GRAVITATIONAL POTENTIAL ENERGY, ESCAPE VELOCITY

1. The change in potential energy when a body of mass m is raised to a height nR from earth's surface is (R = radius of the earth):
(**a)** $\frac{mgR}{\left(1+\frac{1}{n}\right)}$ (b) $\frac{mgR}{\left(1-\frac{1}{n}\right)}$ (c) $\frac{mgR}{n-1}$ (d) $\frac{mgR}{n+1}$
2. A body of mass m rises to a height 5R from the surface of earth. If g is the acceleration due to gravity at the surface of earth, the increase in potential energy is (R = radius of earth):
(a) $\frac{3m}{4}$ **(b)** $\frac{5mgR}{6}$ (c) $\frac{5mgR}{8}$ (d) $\frac{mgR}{5}$
3. The work done in moving a particle of mass m from centre of earth to the surface of the earth is (where R is the radius of the earth):
(a) $\frac{3mgR}{2}$ (b) $-\frac{3mg}{2}$ **(c)** $\frac{mgR}{2}$ (d) Zero
4. If g is the acceleration due to gravity on the earth's surface, the gain in the potential energy of an object of mass m raised from the surface of the earth to a height equal to the radius R of the earth is:
(a) $\frac{3mg}{2}$ (b) $\frac{mgR}{4}$ **(c)** $\frac{mgR}{2}$ (d) $\frac{3mgR}{4}$
5. A ball is thrown vertically upwards with a velocity equal to half the escape velocity from the surface of the earth. The ball rises to a height h above the surface of the earth. If the radius of the earth is R, then h is equal to:
(a) R/2 **(b)** R/3 (c) 2R (d) 4R
6. The escape velocity corresponding to a planet of mass M and radius R is 10 km/s. If the planet's mass and radius were 4M and R/4 respectively, then the corresponding escape velocity would be:
(a) 10 km/s (b) 20 km/s (c) 30 km/s **(d)** 40 km/s
7. The masses and the radii of earth and moon are M_1, R_1 and M_2, R_2 respectively. Their centres are at distance d apart. The minimum speed with which a particle of mass m should be projected from a point midway between the two centres so as to escape to infinity is:
(a) $2\sqrt{\frac{G(M_1+M_2)}{d}}$ (b) $\sqrt{\frac{2G(M_1+M_2)}{d}}$ (c) $\sqrt{\frac{G(M_1+M_2)}{d}}$ (d) $\sqrt{\frac{G(M_1+M_2)}{2d}}$
8. The escape velocity from the earth is 11 km/s. The escape velocity from a planet having twice the radius and the same mean density as the earth would be:
(a) 5.5 km/s (b) 15.5 km/s (c) 11 km/s **(d)** 22 km/s
9. Two stars each of mass M and radius R approach each other to collide head-on. Initially the stars are at a distance r (>>R). Assuming their speeds to be negligible at this distance of separation, the speed with which the stars collide is:
(a) $\sqrt{GM\left(\frac{1}{R}+\frac{1}{r}\right)}$ **(b)** $\sqrt{GM\left(\frac{1}{2R}-\frac{1}{r}\right)}$(c) $\sqrt{GM\left(\frac{1}{2R}-\frac{1}{2r}\right)}$ (d) $\sqrt{GM\left(\frac{1}{R}-\frac{1}{2r}\right)}$
10. Two balls A and B are thrown vertically upwards from the same location on the surface of the earth with velocities $2\sqrt{\frac{gR}{3}}$and $\sqrt{\frac{2gR}{R}}$ respectively, where R is the radius of the earth and g is the acceleration due to gravity on the surface of the earth. The ratio of the maximum height attained by A to that attained by B is:
(a) 1 (b) 2 **(c)** 4 (d) 6

11. A particle of mass m is kept at rest at a height 3R from the surface of earth, where R is radius of earth and M is mass of earth. The minimum speed with which it should be projected, so that it does not return back, is (g is acceleration due to gravity on the surface of earth):

    (a) $\sqrt{\frac{GM}{2R}}$ (b) $\sqrt{\frac{gR}{4}}$ (c) $\sqrt{\frac{GM}{R}}$ (d) $\sqrt{\frac{2GM}{R}}$

12. A body is projected with a velocity of 22.4 km/s from the surface of earth. The velocity of the body when it escapes the gravitational pull of earth is:

    (a) 1.2 x 11.2 km/s (b) 11.2 km/s **(c)** 1.7 x 11.2 km/s (d) 1.5 x 11.2 km/s