PHYSICS

BOOKS - CHHAYA PHYSICS (BENGALI ENGLISH)

NEWTONIAN GRAVITATION AND PLANETARY MOTION

Example

1. If the distance between the centre of a gold sphere of radius 5mm and of a lead sphere of radius 11.5 cm is 15 cm and the force of gravitational attraction

between them is 2.16×10^{-4} dyn , find the value of G, the universal gravitational constant.

Densities of gold and lead are $19.3g \cdot cm^{-3}$ and $11.3g \cdot cm^{-3}$ respectively.

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2. Three particles of the same mass are kept at the vertices of an equilateral triangle. The mass of each particle is m and the length of an arm of the triangle is l. Due to the the mutual gravitational force of attraction, the particles revolve along the circumcircle of the triangle. Find the velocity of each particle.

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

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4. Assuming the earth's orbit around the sun to be circular, show that the area swept by its radius vector in unit time (areal velocity of the earth) is a constant.

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5. How fast (in m^2/s) is area swept out by

(a) the radius from sun to earth ?

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6. How fast (in m^2/s) is area swept out by

(b) the radius from earth to moon ? Given distance of sun to earth $= 1.496 \times 10^{11} m$, distance of earth to moon $= 3.845 \times 10^8 m$ and period of revolution of moon $= \frac{271}{3}$ days.

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7. The distance of the dwarf planet pluto from the sun is 40 times the average distance of the earth from the sun. How much time does pluto take to revolve around the sun ?

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8. Assuming that the earth moves around the sun in a circular orbit, find the orbital speed (in $km \cdot h^{-1}$) and the orbital angular velocity of the earth. The radius of the earth's orbit $= 1.5 \times 10^8 km$.

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9. If the distance of the earth from the sun suddenly decreases to half its present value, then how many days will make a year ?

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10. The mean orbital radius of the earth around the sun is $1.5 \times 10^8 km$. Calculate the mass of the sun if $G = 6.67 \times 10^{-11} N \cdot m^2 \cdot kg^{-2}$.

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11. Assuming that the moon moves around the earth in a circular orbit of radius 3.8×10^5 km in 27 days and the earth moves around the sun in a circular orbit of radius of radius 1.5×10^8 km in 365 days, find the ratio of the masses of the sun and the earth.

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12. Find the mass of the sun considering the orbit of the earth to be circular. Given , distance of the earth from the sun $= 1.49 \times 10^{13} cm$ and $G = 6.66 \times 10^{-8}$ CGS unit.

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13. Two small but heavy spheres , each of mass M are on a horizontal plane separated by a distance r. Find the gravitational potential at the mid-point of the line joining the centres of the two spheres.

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14. At the vertices of an equilateral triangle of side a, three particles each of mass m are kept. Find the gravitational potential and the gravitational field at the centroid of the triangle.

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15. Find the potential energy of a system of four particles of equal masses placed at the corners of a square of side l. Also obtain the potential at the centre of the square.

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16. Four particles of masses m, 2m, 3m and 4m are placed at the four corners of a square of side a. Find the gravitational force on a particle of mass m placed at the centre of the square.

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17. What will be the gain in the potential energy of an object of mass m raised from the surface of the earth to a height equal to the radius R of the earth ?

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18. What will be the percentage increases or decrease in the value of acceleration due to gravity on the surface of the earth , if the radius of the earth decreases by 1% and the mass of the earth remains unchanged ?

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19. The mass of the moon is $\frac{1}{80}$ th of the mass of the earth and its radius is $\frac{1}{4}$ th of that of the earth. Compare the accelerations due to gravity on the earth's and the moon's surface

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20. The average density of the earth is $5500kg \cdot m^{-3}$ the gravitational constant is $6.7 \times 10^{-11} N \cdot m^2 \cdot kg^{-2}$ and the radius of the earth is 6400 km. Using the given values, find the magnitude of the acceleration due to gravity on the surface of the earth.

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21. If the earth considered as a solid sphere of iron of radius 6.37×10^6 m and of density $7.86 g \cdot cm^{-3}$, what will be the magnitude of the acceleration due to gravity on the earth's surface ? Gravitational constant $= 6.58 \times 10^{-8}$ CGS unit.

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22. What will be the value of the acceleration due to gravity at a point 3 km above the earth's surface ?

Diameter of the earth =12800 km and $g = 980cm \cdot s^{-2}$ on the surface of the earth.

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23. An object of mass m is raised up to a small height h above the earth's surface. If the acceleration due to gravity on the earth's surface is g, prove that the weight of the object will decreases by $\frac{2mgh}{R}$ with respect to that on the earth's surface . R =radius of the earth.

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24. At what depth below the surface of the earth will the acceleration due to gravity decreases by 1% with respect to that on the earth's surface ? The earth can be taken as a uniform sphere of radius 6400 km.

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25. The acceleration due to gravity at a height h above the surface of the earth is the same as its value at a depth d below the earth's surface . Find the relationship between d and h.

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26. If the present radius of the earth is doubled keeping the mass unchanged, how will the weight of a body on the surface of the earth change ?

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27. What is the difference in the values of acceleration due to gravity at the polar region and at the equator due to the diurnal motion of the earth ? Radius of the earth=6400 km.

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28. For what value of the angular velocity of the earth, the acceleration due to gravity in the equatorial region would have been zero ? The average density of the earth's material $= 5.5g \cdot cm^{-3}$ and $G = 6.67 \times 10^{-8}$ CGS unit. Find the ratio of this calculated value and the present value of the angular velocity of the earth.

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29. If the diurnal motion of the earth stops due to some reason, what would be the percentage change

in the weight of a body at the equator ? Radius of the earth $= 6400km$ and $g = 9.8m \cdot s^{-2}$.

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30. Find the percentage decreases in weight of a body, when taken 16 km below the surface of the earth. Take radius of the earth as 6400 km.

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31. What is the escape velocity of a meteorite situated 1800 km above the surface of the earth? Given, the

radius of the earth =6300 km and the acceleration due to gravity on the earth's surface $= 9.8m \cdot s^{-2}$.

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32. A man can jump up to a height of 1.5 m on the earth's surface. What should be the radius of a planet having the same average density as that of the earth so that the man can come out of the gravitational field of that planet in one jump ? Radius of the earth is 6400 km.

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33. An artificial satellite revolves around the earth in a circular orbit and is at a height of 300 km above the surface of the earth. Find the orbital speed and the time period of the satellite. The radius of the earth=6400 km, $g = 980cm \cdot s^{-2}$.

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34. A man is positioned in a circular orbit at a height of 1.6×10^5m above the surface of the earth. The radius of the earth is 6.37×10^6m and the mass is 5.98×10^{24} kg. What would be the orbital speed of the man ? $\left(G = 6.67 \times 10^{-11} N \cdot m^2 \cdot kg^{-2}\right)$

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35. Prove that, if the orbital speed of the moon increases by 42% , it would stop orbiting around the earth.

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36. An artificial satellite is orbiting around the earth at a height of 3400 km above the earth's surface in a circular orbit. Find the orbital speed of the satellite. The radius of the earth =6400 km and $g = 980cm \cdot s^{-2}$.

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37. A satellite at a height of 700 km is revolving around the earth in a circular orbit. Find the velocity of the satellite with respect to the earth's surface. (Radius of the earth R=6300 km, $g = 9.8m \cdot s^{-2}$).

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38. A small satellite revolves around a planet of average density $10g \cdot cm^{-3}$. The radius of the orbit of the satellite is slightly more than the radius of the planet. Find the time period of rotation of the satellite. $G = 6.68 \times 10^{-8}$ CGS unit.

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39. Find the velocity with which a body can be projected vertically upwards so that it can reach a height equal to the radius of the earth. The radius of the earth =6400 km, $g = 980cm \cdot s^{-2}$.

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40. Two bodies of masses M and m were initially at infinite distance from each other and they started approaching each other due to their mutural force of gravitation. Prove that their velocity of approach

becomes $\sqrt{\frac{2G}{r}(M+m)}$ when they are at a distance of r from each other.

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41. An artificial satellite is revolving around the earth in a circular orbit. Its velocity is half the value of the escape velocity from the earth.

(i) What is the height of the satellite from the earth's surface ?

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42. An artificial satellite is revolving around the earth in a circular orbit. Its velocity is half the value of the escape velocity from the earth.

(ii) If its revolution around the earth is stopped and the satellite is allowed to fall freely towards the earth, what will be the velocity with which it will strike the earth's surface ? (Radius of the earth = $6.4 \times 10^6 m, g = 9.8 m \cdot s^{-2}$)

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43. Calculate the kinetic energy , potential energy and total energy of a geostationary satellite of mass 100

tonne. The radius of the earth is 6400 km and the radius of the orbit of the satellite is 42400 km.

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44. Two particles of equal mass revolve in a circular path of radius R due to their mutual force of attraction. Find the velocity of each particle.

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45. The acceleration due to gravity at two places are g and g' respectively. A body is dropped from the same height at both places. At the second place, the

required time to touch the ground is t seconds less than that in the first place, while the velocity attained in reaching the ground is higher by a value of v than that in the first place. Show that $gg' = \frac{v^2}{t^2}$.

