PHYSICS

BOOKS - MODERN PUBLISHERS PHYSICS (HINGLISH)

GRAVITATION

Solved Example

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

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2. The planet Mars has two moons. Phobos and Delmos (i) phobos has period 7 hours, 39 minutes and an orbital radius of

$9.4 \times 10^3 km$. Calculate the mass of Mars. (ii) Assume that Earth and mars move in a circular orbit around the sun, with the martian orbit being 1.52 times the orbital radius of the Earth. What is the length of the martian year in days? $\left(G = 6.67 \times 10^{-11} Nm^2 kg^{-2}\right)$

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

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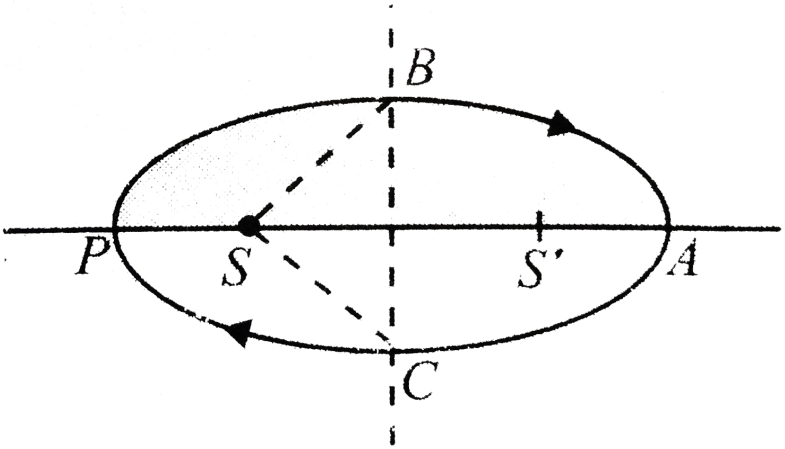
4. Let the speed of the planet at the perihelion P in figure be v_P and the Sun planet distance SP be r_P. Relater r_P, v_P to the corresponding quantities at the aphelion (r_A, v_A). Will the planet

take equal times to transverse BAC and CPB?



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5. Calculate the force of attraction between a sphere of mass 40 kg and another sphere of mass 80 kg with their centres 30 cm apart.

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6. Two particles of equal mass $'m'$ go around a circle of radius R under the action of their mutual gravitaitonal attraction. The speed

of each particle with respect to their centre of a mass is -

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7. Calculate the mass of the sun if the mean orbital radius of Jupiter around the sun is $7.8 \times 10^{11} m$.

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

Time period of revolution = 12 years according to earth

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8. A mango of mass 0.3 kg falls from a tree. Calculate the acceleration of the mango towards the earth. Also calculate the acceleration of the earth towards the mango. Take,

Mass of the earth $= 5.983 \times 10^{24} kg$

Radius of the earth $= 6.378 \times 10^{6} m$

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

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

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

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11. If the earth were made of iron of relative density 7.87, what would be the value of acceleration due to gravity on its surface ? Take, Radius of earth $= 6.37 \times 10^6 m$, $G = 6.67 \times 10^{11} Nm^2 kg^{-2}$

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12. Two brass spheres of diameter 10 cm and 1 cm are placed with their centres 50 cm apart. If the relative density of brass is 8.5, calculate the gravitational attraction between the spheres. If the brass spheres are replaced by lead spheres (relative density greater than brass) of same radii, will the force of attraction increase or decrease ? For earth

Take $R = 6.37 \times 10^8 cm$

Mean density $= 5.53 \times 10^3 kgm^{-3}$

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13. Calculate the weight of a body on the surface of Mars whose mass is 1/9 of the mass of the earth and radius is half the radius of the earth, and the body weighs 60 kg-f on the surface of the earth.

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14. Find the percentage change in acceleration due to gravity on the surface of earth if the radius of the earth shrinks by 1.0%, mass remaining constant.

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15. The radius of the earth is 6,400 km. Calculate the height from the surface of the earth at which the value of g is 81% of the value at the surface.

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16. Calculate the percentage decrease in the weight of a body when it is taken to a height of 40 km above the earth's surface. Radius of earth = 6,400 km.

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17. When weighed on a balance at the top of a cliff 30 m high, weight of an object of mass 0.5 kg is different than that weighted near the foot of the cliff. Calculate the change in weight. Take, Radius of the earth = 6,400 km

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18. Calculate the percentage decrease in the weight of a body when it is taken inside a mine, 2.5 km below the earth's surface. Take,

Radius of earth = 6,400 km

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19. Calculate the depth below the surface of the earth where the acceleration due to gravity is 2% of its value at the earth's surface. Take, Radius of earth = 6,400 km

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20. Compare the weight of a body when it is at (a) 80 km above the earth,s surface and (b) 80 km below the earth's surface. Take radius of earth = 6,400 km.

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21. Find the value of acceleration due to gravity at a place oa latitude 30°. Take, Radius of earth $= 6.38 \times 10^6 m$

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22. If the earth stops rotating about its axis , then what will be the change in the value of g at a place in the equitorial plane ? Radius of the earth = 6400 km.

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

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24. Considering the earth to be a perfect sphere of radius $6.4 \times 10^6 m$, rotating about its axis with a period of 1 day $\left(= 8.64 \times 10^4 s \right)$, calculate the difference in acceleration due to gravity at the poles and the equator.

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25. On a planet whose size is the same and mass is 3 times as that of the earth, calculate the energy required to raise a 5kg mass vertically upwars through a distance of 5m.

Take g on earth $= 10 m / s^2$

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26. Find the velocity of escape at the moon. Given that its radius is 1.7×10^6 m and the value of 'g' is $1.63 ms^{-2}$.

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27. The escape velocity on the surface of earth is 11.2 km/s. If earth has mass 9 times the mass of Mars and radius equal to twice the radius of Mars, calculate the minimum velocity required by a projectile to escape the gravitational field of Mars.

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28. Scientists suspect the presence of black hole (a body whose gravitational force is so strong that nothing can escape from its surface (not even light)) in our universe. Find the condition for a uniform spherical body to be a black hole.

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29. The percentage by which the moon should move faster, so that it escapes from the gravitational field of the earth is:

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30. A particle is located 1,800 km above the surface of earth. Calculate the escape velocity of the particle. Take Radius of earth = 6,400 km

$g = 9.8m / s^2$

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31. An artificial satellite circles around the earth at a height of 2,200 km. Calculate its orbital velocity and period of revolution. Take,

Radius of earth $= 6.37 \times 10^3 km$

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

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

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32. A satellite revolves around a planet of mean density $4.38 \times 10^3 kg/m^3$, in an orbit close to its surface. Calculate the time period of the satellite.

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

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33. An artificial satellite completes a circle around earth in 120 minutes. Calculate the height of the satellite above the earth's surface.

Take, radius of earth = 6,400 km

$g = 9.8m/s^2$

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34. In a sub - stage lunch of a satellite, the first stage brings the satellite to a height of 150 km and the second stage gives it the necessary critical speed to put . It in a circular orbit around the Earth , which stage requires more expenditure of fuel ?

(Given ,

$M_E = 6.0 \times 10^{24}kg, R = 6.4 \times 10^6 m, G - 6.67 \times 10^{-11} Nm^2 kg^{-2}).$

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35. A projectile is launched vertically from earth's surface with an inittial velocity of 10 km/s. Calculate the height it will reach above the earth's surface. Take,

Radius of earth = 6,400 km

$g = 9.8m/s^2$

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36. A $400kg$ satellite is in a circular orbit of radius $2R_E$ around the Earth. How much energy is required to transfer it to a circular orbit of radius $4R_E$? What are the changes in the kinetic and potential energies?

Given $g = 9.81m^{-2}$, $R_E = 6.37 \times 10^6 m$.

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37. A satellite orbits the earth at a height of 400 km, above the surface. How much energy must be expended to rocket the satellite out of the earth's gravitational influence ? Mass of the satellite=200

kg, mass of the earth=6.0×10^{24}kg, radius of the earth=$6.4 \times 10(6)$ m, G=$6.67 \times 10^{-11} Nm^2 Kg^{-2}$.

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38. Calculate the gravitational field intensity when a force of 50 N acts on a body of mass 2 kg in the field.

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39. At which point on the line joining the two bodies of masses 8 kg and 20 kg, placed 1 m apart, is the gravitational field intensity zero ?

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40. Two masses 600 kg and 800 kg are separated by a distance of 0.2 m. What will be te magnitude of the intensity of the

gravitational field at a point distant 0.16m from the 600 kg mass and 0.12 from the 800 kg mass.

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41. The gravitational potential at some point above the surface of the earth is $-4.32 \times 10^7 J/kg$ and acceleration due to gravity at that point is $5.4 m/s^2$. If the mean radius of earth is $6.37 \times 10^6 m$, then find the height of this point from the earth's surface.

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42. If the radius of earth is R, density is ρ and the acceleration due to gravity is g, then calculate the work done in raising an object of mass m through a height h from the earth's surface.

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43. Three mass points each of mass m are placed at the vertices of an equilateral tringale of side l. What is the gravitational field and potential due to three masses at the centroid of the triangle ?

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44. Four particles each of mass m are placed at the vertices of a square of side l. the potential at the centre of square is

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Practice Problems

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

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2. A satellite with a time period of 24 hours is orbiting around the earth at a height of 4R above the earth's surface. Calculate the time period of another satellite at a height of 2R from the surface of earth. Here R is radius of earth.

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3. A body of mass 2- kg attracts another body of mass 30 kg lying at a distance of x cm. Calculate the value of x if the force between their centres is one-fifth of a milligram weight.

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4. Two particles of mass 0.5 kg each go round a circle of radius 20 cm on accound of their mutual gravitational attraction. What will be the speed of each particle ?

