PHYSICS

BOOKS - KUMAR PRAKASHAN KENDRA

PHYSICS (GUJRATI ENGLISH)

GRAVITATION

Section A Questions Answers

1. Describe the model and theory of planetary motions presented in earliest of times.

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2. Explain Kepler's first (Law of Orbits) law for planetary motion.

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3. Describe the method for drawing an ellipse and explain fociofellipse, midpoint, semi major axis.

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4. State and prove Kepler's second law (Law of Areas) of planetary motion.

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5. Write the Kepler law of period (Kepler's third law) for planetary motion.

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6. Give the law of gravitation of Newton.

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7. Write Newton's universal law of gravitation and represent it in mathematical expression.

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8. Explain universal law of gravitation. (AS_1)

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9. Explain principle of super position for gravitational force.

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10. Explain gravitational force exerted by an extended object.

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11. Draw schematic drawing of Cavendish's experiment for determination of universal gravitational constant G and obtain formula used in it.

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12. Obtain an expression of acceleration produced by gravity of earth. OR Obtain general equation of gravitation force at distance r from the centre of earth and derive the equation of acceleration due to gravity on the surface of earth.

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13. Derive the equation for variation of g due to height from the surface of earth.

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14. Find the magnitude of acceleration due to gravity at height of 10 km from the surface of earth.

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15. Derive the equation for variation of g due to depth below the surface of earth.

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16. Derive the equation of g at depth d below the surface of earth.

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17. Explain the variations of acceleration due to gravity inside and outside the earth and draw the graph.

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18. Obtain an expression for the variation in effective gravitational acceleration g' with latitude due to earth's

rotation:

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19. Explain gravitational intensity

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20. Define intensity of gravitation and write its equation, unit and dimensional formula

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21. In Bohr's model of an atom which of the following is an integral multiple of $h/2\pi$?

A. Kinetic energy

B. Radius of an atom

C. Potential energy

D. Angular momentum

Answer:

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22. Define gravitational potential energy. Obtain the formula for the gravitational energy of body at distancer r

$(r > R_c)$ from the centre of earth.

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23. Define gravitational potential. Give its unit. Is gravitational potential vector or scalar ?

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24. Obtain an expression of gravitational potential at a point in the gravitational field of earth. Give the relation between gravitational potential and gravitational potential energy.

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25. Explain escape energy and give its definition.

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26. Explain escape speed.

Watch Video Solution

27. "Why is there no atmosphere on the Moon" – Explain it in terms of escape velocity

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28. What is satellite ? Gives its types and uses.

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29. What is the orbital velocity of satellite ? Derive its equation.

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30. Obtain an equation of orbital time period of satellite revolves around the earth.

Watch Video Solution

31. Obtain an expression of total energy of satellite revolving around the earth.

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32. What is binding energy of satellite ? Write its equation.

Watch Video Solution

33. What is geostationary satellite ? For remain geo stationary obtain the equation of its height from the surface of earth.

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34. What are the conditions necessary for a satellite to appear stationary.

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35. Explain polar satellite .

Watch Video Solution

36. What is weightlessness ? Explain with example.

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Section A Try Yourself Vsqs

1. Describe Ptolemy model for planetary motion.

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2. Give the thoughts of Rushi and Scientist Aryabhatta on the planetary motion.

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3. Describe Nicholas Copernicus model for planetary motion.

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4. Give the contribution of Tycho Brahe on planetary motion.

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5. For proposing universal law of gravitation which laws are taking for help?

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6. Explain Kepler's first (Law of Orbits) law for planetary motion.

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7. State and prove Kepler's second law (Law of Areas) of planetary motion.

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8. Write the Kepler law of period (Kepler's third law) for planetary motion.

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9. Explain universal law of gravitation. (AS_1)

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10. Give the CGS unit of universal gravitational constant (G).

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11. Write CGS and MKS unit of G.

Watch Video Solution

12. Write dimensional formula of universal constant of gravitation (G).

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13. If the mass of two bodies is doubled and the distance of two bodies also doubled, the new gravitational force becomes what ?

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14. What is gravity at a point inside a spherical shell?

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15. Define acceleration due to gravity.

Watch Video Solution

16. Give the magnitude of g on the surface of earth.

Watch Video Solution

17. What is gravitational force on a particl at the centre of earth ?

Watch Video Solution

18. How force of gravity F varies inside the earth at distance $r(r < R_e)$.

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19. How much radius of earth at equator is grater than the radius at poles of earth

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20. Write the difference between G and g .

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21. Write the equation of gravitation acceleration which is used for any height from the surface of Earth.

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22. Write the equation of acceleration which is used for height $h < < R_e$ from the surface of earth.

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23. Find the magnitude of acceleration due to gravity at height of 10 km from the surface of earth.

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24. What is value of acceleration due to gravity (g) at the centre of earth?

Watch Video Solution

25. What will be the variation of g below and above the surface of earth?

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26. Define gravitational potential energy. Obtain the formula for the gravitational energy of body at distancer r $(r > R_c)$ from the centre of earth.

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27. Gravitational potential is negative it does it mean?

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28. What is the change in the potential energy going away from earth?

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29. What is the charge in the potential energy coming near to the earth ?

Watch Video Solution

30. What is the magnitude of potential energy at infinity distance ?

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31. Write the change in gravitational potential energy of a body lifted at height h from the surface of earth ?

Watch Video Solution

32. Define gravitational potential. Give its unit. Is gravitational potential vector or scalar ?

Watch Video Solution

33. Write CGS and MKS unit of G.

Watch Video Solution

34. Define gravitational potential. Give its unit. Is gravitational potential vector or scalar ?

Watch Video Solution

35. Define gravitational potential energy. Obtain the formula for the gravitational energy of body at distancer r $(r > R_c)$ from the centre of earth.

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36. Write the expression of gravitational potential energy and gravitational potential at the surface of earth .

Watch Video Solution

37. Give the difference between gravitational potential energy and gravitational potential.

Watch Video Solution

38. Explain escape energy and give its definition.

Watch Video Solution

39. What is the total energy at infinite distance ? (zero or positive)

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40. A stationary body on a surface of earth have negative energy - What it indicate ?

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41. How much force of gravitation acted on a body at infinite distance from the earth ?

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42. Explain escape energy of body lying on the earth

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43. Give the binding energy of body lying on the earth at distance r from the centre of earth

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44. Give the unit and dimensional formula of escape energy.

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45. Define escape velocity

Watch Video Solution

46. What is the value of escape velocity of a body lying on the surface of earth?

Watch Video Solution

47. What is the value of escape velocity of a body lying on the surface of moon ?

Watch Video Solution

48. On what factors escape velocity does not depend?

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49. What is satellite ? Gives its types and uses.

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50. Give the name of two satellites.

Watch Video Solution

51. Write two uses of satellite.

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52. What is the orbital velocity of satellite ? Derive its equation.

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53. Which force is responsible for necessary centripetal force of satellite revolving around the earth?