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46. A satellite of mass m revolves around the earth in a circular orbit of radius r. Find the angular momentum of the satellite with respect to the centre of the orbit.

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47. A satellite is orbiting in a circular path around the earth close to its surface . What additional velocity is to be imparted to the satellite so that it escapes the earth's gravitational pull ? The radius of the earth= 6400 km and $g = 9.8m \cdot s^{-2}$.

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48. Two satellites A and B of the same mass revolve around the earth in circular orbits. They are at heights of R and 3R respectively from the surface of the earth (R=radius of the earth). Find the ratio of their kinetic energies and potential energies.

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49. Two satellite S_1 and S_2 are orbiting around the earth in circular orbits in the same direction. Time period for the two satellite are 1h and 8h respectively. The radius of the orbit of satellite $S_1 \text{is} 10^4 km$. If satellite S_1 and S_2 are on the same side of the earth, find the linear and angular speed of S_2 with respect to S_1.

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Section Related Questions

1. Write down Newton's law of gravitation.

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2. Derive Newton's law of gravitation from Kepler's law.

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3. An artificial satellite is revolving around the earth in a circular orbit of radius r. If the time period of revolution of the satellite is T, show that $T^2 \propto r^3$.

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4. The earth rotates around the sun in a circular orbit of radius R. Calculate the orbital speed of rotation of the earth around the sun. Also find the time period of rotation. Take the mass of the earth =m, mass of the sum =M.

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5. Define intensity of a gravitational field. Write down its CGS and SI units.

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6. Define gravitational potential .Write down its CGS and SI units.

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7. State the relation between gravitational potential and gravitational intensity.

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8. Derive an expression for gravitational potential energy of a body at a distance r from earth.

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9. What do you mean by acceleration due to gravity ?

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10. Establish a relation between gravitational constant and the mean density of the earth.

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11. Show that the weight of a body at the centre of the earth is zero.

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12. In the earth's atmosphere ,light gases like hydrogen, helium, etc., are scarce- explain why.

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13. An artificial satellite is revolving around the earth at an altitude h above the surface of the earth. Show that the orbital speed and the time period of revolution of the satellite is independent of its mass.

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14. What are the values of orbital speed and time period of revolution of an artificial satellite revolving very close to the earth's surface ?

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15. What do you mean by a parking orbit ?

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16. Determine the height of a geostationary satellite from the surface of the earth.

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17. What is the value of the time period of revolution of a geostationary satellite ?

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18. Find out the expression for the speed of an artificial satellite revolving around the earth in a circular path.

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Higher Order Thinking Skill Hots Questions

1. How will the value of the acceleration due to gravity be affected if

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2. the earth stops rotating

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3. the earth rotates faster ?

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4. What will be the effect on the value of the acceleration due to gravity on the earth's surface , if the radius of the earth suddenly reduces to half its present value and the mass remains constant ?

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5. If the mass and the radius of the earth suddenly reduce to half their present values,

(i) how many hours will be there in a day?

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6. If the mass and the radius of the earth suddenly reduce to half their present values,

(ii) how many days will constitute a year ?

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7. Explain why a person in an artificial satellite orbiting the earth, feels himself to be weightless.

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8. The sun and the earth both exert a gravitational force of attraction on any object on the earth's

surface. The two gravitational forces are in opposite directions during noon and in the same direction at midnight. Will an object weight more at midnight ?

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9. Does the moon have any weight ?

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10. If the value of the universal gravitational constant G starts decreasing very slowly with time, what will be the effect on the motion of the moon around the earth ? Explain clearly .

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11. Select the correct option stating the reason for your choice.

A satellite is revolving around the earth in a circular path. It has (i) constant velocity

(ii) constant acceleration

(iii) variable acceleration.

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12. Select the correct option stating the reason for your choice.

If the mass of the earth remains the same, but its diameter is decreased by 1% the value of the acceleration due to gravity on the surface of the earth

(i) remains the same

(ii) decreases

(iii) increases.

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13. Between the earth and the moon, which one has a greater escape velocity ? Give reason.

or, Is the value of the escape velocity from the earth's

surface the same as that from the surface of the moon ?

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14. Two satellites move around the earth at the same height. The mass of one satellite is twice that of the other. Which satellite has a greater velocity ?

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15. Acceleration due to gravity on the surface of a planet is $196cm \cdot s^{-2}$. If it is safe to jump from a

height of 2m on the earth, what is the safe height for taking a jump on that planet ?

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16. A freely falling body has no weight -explain.

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17. A body is released in space from an artificial satellite moving in a fixed orbit. What happens to the body ?

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18. Why are tidal waves not observed in a large lake ?

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19. What is the condition for setting up an artificial satellite at a height h from the earth's surface ? (Radius of the earth=R , mass of the earth =M)

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20. At what velocity will a rocket escape the gravitational pull of the earth ?

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21. What will be the feeling of an astronaut inside a satellite about his weight when the satellite is in the process of being launched by a rocket?

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22. A piece of matter of mass m is thrown up vertically from the earth's surface and it rises up to a height R. (Radius of the earth=R.) What is the initial velocity of the piece of matter ? Show that the increase in potential energy of the piece of matter $= \frac{1}{2}mgR$.

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23. The force of gravitation on all objects is directly proportional to their masses, yet a heavy body does not fall faster than a light body. Why ?

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24. What will be the change in the mutual force of gravitation between two bodies when the mass of each body as well as the distance separating them are doubled ?

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25. Show that the orbital speed of an artificial satellite increases as the energy of the satellite decreases.

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26. The value of the acceleration due to gravity at a height h from the surface of the earth is g_1 and that at a depth h below the earth's surface is g_2. Show that (radius of earth R $>>$ h) $\frac{g_2}{g_1} = 1 + \frac{h}{R}$

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27. If the acceleration due to gravity at a height h from the surface of the earth is the same as that at a depth h below the surface of the earth, prove that $h = \frac{\sqrt{5}-1}{2}R$ (R=radius of the earth).

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28. The force of attraction of the earth on an apple is of the same magnitude as the force of attraction of the apple on the earth, yet the apple moves towards the earth, but the earth does not move towards the apple. Why?

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29. In which case will the decreases in the value of the acceleration due to gravity be greater (with respect to that on the earth's surface) -at 1 km above the earth's surface or 1 km below the earth's surface ?

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30. Due to some reason, if the average distance of the earth from the sun decreases, will the length of a year increases or decrease ? Give reasons for your answer .

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31. What happens to a satellite if its orbital speed is greater than the escape velocity corresponding to that orbit ?

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32. Why is the span of a year smaller for a planet closer to the sun ?

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33. Suppose there existed a planet that went around the sun eight times as fact as the earth. What would

be its orbital size as compared to that of the earth ?

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34. The force of gravitation between two spherical masses M and m, placed in air, is F . The space between the two spheres is filled with a liquid of relative density 3. What will be the change in the value of the gravitational force acting between the spheres ?

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35. The conservation of what physical quantity does Kepler's second law refer to ?

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36. What is the appearance of a communicating satellite from its plane of projection ?

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37. Is it possible to place an artificial satellite in an orbit such that it is always visible in the sky of Lucknow or New Delhi ? Give the reason.

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38. The gravitational potential energy of a body on the surface of the earth is -6.4×10^6 joule. Explain the statement.

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39. If T is the period of revolution of an artificial satellite orbiting very close to the earth's surface and ρ is the density of the earth, then show that ρT^2 is a universal constant.

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40. Three particles, each of mass m, are placed at the vertices of an equilateral triangle. What is the force acting on a particle of mass 2m placed at the centroid D of the triangle ?

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41. Acceleration due to gravity decreases as we go below the surface of the earth. What will be the nature of the graph between the change of acceleration due to gravity and the depth below the surface of the earth ?