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5. How far from earth must a body be along a line towards the sun so that the sun's gravitational pull on it balances that of the earth . Distance between sun and earth's centre is 1.5×10^{10} km . Mass of the sun is 3.24×10^{5} times mass of the earth .

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6. Calculate the percentage change in acceleration due to gravity if the radius of earth shrinks by 3% keeping mass unchanged.

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7. Keeping mass unchanged if radius of the earth increases by a factor 4, then by which factor density must have to be changed so that the value of g remains same ?

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8. A boy can jump 1m high on the earth's surface. What is the height he will be able to jump on a planet whose density is half of earth's density and radius is one-fourth's radius ?

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9. A man weighs 54 kg on the surface of earth. How much will he weigh on the surface of a planet whose mass is one-fifth and radius is half of that of earth ?

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10. At what height from Earth's surface the acceleration due to gravity becomes 20% of its value on the surface of earth. [Radius of earth = 6,400 km.]

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11. At what height from the surface of earth, the acceleration due to gravity decreases by 2% ? [Radius of earth = 6,400 km.]

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12. Find the weight of a body at a height of 100 km above the surface of earth. The radius of earth is 6,400 km and the body weighs 90 N on earth's surface.

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13. Calculate the percentage change in weight of a body if taken to a height of 10 km above the surface of earth. The radius of earth is 6,400 km.

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14. A body weighs 90 N on the surface of earth. Calculate the gravitational force on the body at a height equal to one-third of the radius of earth.

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15. How much below the Earth's surface the value of g reduces to 30% of its value at the surface of earth? Radius of earth = 6,400 km.

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16. At what depth below the surface of earth the acceleration due to gravity becomes one-third of its value at the surface of earth ?

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17. Calculate the percentage decrease in weight of a body when taken to a tunnel 35 km below the surface of earth.

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18. Calculate the ratio of weights of a body when it is taken to 80 km above the surface of earth and when taken to 80 km below the surface of earth.

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19. Calculate the change in weight of a body of mass 5 kg when it is taken from equator to pole of earth. The time period of rotation of earth around its own axis is 24 hours.

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20. At which angular speed the earth should rotates so that the apparent weight of an object at equator will become zero ?

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21. What will be acceleration due to gravity at the earth's surface of latitude 30° ?

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22. The escape velocity of a body from the earth is $11.2 km / s$. If a body is projected with a velocity twice its escape velocity, then the velocity of the body at infinity is (in km / s)

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23. A planet has a mass 120 times that of earth and radius is 5 times the radius of earth. What is the escape velocity at this planet if the escape velocity at earth's surface is $11.2 kms^{-1}$.

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24. A body is projected vertically upwards from the earth's surface. The body reaches a height equal to one half of radius of earth. Calculate the initial speed with which the body was projected initially.

Radius of earth = 6,400 km

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

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25. Calculate the orbital velocity and time period of revolution of a satellite orbiting around the earth at a distance of 3,000 km.

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26. The International Space Stations (ISS), a habitable artificial satellite, is orbiting around earth at an altitude of 400 km. Calculate the additional velocity required to be given to escape the ISS from gravitational pull of earth.

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27. A spaceship of mass 70 kg is revolving in a circular orbit at a height of 1000 km from the surface of earth. What will be acceleration due to gravity at any point along the path of spaceship ?

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28. Two bodies of masses 5 kg and 10 kg are lying at a distance of 0.5 m. What will be the magnitude of gravitational potential and gravitational field intensity at the middle point of the line joining two bodies ?

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29. Find the distance of a point from the earth's centre where the resultant gravitational field due to the earth and the moon is zero

The mass of the earth is $6.0 \times 10^{24} kg$ and that of the moon is $7.4 \times 10^{22} kg$ The distance between the earth and the moon is $4.0 \times 10^{5} km$.

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30. Calculate the work done in bringing four particles each of mass 10 g at the vertices of a square having side 10 cm, assuming that the particles are brought from infinitely large distance to the respective locations.

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31. Calculate the work required to raise a body of mass m to a height h just above the earth's surface. Radius of the earth is R and acceleration due to gravity at the earth's surface is g.

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Conceptual Questions

1. The force of attraction between two bodies kept in air at a certain distance apart is F. If they ae now kept in water at the same distace apart, what will be the force of attraction between them?

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2. The density of a planet is doubled without changing its radius. How wil it effect the acceleration due to gravity in the planet?

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

object?

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4. The gravitational force of earth acts in the space also till some certain distance from its surface. Then why does an astronaut in an international space station feel weightlessness and floats inside the station ?

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5. If the gravitational forces on the moon are suddenly removed, what will be the path followed by it?

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6. How will your weight be affected at the current location if earth is a hollow sphere instead of a solid sphere of same mass and radius?

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7. A body experiences weighlessness when falling under free fall but it is not the same when the body is falling with the terminal velocity. Explain.

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8. If the atmospheric gases were extremely soluble in water such that the entire atmosphere of the earth is completely absorbed by the waterbodies, resulting in zero atmosphere pressure, then how will it affect the gravitational field of earth?

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9. A satellite is orbiting close to the earth such that it is travelling through a very thin air, not vaccum. Will the resulting air friction slow down the satellite?

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10. Is 'Weight of earth' a meaningful term?

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11. Based on scientific calculations using Newton's law of gravitational force , it is found that the gravitational pull of the Sun on the Moon is twice the gravitational pull of Earth on the Moon. Then why can't the moon escape the Earth?

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12. A small piece of spaceship's body, revolving around the earth, gets broken . Will it eventually fall on the earth?

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13. One physics expert has said that 'We cannot move our fingers without disturbing all stars'. Explain the logic behind this statement.

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14. Two similar objects , initially at rest, were dropped from a same height. If one of the objects is at poles and another is at equator, which will reach the ground quicker?

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

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16. An astronaut on moon claimed that he can jump 6 times higher on moon than that one the earth. How accurate is his claim? Give reason in support of your answer.

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17. No fuel is required by a satellite to circle around the earth. Why?

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

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19. It is observed that when a satellite jumps to a lower orbit in the earth's atmosphere, it becomes hot, which indicates some dissipation of energy. But the orbital speed of the satellite increases as it approaches the earth. Why?

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Tough Tricky Problems

1. Two stars of masses M and 4M have radii x and 3x respectively. The distance between centres of two stars is 12x. A body of mass m

is fired from the surface of bigger sphere towards smaller sphere. Find the minimum initial speed (in terms of G, x, M) required to reach the surface of smaller star.

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2. Three particles x, y, z are placed in a line as shown in the figure. A fourth particle at O is also placed at a perpendicular bisector of line xz. Calculate the total gravitational force at O. All the particle are of some mass.

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3. Two particles P and Q of masses 2 kg and 4 kg initially at a distance of 2m from each other are released. If the particles move under mutual attraction, then find speed of particles P when speed

of Q is 5 cm/hour. Also find the separation between these particles at this instant.

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

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5. Calculate the gravitational field and gravitational potential at the centroid of a triangle when three equal masses one placed at each of its corners.

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6. Two bodies of masses m_1 and m_2 are initially at infinite distance at rest. Let they start moving towards each other due to gravitational attraction. Calculate the (i) ratio of accelerations and (ii) speeds at the point where separation between them becomes r.

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7. Time period of a simple pendulum in a lab at north pole is 3s. If this pendulum is shifted to equator, then what will be new time period at the equator due to rotation of earth ? (Radius of earth = 6,400 km)

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8. S_1 and S_2 are two satellites revolving around a planet P in coplanar circular orbits in anticlockwise direction. Their period of

revolution are 50 minutes and 400 minutes respectively. The radius of orbit of S_2 is $5 \times 10^4 km$.

(a) Find the radius of orbit of S_1

(b) When S_2 is closest to S_1, then find (i) speed of S_1 relative to S_2 and (ii) angular speed of S_1 as observed by astronaut in S_2.

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9. The gravitational field in a certain region is given as

$\vec{E} = \left(3Nkg^{-1}\right)\hat{i} + \left(5Nkg^{-1}\right)\hat{j}$

(a) What will be magnitude of gravitational force acting on a particle of mass 3 g which is placed at the origin ?

(b) What will be gravitational potential at point (12m, 0) and (0, 6m) considering that potential at origin is zero ?

(c) A particle of mass 3 kg is moved from the origin to the point (9m, 4m). Calculate the change of gravitational potential energy.

(d) If the above particle is moved from (5m, 0) to (0, 5m), then find the change in potential energy.

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10. Satellite of mass 200 kg is revolving in a circular orbit of radius $4R_E$ around the earth. Calculate orbit of radius $8R_E$. Also find the changes in kinetic and potential energies $g = 9.8m/s^2$, $R_E = 6,400km$ (radius of earth)

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Ncert File Textbook Exercises

1. Answer the following: (a) You can shield a charge from electrical forces by putting it inside a hollow conductor. Can you shield a body from the gravitational influence of nearby matter by putting it

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

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

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3. Answer the following :

If you compare the graviational force on the Earth due to the sun to that due to the moon you would find that the Sun's pull is greater than the Moon's pull. However, the tidal effect to the Moon's pull is greater than the tidal effect of the Sun. Why ?

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4. Choose the correct alternative

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

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

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

(d) The formula $-GMm\left(\frac{1}{r_2}-\frac{1}{r_1}\right)$ is more/less accurate than the formula $mg(r_2-r_1)$ for the difference of potential energy

between two points r_2 and r_1 distance away from the centre of earth.

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

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

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7. Let us consider that our galaxy consists of 2.5×10^{11} stars each of one solar mass. How long will this star at a distance of $50,000$ light year from the galastic entre take to complete one revolution? Take the diameter of the Milky way to be $10^5 ly$. $G = 6.67 \times 10^{-11} Nm^2 Kg^{-2}$. $(1ly = 9.46 \times 10^{15} m)$

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8. Choose the correct alternative :

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

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

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9. Does the escape speed of a body from the earth depend on (a) the mass of the body. (b) the location from where it is projected. (c) the direction of projection, (d) the height of the location from where the body is launched?