Watch Video Solution

54. What is the orbital velocity of satellite ? Derive its equation.

Watch Video Solution

55. Obtain an equation of orbital time period of satellite revolves around the earth.

Watch Video Solution

56. Obtain an equation of orbital time period of satellite revolves around the earth.

Watch Video Solution

57. Obtain an equation of orbital time period of satellite revolves around the earth.

Watch Video Solution

58. Obtain an expression of total energy of satellite revolving around the earth.

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59. Why the potential energy of the satellite comes negative?

Watch Video Solution

60. Obtain an expression of total energy of satellite revolving around the earth.

Watch Video Solution

61. Why the total energy of satellite comes negative?

Watch Video Solution

62. What is binding energy of satellite ? Write its equation.

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63. Write the expression for binding energy of a satellite.

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64. What is geostationary satellite ? For remain geo stationary obtain the equation of its height from the surface of earth.

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65. What is the orbital period of geo stationary satellite ?

Watch Video Solution

66. What is geostationary satellite ? For remain geo stationary obtain the equation of its height from the surface of earth.

Watch Video Solution

67. Give the uses of geo stationary satellite.

Watch Video Solution

68. Explain polar satellite .

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69. What is the orbital period of polar satellite ?

Watch Video Solution

70. At which height from the surface of earth polar satellite revolving around the earth ?

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71. What is the direction of rotation of polar satellite ?

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72. What is the directions of rotation of geo stationary satellite ?

Watch Video Solution

73. Give the uses of polar satellite

Watch Video Solution

74. What is weightlessness ? Explain with example.

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75. Who decides the upward direction in artificial satellite ?

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76. Which fact is represented by the pictures of astronaut floating in satelliite ?

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Section B Numericals Numerical From Textual Illustration

1. Let the speed of the planet at the perihelion P in figure . (a) be v_p and the Sun - planet distance SP be r_p . Relate $\{r_p, v_p\}$ to the corresponding quantities at the apphelion $\{r_A, v_A\}$. Will the planet take equal take equal times to traverse BAC and CPB ?

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2. Three equal masses of m kg each are fixed at the vertices of an equilateral triangle ABC. (a) What is the force acting on a mass 2 m placed at the centroid G of the triangle ? (b) What is the force if the mass at the vertex A is doubled ? (Take AG = BG = CG = 1 m)

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3. Find the potential energy of a system of four particles placed at the vertices of a square of side l. Also obtain the potential at the centre of the square.

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4. Two uniform solid spheres of equal radii R, but mass M and 4 M have a center to centre separation 6 R, as shown in figure. The two spheres are held fixed. A projectile of mass m is projected from the surface of the sphere of mass M directly towards the centre of the second sphere. Obtain an expression for the minimum speed v of the projectile so that it reaches the surface of the second

sphere.

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5. The planet Mars has two moons, phobos and delmos. (i) phobos has a period 7 hours, 39 minutes and an orbital radius of 9.4 $\times$ 103 km. Calculate the mass of mars. (ii) Assume that earth and mars move in circular orbits 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 ?

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6. Weighing the Earth : You are given the following data: g = 9.81 ms^{-2}, $R_E = 6.37 \times x10^6$ m, the distance to the moon R = $3.84 \times x10^8$ m and the time period of the moon's revolution is 27.3 days. Obtain the mass of the Earth M_E in two different ways.

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7. Express the constant k of Eq. (8.38) in days and kilometres. Given k = $10^{-13}s^2m^{-3}$. The moon is at a distance of $3.84x \times 105$ km from the earth. Obtain its time-period of revolution in days.

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8. A 400 kg satellite is in a circular orbit of radius $2R_E$ about 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 ?

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9. Three equal masses m are placed at the three vertices of the equivlateral triangle. A mass M is placed at the centroid of triangle. Find gravitational force on it. The distance of centroid to vertice is 1 m.

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10. A particle of mass m is placed at each vertices of equilateral triangle. If the particle of 5 kg is placed at the centroid of triangle, then find the gravitational force on it. The distance between centroid to vertice is 2 m.

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11. As shown in figure , four masses each of mass $3\sqrt{2}$ kg at the corners of a square of side 3 m . Calculate the gravitational potential energy of system of these four particles. Also calculate the gravitational potential at the centre of square. $\left(G = 6.67x10^{-11}\right.$ SI unit)

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12. Two solid spherical planets have equal radii and mass of 4M and 9M and distance between their centre is 6R. A body of mass m is projected toward heavy planet, then what should be the ditsance of body of mass m from lighter planet so that the gravitational force on it will be zero ?

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13. Weighing the Earth : You are given the following data: g = 9.81 ms^{-2}, $R_E = 6.37 \times x10^6$ m, the distance to the moon R = $3.84 \times x10^8$ m and the time period of the moon's revolution is 27.3 days. Obtain the mass of the Earth M_E in two different ways.

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14. Find the value of k in equation in day and kilometer. $k = 10^{-13} s^2 m^{-3}$ The distance of artificial satellite from earth is 14R. Where Re = radius of earth. Find its time period.

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15. A 400 kg satellite is in a circular orbit of radius $2R_E$ about 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 ?

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Section B Numerical From Textual Exercise Answer The Following

1. You can shled 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 ?

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2. Acceleration due to gravity is independent of mass of the earth/mass of the body.

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3. Suppose there existed a planet that went around the Sun twice as fast as the earth. What would be its orbital size as compared to that of the earth ?

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4. In one of the satellites of Jupiter has an orbital period of 1.769 days and the radius of the orbit is 4.22×10^8 m. Show that the mass of Jupiter is about one-thousandth that of the sun.

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

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6. Choose the correct alternative :

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

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

energy required to project a stationary object at the same height (as the satellite) out of earth's influence.

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7. 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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8. 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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9. 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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10. In the following two exercises, choose the correct answer from among the given ones, The gravitational intensity at the centre of a hemispherical shell of uniform

mass density has the direction indicated by the arrow as shown in figure. (i) a, (ii) b, (iii)c, (iv) 0

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11. For the above problem, the direction of the gravitational intensity at an arbitrary point P is indicated by the arrow (1) d, (ii) e, (iii) f, (iv) g.

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12. 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 = 2×10^{30}kg.

Mass of the earth = 6×10^{24}kg. Neglect the effect of other planets etc. (orbittal radtus = 1.5×10^{11} m).

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13. How will you 'weigh the sun', that is estimate its mass? The mean orbital radius of the earth around the sun is 1.5×10^{8} km.

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14. A saturn year is 29.5 times the earth year. How far is the saturn from the sun if the earth is 1.50 $\times 10^{8}$ km away from the sun ?

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15. 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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16. 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 weighed 250 N on the surface ?

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

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18. 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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19. 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 $= 6.0 \times 10^{24}$ 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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20. Two stars each of one solar mass $\left(= 2 \times 10^{30} kg \right)$ are approaching each other for a head on collision. When they are a distance 10^9 km, their speeds are negligible. What is the speed with which they collide ? The radius of each star is 10^4 km. Assume the stars to remain undistorted until they collide. (Use the known value of G).

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

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Section B Additional Exercise

1. As you have learnt in the text a geostationary satellite orbits the earth at a height of nearly 36,000 km from the surface of the earth. What is the potential due to earth's gravity at the site of this satellite ? (Take the potential energy at infinity to be zero).