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Exercise Multiple Choice Questions

1. Density of the earth is about

A. $\frac{1}{5.5}$ times the density of water

B. 2 times the density of water

C. 5.5 times the density of water

D. 10 times the density of water

Answer: C

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2. A body of mass m is divided into two parts. The mass of one part is xm and that of the other part is (1-x) m. For a definite distance of separation between them, if the gravitational force of attraction has to be the maximum, the value of x should be

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

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

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

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

Answer: A

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3. Two bodies of masses m_1 and m_2 are initially at rest and infinite distance apart. Due to mutual attraction, they approach each other. When they are r distance apart, their relative velocity of approach is

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

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

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

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

Answer: A

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4. Gravitational force is

A. repulsive

B. electrical

C. conservative

D. non-conservative

Answer: C

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5. Two small but heavy spheres of mass M each are kept at a distance r on a horizontal plane. The magnitude of the gravitational potential at the mid-point of the line joining the centres of the two spheres will be

A. zero

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

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

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

Answer: D

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6. Infinite number of masses, each of mass M , are placed along a straight line at distance of R ,2R,4R,8R, etc. From a reference point O. The magnitude of gravitational potential point O will be

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

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

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

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

Answer: C

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7. In the case of a freely falling spherical body , its acceleration due to gravity depends on

A. mass of the body

B. radius of the body

C. density of the material of the body

D. none of the above

Answer: D

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8. If the earth is assumed to be a sphere of radius R, the height above the surface of the earth where the value of the acceleration due to gravity will be half its value on the earth's surface is

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

B. $h = \frac{R}{\sqrt{2}}$

C. $h = \left(\sqrt{2} + 1\right)R$

D. $h = \left(\sqrt{2} - 1\right)R$

Answer: D

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9. The mass of a planet is 4 times the mass of the earth and its radius is 2 times the radius of the earth. The acceleration due to gravity on that planet is

A. $9.8m \cdot s^{-2}$

B. $19.6m \cdot s^{-2}$

C. $4.9m \cdot s^{-2}$

D. $39.2m \cdot s^{-2}$

Answer: A

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10. The mass of the moon is $\frac{1}{80}$ th of that of the earth and the radius of the moon is $\frac{1}{4}$ th of that of the earth. The ratio of the acceleration due to gravity on the moon and that on the earth is

A. $2:1$

B. $1:2$

C. $1:5$

D. $5:1$

Answer: C

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11. If the diurnal motion of the earth ceases all on a sudden , then the value of the acceleration due to gravity of a body at the equator will

A. remains the same

B. be zero

C. increase

D. decrease

Answer: C

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12. Keeping the mass of the earth constant, if the radius of the earth is made 80% of its present value , the acceleration due to gravity on the earth's surface would

A. remain unchanged

B. decrease by 36% (approx.)

C. increase by 36% (approx.)

D. increase by 56% (approx.)

Answer: D

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13. If the radius of the earth is R , the height above the surface of the earth where the acceleration due to gravity will be 1% of its value on the earth's surface is

A. 8R

B. 9R

C. 10R

D. 20R

Answer: B

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14. If the change in the acceleration due to gravity (g) at an altitude h above the earth's surface is equal to the change in g at a depth x below the earth's surface [assume that both x and h are significantly smaller than the radius of the earth], then

A. x=h

B. x=2h

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

D. $x = h^2$

Answer: B

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15. The acceleration due to gravity on the surface of the earth is $9.8m \cdot s^{-2}$. The size of a planet is the same as that of the earth, but its density is twice the density of the earth. The value of the acceleration due to gravity on that planet is

A. $19.6m \cdot s^{-2}$

B. $9.8m \cdot s^{-2}$

C. $4.9m \cdot s^{-2}$

D. $2.45m \cdot s^{-2}$

Answer: A

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16. A rocket is projected vertically upwards from the surface of the earth (radius =R) with a velocity v. To what height will the rocket rise ?(Neglect air friction)

A. $h = \frac{R}{\frac{2gR}{v^2} - 1}$

B. $h = \frac{R}{\frac{2gR}{v^2} + 1}$

C. $h = R\left(\frac{2gR}{v^2} - 1\right)$

D. $h = R\left(\frac{2gR}{v^2} + 1\right)$

Answer: A

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17. If one moves from the equator to the pole, the value of g

A. remains unchanged

B. decreases

C. increases

D. increases first and the then decreases

Answer: C

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18. If the radius of the earth were to shrink by 1% , its mass remaining the same, the acceleration due to gravity on the surface of the earth would

A. increase

B. decrease

C. remain unchanged

D. be zero

Answer: A

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19. If G is universal gravitational constant and g is acceleration due to gravity then the unit of the quantity $\frac{G}{g}$ is

A. $kg \cdot m^2$

B. kg/m

C. kg/m^2

D. m^2/kg

Answer: D

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20. At what altitude (h) above the earth's surface would the acceleration due to gravity be one-fourth of its value at the earth's surface ? Where R is the radius of the earth.

A. $h=R$

B. $h=4R$

C. $h=2R$

D. $h=16R$

Answer: A

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21. A planet has same density and same acceleration due to gravity as of earth and universal gravitational constant G is twice of earth. The ratio of their radii is

A. $1:4$

B. $1:5$

C. $1:2$

D. $3:2$

Answer: C

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22. The escape velocity from the earth is v_e. If both the mass and the radius of a planet are twice that of the earth, then the escape velocity from that planet will be

A. v_e

B. $2v_e$

C. $4v_e$

D. $16v_e$

Answer: A

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23. The escape velocity of a particle of mass m is

A. directly proportional to m^2

B. directly proportional to m

C. directly proportional to m^0

D. directly proportional to m^{-1}

Answer: C

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24. The value of the escape velocity of a body thrown vertically upwards from the surface of the earth is v. if

the body is thrown making an angle θ with the vertical, then the value of the escape velocity will be

A. v

B. $v\cos\theta$

C. $v\sin\theta$

D. $v\tan\theta$

Answer: A

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25. The value of the escape velocity from the earth is v_e. If the radius of a planet is 4 times that of the earth

and its density is 9 times the density of the earth, then the value of the escape velocity from that planet will be

A. $6v_e$

B. $12v_e$

C. $20v_e$

D. $36v_e$

Answer: B

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26. The escape velocity of a planet is v_e. From this planet a particle is projected upwards with a velocity v. The particle will revolve like a satellite if

A. $\frac{v_e}{\sqrt{2}} < v < 2v_e$

B. $\frac{v_e}{\sqrt{2}} < v < v_e$

C. $v_e < v < \sqrt{2}v_e$

D. $\frac{v_e}{\sqrt{2}} < v < \frac{v_e}{2}$

Answer: B

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27. Escape speed on the surface of a planet varies with the mass m of a body as

A. m^0

B. m

C. m^{-1}

D. m^2

Answer: A

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28. The escape velocity of a body on the surface of earth is 11.2 km/ s. If the earth's mass increases to twice its present value and the radius of the earth becomes half, the escape velocity would become

A. $5.6km \cdot s^{-1}$

B. $11.2km \cdot s^{-1}$

C. $44.8km \cdot s^{-1}$

D. $22.4km \cdot s^{-1}$

Answer: D

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29. Keeping the mass constant , if the radius of the earth is halved, then the span of a day

A. will decrease

B. will increase

C. will remain unchanged

D. no conclusion can be arrived at

Answer: A

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30. The weight of a body on the surface of the earth is W. The weight of that body at an altitude equal to half the radius of the earth will be

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

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

C. $\frac{4W}{9}$

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

Answer: C

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31. A planet in elliptical orbit around a star moves form the point in its orbit furthest from the star to the closest point. The work done by the force of gravity during this movement is

A. zero

B. positive

C. negative

D. infinite

Answer: C

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32. The height of a geostationary satellite from the surface of the earth is

A. 100 km

B. 5 km

C. 36000 km

D. $2 \times 10^5 km$

Answer: C

Watch Video Solution

33. Two satellite of masses m_1 and $m_2(m_1 > m_2)$ are revolving around the earth in orbits of radii r_1 and $r_2(r_1 > r_2)$ with velocities v_1 and v_2 respectively . In this case

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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34. Two satellites A and B are revolving along circular paths of the same radius. The mass of A is 16 times the mass of B. The ratio of the time period of revolution of B to that of A is

A. $1:16$

B. $1:4$

C. $1:2$

D. $1:1$

Answer: D

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35. Two planet are revolving around the sun. their time periods of revolution and the average radii of the orbits are respectively (T_1, T_2) and (r_1, r_2) . The ratio T_1 / T_2 is

A. $\left(\frac{r_1}{r_2}\right)^{1/2}$

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

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

D. $\left(\frac{r_1}{r_2}\right)^{3/2}$

Answer: D

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36. The centripetal force necessary for an artificial satellite revolving along its orbit around the earth is delivered by

A. the combustion of the engine fuel

B. the ejection of exhausted hot gas

C. the gravitational attraction of the sun

D. the gravitational attraction of the earth

Answer: D

Watch Video Solution

37. The radii of the orbits of two satellite A and B revolving around a planet are 4R and R respectively . If the velocity of A is 3v, the velocity of B will be

A. $\frac{4}{3}v$

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

C. 6v

D. 12v

Answer: C

Watch Video Solution

38. In the case of the motion of a planet

A. the orbital velocity in its orbit remains constant

B. the orbital angular velocity remains constant

C. the total angular momentum remains constant

D. the orbital radius remains constant

Answer: C

Watch Video Solution

39. Two small artificial satellite are revolving around the earth in two circular orbits of radii r and

$(r + \Delta r)$. If their time periods of revolution are T and $T + \Delta T$, then $(\Delta r < < r, \Delta T < < T)$

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

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

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

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

Answer: A

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40. If the gravitational force is inversely proportional to the n -th power of the distance, then the time

period of the revolution of a planet around the sun in a circular orbit of radius R will be

A. directly proportional to $R^{\frac{1}{2}(n+1)}$

B. directly proportional to $R^{\frac{1}{2}(n-1)}$

C. directly proportional to R^n

D. directly proportional to $R^{\frac{1}{2}(n-2)}$

Answer: A

Watch Video Solution

41. A satellite of mass m is revolving around the earth at a height x above the surface of the earth. The

radius of the earth is R. If the acceleration due to gravity is g, the orbital speed of the satellite will be