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

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

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12. The gravitational intensity at the centre of the drum head defined by a hemisphere shells has the direction indicated by the arrow in the given figure (i) a, (ii) b, (iii) c , (iv) 0.

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

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14. A rocket is fired from the earth towards the sun. At what distance from the earth's centre is the gravitational force on the rocket zero? Mass of the sun $= 2 \times 10^{30} kg$, mass of the earth $= 6 \times 10^{24} kg$. Neglect the effect of other planets etc. (orbital radius=$1.5 \times 10^{11} m$).

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15. The mean orbital radius of the Earth around the Sun is $1.5 \times 10^{8} km$. Estimate the mass of the Sun.

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

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

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18. Assuming the earth to be a sphere of uniform mass density, how much would a body weigh half way down to the centre of the earth if it weighd 250 N on the surface ?

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

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20. The escape speed of a projectile on the earth's surface is 11.2 km s^{-1}. A body is projected out with thrice this speed. What is the speed of the body far away from the earth? Ignore the presence of the sun and other planets.

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21. A satellite orbits the earth at a height of 400 km, above the surface. How much energy must be expended to rocket the satellite

out of the earth's gravitational influence ? Mass of the satellite=200 kg, mass of the earth=6.0×10^{24}kg, radius of the earth=$6.4 \times 10(6)$ m, G=$6.67 \times 10^{-11} Nm^2 Kg^{-2}$.

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

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23. Two heavy sphere each of mass $100kg$ and radius $0.10m$ are placed $1.0m$ apart on a horizontal table. What is the gravitational

field and potential at the mid point of the line joining the centres of the sphere? Is an object placed at that point in equilibrium? If so, is the equilbrium stable or unstable.

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Ncert File Additional Exercises

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

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

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

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4. A rocket is fired vertically from the surface of Mars with a speed of $2kms^{-1}$. If $20\,\%$ of its initial energy is lost due to Martian atmospheric resistance, how far will the rocket go from the surface of Mars before returning to it? Mass of Mars $= 6.4 \times 10^{23}kg$, radius of Mars $= 3395km$,

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Ncert File Exemplar Problems Objective Questions Multiple Choice Questions

1. The earth is an approximate sphere. If the interior contained matter which is not of the same density every where, then on the surface of the earth, the acceleration due to gravity

A. will be directed towards the centre but not the same everywhere.

B. will have the same value everywhere but not directed towards the centre.

C. will be same everywhere in magnitude directed towards the centre.

D. cannot be zero at any point.

Answer: D

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2. As observed from the earth, the sun appears to move an approx. circular orbit. For the motion of another planet like mercury as observed from the earth, this would

A. be similarly true.

B. not be true because the force between earth and mercury is not inverse square law.

C. not be true because the major gravitational force on mercury is due to sun.

D. not be true because mercury is influenced by forces other than gravitational forces.

Answer: C

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

the CM causing rotation around an axis through the CM. for the earth-sun system (approximating the earth as a uniform density sphere).

A. the torque is zero

B. the torque causes the earth to spin

C. the rigid body result is not applicable since the earth is not even approximately a rigid body.

D. the torque causes the earth to move around the sun.

Answer: A

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4. Satellites orbiting the earth have finite life and sometimes debris of satellites fall to the earth. This is because,

A. the solar cells and batteries in satellites run out.

B. the laws of gravitation predict a trajectory spiralling inwards.

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

D. of collisions with other satellites.

Answer: C

Watch Video Solution

5. Both earth and moon are subjected to the gravitational force of the sun. as observed from the sun, the orbit of the moon

A. will be elliptical

B. will not be strictly elliptical because the total gravitational force on it is not central.

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

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

Answer: B

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6. In our solar system, the inter-planetery region has chunks of matter (much smaller in size compared to planets) called asteriods. They

A. will not move around the sun since they have very small masses compared to sun.

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

C. will move around the sun in closed orbits but not okey Kepler's law.

D. will move in orbits like planets and okey Kepler's laws.

Answer: D

Watch Video Solution

7. Choose the wrong option

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

B. That the gravitational mass and inertial mass are equal in an experimental result.

C. That the acceleration due to gravity on earth is the same for all bodies is due to the equality of gravitational mass and inertial mass.

D. gravitational mass of a particle like proton can depend on the presence of neighbouring heavy objects but the inertial mass cannot.

Answer: D

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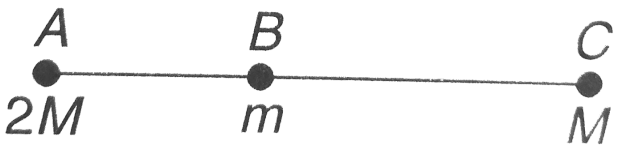
8. particles of masses 2M m and M are resectively at points A , B and C with $AB = \frac{1}{2}(BC)$ m is much - much smaller than M and at time $t = 0$ they are all at rest as given in figure . As subsequent times

before any collision takes palce .



A. m will remain at rest

B. m will move towards M.

C. m will move towards 2M.

D. m will have oscillatory motion

Answer: C

Watch Video Solution

9. Which of the following option are correct ?

A. Acceleration due to gravity decreases with increasing altitude.

B. Acceleration due to gravity increases with increasing depth (assume the earth to be a sphere of uniform density).

C. Acceleration due to gravity increases with increasing latitude.

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

Answer: A::C

Watch Video Solution

10. If the law of gravitational, instead of being inverse-square law, becomes an inverse-cube law

A. planets will not have elliptic orbits.

B. circular orbits of planets are not possible.

C. projectile motion of a stone thrown by hand on the surface of the earth will be approximately parabolic.

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

Answer: A::C

Watch Video Solution

11. If the mass of sun were len times smaller and gravitational consitant G were ten times larger in magnitudes

A. walking on ground would become more difficult.

B. the acceleration due to gravity on earth will not change.

C. Raindrops will fall much faster

D. airplanes will have to travel much faster.

Answer: A::C::D

Watch Video Solution

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

A. all three of Kepler's laws would still be valid

B. only the third law will be valid

C. the second law will not change

D. the first law still be valid

Answer: C::D

Watch Video Solution

13. There have been suggestions that the value of the gravitational constant G becomes smaller when considered over very large time period (in billions of years) in the future. If the happens for our earth.

A. nothing will change

B. we will become hotter after billions of years

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

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

Answer: C::D

Watch Video Solution

14. Supposing Newton's law of gravitation for gravitation force F_1 and F_2 between two masses m_1 and m_2 at positions r_1 and r_2 read

$F_2 = -F_2 = \frac{r_{12}}{r_{12}^3} GM_0^2 \left(\frac{m_1 m_2}{M_0^2} \right)^n$ where M_0 is a constant dimension of mass, $r_{12} = r_1 - r_2$ and n is number. In such a case.

A. the acceleration due to gravity on earth will be different for different objects

B. none of the three laws of Kepler will be valid

C. only the third law will become invalid

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

Answer: A::C::D

Watch Video Solution

15. Which of the following are true ?

A. A polar satellite goes around the earth's pole in north-south direction

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

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

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

Answer: A::C

Watch Video Solution

16. The centre of mass of an extended body on the surface of the earth and its centre of gravity

A. are always at the same point for any size of the body

B. are always at the same point only for spherical bodies.

C. can never be at the same point

D. both can change if the object is taken deep inside the earth

Answer: D

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

Watch Video Solution

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

Watch Video Solution

19. Draw areal velocity time graph for Mars.

Watch Video Solution

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

Watch Video Solution

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

Watch Video Solution

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

Watch Video Solution

23. We can shield a charge from electric fields by putting it inside a hollow conductor. Can we shield a body from the gravitational influence of nearby matter by putting it inside a hollw sphere or by some other means ?

Watch Video Solution

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

Watch Video Solution

25. The gravitational force between a hollow spherical shell (of radius R and uniform density) and a point mass is F. Show the

nature of F versus r graph where r is the distance of the point from the centre of the hollow spherical shell of uniform density

Watch Video Solution

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

Watch Video Solution

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

Watch Video Solution

28. Mean solar day is the time interval between two successive noon when sun passes through zenith point (meridian).

Sidereal day is the time interval between two successive transit of a distant star through the zenith point (meridian).

By drawing appropriate diagram showing the earth's spin and orbital motion, show that mean solar day is 4 min longer than the sidereal day. In other words, distant stars would rise 4 min early every successive day.

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29. Two identical heavy spheres are separated by a distance 10 times their radius. Will an object placed at the mid-point of the line joining their centres be in stable equilibrium or unstable equilibrium ? Give reason for your answer.

Watch Video Solution

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

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

Watch Video Solution

31. Shown are several curves. Explain with reason, which ones amongst them can be possible trajectories traced by a projectile (neglect air friction).

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32. An object of mass m is raised from the surface of the earth to a height equal to the radius of the earth, that is, taken from a

distance R to 2R from the centre of the earth. What is the gain in its potential energy ?