Mass of the earth $6.0 \times 10^{24}(kg)$,

Radius = 6400 km .

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2. A star 2.5 times the mass of the sun and collapsed to a size of 12 km rotates with a speed of 1.2 rev. per second. (Extremely compact stars of this kind are known as neutron stars. Certain stellar objects called pulsars belong

to this category). Will an object placed on its equator remain stuck to its surface due to gravity ?

(Mass of the sun $= 2 \times 10^{30} kg$).

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

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

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Section B Numerical From Darpan Based On Textbook

1. The position vector of the objects of masses 25 kg and 10 kg are (4,7,5)m and (1,3,5) m respectively. Obtain the vector representing the gravitational force on 25 kg object by 10 kg object. (Take $G = 6.67 \times 10^{-11} Nm^{2} kg^{-2}$)

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2. Prove that the ratio of the rate of change of g at a height equal to the earth's radius from the surface of the earth of the value of g at the surface of the earth is equal to $\frac{-1}{4R_e}$

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3. An object is allowed to fall freely towards the earth from a distance $r(>R_e)$ from the centre of the earth. Find the speed of the object when it strikes the surface of the earth.

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4. Imagine a simple pendulum suspensded from a support which at infinite height from the surface of the earth. The bob of the pendulum is close to the surface of the earth. Show that the period of such a pendulum (of infinite length) is $T = 2\pi\sqrt{\frac{R_e}{g}}$

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5. What is the value of acceleration due to gravity on the surface of earth if the entire earth was made of gold ? (Radius of earth = 6400 km , Density of gold $= 19.3 \times 10^3 kg/m^3$ and $G = 6.67 \times 10^{-11}$ MKS)

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6. 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 $= 6.0 \times 10^{24}$ 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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7. An artificial satellite revolves around the earth, remaining close to the surface of the earth, Show that its time period is $T = 2\pi\sqrt{\frac{R_e}{g}}$

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8. The mass and radius of the earth are M_1, R_1 and those for the moon are M_2, R_2 respectively. The distance between their centers is d with that velocity should an object of mass m be thrown away from the mid-point of the line joining them so that it escapes to infinity ?

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9. Consider different planets revolving in different circular orbits around a star of very large mass. If the gravitatonal force between the planet and the star varies as $r^{\frac{-5}{2}}$, r =

distance between them. How does the square of the orbital period T depend on the distance r?

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Section C Objective Questions Vsqs Answer The Following Questions In Short

1. Define universal gravitational constant (G).

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2. On earth, the value of $G = 6.67 \times 10^{-11} Nm^2/kg^2$. What is its value on the moon ?

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3. The ratio of forces between two bodies kept at a certain distance in air to the force between them when kept in water is .....

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4. If two spheres of same material and same radius r are touching each other, then show that the gravitational force between them is directly proportional to r^4

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5. Mass of moon is almost 10 % lesser than that of earth. Then, the gravitational force due to moon on the earth is how much than that on moon due to earth ?

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6. The moon is acted upon by the gravitational force of earth. Why does not moon fall on to earth?

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7. According to Newton's law of gravitation. Equal forces exerted between earth and apple. The earth attracts an

apple, the apple also attract the earth. If it does, why does the earth not 9 move towards the apple ?

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8. According to Newton's law of gravitation, if each body in the universe attracts every other body, why don't two bodies come towards each other?

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9. The gravitational force between two bodies is 1 N. If the distance of these two bodies is doubled, what will be the force of attraction between them ?

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10. Separation between two bodies each of mass 1 kg is 10 cm. Find the force of Gravitation between them $r = 10cm = 10^{-1}m.$

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11. The distance of Pluto from sun is 40 times than the distance of earth from sun. If the mass of earth and Pluto is same, then find the ratio of gravitational force of sun on earth and Pluto.

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Section C Objective Questions Vsqs

1. Define acceleration due to gravity.

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2. By neglecting the air resistance is a heavy and light body each have same acceleration due to gravitation ?

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3. Mention the magnitude of g and G on the centre of earth.

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4. Mention scalar and vector from g and G.

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5. Where does the acceleration due to gravity is larger, equator or poles of the earth? Why?

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6. The magnitude of gravitational intensity at a point is 0.7 N/kg. What would be the magnitude of the gravitational force on a body of 5 kg mass at this point ?

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7. "The value of the escape velocity v_e for a stationary body on the surface of a planet is directly proportional to the mass and the radius of the planet". Is this statement true? If not, correct it and write it.

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8. Shape of the earth is not perfect spherical. How we can say ?

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9. How much radius of earth at equator is grater than the radius at poles of earth

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10. Write dimensional formula of acceleration.

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11. Write the unit and dimensional formula of ratio of gravitational constant and acceleration of gravity.

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12. As we move from poles to equator of earth, the magnitude of acceleration due to gravity increases/decreases correct the sentence.

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13. As we move far from the earth's surface the magnitude of acceleration due to gravity .....

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14. If the magnitude acceleration of gravity on the surface of earth is g, then at height from the surface equal to the radius of earth what will be the magnitude of g?

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15. If the radius of earth is reduced without changing the mass of earth then magnitude of g increases or decrease ?

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16. If radius of the earth is reduced by n times without changing its mass, then what will be the magnitude of g'_e at the surface of earth?

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17. Where does the acceleration due to gravity is larger, equator or poles of the earth? Why?

Watch Video Solution

18. Where does the acceleration due to gravity is larger, equator or poles of the earth? Why?

Watch Video Solution

19. The gravitation force exerted on rocket a time to height h from the surface of earth is $\frac{1}{3}$ time to the gravitation force exerted at the surface of sea. Then obtain the relation between h and R_e (radius of earth).

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20. Find the weight of body of mass 10 kg.

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21. Mention the SI unit of mass and weight.

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22. State difference of mass and weight.

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23. If a body have weight 1 N, then its mass .....

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24. What is the torque acting on the centre of mass due to gravitational force ?

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25. If the radius of the earth is doubled without changing its mass, what will be the change in weight of body of m on the surface of earth ?

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26. If radius of earth becomes half, then find the weight.

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27. If the radius of the earth becomes half of its present value but its density remains unchanged then find the weight of body on the surface of earth.

Watch Video Solution

28. The radii of two planets are R_1 and R_2 and their densities are ρ_1 and ρ_2 respectively. Then find ratio of acceleration due to gravity on the planets.

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29. Distance between two bodies A and B is r. The gravitational force acting on them is inversely proportional to the square of distance. Gravitational force between them varies universally as the 4^{th} power of distance then find the accleration of body A.

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30. What is the acceleration due to gravity on the surface of a planet that has twice the mass and radius of the earth?

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31. What is effect due to latitude on the acceleration due to gravity of any place on the earth?

View Text Solution

32. Find g on polar region due to rotation of earth.

View Text Solution

33. Find g on equator due to rotation of earth.

View Text Solution

34. Find the difference between 'g' on pole and 'g' on equator due to rotation of earth. &p - Se = (g) - (g- R.02) Ep = R.02

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35. Shape of the earth is not perfect spherical. How we can say ?

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36. Why do we feel dizzy on a merry-go-round rotating in vertically upward direction ?

