SATELLITES

1. Three identical bodies of mass M are located at the vertices of an equilateral triangle of side L. They revolve the effect of mutual gravitational force in a circular circumscribing the triangle while preserving the equilateral triangle. Their orbital velocity is:
   (a) $\sqrt{\frac{GM}{L}}$ (b) $\sqrt{\frac{2GM}{L}}$ (c) $\sqrt{\frac{3GM}{L}}$ (d) $\sqrt{\frac{GM}{3L}}$
2. Two satellites X and Y go around the earth in circular orbits at heights of h_X and h_Y respectively from the surface of the earth. Assuming earth to be a uniform sphere of radii R, the ratio of the magnitudes of their orbital velocities is:
   (a) $\frac{h_Y}{h_X}$ (b) $\frac{h_Y+R}{h_X+R}$ (c) $\sqrt{\frac{h_Y}{h_X}}$ **(d)** $\sqrt{\frac{h_Y+R}{h_X+R}}$
3. The total energy of a circularly orbiting satellite is:
   (a) twice the kinetic energy of the satellite (b) half the kinetic energy of the satellite (c) twice the potential energy of the satellite **(d)** half the potential energy of the satellite
4. An artificial satellite moving in a circular orbit around the earth has a total (kinetic + potential) energy E_0. Its potential energy is:
   (a) $3E_0$ **(b)** $2E_0$ (c) $-E_0$ (d) $-2E_0$
5. The ratio of the energy required to raise a satellite upto a height h above the earth of radius R to that the kinetic energy of the satellite into that orbit is:
   (a) R : h (b) h : R (c) R : 2h **(d)** 2h : R
6. Two identical satellites X and Y revolve round the earth in circular orbits at distance 3R and 7R from the surface of the earth. The ratio of the linear momenta of X and Y is (R = radius of the earth):
   (a) 2 : 1 (b) 1:1 **(c)** $\sqrt{2}$: 1 (d) 1 : $\sqrt{2}$
7. Two satellites X and Y go round a planet P in circular orbits having radii 9R and 4R respectively. If the speed of the satellite X is 3v, the speed of satellite B will be:
   (a) 9v/2 (b) 4v (c) 2v/3 (d) v
8. Two satellites are orbiting around the earth in circular orbits of the same radius. One of them is 1000 times greater in mass than the other. Their period of revolution are in the ratio:
   (a) 1: 10 **(b)** 1: 1 (c) 1: 100 (d) 1: 1000
9. The orbit of geostationary satellite is circular, the time period of satellite depends on (i) mass of the satellite (ii) mass of the earth (iii) radius of the orbit (iv) height of the satellite from the surface of the earth:
   (a) (i) only (b) (i) and (ii) (c) (i), (ii) and (iii) **(d)** (ii), (iii) and (iv)
10. The distances of two satellites from the surface of the earth are R and 7R. Their time periods of rotation are in the ratio:
    (a) 1 :7 **(b)** 1 :8 (c) 1 :49 (d) 1 :7
11. The escape velocity for a planet is v_e. A particle is projected from its surface with a speed v. For this particle to move as a satellite around the planet:
    (a) $\frac{v_e}{2} < v < v_e$ (b) $v_e < v < \sqrt{2}v_e$ **(c)** $\frac{v_e}{\sqrt{2}} < v < v_e$ (d) $\frac{v_e}{\sqrt{2}} < v < \frac{v_e}{2}$
12. At what height from the surface of the earth, the total energy of the satellite is equal to its potential energy at a height of 2R from the surface of the earth? (R = radius of earth):
    (a) R/2 (b) R (c) 2R (d) 4R

13. A satellite is in a circular orbit very close to the surface of a planet. At some point it is given an impulse along its direction of motion, causing its velocity to increase n times. It now goes into an elliptical orbit, with the planet at the centre of the ellipse. The maximum possible value of n for this to occur is:
    (a) $\sqrt{3}$ (b) $\sqrt{2}$ + 1 (c) 2 **(d)** $\sqrt{2}$
14. An artificial satellite is orbiting at a height of 1800 km from earth's surface. The earth's radius is 6300 km and g = 10 m/s^2 on its surface. What is the radial acceleration?
    (a) 5 m/s^2 **(b)** 6 m/s^2 (c) 7 m/s^2 (d) 8 m/s^2
15. How long will a satellite, placed in a circular orbit of radius that is ¼th the radius of a geostationary satellite, takes to complete one revolution around the earth?
    (a) 9 hours (b) 6 hours **(c)** 3 hours (d) 1 day
16. 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) $\frac{gR}{R+x}$ **(b)** $\sqrt{\frac{gR^2}{R+x}}$ (c) $\frac{gR^2}{R+x}$ (d) $\frac{gx^2}{R+x}$
17. If an artificial satellite is moving in a circular orbit around the earth with a speed equal to half the magnitude of the escape velocity from the earth, the height of the satellite above the surface of the earth is (where R = Radius of the earth):
    (a) R (b) 2R (c) 3R (d) R
18. A geostationary satellite is orbiting the earth at a height of 6R above the surface of earth R being the radius of earth. The time period of another satellite at a height of 2.5R from the surface of earth, is:
    (a) 12 hour (b) 8 hour (c) $4\sqrt{2}$ hour **(d)** $6\sqrt{2}$ hour
19. A satellite is launched into a circular orbit of radius R around the earth. A second satellite is launched into an orbit of radius 9R. The ratio of their respective periods is:
    (a) 1: 8 **(b)** 1 :27 (c) 1: 64 (d) 1 :16
20. If an earth satellite of mass m orbiting at a distance 2R from the centre of earth has to be transferred into the orbit of radius 3R, the amount of energy required is (R = radius of earth)
    (a) $\frac{mgR}{3}$ (b) $\frac{mgR}{6}$ **(c)** $\frac{mgR}{12}$ (d) $\frac{mgR}{8}$