

Q 05

The escape speed of a projectile on the earth's surface is 11.2 km/s. 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.

Sol. v_e = escape velocity

v = velocity of the body outside the gravitational field of the earth.

According to the law of conservation of energy,

Initial KE of the body = energy spent by the body in crossing the earth's gravitational field + kinetic energy left with the body once outside the earth's gravitational field,

$$\frac{1}{2}m(3v_e)^2 = \frac{1}{2}mv_e^2 + \frac{1}{2}mv^2$$

$$\Rightarrow \frac{9}{2}mv_e^2 - \frac{1}{2}mv_e^2 = \frac{1}{2}mv^2$$

$$\Rightarrow v^2 = 8v_e^2$$

$$\Rightarrow v = \sqrt{8v_e^2} = 2\sqrt{2}v_e$$

As $v_e = 11.2 \text{ km/s}$

$$\Rightarrow v = 2\sqrt{2} \times 11.2 \text{ km/s}$$

$$\Rightarrow v = 31.7 \text{ km/s}$$