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37. At which place on the surface of the earth the value of g is maximum ? Gives its reasons.

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38. If both the mass and the radius of earth decrese by 1% find percentage change in g.

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39. If a person goes to a height equal to radius of earth from its surface, what would be his weight relative to that

on the earth ? And he goes to a same depth, what would be his weight? (i) For height h = Re

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40. How is acceleration due to gravity affected by rotation of earth about its axis ?

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41. If earth stops rotating, what is effect in the value of 'g' at equator ?

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42. When an spacecraft goes from earth to moon along a straight path, what changes occurs in weight?

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43. Which is the important physical quantity required for the description of any force field ?

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44. Gravitational potential of a body of mass mon the surface of earth is ϕ , then what is gravitational potential of body of mass 2m ?

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45. Define gravitational potential. Give its unit. Is gravitational potential vector or scalar ?

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46. The escape velocity for body of mass 1 kg from earth surface is 11.2 km/s, the escape velocity of another body of mass 10 kg will be what ?

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47. On which two physical quantities escape velocity of body thrown on the earth does not depend?

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48. Define intensity of gravitation and write its equation, unit and dimensional formula

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49. What is a relation between Intensity of gravitation and gravitational potential on a point ?

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50. The magnitude of gravitational potential energy at a distance r from the centre of earth is U, then show the weight at this point in the form of U.

Watch Video Solution

51. Is fuel required for a satellite to orbit the earth?

Watch Video Solution

52. For a satellite escape velocity is 11.2 km/s from the earth. If the satellite is launched at an angle of 60° with vertical, then find the escape speed.

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53. Is it necessary to give initial speed of 11.2 km/s to a rocket for its separation from the earth ?

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54. Why the lighter gases like H_2, H_e are rare in earth ?

Watch Video Solution

55. Name two factors which determine whether a planet has an atmosphere or not.

Watch Video Solution

56. Is the angular velocity of planet dependon mass?

Watch Video Solution

57. Let a planet revolving close to the earth, Obtain relation between escape speed and orbital speed.

Watch Video Solution

58. Does speed of planet remain constant in an orbit?

Watch Video Solution

59. What is the effect of decreasing the height of a satellite orbiting around earth on its time period?

Watch Video Solution

60. The escape velocity on the surface of earth is 11.2 km/s. What will be its value on a planet having double the radius and eight times the mass of earth?

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61. Find the kinetic energy needed to project a body of mass m from the surface of earth to infinity.

Watch Video Solution

62. What is the escape velocity from a black hole ?

Watch Video Solution

63. As astronaut dropped a spoon from outside spacecraft will the spoon reach the surface of earth?

Watch Video Solution

64. Give the name of first Indian Astronaut.

Watch Video Solution

65. What is the frequency of oscillation of a pendulum mounted in a lift that is freely falling under gravity ?

Watch Video Solution

66. Distance of two planets from the sun are 10^11 m and 10^{10} m respectively. Then find the ratio of time period of these two planets.

Watch Video Solution

67. In Bohr's model, the atomic radius of the first orbit is r. Then, the radius of the third orbit is

Watch Video Solution

68. If any satellite has kinetic energy $6 \times 10^9 J$, then what its potential energy ? Total energy?

Watch Video Solution

69. A satellite has potential energy $-8 \times 10^9 J$, then what is its binding energy (escape energy)?

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70. The ratio between Bohr radii is

A. 1 : 2 : 3

B. 2 : 4 : 6

C. 1 : 4 : 9

D. 1 : 3 : 5

Answer:

Watch Video Solution

71. What are the factors on which escape velocity depends on ?

Watch Video Solution

72. The period of revolution of a satellite in an orbit becomes 8 times then what will be its radius of orbit?

Watch Video Solution

73. Why rocket does not have escape energy ?

Watch Video Solution

74. Why satellite does not have escape velocity ?

Watch Video Solution

75. What is the direction of rotation of polar satellite ?

Watch Video Solution

76. In what direction does earth rotate ?

Watch Video Solution

77. Why we can observed a whole surface of earth with the help of polar satellite ?

Watch Video Solution

78. When a body brought from infinity to r distance, its potential energy .....

(Fill in the blank)

Watch Video Solution

79. Give the revolution period of our moon around the earth and rotation period of moon about its axis.

Watch Video Solution

80. What is the gravitational potential at infinity distance from the centre of earth ?

Watch Video Solution

Section D Ncert Exemplar Solutions Multiple Choice Questions Mcqs

1. The earth is an approximate sphere. If the interior contained matter which is not of the same density everywhere, 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 in an approximate 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 the earth and mercury is not inverse square law

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

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

Answer: C

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3. Different points in the earth are at slightly different distances from the sun and hence experience different forces 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. 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

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5. Both the earth and the moon are subject 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 the earth

Answer: B

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

A. will not move around the sun, since they have very small masses compared to the 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 obey Kepler's laws

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

Answer: D

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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 relevant in determining the gravitational force on it by an external mass

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

C. That the acceleration due to gravity on the 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 Mare respectively 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. At subsequent times before any collision takes place.

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

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9. If the law of gravitation, instead of being inverse square law, becomes an inverse cube law

A. planets will not have elliptic orbits

B. circular orbits of planets is 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 as spherical shell of uniform density

Answer: A::C

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10. If the mass of the sun were ten times smaller and gravitational constant G were ten times larger in magnitude. Then,

A. walking on ground would become more difficult

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

C. raindrops will fall much faster

D. airplanes will have to travel much faster

Answer: A::C::D

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11. 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 will still be valid

Answer: A::C::D

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12. 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 that 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

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13. Supposing Newton's Law of gravitation for gravitation forces F_1 and F_2 between two masses my and m, at positions r_1 and r_2 read

$$F_1 = -F_2 = -\frac{r_{12}}{r_{12^3}} GM_0^2 \left(\frac{m_1 m_2}{M_0^2}\right)^2$$

where M_0 is a constant of dimension of mass, $r_{12} = r_1 - r_2$ and n is a number. In such a case,

A. the acceleration due to gravity on the 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

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14. 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 east-west direction.

Answer: A::C

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15. 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. is close to each other for objects, say of sizes less than 100 m

Answer: D

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Section D Ncert Exemplar Solutions Miultiple Choice Questions More Than One Options

1. Which of the following options 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::D

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Section D Ncert Exemplar Solutions Very Short Answer Type Question

1. Molecules 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.

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

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3. Draw areal velocity versus time graph for mars.

Watch Video Solution

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

Watch Video Solution

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

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

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7. 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 hollow sphere or by some other means ?

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8. An astronaut inside a small space ship 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 ?

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9. The gravitational force between a hollow spherical shell (of radius R and uniform density) and a point mass is E. 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

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

Watch Video Solution

11. What is the angle between the equatorial plane and the orbital plane of (a) polar satellite ? (b) geostationary satellite ?

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Section D Ncert Exemplar Solutions Short Answer Type Question

1. 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. As per diagram, the earth moves from the point P to Q in one solar day.

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2. 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.

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

(a) KE versus orbital radius R

(b) PE versus orbital radius R

(b) TE versus orbital radius R

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4. Shown are several curves (fig. (a), (b), (c), (d), (e), (f)). Explain with reason, which ones amongst them can be possible trajectories traced by a projectile (neglect air

friction).

