\frac{1}{16}r\right)^h$ 'of its weight on the surface of the earth (radius R) is pR, then find p.

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17. Find out energy required (in Giga Joule) to escape a space shuttle of 1000 kg mass from surface of earth. $(R_e = 6400km)$

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18. If the angular momentum of a satellite of mass $400kg$ moving around the earth in radius $4 \times 10^7 m$ is $y \times 10^{12} kgm^2 s^{-1}$, then find' y. (Answer should be perfect integer)

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19. A particle is thrown with escape velocity v_e from the surface of earth. Calculate its velocity at height 3 R :-

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20. A body is projected vertically upward from. the surface of the earth.with a velocity equal to half its escape velocity. If R is radius of the earth, then the maximum height attained by the,body is $\left(\frac{R}{n}\right)$. Find n.

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21. The ratio of escape velocity at the earth (v_e) to the escape velocity at a planet (v_p)

whose radius and mean density are twice as that of the earth is $\frac{x}{y\sqrt{z}}$. Find $(x+y+z)$

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22. Escape velocity for a projectile at the earth's surface is v_{e^+} A body is projected from the earth's surface with velocity $2\hat{v}_{e^+}$. The velocity of the body when it is at infinite distance from the centre of the earth is $\sqrt{x}v_e$. Find x

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23. The gravitational force between two identical uniform solid-gold spheres of radius r, each in contact, is proportional to r^n. Find n

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24. At what height from the surface of earth the gravitation potential and the value of g are $-5.4 \times 10^7 Jkg^{-2}$ and $6.0ms^{-2}$

respectively ? Take the radius of earth as $6400km$:

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25. A particle is projected upward from the surface of the earth (radius R) with a kinetic energy equal to half the minimum value needed for it to escape. If the height it rises above the surface of the earth is $h = kR$, then find k.

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26. A spherical cavity of radius $\frac{R}{2}$ is made in a sphere of radius R and mass M. The centre of the cavity is at a distance $\frac{R}{2}$ from the centre of the sphere. The intensity of gravitational field at the centre of cavity is $\frac{GM}{nR^2}$. Find n.

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27. Calculate the energy needed for moving a mass of $4kg$ from the centre of the earth to its surfáce (in multiple of 10^8 joule), if radius of

the earth is $6400km$ and acceleration due to gravity at the surface of the earth is $g = 10\frac{m}{(s)^2}$.

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28. On a hypothetical planet, satellite can only revolve in quantized energy level, i,e., magnitude of energy of a satellite is integer multiple of a fixed energy. If two successive orbits have radius R and $\frac{3R}{2}$, what could be

maximum radius of the satellite in terms of R?

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29. A satellite is fired from the surface of the moon of mass M and radius R, with speed v_0 at 30° with the vertical.The satellite reaches a maximum distance of $\frac{5R}{2}$ from the centre of the moon. The value of v_0 is $\sqrt{\frac{xGM}{yR}}$. Find $(x-y)$

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30. The minimum speed should m be projected from point P in the presence of two fixed spherical masses M each at A and B is shown in the figure such that mass m should escape the gravitational attraction of A and B is $x\sqrt{\frac{GM}{a}}$. Find x.

'(##CEN_KSR_PHY_JEE_C10_031_Q02##)'

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31. A particle is projected vertically upward the surface of the earth (radius R_e) with a speed equal to one-fourth of escape velocity. The maximum height attained by it from the surface of the earth is $\frac{R_e}{k}$. Find k.

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32. A particle is projected from point A, which is at a distance $4R$ from 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. Find the speed v_1 if particle passes grazing the surface of the earth. Consider gravitational interaction only between these two. Express you answer in the form $\frac{1000X}{\sqrt{2}}\frac{\sim m}{s}$ and find value of X. (Use $\frac{GM}{R} = 6.4 \times 10^7 \frac{m^2}{s^2}$)

'(##CEN_KSR_PHY_JEE_C10_033_Q03##)'

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33. Assuming that the earth hąs constant density, at what distance d (in (km)) from the earth's surface the gravity above the earth is equal to that below the surface.

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34. Two solid spherical planets of equal radii R have masses $4M$ and $9M$. Their centres are scparated by a distance $6R$. A projectile of mass m is sent from the planet of mass $4M$

towards the heavier planet. If the distance r of the point from the lighter planet where the gravitational 'force on the projectile is zero is kR, then calculate k.

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35. Consider a nebula in the form of a ring of radius R and mass M. A star of mass m(m

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36. The figure below shows a spherical shell of mass M -and radius R in a force-free region with an opening. A par'ticle of mass m is released from a distance R in front of the opening. If the speed with which the particle will hit the point C on the shell, opposite to the opening, is $v = \sqrt{\frac{nGM}{4R}}$, Find n

'(##CEN_KSR_PHY_JEE_C10_037_Q04##)'

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37. Two uniform solid spheres of equal radii R, but mass M. and $4M$ have a centre to centre separation $6R$, as shown in the figure. The two spheres are held fixed. A projectile of mass m is projected from the surface of the sphere of mass M directly towards the center of the second sphere. If the minimum speed v of the projectile so that it reaches the surface of the second sphere is $\sqrt{\frac{xGM}{yR}}$, then find $(x, +y)$

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'(##CEN_KSR_PHY_JEE_C10_038_Q05##)'

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38. A body which is initially at rest at a height $h = 6400km$ above the surface of the earth of radius $R(6400km)$, falls freely towards the earth. If its velocity on reaching the surface of earth is $2^N \times 10^3 \frac{m}{s}$, then calculate N. (Take $g =$ acceleration due to gravity on the surface of the earth $= 10\frac{m}{(s)^2}$)

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39. Gravitational acceleration on the surface of a planet is $\frac{\sqrt{6}}{g}$, where g is the gravitational acceleration on the surface of the earth. The average mass density of the planet is $\frac{2}{3}$ times that of the earth. If the escape speed on the surface of the earth is taken to 'be $11 \cdot (km)(s)^{-1}$, then the escape speed (in $\frac{km}{s}$) on the surface of the planet will be

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