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

Watch Video Solution

42. The ratio of the magnitudes of the kinetic energy and the potential energy of an artificial satellite

revolving around the earth is `

A. $1:2$

B. $1:\sqrt{2}$

C. $2:1$

D. $\sqrt{2}:1$

Answer: A

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43. Kepler's second law is the consequence of the law of conservation of

A. linear momentum

B. energy

C. angular momentum

D. mass

Answer: C

Watch Video Solution

44. A satellite is moving in an orbit around a planet with kinetic energy k and potential energy v. The satellite will escape from the gravitational pull of the planet if its kinetic energy becomes-

A. half

B. double

C. three times

D. four times

Answer: B

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

A. 0°

B. 60°

C. 90°

D. 120°

Answer: A

Watch Video Solution

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

A. 0°

B. 90°

C. 120°

D. 180°

Answer: B

Watch Video Solution

47. A geostationary satellite orbits around the earth surface in a circular orbit of radius 36,000 km. then, he time period of a spy satellite orbiting seventeen hundred kilometers above the earth's surface $(R_e = 6400km)$ will approximately be

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

B. 1h

C. 2h

D. 4h

Answer: C

Watch Video Solution

48. 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. $1.5E_0$

C. $-2E_0$

D. E_0

Answer: C

Watch Video Solution

49. Reason of weightlessness in a satellite is

A. zero gravity

B. no atmosphere

C. zero reaction force by satellite surface

D. none of the above

Answer: C

Watch Video Solution

50. A body projected vertically from the earth reaches a height equal to earth's radius returning to the earth. The power exerted by the gravitational force is greatest

A. at the instant just before the body hits the earth

B. it remains constant all the through

C. at the instant just after the body is projected

D. at the highest position of the body

Answer: A

View Text Solution

51. An orbiting satellite has

A. only kinetic energy

B. only potential energy

C. kinetic and potential energy

D. zero energy

Answer: C

Watch Video Solution

52. If the daily rotation of the earth ceases suddenly, then the weight of a body situated at the north pole will

A. be zero

B. remain the same

C. increase

D. decrease

Answer: B

Watch Video Solution

53. In the case of a freely falling body, which of the graphs will indicate accurately the distance vs variation ? (air resistance is neglected)

A. 

B. 

C. 

D. 

Answer: A

View Text Solution

54. The radius of a uniform sphere is R and its mass is M. The values of the gravitational intensity at distance r_1 and r_2 from the centre of the sphere 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. $\frac{F_1}{F_2} = \frac{r_1^2}{r_2^2}$, if $r_1 > R$ and $r_2 > R$

C. $\frac{F_1}{F_2} = \frac{r_1}{r_2}$, if $r_1 > R$ and $r_2 > R$

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

Answer: A

Watch Video Solution

55. Dimensional formula of gravitational field intensity is

A. MLT^{-1}

B. MLT^{-2}

C. M^0LT^{-2}

D. $M^0L^2T^{-1}$

Answer: C

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Exercise Very Short Answer Type Questions

1. What is the name of the mutual force acting between any two bodies in the universe ?

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2. What is the value of G in the CGS system ?

Watch Video Solution

3. What is the unit of G in SI ?

Watch Video Solution

4. What is the unit of gravity in SI ?

Watch Video Solution

5. State whether the value of g increases or decreases due to increases in depth below the earth's surface.

Watch Video Solution

6. Do the friction arises due to gravitation ?

Watch Video Solution

7. What will be the force of attraction of 1kg lead on the earth and the force of attraction of the earth on 1kg lead ?

Watch Video Solution

8. What it the value of G in SI ?

Watch Video Solution

9. What is the unit of G in the CGS system ?

Watch Video Solution

10. What is the dimension of G ?

Watch Video Solution

11. The gravitational force is a conservative force' true or false ?

Watch Video Solution

12. Is the gravitational force between two bodies in air equal to that inside water ?

Watch Video Solution

13. Does gravitational force depend on temperature ?

Watch Video Solution

14. State whether your weight will increase or decrease if the daily rotation of the earth ceases.

Watch Video Solution

15. What will be the gravitational potential on the surface of a planet of mass M and radius R ?

Watch Video Solution

16. If the potential and kinetic energies of an artificial satellite revolving around the earth are U and K respectively, what will be the relation between U and K ?

Watch Video Solution

17. If a body of mass m is at a distance r in the gravitational field of a body of mass M , what will be the gravititional potential energy of the body ?

Watch Video Solution

18. What is the weight of a body at the centre of the earth ?

Watch Video Solution

19. What is the value of the acceleration due to gravity at the centre of the earth ?

Watch Video Solution

20. Where does a body weight more at the pole or at the equator ?

Watch Video Solution

21. What is the value of the acceleration due to gravity of all bodies (heavy or light) at a particular place ?

Watch Video Solution

22. Write down the relation between g and G .

Watch Video Solution

23. What is the relation between the mean density of the earth and G ?

Watch Video Solution

24. Write down the variation of the acceleration due to gravity at a point above the surface of the earth to the square of the distance of that point from the centre of the earth.

Watch Video Solution

25. The value of g at the poles is greater than its value at the equator -true or false ?

Watch Video Solution

26. What is the value of the acceleration due to gravity on the surface of the earth ?

Watch Video Solution

27. The decrease in the acceleration due to gravity at a height above the earth's surface is ..... the decrease in the acceleration due to gravity at the same depth below the surface of the earth. [Fill in the blanks]

View Text Solution

28. The acceleration due to gravity at a height above the earth's surface is .....than that at the same depth below the surface of the earth. [Fill in the blanks]

Watch Video Solution

29. Give the value of the angular velocity of the earth for which the acceleration due to gravity at the equator would be zero.

Watch Video Solution

30. If the diurnal motion of the earth ceases, write the variation of g at all places except at the poles.

Watch Video Solution

31. If the angular velocity of the earth is increased , write the variation of g all place except at the poles.

Watch Video Solution

32. If the radius of the earth is halved keeping its mass unchanged, then the acceleration due to gravity would be .....times of its previous value.

Watch Video Solution

33. During free fall, the weight of a body becomes.....

Watch Video Solution

34. What will be the value of acceleration due to gravity on the earth's surface if its radius is decreased by 1% keeping the mass unchanged ?

Watch Video Solution

35. Where is the escape velocity of a body greater - from the earth or from the moon ?

Watch Video Solution

36. How does the escape velocity of a body from the earth depend on the mass of the body thrown ?

Watch Video Solution

37. From the surface of a planet, the escape velocity of all bodies - heavy or light - is ..... [Fill in the blanks]

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38. From the surface of the moon, give the value of the escape velocity .

Watch Video Solution

39. What is the relation between orbital and escape velocity ?

Watch Video Solution

40. When a body coming from infinity falls on the earth's surface, give its velocity .

Watch Video Solution

41. The orbital speed of a planet around the sun depends on the mass of the planet -is this statement true or false ?

Watch Video Solution

42. A comet orbits the sun in a highly elliptical orbit. Does the comet have constant (a) linear speed (b) angular speed, (c) angular momentum, (d) kinetic energy, (e) potential energy ,(f) total energy

throughout its orbit ? Neglect any mass loss of the comet when it comes very close to the sun.

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43. The time period of revolution of an artificial satellite in an orbit just outside the equatorial plane depends only on the mean density of the earth. Is this statement true or false ?

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44. An artificial satellite appears to be stationary with respect to an observer on the earth. At what height

(approx.) above the earth's surface is it placed ?

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45. What is the name of the orbit where an artificial satellite appears to be at rest from the earth ?

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46. What time will a polar satellite take to revolve around the earth once ?

Watch Video Solution

47. In which plane of the earth, does the orbit of a geostationary satellite always lie ?

Watch Video Solution

48. Write down one most important application of geostationary satellite.

Watch Video Solution

49. Assuming that the earth revolves around the sun in a circular orbit, the line joining the earth and the centre of its orbit covers.....area. [Fill in the blanks]

Watch Video Solution

50. If the distance between the sun and the earth were half the present value, the span of a year would be of .....days. [Fill in the blanks]

Watch Video Solution

51. If two satellite revolve in two different circular orbits, the orbital speed of the external satellite will be....than that of the inner satellite . [Fill in the blanks]

Watch Video Solution

52. The orbital speed of a satellite of the earth does not depend on the mass of the satellite -true or false

Watch Video Solution

53. Two satellite A and B are revolving around the earth at the same height .The mass of the satellite A is twice that of B . What will be the speed of A that of B ?

Watch Video Solution

54. If the orbital speed of an artificial satellite revolving very close to the earth is v and the escape velocity from the surface of the earth is v_e then $v_e = \ldots\ldots\ldots\ldots X v$.[Fill in the blanks]

Watch Video Solution

55. A geostationary satellite orbits the earth once in 24 h in the .....of the diurnal motion of the earth. [Fill in the blanks]

Watch Video Solution

56. If the radius of the earth is R, what will be the distance of a geostationary satellite from the centre of the earth ?