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5. 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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6. 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 (figure).

If the mass is moved further away such that OP becomes 2h by what factor the force of gravitation will decrease, if h = r?

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Section D Ncert Exemplar Solutions Long Answer Type Question

1. A star like the sun has several bodies moving around it at different distances. Consider that all of them are moving in circular orbits. Letr be the distance of the body from the centre of the star and let its linear velocity be v, angular velocity , ω kinetic energy K, gravitational

potential energy U, total energy E and angular momentum I. As the radius r of the orbit increases, determine which of the above quantities increase and which ones decrease. As shown in figure, where a body of mass m is revolving around a star of mass M. Linear velocity of the body,

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2. Six point masses of mass m each are at the vertices of a regular hexagon of side l. Calculate the force on any of the masses.

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3. A satellite is to be placed in equatorial geostationary orbit around the earth for communication.

(a) Calculate height of such a satellite.

(b) Find out the minimum number of satellites that are needed to cover entire earth, so that atleast one satellite is visible from any point on the equator.

$[M = 6 \times 10^{24} kg, R = 6400 km, T = 24 h, G = 667 x 10^{-11}$ SI unit]

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4. Earth's orbit is an ellipse with eccentricity 0.0167. Thus the earth's distance from the sun and speed as it moves

around the sun varles from day-to-day. This means that the length of the solar day is not constant through the year. Assume that the earth's spin axis is normal to its orbital plane and find out the length of the shortest and the longest day. A day should be taken from noon to noon. Does this explain variation of length of the day during the year?

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5. A satellite is in an elliptic orbit around the earth with aphelion of 6R and perihelion of 2R where R = 6400 km is the radius of the earth . Find the velcoity of the satellite at apogee and perigee.[$G = 6.67 \times 10^{-1}$ SI unit and $M = 6 \times 10^{24} kg$]

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Section E Multiple Choice Questions Mcqs

1. Which one of the following is the physical quantity of the unit $\frac{Nm^2}{(kg)^2}$?

A. Linear momentum

B. Gravitational force

C. Universal gravitational constant

D. Acceleration of gravity

Answer: D

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2. For different satellite revolving around a planet in different circular orbit, which of the following shows the relation between the angular momentum L and the orbital radius r?

A. $L \propto r^2$

B. $L \propto \sqrt{r}$

C. $L \propto \frac{1}{r^2}$

D. $L \propto \frac{1}{\sqrt{r}}$

Answer: B

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3. If the gravitational potential at the earth's surface is de

What is the gravitational potential at a height from earth's surface equal to its radius?

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

B. ϕ_e

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

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

Answer: A

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4. If the time period of a satellite in the orbit of radius r around a planet is T. Then the time period of a satellite in

orbit of radius 4r is T = ...

A. 4T

B. 8T

C. 2T

D. 16T

Answer: B

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5. Write dimensional formula of universal constant of gravitation (G).

A. MLT

B. $M^{-1}LT^2$

C. $M^0L^0T^0$

D. $M^{-1}L^3T^{-2}$

Answer: D

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6. If the earth be at one half of its present distance from the sun. How many approximate days will be there in a year ? (Present year of the 365 days. Assume orbit to be circular)

A. 365 days

B. 300 days

C. 200 days

D. 129 days

Answer: D

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7. What kind of relation exists between kinetic energy (E_k) and orbital radius (r) of the satellite revolving around the earth?

A. $E_k \propto r$

B. $E_k \propto r^2$

C. $E_k \propto \frac{1}{r}$

D. $E_k \propto \frac{1}{r^2}$

Answer: C

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8. Geo-stationary satellite is at ..... height from surface of Earth.

A. 3.5860×10^7

B. 4.2260×10^7

C. 3.5860×10^6

D. 4.2260×10^6

Answer: A

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9. Using orbital radius r and the corresponding periodic time T of different satellite revolving around a planet, what would be the slope of graph of $\log T \to \log r$?

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

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

C. 3

D. 2

Answer: A

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10. The diamensional formula of gravitational potential is .....

A. $M^1L^1T^{-1}$

B. $M^0L^2T^{-2}$

C. $M^1L^2T^{-2}$

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

Answer: B

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11. Two satellite revolving around a planet in the same orbit have the ratio of their masses $\frac{m_1}{m_2} = \frac{1}{4}$ The ratio of

their orbital velocities $\frac{v_1}{v_2} = ...$

A. 1

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

C. 2

D. 4

Answer: A

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12. The magnitude of gravitational intensity at a point is 0.7 N/kg. What would be the magnitude of the gravitational force on a body of 5 kg mass at this point ?

A. 0.14 N

B. 3.5 N

C. 7.14 N

D. 0 N

Answer: B

Watch Video Solution

13. The SI unit of $\frac{g}{G}$ is .....

A. kg/m^2

B. kg/m

C. kgm^2

D. $kg.\ m$

Answer: A

Watch Video Solution

14. How much radius of earth at equator is grater than the radius at poles of earth

A. 21 m

B. 24 km

C. 24 m

D. 21 km

Answer: A

Watch Video Solution

15. The time period of polalr satellite is almost [April - 2015)

A. 100 days

B. 100 minutes

C. 100 hours

D. 100 seconds

Answer: B

Watch Video Solution

16. The radii of two planets are R_1 and R_2 and their densities are ρ_1 and ρ_2 respectively. Then find ratio of acceleration due to gravity on the planets.

A. $\frac{r_2}{r_1} \cdot \frac{\rho p_1}{\rho_2}$

B. $\frac{r_2\rho_2}{r_1\rho_1}$

C. $\frac{r_1}{r_2} \cdot \frac{\rho p_2}{\rho_1}$

D. $\frac{r_1\rho_1}{r_2\rho_2}$

Answer: B

Watch Video Solution

17. Which of the following graph shows the variation in the value of 'g' with increasing distance from the centre of the earth. [R_e = Radius of earth]

A. 

B. 

C. 

D. 

Answer: D

View Text Solution

18. The largest and the shortest distance of the earth from the sun are r_1 and r_2 . Its distance from the sun when it is at pependicular to the major-axis of the orbit drawn from the sun is .....

A. $\frac{r_1 + r_2}{4}$

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

C. $\frac{2r_1 r_2}{r_1 + r_2}$

D. $\frac{r_1 + r_2}{3}$

Answer: C

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19. A satellite A of mass m is at a distance of r from the surface of the earth. Another satellite B of mass 2m is at a distance of 2r from the earth's centre. Their time periods are in the ratio of

A. $1:2$

B. $1:16$

C. $1:32$

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

Answer: D

Watch Video Solution

20. If the gravitational force between two objects were proportional to $\frac{1}{R}$ (and not as $\frac{1}{R^2}$) where R is the distance between them, then a particle in a circular path (under such a force) would have its orbital speed v_1 proportional to .....

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

B. R°

C. R^1

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

Answer: B

Watch Video Solution

21. The radius of earth is about 6400 km and that of mars is 3200 km. The mass of the earth is about 10 times mass of mars. An object weights 200 N the surface of earth its weight on the surface of mars will be .....

