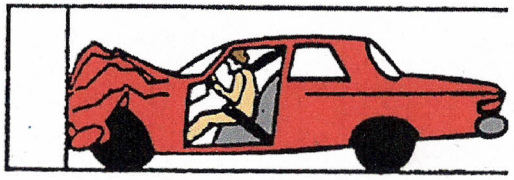
Warm up 03.27.2018

A 1000 kg car is crash-tested against a rigid wall. The car is accelerated by a cable underneath it, which provides a constant force of 500. N for a distance of 10.0 m.

a. What is the velocity just before it hits the wall?

b. The car's "crumple zone" crumples 2 m upon impact. What is the force the car experiences upon impact?



$m = 1000\,Kg$

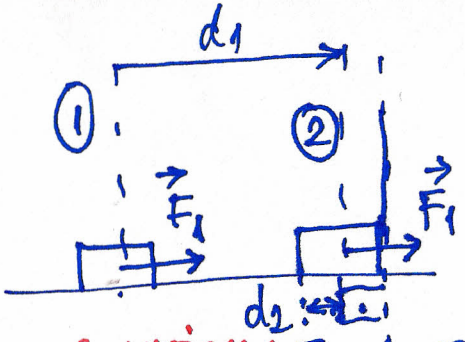
$F_1 = 500\,N$

$d_1 = 10\,m$

$d_2 = 2\,m$

a) $v_2 = ?$

b) $F_2 = ?$



(a) SOLUTION 1

$$a = \frac{F_1}{m} = \frac{500N}{1000Kg} = 0.5\,m/s^2$$

$v_1 = 0\,m/s$

$$v_2^2 = v_1^2 + 2 \cdot a \cdot d_1$$

$$v_2 = \sqrt{v_1^2 + 2a \cdot d_1} = \sqrt{(0\,m/s)^2 + 2 \cdot 0.5\,m/s^2 \cdot 10m}$$

$$v_2 = \sqrt{10}\,m/s = 3.16\,m/s$$

SOLUTION 2

$\Delta KE = W$

$W = F_1 \cdot d_1 = 500N \cdot 10m$

$W = 5000\,J$

$\Delta KE = Kf - Ki = \frac{mv_f^2}{2}$

$$v_f = v_2 = \sqrt{\frac{2\Delta KE}{m}} = \sqrt{\frac{2W}{1000Kg}}$$

$v_2 = 3.16\,m/s$

(b) $\Delta KE = W$

$W = F_2 \cdot d_2$

$$\rightarrow F_2 = \frac{\Delta KE}{d_2}$$

$$|\Delta KE| = \frac{m \cdot v_2^2}{2}$$

$$F_2 = \frac{m \cdot v_2^2}{2 \cdot d_2}$$

$$F_2 = \frac{1000Kg \cdot 10\,m^2/s^2}{2 \cdot 2m}$$

$$F_2 = 2500N$$