Watch Video Solution

57. A person inside an artificial satellite revolving around the earth feels weightless- true or false ?

Watch Video Solution

58. The orbit of a polar satellite lies in the .....plane.

Watch Video Solution

59. The total energy of an artificial satellite of mass m revolving around the earth of mass M is ..... The radius of the orbit of the satellite =r. [Fill in the blanks]

Watch Video Solution

60. What will be the length of a year if the distance between the earth and the sun is increased to twice the present value ?

Watch Video Solution

61. What is the dimension of gravitational intensity ?

Watch Video Solution

62. What is the unit of the intensity of gravitational field ?

Watch Video Solution

63. Where is the weight of a body greater -at the equator or at the poles ?

Watch Video Solution

64. State whether your weight will increase or decrease if the angular velocity of the earth increases.

Watch Video Solution

65. State whether the value of g increases or decreases if one moves from the equator to the pole.

Watch Video Solution

66. Where on the surface of the earth is the value of g least due to the diurnal motion of the earth ?

Watch Video Solution

67. If the force of gravity ceases to act suddenly, then all bodies would become weightless -true or false ?

Watch Video Solution

Exercise Short Answer Type Questions I

1. What will be the change in the gravitational force between two bodies if both the masses and the distance are doubled ?

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2. Show that the escape velocity for all bodies- heavy or light- is the same.

Watch Video Solution

3. Why is there no atmosphere on the surface of the moon ?

Watch Video Solution

4. Which one is greater- the force of attraction of 1 kg lead on the earth or the force of attraction of the earth on 1kg lead ?

Watch Video Solution

5. The weight of a body on the earth's surface is W. if the radius of the earth becomes double keeping its mass unchanged, what will be the weight of the body ?

Watch Video Solution

6. Why do different planets have different escape velocities ?

Watch Video Solution

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

Watch Video Solution

8. The artificial satellite do not have any fuel but even it remains orbiting around the earth. Explain why .

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9. Suppose the earth stops rotating about its axis. What will be the effect on the weight of bodies ?

Watch Video Solution

10. Why cannot we use a clock having pendulum in a satellite revolving around earth ?

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11. Where does the body weight more at the surface of the earth or in a mine ?

Watch Video Solution

12. Give two uses of polar satellites.

Watch Video Solution

Watch Video Solution

Exercise Short Answer Type Questions Ii

1. If the average distance between the sun and the earth decreases for some reason , then state whether the length of a year will increase or decrease. Give the reason for your answer .

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2. A body of mass 100 g is suspended from a spring balance held by a boy. If the spring balance is allowed

to fall freely in air, what will be the reading in the balance ?

Watch Video Solution

3. A person ascends vertically from the earth's surface to a height which is the same as the earth's radius. Then he descends to the centre of the earth. What will be the weight of the person with respect to his weight on the earth's surface in each case ?

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4. If the diameter of the earth becomes twice its present value but its mass remains unchanged, then how would be the weight of an object on the surface of the earth affected ?

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Problem Set I

1. Two piece of iron are kept at a distance of 20 cm. The mass of each of the piece is 100 kg. What is the gravitational force acting between them ? Given , $g = 6.67 \times 10^{-11} N \cdot m^2 \cdot kg^{-2}$.

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2. Two lead spheres are kept at a distance of 30 cm . The mass of each sphere is 100 kg. The mutual force of gravitational attraction between them is equal to the weight of a mass of 0.75 mg. Determine the gravitational constant .

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3. The distance between the centres of two spheres of masses 50 kg and 10 kg is 30 cm. The mutual force of attraction between them is equal to the weight of a

body of mass $\frac{1}{28}$ mg. Determine the value of the gravitational constant.

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4. A sphere of mass 40 kg is alternated by another sphere of mass 15kg with a force of $\frac{1}{10}$mg -wt . Find the value of G if the separation between the spheres is 20 cm.

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5. At what height above the surface of earth acceleration due to gravity will be

(i) 4%

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6. At what height above the surface of earth acceleration due to gravity will be

(ii) 50% of its value on the surface of the earth. Given radius of earth =6400 km.

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7. A body weight 90 kgf on the surface of earth. How much will it weight on the surface of a planet whose mass is $\frac{1}{9}$ and radius $\frac{1}{2}$ that of the earth ?

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8. The radius of the earth is 6.38×10^8 cm. its mean density is $5.5g \cdot cm^{-3}$ and the universal gravitational constant is 6.67×10^{-8} CGS unit. What is the gravitational potential at any point on the earth's surface ?

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9. Two masses 800 kg and 600 kg are at a distance of 0.25 m apart. Calculate the gravitational potential at a

point distant 0.02 m from 800 kg mass and 0.15 m from 600 kg mass. $G = 6.67 \times 10^{-11} N \cdot m^2 \cdot kg^{-1}$.

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10. At what height above the surface of the earth will the acceleration due to gravity be one-fourth of its value on the surface of the earth ?[Radius of the earth =R]

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11. At what height above the surface of the earth will the acceleration due to gravity be half of its value on

the earth's surface ? Radius of the earth =6400 km.

Watch Video Solution

12. At what depth below the surface of the earth will the acceleration due to gravity be one-fourth of its value on the earth's surface ? Assume that the earth is a homogeneous sphere of uniform density of radius R.

Watch Video Solution

13. If the mass of the earth is 6×10^{27}g and its radius 6400 km, what will be the acceleration due to gravity

at a height 64 km above the earth's surface ? Given that $G = 6.67 \times 10^{-8}$ CGS unit.

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14. If the radius of the earth is 6400 km, $g = 9.8m \cdot s^{-2}$ and $G = 6.7 \times 10^{-8}$ CGS unit, determine the mass of the earth.

Watch Video Solution

15. Show that if the earth stops rotating about its axis, then the acceleration due to gravity at the

equator will increase by $3.38cm \cdot s^{-2}$. The radius of the earth $= 6.4 \times 10^8 cm$.

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16. Choose the correct alternative :

(i) Acceleration due to gravity (increases /decreases) with increasing altitude.

Watch Video Solution

17. Choose the correct alternative :

(ii) Acceleration due to gravity (increases/ decreases)

with increasing depth (assume the earth to be a sphere of uniform density).

Watch Video Solution

18. Choose the correct alternative :

(iii) Acceleration due to gravity is independent of (mass of the earth / mass of the body).

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19. Choose the correct alternative :

(iv) The formula $-GMm(1/r_2 - 1/r_1)$ is (more/less) accurate than the formula $mg(r_2 - r_1)$

for the difference of potential energy between two points r_2 and r_1 distance away from the centre of the earth.

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20. If both the radius and the mean density of a planet are half the radius and the mean density of the earth, what will be the acceleration due to gravity on the surface of that planet ? Given that the acceleration due to gravity on the earth's surface $= 980cm \cdot s^{-2}$

Watch Video Solution

21. Calculate the angular velocity of the earth for which effective acceleration due to gravity at the equator becomes zero. In this condition, what will be the length of the day ? Take $R_e = 6400km$ and $g = 10m \cdot s^{-2}$

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22. Find the percentage decrease in the weight of a body when taken 32 km below the surface of the earth. Take radius of earth =6400 km.

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23. The density of a planet is $\frac{1}{3}$ rd that of the earth and its radius is $\frac{1}{4}$ th that of the earth. If a person can jump up to 2m on the surface of the earth, what is the maximum height up to which the person can jump on that planet ?

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24. Determine the value of the escape velocity from the surface of the moon. The radius of the moon= $1.7 \times 10^6 m$ and its mass = $7.35 \times 10^{22} kg$.

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

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25. The radius of a planet is double than that of the earth but their average densities are the same. If the escape velocities of the planet and the earth are v_p and v_e respectively, then prove that $v_p = 2v_e$.

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26. How much energy would be needed for a body of mass 10 kg to escape from the earth ? Take $g = 10m \cdot s^{-2}$ and $R_e = 6400km$.

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27. The planet Mercury revolves around the sun once in 88 days. If the mean distance between the earth and the sun is 1.5×10^8km , what is the mean distance of Mercury from the sun ?

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28. Two planets are revolving around a star and the ratio of their average orbital radii is 2:1 . Determine the ratio of their time periods.

Watch Video Solution

29. An artificial satellite revolves around the earth in a circular path at a distance of 3400 km from the earth's surface. Find the velocity of the artificial satellite . The radius of the =6400km, $g = 980cm \cdot s^{-2}$.

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30. Let us assume that our galaxy consists of 2.5×10^{11} stars each of one solar mass. How long will a star at a distance of 50,000 ly from the galactic centre take to complete one revolution ? Take the diameter of the Milky Way to be 10^5 ly.

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31. Choose the correct alternative:

(i) If the zero of potential energy is at infinity, the total energy of an orbiting satellite is negative of its (kinetic/potential) energy.

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32. Choose the correct alternative:

(ii) The energy required to launch an orbiting satellite out of the earth's gravitational influence is (more/less) than the energy required to project a

stationary object at the same height (as the satellite) out of the earth's influence.

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33. A satellite of mass 1000 kg moves in a circular orbit of radius 7000 km around the earth. Calculate the total energy required to place the satellite in orbit from earth's surface. Take Radius of earth =6400 km and $g = 10m \cdot s^{-2}$.

