During a test a rocket travels upward at 75meters/sec^2,and when it is 40 meters from the ground its engine fails. Determine the maximum height sb reached by the rocket and its speed just before it hits the ground. While in motion the rocket is subjected to a constant downward acceleration of 9.81meters/sec*sec due to gravity. Neglect the effect air resistance?

rocket travels upward with uniform acceleration:

$h_0 = \frac{at_0^2}{2}$

$h_0 = 40\ metres$

$a = 75\frac{meters}{s^2}$

t_0 – time before engine fails

$t_0 = \sqrt{\frac{2h_0}{a}}$

Therefore, velocity then engine fails

$v_0 = a * t_0 = \sqrt{2h_0 a}$

Velocity of rocket after that equals:

$v = v_0 - gt$

maximum height if $v = 0$. Therefore:

$t = \frac{v_0}{g}$

$h_{max} = h_0 + v_0 t - \frac{gt^2}{2} = h_0 + \frac{v_0^2}{2g} = h_0 + \frac{h_0 a}{g} = h_0\left(1 + \frac{a}{g}\right) = 40 * \left(1 + \frac{75}{9.81}\right) = 345.8\ m$

The law conservation of energy:

$mgh_{max} = \frac{mv_m^2}{2}$

v_m – speed of rocket just before it hits the ground

$v_m = \sqrt{2gh_0\left(1 + \frac{a}{g}\right)} = \sqrt{2h_0(a + g)} = \sqrt{2 * 40 * (75 + 9.81)} = 82.4\ m/s$

Answer: $h_{max} = 345.8\ m,\ \ v_m = 82.4\ m/s$