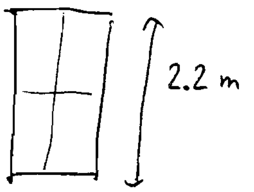
Ch 2 - #32, 33, 35

(32)



flowerpot falls a distance of $0.85 \times 2.2\,m = 1.87\,m$
at 30 frames/s, 6 frames take 0.20 s

$$v_{avg} = \frac{1.87\,m}{0.20\,s} = 9.35\,m/s = v \text{ at center of window}$$

Suppose pot was dropped from rest. How long had it been falling?

$$v_f = v_i - g(\Delta t) \Rightarrow \Delta t = \frac{-9.35\,m/s}{9.80\,m/s^2} = 0.954\,s.$$

What is original height above center of window?

$$y_f = y_i + v_{iy}\Delta t + \tfrac{1}{2}(-g)(\Delta t)^2$$

$$(y_f - y_i) = \tfrac{1}{2}(-g)(\Delta t)^2 = \tfrac{1}{2}(-9.8\,m/s^2)(0.954\,s)^2 = -4.46\,m$$

so 4.46 m above center of window.
Assume each floor in the building is 10' = 3.0 m high.
So the pot could have dropped from rest from the floor of a balcony on the 6th floor, or else perhaps was thrown down by someone on the 5th floor.

(33) As the ball is brought to rest from 50 m/s,

$$\Delta p = m\,\Delta v = (0.057\,kg)(50\,m/s) = 2.85\,kg \cdot m/s$$

Assume it slows down at a uniform rate from 50 m/s to 0,
so $v_{avg} = 25\,m/s$.

$$v_{avg} = \frac{\Delta r}{\Delta t} \Rightarrow \Delta t = \frac{\Delta r}{v_{avg}} = \frac{0.02\,m}{25\,m/s} = 0.0008\,s$$

$$F_{avg} = \frac{\Delta p}{\Delta t} = \frac{2.85\,kg \cdot m/s}{0.0008\,s} = 3600\,N$$

(35) $\Delta p = F\,\Delta t = \left(\langle 6\times10^4, 0, 0\rangle\ N\right)(3.4\ s) = \langle 20.4\times10^4, 0, 0\rangle\ kg\cdot m/s$

$$\Delta v = \frac{\Delta p}{m} = \frac{\langle 20.4\times10^4, 0, 0\rangle\ kg\cdot m/s}{1.5\times10^5\ kg} = \langle 1.36, 0, 0\rangle\ m/s$$

$$v_f = v_i + \Delta v = \langle 0, 20000, 0\rangle\ \tfrac{m}{s} + \langle 1.36, 0, 0\rangle\ m/s$$

$$= \langle 1.36, 20000, 0\rangle\ m/s$$

During burn, $v_{avg} = \frac{1}{2}(v_i + v_f) = \langle 0.68, 20000, 0\rangle\ m/s$

$$\Delta r = v_{avg}\,\Delta t = \left(\langle 0.68, 20000, 0\rangle\ \tfrac{m}{s}\right)(3.4s) = \langle 2, 68000, 0\rangle\ m$$

$$r_f = r_i + \Delta r = \langle 12000, 15000, 0\rangle m + \langle 2, 68000, 0\rangle m = \langle 12002, 83000, 0\rangle m$$

Now it coasts at v_f for 3600 s.

$$\Delta r = \left(\langle 1.36, 20000, 0\rangle\ m/s\right)(3600s) = \langle 4896, 72000000, 0\rangle\ m$$

$$r_f = \langle 12002, 83000, 0\rangle\ m + \langle 4896, 72000000, 0\rangle\ m$$

$$= \langle 16900, 72083000, 0\rangle\ m = \langle 16.9, 72083, 0\rangle\ km$$