Watch Video Solution

34. An artificial satellites is revolving at a height of 500 km above the earth's surface in a circular orbit, completing one revolution in 98 minutes. Calculate the mass of the earth. Given $G = 6.67 \times 10^{-11} N \cdot m^2 \cdot kg^{-2}$ and $R_e = 6.4 \times 10^6 m$

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Problem Set Ii

1. The distance the sun and the earth is $1.5 \times 10^8 km$. At what point on the line joining them, will the gravitational attraction of the sun and that of the

earth be equal but opposite ? (Mass of the sun is 336400 times the mass of the earth)

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2. A spherical mass of 20 kg lying on the earth's surface is attracted by another spherical mass of 250 kg with a force equal to the weight of 0.25 mg-wt . The centres of the two masses are 30 cm apart. Calculate the mass of the earth. Radius of earth $= 6 \times 10^6$m.

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3. Mass of the earth is 81 times has mass of the moon. The distance between earth and moon is 4×10^5 km. calculate the position of the point on the line joining the centres of earth and moon where the gravitational field is zero.

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4. The radius of earth is $6.37 \times 10^6 m$, its mean density is $5.5 g \cdot cm^{-3}$. Calculate the earth's surface potential.

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5. If the acceleration due to gravity at a altitude h $(h << R)$ above the earth's surface is g_1 and at the same depth below the surface of the earth is g_2, then prove that $g_2 = g_1\left(1 + \frac{h}{R}\right)$. [R=radius of the earth]

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6. Assume that the earth is a uniform sphere of radius R. If the acceleration due to gravity at a height h above the earth's surface is g_1 and at the same depth below the surface of the earth is $g_2 (h < R)$, then show that, $g_2 = g_1\left(1 - \frac{h}{R}\right)\left(1 + \frac{h}{R}\right)^2$.

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7. Assume that the earth is a uniform sphere of radius R. If the acceleration due to gravity at an altitude h is the same as its value at the same depth below the surface of the earth, then show that $h = \frac{1}{2}(\sqrt{5} - 1)R$.

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8. The acceleration due to gravity at a hill station is less by 0.05% with respect to that at sea level. What is the height of that hill station? The radius of the earth =6400 km.

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9. If the span of a day on the earth would have been 6 days, what would be the percentage decrease in the acceleration due to gravity at the equator compared to that at the poles ? (Radius of the earth =6400 km, value of g at the poles $=981 cm \cdot s^{-2}$

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10. A body of mass m is raised to a height h from a point on the surface of the earth of the earth where the acceleration due to gravity is g. Prove that the

loss of weight due to variation of g is $\frac{2mgh}{R}$, where R is the radius of the earth.

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11. How much below the surface of earth does acceleration due to gravity become 1% of its value at the earth's surface ? The earth is assumed to be a sphere of radius $6.4 \times 10^6 m$.

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12. The ratio of the mass of the moon to that of the earth is 1:81. If the radius of the moon is assumed to

be one-fourth of that of the earth , then what is the acceleration due to gravity on the surface of the moon in terms of that on the earth's surface ? Hence, find the escape velocity from the surface of the moon in terms of that from the earth's surface.

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13. A rocket is fired vertically with a speed of $5km \cdot s^{-1}$ from the earth's surface . How far from the earth does the rocket go before returning to the earth ? Mass of the earth=$6.0 \times 10^{24}kg$, mean radius of the earth= $6.4 \times 10^{6}m, G = 6.67 \cdot 10^{-11}N \cdot m^{2} \cdot kg^{-2}$.

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14. A rocket starts vertically upward with speed v_0. Show that its speed v at height h is given by $v_0^2 - v^2 = \frac{2gh}{1 + \frac{h}{R}}$ where R is the radius of the earth.

Watch Video Solution

15. A body is projected vertically upwards from the surface of earth with a velocity equal to half of escape speed. What is the maximum height attained by the body ?

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16. The moon revolves around the earth once in $\frac{271}{3}$ days. If the average distance between the earth and moon is 384000km , determine the orbital speed and the orbital angular velocity of the moon.

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17. A satellite is revolving around the earth at an altitude of 700 km. Determine the horizontal velocity of the satellite. The radius of the earth =6300km , $g = 9.8m \cdot s^{-2}$

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18. The radius of the earth = R. if a geostationary satellite is revolving along a circular path at an altitude of 6R above the surface of the earth, what will be the time period of revolution of another satellite revolving around the earth at an altitude of 2.5R ?

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19. An artificial satellite circled around the earth at a distance of 3400 km. Calculate its orbital velocity and

period of revolution. Radius of earth =6400 km and $g = 9.8m \cdot s^{-2}$.

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

(i) Determine the height of satellite above the earth's surface.

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

(ii) if the satellite is stopped suddenly in its orbit and allowed to fall freely on to the earth, find the speed with which it hits the surface of the earth. Take $g = 9.8m \cdot s^{-2}$ and $R_e = 6400km$.

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22. The mass and the radius of the moon are $\frac{1}{80}th$ and $\frac{1}{4}th$ respectively of the mass and the radius of the earth. If a body is thrown vertically

upwards with a velocity of $14m \cdot s^{-1}$ on the moon's surface , then up to what height will it rise ?

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23. The radius of the planet jupiter is 71000 km and the escape velocity from the surface of this planet is $59.6km \cdot s^{-1}$. Determine the acceleration due to gravity on the surface of jupiter.

Watch Video Solution

24. A body of mass m is raised from the surface of the earth up to a height equal to the radius R of the

earth. If the acceleration due to gravity on the earth's surface is g , prove that the potential energy of the body has increased by $\frac{1}{2}$ mgR.

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25. Two stars each of one solar mass $\left(= 2 \times 10^{30} kg \right)$ are approaching each other for a head-on collision . When they are $10^{9} km$ apart, their speeds are negligible. What is the speed with which they collide ? The radius of each star is $10^{4} km$. Assume the stars remain undistorted until they collide. (Use the known value of G).

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26. Two heavy spheres each of mass 100 kg and radius 0.10 m are placed 1.0 m apart on a horizontal table. What is the gravitational force and potential at the mid-point of the line joining the centres of the spheres ? Is an object placed at that point in equilibrium ? if so, is the equilibrium stable or unstable ?

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27. An artificial satellite is moving in an orbit around the earth with a velocity equal to one-third the

escape velocity from the surface of the earth.

(i) Find the height of the satellite from the surface of the earth.

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28. An artificial satellite is moving in an orbit around the earth with a velocity equal to one-third the escape velocity from the surface of the earth.

(ii) The satellite comes to rest in its orbit and then is allowed to fall freely on to the surface of the earth. Find the speed with which the satellite strikes the earth's surface. Given radius of earth =6400 km.

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29. Show that the moon would escape if its speed were increased by 42% .

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Problem Set Ii Hots Numerical Problems

1. The average distance of the sun from the earth is 1.5×10^8km and the average distance of the moon from the earth is 384000 km. if the attraction of the sun on the earth is 180 times the attraction of the

moon ,how many times is the mass of the sun greater than that of the moon ?

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2. The mass and the diameter of the planet jupiter are 309 times and 11 times the mass and the diameter of the earth respectively. Determine the acceleration due to gravity on the surface of jupiter.

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3. A body is projected vertically upwards with a kinetic energy which is half of the minimum kinetic energy

required to escape the earth's gravitational attraction. Calculate the maximum height attained by the body. (Radius of the earth=R)

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4. The masses and radii of the earth and the moon are M_1, R_1 and M_2, R_2 respectively. Their centres are at a distance d apart. Find the minimum speed with which a particle of mass m should be projected from a point midway between the two centres so that it escape to infinity.

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5. A body is thrown vertically upwards with a velocity v from the surface of the earth. Show that the height h up to which the body will rise is given by $h = \frac{v^2 R}{2gR - v^2}$ here ,R=radius of the earth , g=acceleration due to gravity.

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6. Imagine a light planet revolving around a very heavy star in a circular path. The radius of the orbit =R and the time period of revolution =T. if the gravitational force of attraction between the star and the planet is directly proportional to $R^{-5/2}$, then the

relation between T and R would be $T^2 \propto R^n$. Determine the value of n.

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7. The orbital angular momentum of the earth with respect to the sun divided by the mass of the earth is $4.4 \times 10^{15} m^2 \cdot s^{-1}$. Determine the area enclosed by the orbit of the earth.

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8. What will be the kinetic energy , potential energy and total energy of an artificial satellite of mass 10^5kg

situated at a height of 3400 km above the surface of the earth ?$[g = 9.8m \cdot s^{-2}$, radius of the earth=6400 km]

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9. As you have learnt in the text ,a geostationary satellite orbits the earth at a height of nearly 36000 km from the surface of the earth. What is the potential due to earth's gravity at the site of this satellite? (Take the potential energy at infinity to be zero.) Mass of the earth=$6.0 \times 10^{24} kg$, radius =6400 km.

