Q- A builder throws tiles weighing 1.5 Kg horizontally at a speed of 1m/s from a roof 30m high
(a) How far away from the house will the tiles land?
(b) What is the speed of a tile as it hits the ground?
(c) What is the kinetic energy of the tile at ground level?

The question is related to motion in two dimensions.

During the fall tiles are experience gravitational force (weight) and due to which experiences an acceleration in downward direction called acceleration due to gravity and its magnitude is $g = 9.8$ m/s^2.

As any vector is having no effect (component) in the direction perpendicular to it, we can solve for motion separately in any two perpendicular direction and here we solve separately for horizontal and vertical directions.
As the acceleration of the tiles is in vertical direction, its horizontal component will be zero and hence it will move horizontally with the constant horizontal velocity of $v_x = 1$ m/s,

As the tile is thrown horizontally its initial vertical velocity is zero and moves vertically downwards with acceleration $g = 9.8$ m/s^2. The time of flight can be calculated by considering vertical motion to cover the distance equal to the height of the roof.

Using the second equation of motion [$s = ut + ½$ at^2] for this vertical motion the time to reach ground is given by

$$h = ut + \frac{1}{2}gt^2$$

Or $\quad h = 0*t + \frac{1}{2}*g*t^2$

Or $\quad t^2 = \frac{2h}{g}$

Gives $\quad t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2*30}{9.8}} = \sqrt{6.122} = 2.474\,\text{s}$

a)

During this time of fall, horizontally the tile is moving with constant velocity of $v_x = 1.0$ m/s and hence the horizontal distance covered by the tile in this time will be given by

Horizontal distance = horizontal velocity*time

= v_x*t = 1.0*2.474 = 2.474 m.

Hence the tiles will land at a distance of 2.474 m form the house.

b)

The tiles will acquire vertical velocity during the flight because of the acceleration g and hence at the time of landing on ground its vertical velocity is given by using first equation of motion [v = u + at] as

v_y = 0 + 9.8*2.474 = 24.245 m/s

As the tiles have both velocities simultaneously hence the resultant velocity is given by

$$v = \sqrt{v_x^2 + v_y^2} = \sqrt{1^2 + 24.245^2} = \sqrt{1 + 587.830} = 24.266 \text{ m/s.}$$

Hence the speed with which the tile strikes the ground will be 24.27 m/s.

c)

The kinetic energy of a moving object is given by

$$KE = \frac{1}{2}mv^2$$

Hence the kinetic energy of the tile will be

$$KE = \frac{1}{2}\, mv^2 = \frac{1}{2} * 1.5 * 24.27^2 = 441.8 \ J$$