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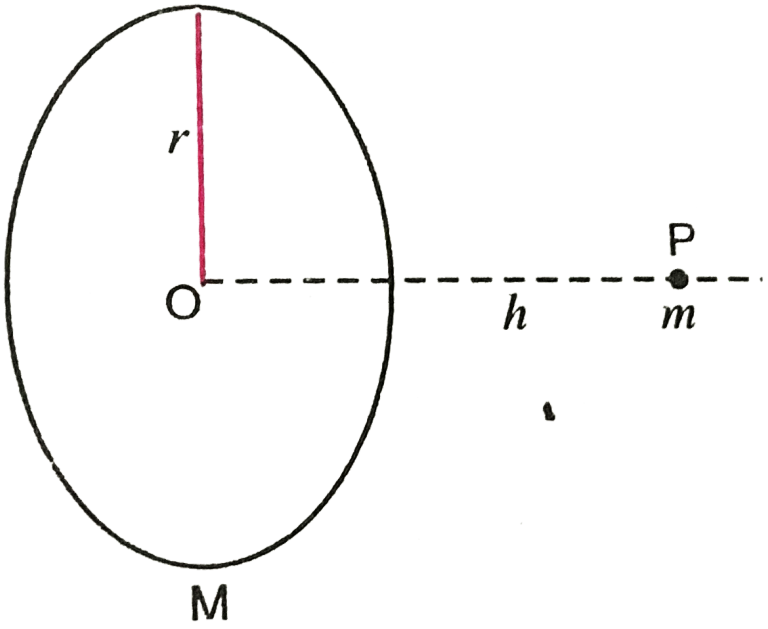
33. A mass m is placed at P a distance h along the normal through the centre O of a thin circular ring of mass M and radius r Fig.

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



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Higher Order Thinking Skills Advanced Level

1. A uniform solid sphere of mass M and radius R exerts a gravitational force F_g on a particle of mass m placed at a point P at a distance of 4 R from centre of sphere. Suppose a spherical cavity of radius $\frac{R}{2}$ is cut into the sphere.

The sphere with cavity exerts a force F_c on the same particle, placed at P. Find the ratio F_g / F_c. Also find the force of attraction due to remaining part of bigger mass. Let force due to remaining part is F'.

View Text Solution

2. A body of mass m is from surface of the earth projected vertically upwards with a velocity such that it rises to a height of 20 m. If the same body is projected with same velocity from a planet density is $\frac{1}{4}$ th of density of earth and radius is $\frac{1}{2}$ of that of Earth, then find the height to which the body will rise on the planet.

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3. A satellite S_1 is revolving in a circular orbit of radius R around the earth. Another satellite S_2 is revolving in an orbit of radius 2.02 R. By which percentage the period of satellite S_2 will be longer than S_1 ?

Watch Video Solution

4. After drilling a tunnel from surface of earth to the centre, a body of mass m is dropped into the tunnel. Calculate the speed with which the body strikes the bottom of tunnel. Here, M is the mass of earth and R is radius of earth.

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5. A pendulum clock and a wrist watch are taken from the earth's surface to a mountain. What will be the effect on their time periods at the mountain ?

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6. In satellite launching, what will be the path of the satellite if the total energy of the projected satellite is positive?

Watch Video Solution

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

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8. A person on the moon experiences gravitational force but same person experiences weightlessness in an artificial satellite of earth. Explain.

Watch Video Solution

9. A simple pendulum is suspended from the roof of a vehicle which on an inclined plane of inclination θ. The period of the pendulum when the vehicle is at rest is T. What will be the time period of oscillation of a pendulum ?

Watch Video Solution

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

Watch Video Solution

11. Suppose a light planet is revolving around a heavy star in a circular orbit of radius r and period of revolution T. The gravitational force of attraction between the star and the planet is proportional to $\frac{1}{r^{3/2}}$. Derive the relation between T and r.

Watch Video Solution

12. The time period of a simple pendulum is T_1 on the surface of earth. If taken to a height 2 R above the surface of earth, the time

period becomes T_2. What will be the value of T_1/T_2 ? (R is the radius of earth).

Watch Video Solution

13. What will be the effect on the acceleration due to gravity at poles and at equator

(a) If earth stops rotating ?

(b) If rate of rotation of earth increases ?

Watch Video Solution

14. For ordinary heights, the path of a projectile is parabolic but for great heights the path is elliptical. Explain.

Watch Video Solution

15. From the surface of earth, a body is projected upwards with a kinetic energy equal to one-third of the energy required to escape. Calculate the height up to which the body will rise above the surface of earth.

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Revision Exercises Very Short Answer Questions

1. Why G is known as universal gravitational constant?

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

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3. Spheres of the same material and same radius r are touching each other. Show that gravitational force between them is directly proportional to r^4.

Watch Video Solution

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

Watch Video Solution

5. If a body of mass m is taken to the surface of moon, how will the inertial mass, gravitational mass and weight of the body be affected?

Watch Video Solution

6. The weight of a body at the centre of the earth is

Watch Video Solution

7. What is the gravitational force between two bodies at an infinite distance from each other?

Watch Video Solution

8. What is the direction of force of gravity on a body?

Watch Video Solution

9. What is the value of the acceleration due to gravity at a height equal to radius of earth?

Watch Video Solution

10. If the diameter and mass of the earth becomes twice of its original value , then how will the acceleration due to gravity will change?

Watch Video Solution

11. Where is 'g' greater, at poles or at equator ?

Watch Video Solution

12. How the value of g changes as one moves from equator to pole?

Watch Video Solution

13. How the value of g changes with increase in latitude of a place?

Watch Video Solution

14. What is the unit and dimensional formula of gravitaional intensity?

Watch Video Solution

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

Watch Video Solution

16. Define orbital speed of a satellite.

Watch Video Solution

17. What is the direction of the orbital speed of a orbiting satellite?

Watch Video Solution

18. What is the direction and orbital speed of a geostationary satellite?

Watch Video Solution

19. Time period of revolution of polar satellite is around

Watch Video Solution

20. What is the escape speed of the Sun ?

Watch Video Solution

21. Give two examples of geostationary satellites.

Watch Video Solution

22. Why is gravitational potential energy negative?

Watch Video Solution

23. Keeping mass constant, if the diameter of the earth becomes twice, then how will the weight be affected?

Watch Video Solution

24. What is the shape of earth at poles?

Watch Video Solution

25. The time period of a simple pendulum at the centre of the earth is

Watch Video Solution

26. If the earth is rotating fast, how will the value of g change at poles?

Watch Video Solution

27. Where will a body weigh more: at the centre of earth or at the surface of earth?

Watch Video Solution

28. Does the escape velocity of a body depend on the density of a planet?

Watch Video Solution

29. What do you mean by weightlessness?

Watch Video Solution

30. The escape velocity for a body of mass 10 kg on a planet P is $11.2km/s$. What will be escape velocity at the same planet for a body of mass 20 kg ?

Watch Video Solution

Revision Exercises Additional Questions

1. Gravitational forces are

A. Weak forces

B. Central forces

C. Conservative in nature

D. All of above

Answer:

Watch Video Solution

2. If the gravitational potential energy of a body at a distance r from the centre of the earth is U, then it's weight at that point is

A. zero

B. U/r

C. U/r^2

D. Ur

Answer:

Watch Video Solution

3. Two satellites having their masses in the ratio of 4:9 are revolving in orbits of radius R. The ratio of their time periods will be

A. $2:3$

B. $1:1$

C. $4:4$

D. $3:3$

Answer:

Watch Video Solution

4. Polar satellites

A. used for communication purposes

B. are sun synchronous

C. have altitude of 1500-2000 km from the surface of earth.

D. have time period of 24 hours

Answer:

Watch Video Solution

5. If earth stops rotating

A. g will increase at the poles by a value $0.34m/s^2$

B. g will increase at the equator by a value $0.034m/s^2$

C. g will decrease at the equator by a value $0.34m/s^2$

D. g will decrease at the poles by a value $0.34m/s^2$

Answer:

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Revision Exercises Fill In The Blanks

1. Tides are formed due to gravitational force of

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2. The acceleration due to gravity is ..... at the surface of earth and ..... is at the centre of earth.

Watch Video Solution

3. The power of M in the dimensional formula for gravitational potential is .....

Watch Video Solution

4. ..... is the minimum velocity with which a body must be projected vertically upwards in order to escape earth's gravitational field.

Watch Video Solution

5. Orbital velocity of a satellite depends on the .....the planet around which the satellite revolves.

Watch Video Solution

6. The areal velocity of the planets revolving around the sun is ..... .

Watch Video Solution

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

Watch Video Solution

8. A body is said to be in state of.....when its apparent weight is zero.

Watch Video Solution

Revision Exercises Short Answer Type Question

1. State and explain Newton's law of gravitation. Also mention the dimensional formula and units of G.

Watch Video Solution

2. Derive an expression for the variation of g with the height from the surface of Earth.

Watch Video Solution

3. At what depth from the surface of the earth, the acceleration due to gravity will be half the value of g on the surface of the earth ?

Watch Video Solution

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

Watch Video Solution

5. What would happen if gravity suddenly disappears?

Watch Video Solution

6. Does earth imparts equal acceleration to all bodies ? If yes why ?

Watch Video Solution

7. Why the moon has no atmosphere ?

Watch Video Solution

8. What do you mean by intensity of gravitational field and gravitational potential ? What are their units and dimensional formulas ?

Watch Video Solution

9. Derive an expression for the electric field intensity at a point outside a charged conducting sphere.

Watch Video Solution

10. What is meant by gravitational potential energy of a body ? Derive an expression for the gravitational potential energy for a body of mass m lying at a distance r from the centre of Earth.

Watch Video Solution

11. PRINCIPLE OF LAUNCHING A SATELLITE

Watch Video Solution

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

Watch Video Solution

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

Watch Video Solution

14. Define escape velocity of an object.

Watch Video Solution

15. Show that the escape velocity of an object from the speeds of two planets of masses 2M and 3M and radii 2R and R respectively.

View Text Solution

16. What are geostationary satellites? What are the necessary conditions for a satellite to appear stationary ?

Watch Video Solution

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

Watch Video Solution

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

Watch Video Solution

19. For a satellite orbiting very close to earth's surface, total energy is

Watch Video Solution

20. What is weightlessness ? What are the problems of weightlessness faced by an astronaut ?

Watch Video Solution

Revision Exercises Long Answer Questions

1. What is meant by acceleration sue to gravity ? Discuss the varitation of g with (i) height, (ii) depth and (iii) rotation of earth.

