PHYSICS

BOOKS - MODERN PUBLICATION

Motion of Satellites

Example

1. An artificial satellite circles around the earth at a distance of 3400km. Calculate the period

of revolution and orbital velocity. given radius of the earth-6400km g= 980cms^{-2}

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2. The mean orbital radius of the earth around the sun is 1.5×10^8 km. Estimate the mass of the sun, if G=$6.67 \times 10^{-11} Nm^2 kg^{-2}$

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3. The period of moon around the earth is 27-3 days and the radius of the orbit is $3.9x10^5km$. If G= $6.67 \times 10^{-11}Nm^2kg^{-2}$, find the mass of the earth.

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4. An earth's satellite makes a circle around the earth in 90 minutes. Calculate the height of the satellite above the earth's surface. Given

radius of the earth is 6400 km and g= $980 cm s^{-2}$

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5. Two satellites A and B, each of mass 50 kg are in circular orbits at altitudes of 1,000 km and 35,000 km respectively. What is the difference in the gravitational potential energies of the two satellites in their respective orbits? Given that mass of the

earth, M=$6x10^{24}kg$ radius of the earth, R= 6.4×10^6 m and G=$6.67x10^{-11}Nm^2kg^{-2}$

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6. A satellite is moving in an orbit of radius raround the earth. Find the ratio of its kinetic energy to potential energy

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7. A satellite is moving in an orbit of radius raround the earth. Find the ratio of its kinetic energy to total energy of the satellite

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8. A satellite orbits the earth at a height of 500 km from its surface. Compute its kinetic energy. Given, mass of satellite = 300 kg, mass of the earth-$6.0x10^{24}kg$, radius of the earth - $6.4x10^{6}$ m, G-$6.67 \times 10^{-11}Nm^{2}kg^{-2}$

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9. A satellite orbits the earth at a height of 500 km from its surface. Compute its potential energy. Given, mass of satellite = 300 kg, mass of the earth-$6.0x10^{24}kg$, radius of the earth - $6.4x10^{6}$ m, G-$6.67 \times 10^{-11}Nm^{2}kg^{-2}$

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10. A satellite orbits the earth at a height of 500 km from its surface. Compute its potential

energy. Given, mass of satellite = 300 kg, mass of the earth-$6.0x10^{24}kg$, radius of the earth - $6.4x10^{6}$ m, G-$6.67 \times 10^{-11}Nm^{2}kg^{-2}$

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11. An artificial satellite is moving in a circular orbit around the earth with aspeed equal to half the magnitude of escape velocity from the earth. Determine the height of the satellite above the earth's surface.

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12. An artificial satellite is moving in a circular orbit around the earth with aspeed equal to half the magnitude of escape velocity from the earth. Determine the height of the satellite above the earth's surface.

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13. Consider an earth satellite so positioned that it appears stationary to an observer on earth and serves the purpose of a fixed relay

station for inter-continental transmission of television and other communications. What should be the height at which the satellite should be positioned and what would be the direction of motion? Given, radius of earth, Rs. 6,400 km.

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14. Two satellites S_1 and S_2, revolve round a planet in coplanar circular orbits in the same sense. Their periods of revolutions are 1 h and

8 h respectively. The radius of the orbit of S_1 is 10^4 km. When S_2 is closest to S_1 find (1) the speed of S_2 relative to S_1

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15. Two satellites S_1 and S_2, revolve round a planet in coplanar circular orbits in the same sense. Their periods of revolutions are 1 h and 8 h respectively. The radius of the orbit of S_1 is 10^4 km. When S_2 is closest to S_1 find the

angular speed of S_2 actually observed by an astronaut in S_1

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16. What provides the centripetal force to a satellite revolving around the earth?

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17. Does the orbital velocity depend on the mass of the satellite? Explain

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18. Express time period of a satellite in terms of its density of the planet.

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19. What is the time period and radius of the moon's orbit around the earth?

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20. If suddenly the gravitational force of attraction between earth and a satellite revolving around it becomes zero, what will happen to the satellite?

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21. A satellite of mass 'm' is revolving in a circular orbit of radius 'r' around the earth of mass M. What is the total energy of the satellite?

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22. What are the signs of kinetic energy, potential energy and the total energy of a satellite revolving around the earth?

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23. What is geostationary satellite? Calculate height of geostationary satellite.

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24. What is the sense of rotation of a geostationary satellite?

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25. What is the time period a geostationary satellite?

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26. What is the height of a geostationary satellite above the surface of the earth?

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27. What is a parking orbit?