A. 8 N

B. 20 N

C. 40 N

D. 80 N

Answer: D

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22. The distance of two planets from the sun are 10^{13} m and 10^{12} m respectively. The ratio of time period of the planets is .....

A. $\sqrt{10}$

B. 100

C. $10\sqrt{10}$

D. $\frac{1}{\sqrt{10}}$

Answer: C

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23. The earth (mass $= 6 \times 10^{24}$ kg) revolves around the sun with an angular velocity of 2×10^{-7} rad/s in a circular orbit of radius 1.5×10^{8} km. The force exerted by the sun on the earth, in newton, is .....

A. 18×10^{25}

B. zero

C. 27×10^{39}

D. 36×10^{21}

Answer: D

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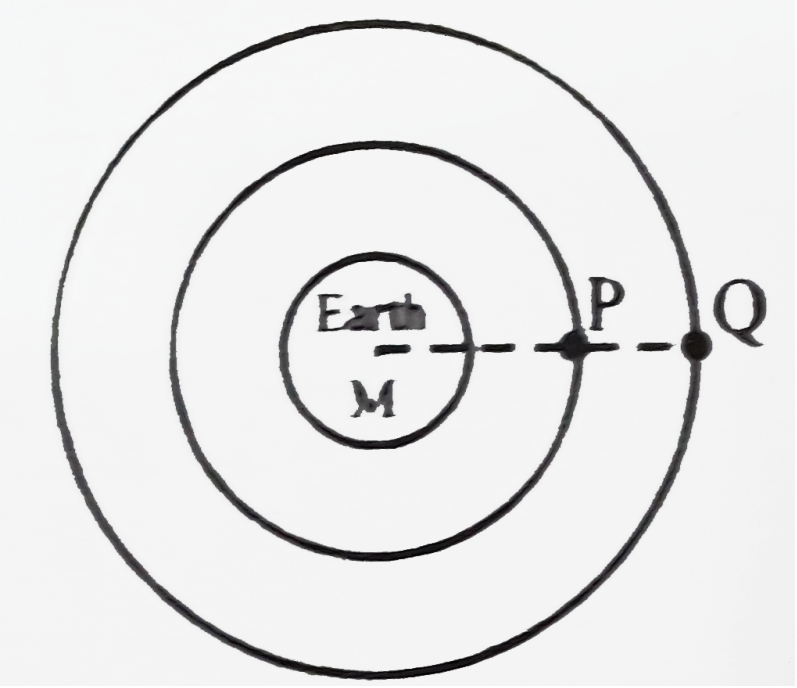
24. A satellite P is revolving around the earth at a height = h radius of earth=(R) above equator. Another satellite Q is at a height =$2h$ revolving in oppisite direction. At an instant the two are at same vertical line passing through centres of sphere. Find the least time of after which again they are in this situation.



A. It will continue to move with the same speed v along the original orbit of spacecraft

B. It will move with the same sprad, tangentally to the spacecraft.

C. It will fall down to earth gradually.

D. It will go very far in the space

Answer: A

Watch Video Solution

25. The acceleration due to gravity on the planet. A is 9 times the acceleration due to the gravity on planet B. A

man Jumps to a height of 2m on the surface of A. What is the height of jump by the same person on the planet B ?

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

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

C. 18 m

D. 6 m

Answer: C

Watch Video Solution

26. Two spheres of masses m and M are situated in air and the gravitational force between them is F. The space

around the masses is now filled with a liquid of specific gravity 3. The gravity force will now be .....

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

B. 3F

C. F

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

Answer: C

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27. The density of a newly discovered planet is twice that of earth. The acceleration due to gravity at the surface of the planet is equal to gravity at the surface the planet is

equal to that at the surface of the earth. If the radius of the earth is R , the radius of the planet would be .....

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

B. 2R

C. 4R

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

Answer: A

Watch Video Solution

28. Imagine a new planet having the same density as that of earth but it is 3 times bigger than the earth in size. If

the acceleration due to gravity of the surface of earth is g and that on the surface of the new planet is g', then .....

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

B. $g' = 27g$

C. $g' = 9g$

D. $g' = 3g$

Answer: D

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29. The earth is assumed to be a sphere of radius R. A platform is arranged at a height R from the surface of the earth. The escape velocity of a body from this platform is

fu, where v is its escape velocity from the surface of the earth the value of f is .....

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

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

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

D. $\sqrt{2}$

Answer: A

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30. The figure shows elliptical orbit of a planet m about the sun S. The shaded area SCD is twice the shaded are SAB. If t_1 is 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

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31. A particle of mass M is situated at the center 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. $-\frac{3GM}{a}$

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

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

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

Answer: A

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32. A particle of mass m is thrown upwards from the surface of the earth, with a vilocity U. The mass and the radius of the earth are respectively, M and G is

gravitational constant and g is acceleration due to gravity on the surface of the earth. The minimum value of U so that the particle does not return back to earth, is.....

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

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

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

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

Answer: A

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33. Which one of the following plots represent the variation of gravitational field on a particle with distance r

due to a thin spherical shell of radius R? (r is measured from the centre of the spherical shell)

A. 

B. 

C. 

D. 

Answer: B

View Text Solution

34. Average densities of two planets is same but their radii are R_1 and R_2. If the acceleration of gravity on planets are g_1 and g_2 respectively, then

A. $\frac{g_1}{g_2} = \frac{R_1}{R_2}$

B. $\frac{g_1}{g_2} = \frac{R_2}{R_1}$

C. $\frac{g_1}{g_2} = \frac{R_1^2}{R_2^2}$

D. $\frac{g_1}{g_2} = \frac{R_1^3}{R_2^3}$

Answer: A

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35. Escape velocity for earth surface is 11 km/s. If the radius of any planet is two times the radius of the earth but average density is same that of earth, then the escape velocity at the planet will be .....

A. 22 km/s

B. 11km/s

C. 5.5 km/s

D. 15.5 km/s

Answer: A

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36. If v_0 be the orbital velocity of a satellite in a circular orbit close to the earth's surface and v_e is the escape velocity from the earth, then relation between the two is .....

A. $v_e = v_o$

B. $\sqrt{2}v_o = v_e$

C. $v_e = \frac{v_o}{\sqrt{2}}$

D. No relation between v_e and v_o

Answer: B

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37. The motion of planet in the solar system is an example of the conservation of .....

A. mass

B. linear momentum

C. angular momentum

D. energy

Answer: C

Watch Video Solution

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

(G = gravitational constant and g = acceleration due to gravity)

A. $\left(\frac{GM}{r}\right)^{\frac{1}{2}} \leq C$

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

C. $\left(\frac{2GM}{r}\right)^{\frac{1}{2}} \geq c$

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

Answer: A

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39. The force of gravitation is .....

A. repulsive

B. conservative

C. electrostatic

D. non - conservative

Answer: B

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40. Geo-stationary satellite is at ..... height from surface of Earth.

A. 16000 km

B. 22000 km

C. 28000 km

D. 36000 km

Answer: D

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41. Which of the following statement is true?