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10. A spaceship is stationed on Mars. How much energy must be expended on the spaceship to launch it out of the solar system ? Mass of the spaceship= $1000kg$, mass of the sun $= 2 \times 10^{30} kg$, mass of Mars $= 6.4 \times 10^{23} kg$, radius of Mars = $3395km$, mass of the orbit of Mars $= 2.28 \times 10^{8} km$, $G = 6.67 \times 10^{-11} N \cdot m^2 \cdot kg^{-2}$.

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11. A star 2.5 times the mass of the of the sun and collapsed to a size of 12 km rotates with a speed of 1.2

rev. per second. (Extremely compact stars of this kind are known as neutron stars. Certain stellar objects called pulsars belong to this category). Will an object placed on its equator remain stuck to its surface due to gravity ? (mass of the sun$2 \times 10^{30} kg$).

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12. Prove that in the case of an artificial satellite revolving around a spherical planet, its minimum time period of revolution depends only on the mean density of the planet.

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13. The masses of two planets are M and 16M respectively. Their radii are a and 2a respectively and their centres are 10 a apart. A body of mass m is fired straight from the surface of the larger planet towards the smaller planet. What should be the minimum projectile speed so that it reaches the surface of the smaller planet ? Obtain the expression in terms of G, M and a.

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14. A body of mass M is divided into two parts -one of mass m and another of mass (M-m) . The two pieces

are kept at a distance . What should be the value of the ratio $\frac{m}{M}$, so that the gravitational force of attraction between the two piece will be the maximum ?

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Entrance Corner Assertion Reason Type

1. Statement I: An astronaut in an orbiting space station above the earth experiences weightlessness.

Statement II: An object moving around the earth under the influence of earth's gravitation force is in a state of free fall.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

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

View Text Solution

2. Statement I: If time period of a satellite revolving in circular orbit in equatorial plane is 24h, then it must be geostationary satellite.

Statement II: Time period of a geostationary satellite is 24 h.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: D

 Watch Video Solution

3. Statement I: Gravitational force between two masses in air is F. if they are immersed in water force will remain F.

Statement II: Gravitational force does not depend on the medium between the masses.

A. Statement I is true, statement II is true, statement II is a correct explanation for

statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

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

4. Statement I: The binding energy of a satellite does not depend upon the mass of the satellite.

Statement II: Binding energy is the negative value of total energy of satellite .

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: D

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5. Statement I: Kepler's laws for planetary motion are consequence of Newton's laws.

Statement II: Kepler's laws can be derived by using Newton's laws.

A. Statement I is true, statement II is true, statement II is a correct explanation for statement I.

B. Statement I is true , statement II is true, statement II is not a correct explanation for statement I.

C. Statement I is true, statement II is false.

D. Statement I is false, statement II is true.

Answer: D

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Entrance Corner Multiple Correct Answers Type

1. An orbiting satellite will escape if

A. its speed is increased by 41%

B. its speed in the orbit is made $\sqrt{(1.5)}$ times of its initial value

C. its kinetic energy is doubled

D. it stops moving in the orbit

Answer: A::C

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2. A comet is revolving around the sun in a highly elliptical orbit. Which of the following will remain constant throughout its orbit ?

A. kinetic energy

B. potential energy

C. total energy

D. angular momentum

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

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3. Which of the following are correct ?

A. out of electrostatic, electromagnetic , nuclear and gravitational interactions the gravitational interaction is the weakest

B. if earth were to rotate faster than its present speed, the weight of an object would decrease at the equator but remain unchanged at the poles

C. the mass of earth in terms of g,R and G is $\left(gR^2/G\right)$

D. if earth stops rotating in its orbit around the sun there will be no variation in the weight of a body on the surface of earth

Answer: C::D

View Text Solution

4. A small mass m is moved slowly from the surface of the earth to a height h above the surface. The work done (by an external agent) in doing this is

A. mgh , for all values of h

B. mgh for $h < \ < R$

C. $\frac{1}{2}mgR$, for $h = R$

D. $-\frac{1}{2}mgR$ for $h = R$

Answer: B::C

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Entrance Corner Comprehension Type

1. The gravitational field in a region is given by

$$\vec{E} = \left(5N \cdot kg^{-1}\right)\hat{i} + \left(12N \cdot kg^{-1}\right)\hat{j}$$

(i) Find the magnitude of the gravitational force acting on a particle of mass 2kg placed at the origin.

A. 26N

B. 30N

C. 20N

D. 35N

Answer: A

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2. The gravitational field in a region is given by

$\overrightarrow{E} = \left(5N \cdot kg^{-1}\right)\hat{i} + \left(12N \cdot kg^{-1}\right)\hat{j}$

(ii) Find the potential at the points (12m, 0) and (0,5m) if the potential at the origin is taken to be zero.

A. $-30J \cdot kg^{-1}, \ -30J \cdot kg^{-1}$

B. $-40J \cdot kg^{-1}, \ -30J \cdot kg^{-1}$

C. $-60J \cdot kg^{-1}, \ -60J \cdot kg^{-1}$

D. $-40J \cdot kg^{-1}, \ -50J \cdot kg^{-1}$

Answer: C

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3. The gravitational field in a region is given by

$\vec{E} = \left(5N \cdot kg^{-1}\right)\hat{i} + \left(12N \cdot kg^{-1}\right)\hat{j}$

(iii) Find the change in gravitational potential energy if a particle of mass 2 kg is taken from the origin to the point (12m,5m).

A. $-225J$

B. $-240J$

C. $-245J$

D. $-250J$

Answer: B

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4. The gravitational field in a region is given by

$\vec{E} = \left(5N \cdot kg^{-1}\right)\hat{i} + \left(12N \cdot kg^{-1}\right)\hat{j}$

(iv) Find the change in potential energy if the particle is taken from (12m,0) to (0,5m).

A. $-10J$

B. $-50J$

C. zero

D. $-60J$

Answer: C

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Entrance Corner Integer Answer Type

1. Gravitational acceleration on the surface of a planet is $\left(\sqrt{6}/11\right)$ 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 $km \cdot s^{-1}$, the escape speed on the surface of the planet in $km \cdot s^{-1}$ will be

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2. A binary star consists of two stars A (mass 2.2 M_s) and B (mass $11M_s$), where M_s is the mass of the sun. They are separated by distance d and are rotating about their centre of mass, which is stationary. The ratio of the total angular momentum of the binary star to the angular momentum of star B about the centre of mass is

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3. A particle is projected vertically upwards from the surface of the earth of radius R, with a kinetic energy equal to half of the minimum value needed for it to escape. The maximum height to which it rises above

the surface of the earth is nR. What should be the value of n ?

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4. The time period of a satellite A, whose orbital radius is r_0 is T_0 and the time period of a satellite B having radius $4r_0$ is T_B . Find the ratio of T_B and T_0.

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5. Two particles of masses m_1 and m_2 are kept at a separation of d. when a third particle is kept at a

distance of $\frac{d}{3}$ from m_1 , then it does not experience any net force. Determine the ratio $\frac{m_2}{m_1}$.

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Examination Archive With Solutions Wbchse

1. Show that for planetary motion around the sun, the orbital velocity of a planet is maximum and minimum at the nearest and furthest point respectively from the sun.

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2. At what height above the surface of the earth is the gravitational potential energy of a body equal to that on the surface of the moon ? Assume that the mass of the earth is 80 times that of the moon and the radius of the earth is 4 times that of the moon. Given ,Radius of the earth =6400 km.

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3. does the motion of a satellite obey Kepler's laws ?

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4. The orbital velocity of a satellite in a circular orbit close to the earth is v_0 . If the escape velocity of an object projected from the earth be v_e, then the ratio of these two velocities is

A. $1:1$

B. $\sqrt{2}:1$

C. $\sqrt{3}:1$

D. $2:1$

Answer: B

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5. Find expressions for the potential energy (V) and the kinetic energy (K) of the moon in the gravitational field of the earth. Hence find the total energy of the moon and state the significance of its negative sign.

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6. What is a geostationary satellite ?

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7. An artificial satellite of mass m is moving round the earth in an orbit of radius 2R. How much work is to be

done to transfer the satellite to an orbit of radius 4R ? How will the potential energy of the satellite change ? (R=Radius of earth)

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8. Suppose the gravitational force varies inversely as the n th power of the distance. Thus the time period of a planet moving in a circular orbit of radius r around the sun will be proportional to

A. $r^{\frac{n+1}{2}}$

B. r^n

C. $r^{\frac{n-1}{2}}$

D. r^{-n}

Answer: A

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9. What are the characteristics of geostationary satellite and polar satellite ? Why polar satellite are called weather satellite -Explain.

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10. What will be the velocity of rotating of earth about its own axis so that a body becomes weightless

at the equator ?

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11. What is the relation between average density and radius of the earth ?

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12. A planet is rotating round a heavy star along a circular path of radius R with time T. if the gravitational force of attraction between planet and star is proportional to $R^{-\frac{5}{2}}$, then $T^2 \propto R^x$. What is the value of x ?

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13. A man on earth can jump to a maximum height of 2m. To what maximum height the man will be able to jump to another planet whose density is $\frac{1}{3}$ of the density of earth and radius is $\frac{1}{4}$ of the radius of earth ?