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28. What is the full form of geostationary satellite "APPLE"?

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29. Name India's first cosmonaut.

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30. Give two uses of geostationary satellite.

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31. Give two uses of polar satellite.

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32. What is weightlessness?

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33. Why does an astronaut in space feel weightlessness?

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34. Answer the following questions : What is the frequency of oscillation of a simple pendulum mounted in a cabin that is freely falling under gravity ?

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35. The earth is acted upon by the gravitational attraction of the sun. Why does not the earth fall into the sun?

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36. The artificial satellite does not have any fuel, but even then it remains orbiting around the earth. Why? Explain.

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37. Why does a satellite need no fuel to go around a planet in its fixed orbit?

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38. If a spoon is dropped from an artificial satellite orbiting around the earth, will it reach the surface of earth? If not, then explain why.

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

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40. Why are space rockets usually launched from west to east?

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41. Is moon a planet? What is the speed of the moon around the sun compared to that of the earth around the sun?

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42. If a satellite going around the earth suddenly loses height, will there be a change in time period of the satellite?

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43. What will be the kinetic energy needed to project a body of mass m from the surface of the earth (radius R) to infinity?

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44. Air friction increases the velocity of satellite. explain.

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45. If an earth's satellite is put in an orbit at some height h,where the resistance due the atmosphere cannot be neglected,how will the motion of the satellite be affected?

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46. When a satellite is suddenly stopped in its orbit, what will happen to it?

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47. Two satellites of same mass are launched in the same orbit round the earth rotate opposite to each other. They collide inelastically and stick together as wreckage. The total energy of the system just after collision is:

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48. A satellite with kinetic energy E_k is revolving round the earth in a circular orbit. How much more kinetic energy should be given, so that it may just escape into the outer space?

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49. State the necessary conditions for a satellite to appear stationary.

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50. State the necessary conditions for a satellite to appear stationary.

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51. If T is period of a satellite revolving just above the surface of a planet whose average density is ρ show that ρT^2 is a universal constant.

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52. what is the difference between ordinary and geostationary satellite?

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53. State the necessary conditions for a satellite to appear stationary.

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54. what is a retrorocket and its function?

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55. Imagine yourself in a spacecraft in circular orbit well behind the space station in the same orbit. You intend to dock with the space station. How can it be done? Explain

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56. It is usually said that inside an artificial satellite, a simple pendulum does not oscillate. Do you agree with the statement? Justify your answer.

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57. A body has a sense of weightlessness in a satellite revolving round the earth.Why?

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58. Why does an astronaut in space feel weightlessness?

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59. The astronauts in a satellite orbiting the Earth feel weightlessness. Does the weightlessness depend upon the distance of the satellite from the Earth ? If so how ? Explain your answer.

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60. A person sitting in an artficial satellite feels weightlessness but a person sitting on moon(which is a satellite of earth) feels some weight.Explain.

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61. An artificial satellite is going around the earth close to its surface Calculate the orbital velocity and time taken by it to complete one

round. The radius of earth = 6,400 km. acceleration due to gravity= $9.8ms^{-1}$

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62. An artificial satellite is going around the earth at a distance of 1600 km. calculate the period of revolution and orbital velocity. given radius of earth = 6400 km and acceleration due to gravity= $9.8ms^{-1}$

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63. A remote sensing satelite of the earth revolves in a circular orbit at a height of 250 km above the earth's surface. What is the orbital speed. radius of earth = 6.38×10^6m and acceleration due to gravity= $9.8ms^{-1}$

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64. A remote sensing satellite of earth revolves in a circular orbit at a height of 250 km above the earth's surface. What is the period of revolution of the satellite. radius of earth =

6.38×10^6m and acceleration due to gravity= $9.8ms^{-1}$

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65. A satellite revolves round a planet in an orbit just above the surface of planet. Taking G- $6.67 \times 10^{-11} Nm^2 kg^{-2}$and the mean density of the planet - $5.51 \times 10^3 kgm^{-3}$, find the period of the satellite.

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66. An artificial satellite is in a circular orbit at 500 km above. the earth's surface. What is the acceleration of the satellite ? Take radius of the earth as 6.5×10^6 m.

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67. An artificial satellite is in a circular orbit at 500 km above. the earth's surface. What is the acceleration of the satellite ? Take radius of the earth as 6.5×10^6 m.