A. g is less at the earth's surface than at a height above it or a depth below it.

B. g is same at all places on the surface of the earth

C. g has its maximum value at the equator .

D. g is greater at the poles than at the equator

Answer: D

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42. The mass and diameter of a planet have twice the value of the corresponding parameters of earth. The acceleration on the surface of planet .....

A. $9.8m/s^2$

B. $4.9m/s^2$

C. $980m/s^2$

D. $19.6m/s^2$

Answer: B

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43. The value of g at a particular point is $9.8m/s^2$ Suppose the earth suddenly shrinks uniformly to half its present size without losing any mass. The value of g at the same point (assuming that the distance of the point from the centre of the earth does not shrink) will now be : .....

A. $4.9m/s^2$

B. $3.1m/s^2$

C. $9.8m/s^2$

D. $19.6m/s^2$

Answer: C

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

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

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

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

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

Answer: C

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45. If the angular speed of earth increases two times then the acceleration of gravity (g) at north pole becomes .....

A. twice

B. half

C. same as it is

D. zero

Answer: C

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46. The relation between acceleration of gravity at pole and at an equator of earth is .....

A. $g_p < g_e$

B. $g_p = g_e = g$

C. $g_p = g_e < g$

D. $g_p > g_e$

Answer: D

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47. If the mass of earth is M, radius R and G is universal gravitational constant then the workdone against gravity to move a body of mass 1 kg from the surface of earth to infinity will be

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

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

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

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

Answer: B

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48. The density of a planet is ρ The orbital period of a satellite revolving around it with remaining close to its surface is .....

A. $\left(\frac{3\pi}{G\rho}\right)^{\frac{3}{2}}$

B. $\left(\frac{3\pi}{G\rho}\right)^{\frac{1}{2}}$

C. $\left(\frac{3\pi}{2G\rho}\right)^{\frac{3}{2}}$

D. $\left(\frac{3\pi}{2G\rho}\right)^{\frac{1}{2}}$

Answer: B

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49. The escape velocity from the surface of earth is v_e . The escape velocity from the surface of a planet whose mass and radius are 3 times those of the earth will be .....

A. v_e

B. $3v_e$

C. $9v_e$

D. $27v_e$

Answer: A

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50. A body weight 72 N moves from the surface of earth at a height half of the radius of the earth , then gravitational force exerted on it will be .....

A. 72 N

B. 28 N

C. 10 N

D. 32 N

Answer: D

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51. The radius of the earth is 4 times that of the moon and its mass is 80 times that of the moon. If the acceleration due to gravity on the surface of the earth is $10m/s^2$ that on the surface of the moon will be .....

A. $1ms^{-2}$

B. $2ms^{-2}$

C. $3ms^{-2}$

D. $4ms^{-2}$

Answer: B

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

A. 2.5R

B. 4.5 R

C. 7.5R

D. 1.5R

Answer: C

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53. Suppose the gravitational force varies inversely as the nth power of distance. Then the time period of planet in circular orbit of radius R around the sun will be proportional to .....

A. $R^{\left(\frac{n+1}{2}\right)}$

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

C. R^n

D. $R^{\left(\frac{n-2}{2}\right)}$

Answer: A

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

A. gx

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

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

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

Answer: D

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55. A particle of mass 10 g is kept of the surface of a uniform sphere of mass 100 kg and radius 10 cm. Find the work to be done against the gravitational force between them to take the particle far away from the sphere. (Take $G = 6.67 \times 10^{-11} Nm^2 / kg^2$?

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

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

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

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

Answer: B

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56. A planet in a distant solar system is 10 times more massive than the earth and its radius is 10 times smaller. Given that the escape velocity from the earth is $11kms^{-1}$, the escape velocity from the surface of the planet would be .....

A. $1.1kms^{-1}$

B. $11kms^{-1}$

C. $110kms^{-1}$

D. $0.11kms^{-1}$

Answer: C

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

A. $\sqrt{2}R$

B. 2R

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

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

Answer: B

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58. Four particles, each of mass M and equidistant "from each other, move along a circle of radius R under the action of the mutual gravitational attraction. The speed of each particle is ..... (G = universal gravitational constant)

A. $\sqrt{\frac{GM}{R}\left(1+2\sqrt{2}\right)}$

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

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

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

Answer: B

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59. From a solid sphere of mass M and radius $\frac{R}{2}$ aspherical portion of radius ž is romoved as shown in figure. Taking gravitational potential V = 0 and $r = \infty$, the potential at the centre of the cavity thus form is ..... . (G = Gravitational constant)

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

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

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

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

Answer: B

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60. Kepler's third law states that square of period of revolution (T) of a planet around the sun is proportional to third power of average distance r between sun and planet. That means $T^2 = Kr^3$ here K is constant.

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

A. $GK = 4\pi^2$

B. $GMK = 4\pi^2$

C. $K = G$

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

Answer: B

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61. A satellite s is moving in an elliptical orbit ,paround the earth. The mass of the satellite is very small compared to the mass of the earth, Then,

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

B. The angular momentum of s about the centre of the earth changes in direction, but its magnitude remains constant.

C. The total mechanical energy of s varies periodically with time.

D. The magnitude of s remains constant

Answer: A

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62. A remote - sensing satellite of earth revolves in a circular orbit at a height of 0.25 x 106 m above the surface of earth. It earth's radius is $6.38 \times 10^6 m$ and $g = 9.8 ms^{-2}$, then the orbital speed of the satellite is .....

A. $6.67 kms^{-1}$

B. $7.76 kms^{-1}$

C. $8.56 kms^{-1}$

D. $9.13 kms^{-1}$

Answer: B

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63. Find the weight of the atmosphere around the earth (take the radius of earth as 6400km.)

A. 1600 km

B. 1400 km

C. 2000 km

D. 2600 km

Answer: D

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64. Starting from the centre of the earth having radius R, the variation of g (acceleration due to gravity) is shown by which one of the following graph ?

A. 

B. 

C. 

D. 

Answer: D

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65. These both situation is truely shown in graph (D) A satellite of mass m is orbiting the earth (of radius R) at a height h from its surface. The total energy of the satellite in terms of g_0 , the value of acceleration due to gravity at the earth's surface, is

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

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

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

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

Answer: D

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66. Imagine Earth to be a solid sphere. If the value of acceleration due to gravity at a depth 'd' below Earth's surface is the same as its value at a height 'h' above its surface and is equal to $\frac{g}{4}$ then the ratio of $\frac{h}{d}$ will be .....

A. 1

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

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

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

Answer: B

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67. A satellite of mass m revolving in a circular orbit of radius $3R_E$ around the earth (mass of earth is Me and radius is R_E). How much excess energy be spent to bring it to orbit of radius $9R_E$?

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

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

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

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

Answer: D

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68. Which of the following is the evidence to show that there must be a force acting on earth and directed towards the sun ?

A. Deviation of the falling bodies towards east.

B. Revolution of the earth round the sun

C. Phenomenon of day and night

D. Apparent motion of sun round the earth.

Answer: B

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

A. $-2mgR_e$

B. $2mgR_e$

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

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

Answer: D

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70. Suppose the gravitational force varies inversely as the nth power of distance. Then the time period of planet in circular orbit of radius R around the sun will be proportional to .....