Watch Video Solution

2. State Kepler's laws of planetary motion.

Watch Video Solution

3. A geostationary satellite

Watch Video Solution

4. (a) Distinguish between inertial and gravitational mass.

(b) Which is more fundamental -mass or weight- and why ?

(c) Why moon travellers load heavy weights at their back before landing on the moon ?

View Text Solution

Revision Exercises Numerical Problems

1. A body of mass 30 kg attracts another body of mass 20 kg with force F. Find the value of F if distance between the centres of two bodies is 30 cm.

Watch Video Solution

2. Calculate the speed of Jupiter if the mass of Jupiter is $1.9 \times 10^{27} kg$. Distance from the sun is $7.8 \times 10^{11} m$ and the mass of the sun is $2 \times 10^{30} kg$.

Watch Video Solution

3. How will the acceleration due to gravity change if the radius of earth shrinks by 5% keeping mass unchanged ?

Watch Video Solution

4. The mass of a body is 60 kg on the surface of earth. How much will it weigh on a planet whose mass is 3 times and radius is 2 times that of earth ?

Watch Video Solution

5. At what height above the surface of earth, the acceleration due o to gravity of earth ? Radius by 51% of its value on the surface of earth ? Redius of earth = 6,400 km.

View Text Solution

6. How much below the earth's surface the acceleration due to gravity reduces to 64% of its value on the surface of earth ?

View Text Solution

7. What will be percentage decrease in weight of body when taken to the depth of 64 km below the surface of earth ?

View Text Solution

8. Calculate the change in weight of a 20 kg body, when it is taken from equator to pole of earth.

View Text Solution

9. At what height from the surface of earth the value of g is same as at a depth of $\frac{R}{4}$?

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10. What will be acceleration due to gravity on a planet whose mass is 4 times and radius is 2 times that of earth ?

Watch Video Solution

11. Moon takes nearly 27 days to revolve around earth. If the mass od moon is two-third of its present mass, then what will be the period of revolution of moon around earth. Assume that values of all other things remain unchanged.

Watch Video Solution

12. A planet of mass m is revolving around the sun in an elliptical orbit. The minimum and maximum distances of the planet from the sun are s_1 and s_2. Derive the relation between time period of the planet in terms of s_1 and s_2.

View Text Solution

13. Two planets A and B are at distances of 10^9 m and $10^{11}m$ from the sun respectively. Calculate the ration of speeds of the two planets.

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14. What will be gravitational intensity (I) and gravitational potential (V) at a height equal to 5 times the radius of earth ?

Watch Video Solution

15. A satellite is revolving around the earth in a circular orbit of radius r with speed v. What will be the effect on speed f satellite if radius is decreased by 5% ?

Watch Video Solution

16. What is the maximum height attained by a body projected with a velocity equal to one- third of the escape velocity from the surface of the earth? (Radius of the earth=R)

Watch Video Solution

17. Two satellites S_1 and S_2 are revolving around a planet P in circular orbits of radii 4R and 9R respectively. If the speed of satellite S_1 is 2V, then calculate the speed of satellite S_2.

View Text Solution

18. The mass of Saturn is 95 times that of earth and radius is 9.5 times the radius of earth. What will be escape velocity on the surface of saturn if the escape velocity on earth's surface is $11.2 kms^{-1}$?

Watch Video Solution

19. Three mass points each of mass m are placed at the vertices of an equilateral tringale of side l. What is the gravitational field and potential due to three masses at the centroid of the triangle ?

Watch Video Solution

A Competition File Objective Type Questions Multiple Choice Questions With One Correct Answer

1. Find the duration of the day if the rotation of earth about its axis speeds up in such a way that a person on the equator feels weightlessness.

A. $2\pi\sqrt{\frac{R^2}{g^3}}$

B. $\frac{1}{2\pi}\sqrt{\frac{R}{g}}$

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

D. $\frac{1}{2\pi}\sqrt{\frac{R}{g^3}}$

Answer: C

Watch Video Solution

2. At satellite of mass m is launched from the surface of a planet of mass M and radius R in a circular orbit at an altitude of 3R. K.E. of satellite at the time of launching is

A. $\frac{7}{8}\frac{GMm}{R}$

B. $\frac{8}{7}\frac{GMm}{R}$

C. $\frac{6}{7}\frac{GMm}{R}$

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

Answer: A

Watch Video Solution

3. Two satellites are at distances of 2R and 4R respectively from the surface of earth. The ratio of their time periods will be :

A. $\sqrt{\frac{125}{27}}$

B. $\sqrt{\frac{27}{125}}$

C. $\sqrt{\frac{54}{125}}$

D. $\sqrt{\frac{8}{125}}$

Answer: B

Watch Video Solution

4. The acceleration due to gravity at the surface of earth (g_e) and acceleration due to gravity at the surface of a planet (g_p) are equal. The density of the planet is three times than that of earth. The ratio of radius of earth to the radius of planet will be.

A. $1:3$

B. $1:9$

C. $3:1$

D. $9:1$

Answer: C

Watch Video Solution

5. The bodies of mass m and 4m are placed at a distance of 6m apart. P is the point on the line joining two bodies where gravitational field is zero. The gravitational potential at this point is

A. $-\frac{3}{2}Gm$

B. $-\frac{5}{2}Gm$

C. $-\frac{9}{2}Gm$

D. $-\frac{7}{2}Gm$

Answer: A

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6. A mass of 5 kg is brought from infinity (mass at rest) to a point A. When the mass reaches at point A it is moving with speed of

$5ms^{-1}$. If -6 J of work is done by a person to displace the mass, then potential at point A is

A. 11.7 V

B. $-13.7V$

C. $-23.7V$

D. 29.7 V

Answer: B

Watch Video Solution

Competition File Objective Type Questions Multiple Choice Questions With One Correct Answer

1. Due to certain mass distribution, the gravitational field along X-axis is given as $I = \frac{K}{r^4}$ (where K is a constant). Considering the

value of gravitational potential to be zero at infinity, its value at a distance x will be

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

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

C. $\frac{K}{2}x^3$

D. $\frac{K}{3x^3}$

Answer: D

Watch Video Solution

2. Two satellites P and Q have their radii ratio as 4 : 1. The speed of satellite P is 2V. The speed of satellite Q will be

A. 4V

B. 3V

C. 2V

D. 5V

Answer: A

Watch Video Solution

3. The average density and time period of a planet are ρ and T. A satellite is revolving just above the surface of planet. If the universal gravitational constant is G, then T^2 is equal to

A. $\frac{3\pi}{G\rho}$

B. $\frac{4\pi G}{\rho^2}$

C. $\frac{4\pi^2 G}{\pi\rho}$

D. $\frac{1}{\rho G\pi}$

Answer: A

View Text Solution

4. In a hypothetical situation, the density of earth becomes three times that of its original density, but its radius remains same. The acceleration due to gravity becomes : (take $g = 10m/s^2$ on the earth)

A. $20m/s^2$

B. $40m/s^2$

C. $30m/s^2$

D. $10m/s^2$

Answer: C

View Text Solution

5. The total energy of a satellite having mass m orbiting around the earth has mass M in a circular orbit with velocity v is

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

B. $-\frac{1}{2}mv^2$

C. mv^2

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

Answer: B

View Text Solution

6. On the surface of earth, the escape velocity of a body is $11.2km/s$. If mass of earth is made half and radius becomes twice, then the escape velocity will become

A. 5.6 km/s

B. 22.4 km/s

C. 33.4 km/s

D. 11.2 km/s

Answer: A

View Text Solution

7. Two bodies of masses 50 kg and 200 kg are placed at a distance of 1m. The distance from the larger body at which the intensity of gravitational field will be zero is

A. $\frac{1}{3}m$

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

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

D. $\frac{5}{3}m$

Answer: B

View Text Solution

8. A planet is rotating around the sun with the orbital radius three times than that of earth. The time period of this planet will be (For earth, time period is 365 days)

A. 1,862 days

B. 1,000 days

C. 1,500 days

D. 2,000 days

Answer: A

View Text Solution

9. On the surface of earth, the time period of a simple pendulum is T_e. When the pendulum is taken to a height of 2R above the surface of earth, the time period becomes T_h. (R is radius of earth.) The value of $\frac{T_e}{T_h}$ is

A. $1:9$

B. $9:1$

C. $1:3$

D. $3:1$

Answer: C

View Text Solution

10. An object of mass m is ejected from a satellite revolving around earth at a distance r with constant speed v. If the object excapes

from gravitational pull of earth, then the kinetic energy with which the object is thrown is

A. $-0.5mv^2$

B. $0.5mv^2$

C. mv^2

D. $-mv^2$

Answer: B

View Text Solution

11. At the surface of earth, the acceleration due to gravity is g. If an object of mass m is raised from the surface of earth to a height equal to radius of earth (R). The potential energy gained by the object is

A. mgR

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

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

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

Answer: C

View Text Solution

12. A spring is stretched by 2 cm by an object attached to It near the surface of earth. How much extension of the same spring take place by the same object when taken to a point 3,200 km above the surface of earth (Radius of earth = 6,400 km)

A. 0.5 cm

B. 0.4 cm

C. 0.9 cm

D. 0.9 cm

Answer: C

View Text Solution

13. The gravitational potential at a point at height h from the surface of earth is $-6.50 \times 10^7 Jkg^{-1}$, and acceleration due to gravity is $7.2m/s^2$. Calculate the value of h if radius of earth is 6400 km.