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68. Venus has a rotational period of 243 days. What would be the altitude of a satellite synchronised to be stationary for this planet. Given that radius of the venus is 6,050 km and acceleration due to gravity on its surface is $9.8ms^{-2}$

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69. Two identical satellites A and B are in circular orbits at altitudes of 500 km and 850 km respectively. What is the ratio of their (i) kinetic energies and (ii) potential energies? Given that radius of the earth, R-6.4 x 10^6 m and the gravitational constant, G-$6.67x10^{-11}Nm^2kg^{-2}$

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70. What are the signs of kinetic energy, potential energy and the total energy of a satellite revolving around the earth?

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71. What is the binding energy of the earth-sun system neglecting the effect of presence of other planets and satellites. Given that mass of the earth, $M_e = 6 \times 10^{24}$kg. mass of the sun, $M_s = 2 \times 10^{30}$ kg: distance between

the earth and the sun, r= $1.5x10^{11}$ m and gravitational constant, G= $6.6x10^{-11}Nm^2kg^{-2}$

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72. A satellite of mass 1,000 kg moves in a circular orbit of radius 7,000 km round the earth. Calculate the total energy required to place the satellite in the orbit from the earth's surface Assuming initially it to be at rest. Take $g = 10ms^{-2}$, radius of the carth, R-6,400 km.

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73. A spaceship is launched into a circular orbit close to the earth's surface. What additional velocity has now to be imparted to the spaceship in the orbit to overcome the gravitational pull. Radius of the earth = 6,400 km, g-$9.8ms^2$

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74. A sky laboratory of mass 2×10^3 kg has to be lifted from one circular orbit of radius 2 R into another circular orbit of radius 3 R. Calculate the minimum energy required, if the radius of the earth. R = 6.37×10^6 m and g= $9.8ms^2$?

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75. Show that the moon would depart for ever, if its speed was increased by 42%.

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76. A geostationary satellite is orbiting the earth at a height 6 R above the surface of earth, where R is the radius of the earth. The time period of another satellite orbiting at the height 2.5 R from the surface of the earth will be approximately :

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Exercise

1. Define orbital velocity of a satellite. Obtain an expression for orbital velocity of a satellite.

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2. Define orbital velocity and the time period of a satellite. Derive expressions for these

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3. Define orbital velocity of a satellite. Obtain an expression for orbital velocity of a satellite.

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4. Define orbital velocity and the time period of a satellite. Derive expressions for these

Watch Video Solution

5. Define orbital velocity of a satellite. Obtain an expression for orbital velocity and time period of the satellite.

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6. Define orbital velocity of a satellite. Obtain an expression for orbital velocity and time period of the satellite.

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7. Define orbital velocity of a satellite. Derive an expression for it.

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8. Derive expression for the time period of a satellite revolving around the earth.

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9. Define orbital velocity of a satellite. Obtain an expression for orbital velocity and time period of the satellite.

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10. A satellite of mass m is revolving around a planet of mass M in a fixed circular orbit of radius r. Find expression for its angular momentum.

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11. A satellite is revolving in a circular path close to a planet of density p. Find an expression for its period of revolution.

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12. What do you understand by parking orbits ? Derive an expression for the total energy of a satellite in a circular orbit.

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13. What is geostationary satellite ?Write its two applications.

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14. What do you understand by a geostationary satellite?.

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15. State Kepler's laws of planetary motion. Explain the weightlessness experienced by an astronaut orbiting the earth in a space capsule.

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16. Why does an astronaut in space feel weightlessness?

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17. What is weightlessness? How does the weight of the man vary, when the cabin of the lift moves upwardsnwith an acceleration a?

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18. What is weightlessness? How does the weight of the man vary, when the cabin of the lift moves downwards with an acceleration a?

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19. What is a satellite? Obtain expression for orbital velocity. How do the expressions for orbital velocity and time period modify, when the orbit of the satellite is just above the surface of the earth?

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20. What is a satellite? Obtain expression for period of revolution. How do the expressions for orbital velocity and time period modify,

when the orbit of the satellite is just above the surface of the earth?

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21. What is a satellite? Obtain expression for height of the orbit above the surface of earth. How do the expressions for orbital velocity and time period modify, when the orbit of the satellite is just above the surface of the earth?

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22. Define orbital velocity of a satellite. Obtain an expression for orbital velocity and time period of the satellite.

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23. State the necessary conditions for a satellite to appear stationary.

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24. What is a satellite? Obtain expression for the orbital velocity, time period, altitude and angular momentum of a satellite of mass m revolving around earth at a height h above its surface.

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25. Show that an artificial satellite circling round the earth in an orbit of radius R obeys Kepler's third law s The ratio of the square of

its time period of revolution to the cube of its orbital radius is constant.

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