A. $R^{\left(\frac{n+1}{2}\right)}$

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

C. R^n

D. $R^{\left(\frac{n-2}{2}\right)}$

Answer: A

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

A. $K_B > K_A > K_C$

B. $K_B > K_A > K_C$

C. $K_B > K_A > K_C$

D. $K_B > K_A > K_C$

Answer: D

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72. If the mass of the sun were ten times smaller and gravitational constant G were ten times larger in magnitude. Then,

A. g' on the Earth will not change .

B. Reindrops will fall faster

C. Time period of a simple pendulum on the Earth would decrease

D. Walking on the ground would become more difficult.

Answer: A

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73. At what temperature will the rms speed of oxygen molecules become just sufficient for escaping from the Earth's atmosphere ? (Given : Mass of oxygen molecule (m) $= 2.76 \times 10^{-26} kg$, Boltzmann's constant $k_B = 1.38 \times 10^{-23} JK^{-1}$)

A. $1.254 \times 10^4 K$

B. $2.508 \times 10^4 K$

C. $5.016 \times 10^4 K$

D. $8.360 \times 10^4 K$

Answer: D

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Section F Questions From Module

1. Two particles of equal mass m move around a circle of radius R under the influence of their mutual gravitational attraction, the speed of each particle with respect to their center of mass will be .....

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

B. $\sqrt{\frac{Gm}{4R}}$

C. $\sqrt{\frac{Gm}{3R}}$

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

Answer: B

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2. The gravitational force between two stones each of mass 1 kg placed at a distance of Im in vaccum is .....

A. zero

B. $6.675 \times 10^{-5} N$

C. $6.675 \times 10^{-11} N$

D. $6.675 \times 10^{-8} N$

Answer: C

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

A. $\frac{GMm}{12R}$

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

C. $\frac{GMm}{8R^2}$

D. $\frac{GMm}{6R}$

Answer: D

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4. If v_0 be the orbital velocity of a satellite in a circular orbit close to the earth's surface and v_e is the escape velocity from the earth, then relation between the two is .....

A. $v_o = \sqrt{2v_c}$

B. $v_o = v_c$

C. $v_c = v_o\sqrt{2}$

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

Answer: D

Watch Video Solution

5. The density of earth increased 4 times and its radius becomes half then our weight will ....

A. be four times its present value

B. be doubled

C. remains same

D. be halved

Answer: B

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6. If the speed of rotation of earth increases from existing speed, then the weight of a body is .....

A. increases at an equator and remain unchanged at pole.

B. decreases at an equator and remain unchanged at poles.

C. remains unchanged at an equator but decreases at poles.

D. remains unchanged at an equator but increases at poles.

Answer: B

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7. For satellite rotating in an orbit around the earth the ratio of kinetic energy to potential energy is .....

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

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

C. 2

D. $\sqrt{2}$

Answer: A

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8. A body of mass m taken from the earth's surface to the height h = 3R (R = Radius of earth) The change in gravitational potential energy of the body will be .....

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

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

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

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

Answer: B

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9. The mass and diameter of a planet have twice the value of the corresponding parameters of earth. The acceleration on the surface of planet .....

A. $9.8m/\sec^2$

B. $4.9m/\sec^2$

C. $980m/\sec^2$

D. $19.6m/\sec^2$

Answer: B

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10. Two planets if radii in the ratio 2:3 are made from the material of density in the ratio 3:2. Then the ratio of acceleration due to gravity at the surface of the two planets will be .....

A. $1:1$

B. $2:25:1$

C. $4:9$

D. $0:12:1$

Answer: A

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11. The escape speed of body thrown vertically from the surface of earth is 11 km/s. If this body thrown at 45° to vertical then its escape speed will be .....

A. $11\sqrt{2}$ km/s

B. 22 km/s

C. 11 km/s

D. $\frac{11}{\sqrt{2}}$ km/s

Answer: C

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12. Two planet of masses in the ratio 1:2, its radii in the ratio 1:2. Then the ratio of acceleration due to gravity will be .....

A. $1:2$

B. $2:1$

C. $3:5$

D. $5:3$

Answer: B

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13. Two satellite A and B go around a planet in circular orbits having radii 4R and R respectively. If the speed of satellite A is 3v, the speed of satellite B would be .....

A. 12v

B. 6v

C. $\frac{4}{2}v$

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

Answer: B

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14. What would be the angular speed of earth, so that body lying on equator may appear weightless?

($g = 10m/s^2$, radius of earth = 6400 km)

A. 1.25×10^{-3} rad/sec

B. 1.56×10^{-3} rad/sec

C. 1.25×10^{-1} rad/sec

D. 1.56×10^{-1} rad/sec

Answer: A

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15. The time period of a satellite of earth is 5 hr. If the seperation between the earth and satellite is increased to 4 times the previous value the new time period will become ....

A. 10 hr

B. 80 hr

C. 40 hr

D. 20 hr

Answer: C

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16. If radius of earth is R, then the height h at which the value of 'g' becomes one fourth is .....

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

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

C. R

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

Answer: C

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17. A satellite A of mass m is at a distance of r from the surface of the earth. Another satellite B of mass 2m is at a

distance of 2r from the earth's centre. Their time periods are in the ratio of

A. $1:2$

B. $1:16$

C. $1:32$

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

Answer: D

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18. A geostationary satellite is revolving around the earth. To make it escape from gravitational field of earth its velocity must be increase .....

A. $100\ \%$

B. $41.4\ \%$

C. $50\ \%$

D. $59.6\ \%$

Answer: B

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19. The velocity with which a projectile must be fired so that it escapes earth's gravitation, does not depend on .....

A. mass of the earth

B. mass of projectile

C. radius of the projectile orbit.

D. gravitational constant (G)

Answer: B

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20. The escape velocity of the surface of earth is 11.2 km/s. What would be the escape velocity of the surface of another planet of the same mass but $\frac{1^{th}}{4}$ times the radius of the earth ?

A. 44.8 km/s

B. 22.4 km/s

C. 5.6 km/s

D. 11.2 km/s

Answer: B

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Questions Paper Section A

1. The magnitude of gravitational intensity at a point is 0.7 N/kg. What would be the magnitude of the gravitational force on a body of 5 kg mass at this point ?

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2. If potential energy of a satellite is $-8 \times 10^9 J$, then its binding energy is ..... .

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3. State and prove Kepler's second law (Law of Areas) of planetary motion.

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4. Why G called the universal constant in Newton's law of universal gravitation ?

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5. Mention SI unit of $\frac{G}{g}$

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6. Who provides the centripetal force to geostationary satellite ?

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Questions Paper Section B

1. Define intensity of gravitation and write its equation, unit and dimensional formula

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2. Derive the expression of escape velocity (esape speed) of a stationary body on the surface of earth.

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Questions Paper Section C

1. A 70 kg man stands in contact against the inner wall of a hollow cylindrical drum of radius 3 m rotating about its vertical axis with 200 rev/min. The coefficient of friction between the wall and his clothing is 0.15. What is the minimum rotational speed of the cylinder to enable the

man to remain stuck to the wall (without falling) when the floor is suddenly removed ?

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

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Questions Paper Section D

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

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