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14. If the radius of the earth becomes half of the present radius , mass being constant, the weight of a body will be

A. halved

B. one-fourth

C. doubled

D. four times

Answer: D

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15. Determine the dimension of gravitational constant

.

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16. The value of the acceleration due to gravity at a height h from the surface of the earth is g_1 and that at a depth h below the earth's surface is g_2 .Show that $\frac{g_2}{g_1} = \left(1 + \frac{h}{R}\right)$ [Radius of earth $R > > h$]

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17. Gravitational force is

A. repulsive

B. electrical

C. conservative

D. non-conservative

Answer:

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18. Define gravitational constant. State its SI unit.

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19. Mass remaining constant , if the radius of the earth decreases by 1% what is the percentage change in acceleration due to gravity on the surface of the earth ?

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20. An object is projected vertically upwards with a velocity u from the surface of the earth. Show that the maximum height reached by the object is $h = \frac{u^2 R}{2gR - u^2}$ where R is the radius of the earth. Calculate escape velocity from it.

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21. Considering the earth as a uniform sphere of radius R show that if the acceleration due to gravity at a height h from the surface of earth is equal to the

acceleration due to gravity at the same depth, then $h = \frac{1}{2}(\sqrt{5} - 1)R$.

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22. Keeping the mass fixed , if the radius of the earth is halved, the acceleration due to gravity at any place will be

A. half of the original

B. one-fourth of the original

C. doubled of the original

D. four times of the original

Answer: D

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23. Define acceleration due to gravity. Deduce an expression of the acceleration of the acceleration due to gravity at a place on the surface of the earth due to its rotating.

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24. What is meant by gravitational potential energy ? Deduce an expression of the total energy of a planet

in its orbit.

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Examination Archive With Solutions Wbjee

1. An artificial satellite moves in a circular orbit around the earth. Total energy of the satellite is given by E.The potential energy of the satellite is

A. $-2E$

B. $2E$

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

D. $\frac{-2E}{3}$

Answer: B

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2. Two particle of mass m_1 and m_2 approach each other due to their mutual gravitational attraction only. Then

A. acceleration of both the particles are equal

B. acceleration of the particle of mass m_1 is proportional to m_1

C. acceleration of the particle of mass m_1 is proportional to m_2

D. acceleration of the particle of mass m_1 is inversely proportional to m_1.

Answer: C

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3. A satellite has kinetic energy K, potential energy V and total energy E. which of the following statements is true ?

A. $K = -V/2$

B. $K = V/2$

C. $E = K/2$

D. $E = -K/2$

Answer: A

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4. The ratio of acceleration due to gravity $g_1 : g_2$ on the surface of two planets is $5:2$ and the ratio of their respective average densities $\rho_1 : \rho_2$ is $2:1$. What is the ratio of respective escape velocities $v_1 : v_2$ from the surface of the planets?

A. $5:2$

B. $\sqrt{5}:\sqrt{2}$

C. $5:2\sqrt{2}$

D. $25:4$

Answer: C

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Examination Archive With Solutions Jee Main

1. Four particles, each of mass M and equidistant from each other, move along a circle of radius R under the

action of their mutual gravitational attraction, the speed of each particle is

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

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

C. $\sqrt{\frac{GM}{R}(1+2\sqrt{2})}$

D. $\frac{1}{2}\sqrt{\frac{GM}{R}(1+2\sqrt{2})}$

Answer: D

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2. From a solid sphere of mass M and radius R, a spherical portion of radius $\frac{R}{2}$ is removed as shown in

the figure. Taking gravitational potential V=0 at $r = \infty$, the potential at the centre of the cavity thus formed is (G=gravitational constant)

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

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

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

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

Answer: B

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

A. $\sqrt{2gR}$

B. $\sqrt{gR}$

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

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

Answer: D

Watch Video Solution

4. The variation of acceleration due to gravity g with distance d from centre of the earth is best represented by (R=earth 's radius):

A. 

B. 

C. 

D. 

Answer: D

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1. 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

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2. 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

View Text Solution

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

i.e.,$T^2 = Kr^3$

here K is constant.

If the masses of sun and planet are M and m respectively, then as per Newton's law of gravitation, force of attraction between them is

$F = \frac{GMm}{r^2}$ here G is gravitational constant

The relation between G and K is described as

A. $GK = 4\pi^2$

B. $GMK = 4\pi^2$

C. K=G

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

Answer: B

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Examination Archive With Solutions Neet

1. The ratio of escape velocity at earth $(v_e)$to the escape velocity at a planet (v_p) whose radius and mean density are twice as that of earth is

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

B. $1:4$

C. $1:\sqrt{2}$

D. $1:2$

Answer: A

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2. At what height from the surface of earth the gravitation potential and the value of g are $-5.4\times10^{7}J\cdot kg^{-1}$ and $6m\cdot s^{-2}$ respectively ? Take the radius of earth as 6400 km.

A. 1600 km

B. 1400 km

C. 2000 km

D. 2600 km

Answer: D

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3. Imagine earth to be a solid sphere of mass M and radius R. if the value of acceleration due to gravity at a depth d below earth's surface is same as its value at a height h above its surface and equal to $\frac{g}{4}$ (where g

is the value of acceleration due to gravity on the surface of earth), the ratio of $\frac{h}{d}$ will be

A. 1

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

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

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

Answer: B

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4. A satellite of mass m is in circular orbit of radius $3R_E$ about earth (mass of earth M_E , radius of earth

R_E).

How much additional energy is required to transfer the satellite to an orbit of radius $9R_E$?

A. $\frac{GM_Em}{3R_E}$

B. $\frac{GM_Em}{18R_E}$

C. $\frac{3GM_Em}{2R_E}$

D. $\frac{GM_Em}{9R_E}$

Answer: D

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5. The kinetic energies of a planet in an elliptical orbit about the sun , at position 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 S as shown in the figure. Then

A. $K_B < K_A < K_C$

B. $K_A > K_B > K_C$

C. $K_A < K_B < K_C$

D. $K_B > K_A > K_C$

Answer: B

View Text Solution

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

A. Time period of a simple pendulum on the earth would decrease

B. Walking on the ground would become more difficult

C. Raindrops will fall faster

D. g on the earth will not change

Answer: D

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Cbse Scanner

1. What is the reason for absence of atmosphere in some planets?

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2. State Kepler's laws on planetary motion. Explain the way the three laws can be proved.

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3. Discuss the variation of g with depth. What happens to g at the centre of earth?

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4. Define orbital speed. Derive the expression for it.

Watch Video Solution

5. Define escape velocity. Derive the expression for it.

Watch Video Solution

6. A body weight 63N 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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7. Deduce Kepler's second laws of planetary motion for a planet.

Watch Video Solution

8. Obtain an expression showing variation of acceleration due to gravity with height .

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9. Why does a satellite not need any fuel to circle around the earth? Is it possible to place an artificial satellite in an orbit such that it always visible in the sky of New Delhi ?

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10. What would be the weight of a person, if he goes to a height equal to radius of earth from its surface ?

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11. Derive an expression for the escape velocity of an object from the surface of earth. What is its value on the earth's surface ?

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12. A saturn year is 29.5 times the earth year. How far is the saturn from the sun if the earth is 1.5×10^8 km

away from the sun ?

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13. Derive an expression for acceleration due to gravity at a depth d from earth's surface . Is it increases or decreases.

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14. A remote-sensing satellite of earth revolves in a circular orbit at a height of 0.25×10^6m above the surface of earth. Find the orbital speed and the

period of revolution of satellite . Given : Earth's radius $R_e = 6.38 \times 10^6 m$ and $g = 9.8 m/s^2$.

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15. Define escape velocity. Derive an expression for escape velocity.

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16. According to Newton's law of gravitation , everybody in this universe attracts every other body with a force, which is directly proportional to the product of their masses and the inversely

proportional to the square of the distance between their centres, i.e., $F \propto \frac{m_1 m_2}{r^2}$ or $F = G\frac{m_1 m_2}{r^2}$ where G is universal gravitational constant $= 6.67 \times 10^{-11} N \cdot m^2 \cdot kg^{-2}$.

Read the above passage and answer the following questions :

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

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17. According to Newton's law of gravitation , everybody in this universe attracts every other body with a force, which is directly proportional to the product of their masses and the inversely

proportional to the square of the distance between their centres, i.e., $F \propto \frac{m_1 m_2}{r^2}$ or $F = G\frac{m_1 m_2}{r^2}$ where G is universal gravitational constant $= 6.67 \times 10^{-11} N \cdot m^2 \cdot kg^{-2}$.

Read the above passage and answer the following questions :

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

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18. According to Newton's law of gravitation , everybody in this universe attracts every other body with a force, which is directly proportional to the

product of their masses and the inversely proportional to the square of the distance between their centres, i.e., $F \propto \frac{m_1 m_2}{r^2}$ or $F = G\frac{m_1 m_2}{r^2}$ where G is universal gravitational constant $= 6.67 \times 10^{-11} N \cdot m^2 \cdot kg^{-2}$.

Read the above passage and answer the following questions :

(iii) What values of life do you learn from it ?

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19. A body weight 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 earth ?

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