A. 2,627 km

B. 3,627 km

C. 4,627 km

D. 1,900 km

Answer: A

View Text Solution

14. The escape velocity of a body at the surface of planet P is $\frac{1}{\sqrt{5}}$ times than that at surface of earth. The radius of planet is $\frac{1}{24}$ times the radius of earth. The acceleration due to gravity for planet is

A. $2.4g_e$

B. $2.8g_e$

C. $4.8g_e$

D. $3.0g_e$

Answer: C

View Text Solution

15. Let the acceleration due to gravity be g_1 at a height h above the earth's surface g_2 at a depth d below the earth's surface. If

$g_1 = g_2, h < < R$ and $d < < R$ then

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

B. h = 2d

C. h = 3d

D. h = d

Answer: A

Watch Video Solution

Competition File B Multipe Choice Questions From Competitive Examinations Aipmt Neet Other State Boards For Medical Entrance

1. A body weighs 200 N on the surface of the earth. How much will it weigh half way down to the centre of the earth ?

A. 150 N

B. 200 N

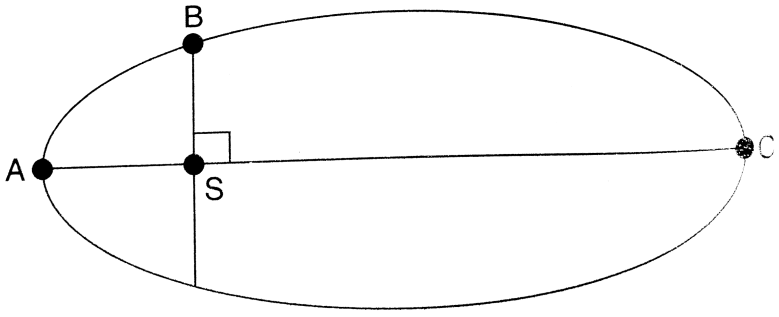
C. 250 N

D. 100 N

Answer: D

Watch Video Solution

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



A. $K_B < K_A < K_C$

B. $K_A > K_B > K_C$

C. $K_A < K_B < K_C$

D. $K_B > K_A > K_C$

Answer: B

Watch Video Solution

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

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

B. S_1 and S_2 are moving with same speed

C. The kinetic energies of two satellites are equal

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

Answer: B

Watch Video Solution

4. 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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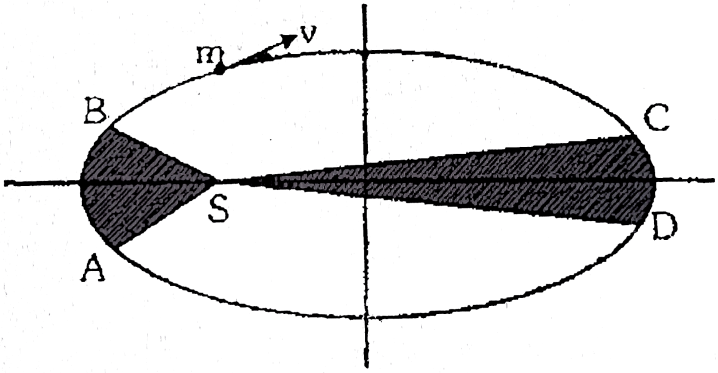
5.



The figure shows elliptical orbit of a planet m about the sun S. the shaded area SCD is twice the shaded area SAB. If t_1 be the time for the planet to move from C to D and t_2 is the time to move from A to B, then:

A. $t_1 = 4t_2$

B. $t_1 = 2t_2$

C. $t_1 = t_2$

D. $t_1 > t_2$

Answer: B

Watch Video Solution

6. A particle of mass M is situated at the centre of a spherical shell of same mass and radius 'a'. The gravitational potential at a point situated at $\frac{a}{2}$ distance from the centre, will be

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

B. $-\frac{4GM}{a}$

C. $-\frac{3GM}{a}$

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

Answer: C

Watch Video Solution

7. A plenet moving along an elliptical orbit is closest to the sun at a distance r_1 and farthest away at a distance of r_2. If v_1 and v_2 are the linear velocities at these points respectively, then the ratio $\frac{v_1}{v_2}$ is

A. $(r_1/r_2)^2$

B. r_2/r_1

C. $(r_2/r_1)^2$

D. r_1/r_2

Answer: B

Watch Video Solution

8. A body projected vertically from the earth reaches a height equal to earth's radius before returning to the earth. The power exerted

by the gravitational force is greatest.

A. at the highest position of the body

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

C. it remains constant all through

D. at the instant just after the body is projected.

Answer: B

Watch Video Solution

9. Assuming that tha gravitational potential energy of an object at infinity is zero, the change in potential energy (final - initial) of an object of mass m, when taken to a height h from the surface of earth (of radius R), is given by

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

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

C. $\frac{GMmh}{R(R+H)}$

D. mgh

Answer: C

Watch Video Solution

10. The time period of a geostationary satellite is 24 h, at a height $6R_E$ (R_E is radius of earth) from surface of earth. The time period of another satellite whose height is $2.5R_E$ from surface will be

A. $\frac{12}{2.5}h$

B. $6\sqrt{2}h$

C. $12\sqrt{2}h$

D. $\frac{24}{2.5}h$

Answer: B

View Text Solution

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

A. $4GM_p\mu / D_p^2$

B. $4GM_p / D_p^2$

C. $GM_p\mu / D_p^2$

D. GM_p / D_p^2

Answer: B

Watch Video Solution

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

A. $10^{-9} m$

B. $10^{-6} m$

C. $10^{-2} m$

D. 100 m

Answer: C

Watch Video Solution

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

A. 

B. 

C. 

D. 

Answer: A

Watch Video Solution

14. Kepler's third law states that square of period revolution (T) of a planet around the sun is proportional to third power of average distance i between sun and planet i.e. $T^2 = Kr^3$

here K is constant

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

A. $GK = 4\pi^2$

B. $GMK = 4\pi^2$

C. K = G

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

Answer: B

Watch Video Solution

15. Two spherical bodies of mass M and 5M & radii R & 2R respectively are released in free space with initial separation between their centres equal to 12R. If they attract each other due to gravitational force only, then the distance covered by the smallar body just before collision is

A. 2.5 R

B. 4.5 R

C. 7.5 R

D. 1.5 R

Answer: C

Watch Video Solution

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

A. 1,600 km

B. 1,400 km

C. 2,000 km

D. 2,600 km

Answer: D

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Competition File Jee Main Other State Boards For Engineering Entrance

1. Take the mean distance of the moon and the sun from the earth to be$0.4 \times 10^6 km$ and $150 \times 10^6 km$ respectively. Their masses are $8 \times 10^{22} kg$ and $2 \times 10^{30} kg$ respectively. The radius of the earth of is $6400 km$. Let ΔF_1 be the difference in the forces exerted by the moon at the nearest and farthest points on the earth and ΔF_2 be the difference in the force exerted b the sun at the nearest and farthest points on the earth. Then, the number closest to $\frac{\Delta F_1}{\Delta F_2}$ is :

A. 6

B. 10^2

C. 2

D. 0.6

Answer: C

Watch Video Solution

2. The relative uncertainty in the period of a satellite orbiting around the earth is 10^{-2}. If the relative uncertainty in the radius of the orbit is negligible, the relative uncertainty in the mass of the earth is :

A. 2×10^{-2}

B. 6×10^{-2}

C. 3×10^{-2}

D. 10^{-2}

Answer: A

Watch Video Solution

3. The height at which the acceleration due to gravity becomes $\frac{g}{9}$ (where g =the acceleration due to gravity on the surface of the earth) in terms of R, the radius of the earth, is :

A. 2R

B. $R/\sqrt{2}$

C. R/2

D. $\sqrt{2}$

Answer: A

Watch Video Solution

4. Suppose that angular velocity of rotation of earth is increased. Then, as a consequence :

A. Weight of the object everywhere on the earth will decrease

B. Weight of the object everywhere on the earth will increase

C. Except at poles weight of the object on the earth will decrease

D. There will be no change in weight anywhere on the earth.

Answer: C

Watch Video Solution

5. If the angular momentum of a planet of mass m, moving around the Sun in a circular orbit is L, about the center of the Sun, its areal velocity is :

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

B. $\frac{4L}{m}$

C. $\frac{L}{2m}$

D. $\frac{L}{m}$

Answer: C

Watch Video Solution

6. The energy required to take a satellite to a height 'h' above Earth surface (radius of Earth $= 6.4 \times 10^3$ km) is E_1 and kinetic energy required for the satellite to be in a circular orbit at this height is E_2 . The value of h for which E_1 and E_2 are equal, is:

A. $1.28 \times 10^4 km$

B. $6.4 \times 10^3 km$

C. $3.2 \times 10^3 km$

D. $1.6 \times 10^6 km$

Answer: C

Watch Video Solution

7. A body of mass m is moving in a circular orbit of radius R about a planet of mass M. At some instant, it splits into two equal masses. The first mass moves in a circular orbit of radius $\frac{R}{2}$. And the other mass, in a circular orbit of radius $\frac{3R}{2}$. The difference between the final and initial total energies is :

A. $+\frac{Gm}{6R}$

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

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

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

Answer: C

Watch Video Solution

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

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

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

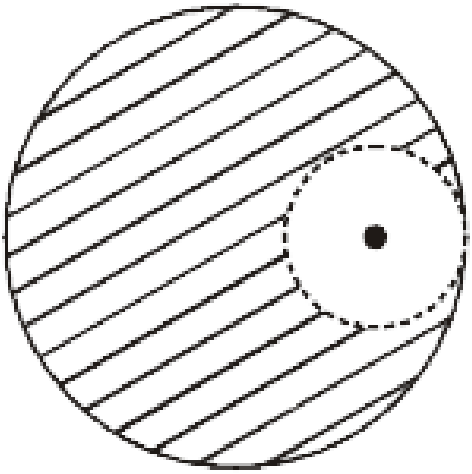
D. $\sqrt{\frac{GM}{R}(1+2\sqrt{2})}$

Answer: A

Watch Video Solution

9. From a solid sphere of mass M and radius R, a spherical portion of radiu $\frac{R}{2}$ 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. $\frac{-GM}{R}$

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

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

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

Answer: A

Watch Video Solution

10. 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. $\sqrt{gR/2}$

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

Answer: D

Watch Video Solution

11. The value of acceleration due to gravity at earth's surface is $9.8ms^{-2}$. The altitude above its surface at which the acceleration due to gravity decreases to , is close to: (radius of earth $= 6.4 \times 10^6 m$)

A. $2.6 \times 10^6 m$

B. $6.4 \times 10^6 m$

C. $9.0 \times 10^6 m$

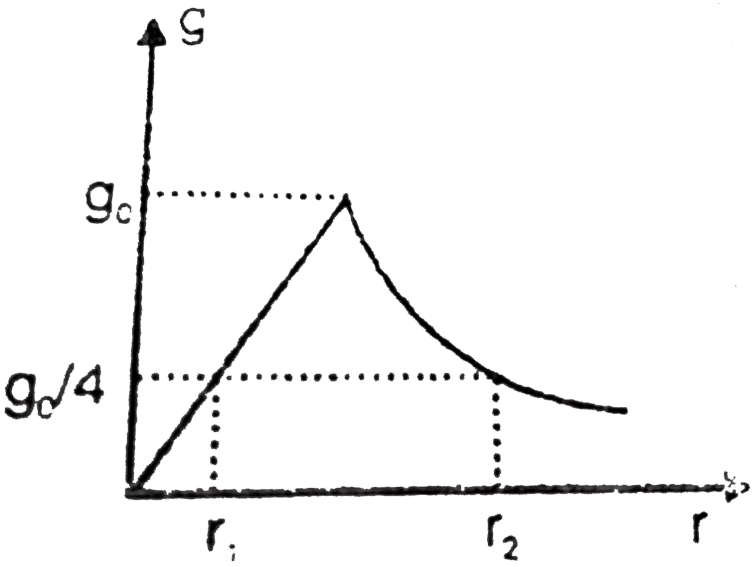
D. $1.6 \times 10^6 m$

Answer: A

View Text Solution

12. Figure shows variation of acceleration due to gravity with distance from centre of a uniform spherical planet, Radius of planet

is R. What is $r_2 - r_1$



A.

B.

C.

D.

Answer: D

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13. If the earth has no rotational motion, the weight of a person on the equation is W. Detrmine the speed with which the earth would have to rotate about its axis so that the person at the equator will weight $\frac{3}{4}$ W. Radius of the earth is 6400 km and g = 10 m/s^2.

A. $1.1 \times 10^{-3} \text{rad/s}$

B. $0.83 \times 10^{-3} \text{rad/s}$

C. $0.63 \times 10^{-3} \text{rad/s}$

D. $0.28 \times 10^{-3} \text{rad/s}$

Answer: C

Watch Video Solution

14. The mass density of a spherical body is given by $\rho(r) = \frac{k}{r}$ for $r \leq R$ and $\rho(r) = 0$for r > R , where r is the distance from the

centre. The correct graph that describes qualitatively the acceleration, a, of a test particle as a function of r is :

A. 

B. 

C. 

D. 

Answer: B

Watch Video Solution

15. A test particle is moving in a circular orbit in the gravitational field produced by a mass density $\rho(r) = \frac{K}{r^2}$. Identify the correct relation between the radius R of the particle's orbit and its period T:

A. TR is a contant

B. T^2 / R^3 is a constant

C. T / R^2 is a constant

D. T/R is a constant

Answer: D

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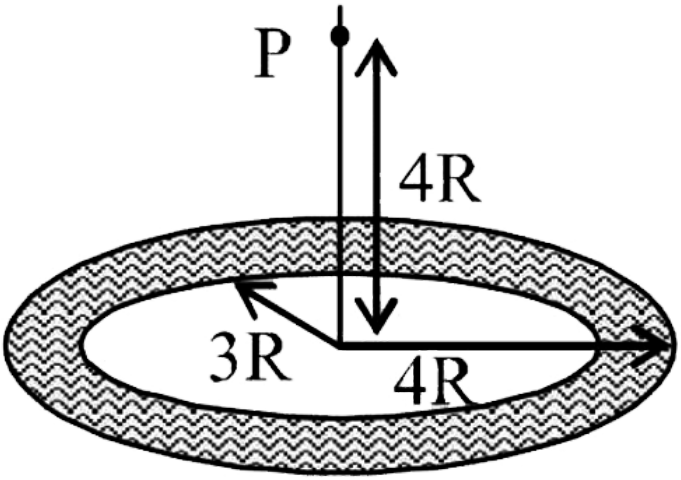
Competition File Jee Advanced For Iit Entrance

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

P on its axis to infinity is



A. $\frac{2GM}{7R}(4\sqrt{2}-5)$

B. $\left(-\frac{2GM}{7R}\right)(4\sqrt{2}-5)$

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

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

Answer: A

Watch Video Solution

2. Graviational acceleration on the surface of plane fo $\frac{\sqrt{6}}{11}g.$ where g is the gracitational acceleration on the surface of the earth. The average mass density of the planet is $\frac{2}{3}$ times that of the earth. If the escape speed on the surface of the earht is taken to be $11kms^{-1}$ the escape speed on teh surface of the planet in kms^{-1} will be

A. 1

B. 2

C. 3

D. 4

Answer: C

Watch Video Solution

3. A satellite is moving with a constant speed 'V' in a circular orbit about the earth. An object of mass 'm' is ejected from the satellite such that it just escapes form the gravitational pull of the earth. At the tme of its ejection, the kinetic energy of the object is

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

B. mV^2

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

D. $2mV^2$

Answer: B

Watch Video Solution

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

lower a wire of the same length and a linear mass density $10^{-3}kgm(\_1)$ into it. If the wire is not touching anywhere, the force applied at the top of the wire by a person holding it inplace is (take the radius of Earth $=6\times10^{6}m$ and the acceleration due to gravity on Earth is $10ms^{-2}$

A. 96 N

B. 108 N

C. 120 N

D. 150 N

Answer: B

Watch Video Solution

5. A rocket is launched normal to the surface of the earth, away from the sun, along the line joining the sun and the earth. The sun

is 3×10^5 times heavier than the earth and is at a distance 2.5×10^4 times larger than the radius of the earth. the escape velocity from earth's gravitational field is $u_e = 11.2 kms^{-1}$. The minmum initial velocity $(u_e) = 11.2 kms^{-1}$. the minimum initial velocity (u_s) required for the rocket to be able to leave the sun-earth system is closest to (Ignore the rotation of the earth and the presence of any other planet

A. $v_s = 72 Kms^{-1}$

B. $v_s = 22 Kms^{-1}$

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

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

Answer: C

Watch Video Solution

6. Consider a spherical gaseous cloud of mass density $\rho(r)$ in a free space where r is the radial distance from its centre. The gaseous cloud is made of particle of equal mass m moving in circular orbits about their common centre with the same kinetic energy K. The force acting on the particles is their mutual gravitational force. If $\rho(r)$ is constant with time. the particle number density n(r)=$\rho(r)$ /m is : (g =universal gravitational constant)

A. $\frac{K}{\pi r^2 m^2 G}$

B. $\frac{K}{6\pi r^2 m^2 G}$

C. $\frac{3K}{\pi r^2 m^2 G}$

D. $\frac{K}{2\pi r^2 m^2 G}$

Answer: D

Watch Video Solution

Competition File C Multiple Choice Questions

1. A satellite having mass much smaller than the mass of earth is revolving in an elliptical orbit around the earth. In this case

A. The acceleration of satellite is always directed towards the centre of earth.

B. The total mechanical energy of satellite remains constant.

C. The magnitude and direction of angular momentum remain conserved.

D. The linear momentum of satellite is maximum when it is farther from earth.

Answer: A::B::C

Watch Video Solution

2. The acceleration due to gravity

A. decreases on account of rotation of earth.

B. increases with increase in latitude of a place.

C. increases on account of rotation of earth.

D. increases in moving away from the centre if r gt radius of earth.

Answer: A::B

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3. By some means if universal gravitational constant (G) starts decreasing then

A. time period of revolution of earth will increase.

B. length of day will increase.

C. Earth will follow a spiral path of increasing radius.

D. Kinectic energy of earth will decrease.

Answer: A::C::D

View Text Solution

4. Which of the following statements are incorrect?

A. The point at which a planet is closest to the sun is perihelion.

B. The point at which a planet is farthest from the sun is aphelion.

C. The areal velocity of a planet around the sun is not constant.

D. Gravitational force between two bodies can be attractive or repulsive.

Answer: C::D

Watch Video Solution

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

A. is minimum at equator and maximum at poles.

B. remains unchaned at poles when earth stops rotating.

C. remains unchanged at poles when earth is in motion.

D. remains unchanged at equator whether earth is at rest or rotating.

Answer: A::B::C

Watch Video Solution

6. The gravitational potential

A. is same everywhere inside a uniform spherical shell.

B. at a point is always negative.

C. is maximum at infinity.

D. of a body is the gravitational potential energy per unit mass of the body.

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

Watch Video Solution

7. Orbital speed of a satellite

A. decreases with increase in height of satellite.

B. is independent of the mass of satellite.

C. is along the tangent to the orbital path of satellite.

D. is independent of the mass and radius of the planet around which the revolution of satellite takes place.

Answer: A::B::C

Watch Video Solution

8. Polar satellites

A. are sun-synchronous satellites.

B. cross the equator at different instants of time.

C. are used for communication purposes.

D. are also known as remote sensing satellites.

Answer: A::D

View Text Solution

9. Which of the following are essential conditions for a satellite to be geostationary?

A. It should be at a height of 36000 km above the surface of earth.

B. Its orbit may be circular or elliptical.

C. It should rotate from west to east.

D. Its orbital speed should be 3.1 km//s.

Answer: A::C::D

Watch Video Solution

10. The masses of two spherical planets A and B are M_A and M_B, surface areas are S and 9 S respectively. The mass of a spherical planet C is $(M_A + M_B)$. If the densities of all the planets A, B, C are

same, then the escape velocities V_A, V_B, V_C from the surface of these planets follow:

A. V_C gt V_B gt V_A

B. $V_B = 3V_A$

C. V_C lt V_B lt V_A

D. V_C gt V_B lt V_A

Answer: C::D

View Text Solution

11. Two spherical planets P and Q have the same uniform density ρ, masses M_p and M_Q and surface areas A and 4A respectively. A spherical planet R also has uniform density ρ and its mass is $(M_P + M_Q)$. The escape velocities from the plantes P,Q and R are $V_P V_Q$ and V_R respectively. Then

A. V_Q gt V_R gt V_P

B. V_R gt V_Q gt V_P

C. $V_R / V_P = 3$

D. $V_P / V_Q = \frac{1}{2}$

Answer: B::D

Watch Video Solution

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

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

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

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

D. The energy of the mass m remains constant.

Answer: B::D

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Competition File D Multiple Choice Questions

1. The S.I. units of intensity of gravitational field

A. J/kg

B. J/kgs^2

C. N/kg

D. m/s^3

Answer: C::D

Watch Video Solution

2. The dimensional formula of intensity of gravitational field

A. MLT^{-2}

B. $ML^{-1}T^{-2}$

C. MLT^{-3}

D. M^0LT^{-2}

Answer: D

Watch Video Solution

3. The value of intensity of gravitational field at infinite distance from the body is

A. zero

B. infinite

C. less than unity

D. unity

Answer: A

Watch Video Solution

4. Two bodies of masses 50 kg and 100 kg are at a distance 1m apart. The intensity of gravitational field at the mid-point of the line joining them is (in joules)

A. 100G

B. 150G

C. 50G

D. 200G

Answer: A

Watch Video Solution

5. The escape velocity for a body projected from a planet depends on

A. mass of the body

B. angle of projection

C. mass of the planet

D. radius of the body

Answer: C::D

Watch Video Solution

6. 618 km//s is the escape velocity from the surface of

A. Earth

B. Moon

C. Jupiter

D. Sun

Answer: D

View Text Solution

7. A body from the surface of a planet has a escape veloctiy of 8 km/s . If the mass of the body is made twice, then the escape velocity is

A. 8 km/s

B. $2\sqrt{2}km/s$

C. 16 km/s

D. 4 km/s

Answer: A

Watch Video Solution

8. Show that Moon would depart forever if its speed were incresed by 42% .

A. 0.42

B. 0.52

C. 0.7

D. 0.9

Answer: A

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Competition File Assertion Reasion Type Questions

1. Assertion : The time period of a freely falling pendulum is infinite.

Reason : The effective value of acceleration due to gravity becomes zero.

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

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

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: A

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2. Assertion : There is no atmosphere on the moon.

Reason : The escape velocity on the surface of moon is very small. Due to this, molecules of the gases easily escape.

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

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

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: A

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

Reason: Gravitational potential energy of an object is negative.

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

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

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: B

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4. Assertion : The forces of friction arise due ot gravitational attraction.

Reason : The gravitational forces can be attractive and repulsive.

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

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

C. If assertion is correct but reason is incorrect.

D. If both assertion and reason are incorrect

Answer: D

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5. For a satellite the escape velocity is 11km/s. If the satellite is launched at an angle of 30° with the vertical, then the escape velocity will be

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

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

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: C

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6. Assertion : The speed of a satellite is constant if the orbital path of the satellite is elliptical.

Reason : Speed of a satellite is not constant if orbital path of the orbit is elliptical according to Kepler's laws of motion. Here, Areal velocity is constant.

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

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

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: D

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7. Assertion : The time period of a satellite revolving very close to the surface of earth is less.

Reason : According to Kepler's law, square of time period of revolution is directly proportional to the cube of semi-major axis.

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

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

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: A

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8. Assertion : Gravitational potential energy increases if we move away from the surface of earth.

Reason : Gravitational potential energy is zero at infinity.

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

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

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: B

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9. Assertion : Time period of revolution of a polar satellite of earth is 100 minutes.

Reason : Polar satellites are Sun-synchronous satellites.

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

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

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: B

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10. Assertion : If the distance of the earth from the Sun becomes one half of the present distance, then the number of days in one year on earth will become 236.

Reason : Earth revolves around the sun in an elliptical orbit.

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

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

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: B

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11. This question contains Statement -1 and Stantement -2 Of the four choices given after the statements, choose the one that best desctibes the two statemesnts.

Statement -1:

For a mass M kept at the center of a cube of side 'a', the flux of gravitational field passing through its sides $4\pi GM$.

Statement -2:

If the direction of a field due to a point source is radial and its dependence on the distance 'r' from the source is given as $\frac{1}{r^2}$, its flux throught a closed surface depends only on the strength of the source enclosed by the surfcae and not on the size or shape of the surface.

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

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

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: A

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

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

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

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

C. If assertion is correct but reason is incorrect.

D. If assertion is incorrect but reason is correct.

Answer: A

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Competition File Matching Type Questions

1. A planet of mass M, has two natural satellites with masses m1 and m2. The radii of their circular orbits are R_1 and R_2 respectively. Ignore the gravitational force between the satellites. Define v_1, L_1, K_1 and T_1 to be, respectively, the orbital speed, angular momentum, kinetic energy and time period of revolution of satellite 1 , and v_2, L_2, K_2 and T_2 to be he corresponding quantities of satellite 2. Given $m_1/m_2 = 2$ and $R_1/R_2 = 1/4$, match the ratios

in List-I to the numbers in List-II.

List–I		List–II	
P.	$\frac{\nu_1}{\nu_2}$	1.	$\frac{1}{8}$
Q.	$\frac{L_1}{L_2}$	2.	1
R.	$\frac{K_1}{K_2}$	3.	2
S.	$\frac{T_1}{T_2}$	4.	8

A. P - 4, Q - 2, R - 1, S - 3

B. P - 3, Q - 2, R - 4, S - 1

C. P - 2, Q - 3, R - 1, S - 4

D. P - 2, Q - 3, R - 4, S - 1

Answer: B

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Competition File Matrix Match Type Questions

1. 

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2. 

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3. 

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Competition File Integer Types Questions

1. The mean densities of a planet and earth are in the ratio of $\frac{5}{2}$ and ratio of their radii is $4:5$. A boy can jump 5 m on the surface of earth, then with identical efforts what is the height to which he can jump on the planet ?

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2. The radius of earth is increased by 2%. By what precentage the acceleration due to gravity will change assuming mass remaining unchanged ?

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

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4. Calculate the resultant gravitational potential in terms of G (universal gravitational constant) if infinite number of masses of 2kg each are placed along the X-axis at $x = \pm 1m, \pm 2m, \pm 4m, \pm 8m, \ldots$

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5. Two spherical bodies of masses m and 6m and radii R and 2R respectively are released in free space with initial separation between their centres equal to 10 R . If they attract each other due to gravitational force only , then the distance covered by smaller sphere just before collisions will be

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6. S_1 and S_2 are two satellites of radii R and 9R revolving around a planet P in circular orbits. If speed of S_1 is 6V, then how many times the speed of S_2 is greater than speed of S_2 ?

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7. What is the gravitational potential energy (MJ) of a body of mass 3 kg on a planet where escape velocity is $4kms^{-1}$?

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8. A satellite S_1 of mass m is revolving at a distance of R from centre of earth and the other satellite S_2 of mass 4m is revolving at a distance of 4R from the centre of earth. The time periods of revolution of two satellites are in the raito 1 : n. Find the value of n.

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9. The acceleration due to gravity becomes $\frac{g}{16}$ at a height of nR from the surface of earth. Find the value of n.

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

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11. A bullet is fired vertically upwards with a velocity v from the surface of a spherical planet when it reaches its maximum height, its acceleration due to the planet's gravity is $\frac{1}{4}th$ of its value at the surface of the planet. If the escape velocity from the planet is

$V_{\text{escape}} = v\sqrt{N}$, then the value of N is : (ignore energy loss due to atmosphere).

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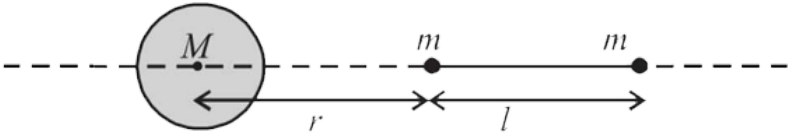
12. A larger spherical mass M is fixed at one position and two identical point masses m are kept on a line passing through the centre of M. The point masses are connected by rigid massless rod of length l and this assembly is free to move along the line connecting them. All three masses interact only throght their mutual gravitational interaction. When the point mass nearer to M is at a distance r =3l form M, the tensin in the rod is zero for

$m = k\left(\frac{M}{288}\right)$. The value of k is



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Chapter Practice Test

1. The weight of a body at the centre of the earth is

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2. If the diameter and mass of the earth becomes twice becomes twice of its original value, then how will the acceleration due to gravity change ?

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3. What is the unit and dimensional formula of gravitational field intensity ?

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4. Does the escape velocity of a body depend on the density of a planet ?

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

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6. Escape velocity from the surface of moon is less than that from the surface of earth because the moon has no atmosphere while earth has a very dense one.

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7. Distinguish between polar satellites and geostationary satellites.

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

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9. What is binding energy of a satellite?

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10. How will the acceleration due to gravity will change if the radius earth shrinks by 5% keeping mass unchanged ?

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11. Derive an expression for the variation of g with the height from the surface of the Earth.

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

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13. Define escape velocity of an object.

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14. State Kepler's laws of planetary motion.

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15. Knowing the value of g, how can we calculated the mass and density of Earth?

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