

$$v_1 = 0$$

$$v_1' = ?$$

Review 6 & 7

1. A 4 kg model rocket is launched, shooting 50 g of burned fuel from its exhaust at an average velocity of 6.25 m/s. What is the velocity of the rocket after the fuel has burned?

$$m_1 v_1 + m_2 v_2 = m_1 v_1' + m_2 v_2'$$

$$(4)(0) + (0.05)(0) = (4) v_1' + (0.05)(-6.25)$$

$$4 v_1' = -(0.05)(-6.25)$$

$$v_1' = -\frac{(0.05)(-6.25)}{4}$$

$$v_1' = +7.81 \times 10^{-2} \frac{m}{s}$$

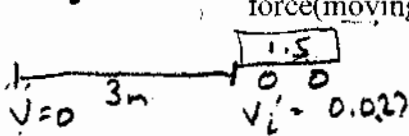
2. A thread holds two carts together on a frictionless surface. A compressed spring acts upon the carts. After the thread is burned the 1.5 kg cart moves with a velocity of 27 cm/s to the left. What is the velocity of the 4.5 kg cart?

$$m_1 = 1.5 \text{ kg}$$

$$m_2 = 4.5 \text{ kg}$$

$$v_1 = 0.027 \frac{m}{s}$$

$$v_2 = ?$$



- a. If the coefficient of friction is .2 and the cart to left travels 3 m, with what force (moving) did the spring act?

$$v^2 = v_i^2 + 2ad$$

$$0 = (0.027)^2 + 2a(3)$$

$$a = -1.22 \times 10^{-3} \frac{m}{s^2}$$

$$F_{fr} = \mu (1.5) 9.8$$

$$= 2.94 \text{ N}$$

$$F_{NET} = 1.5 (1.22 \times 10^{-3})$$

$$= 1.83 \times 10^{-3} \text{ N}$$

$$F_{NET} = F_m - F_{fr}$$

$$1.83 \times 10^{-3} = F_m - 2.94$$

$$F_m = 2.94 \text{ N}$$

$$F_m = 2.94 \text{ N}$$

$$F_{fr} = \mu (4.5) 9.8 = 8.82 \text{ N}$$

3. A colonial gunner sets up his 225 kg cannon at the edge of the flat top of a high tower. It shoots a 4.5 kg cannon ball horizontally. The ball hits the ground 215 m from the base of the tower. The cannon also moves, on frictionless wheels, and falls off the back of the tower, landing on the ground.



- a. What is the horizontal distance of the cannon's landing, measured from the base of the back of the tower?

$$x = v_x t$$

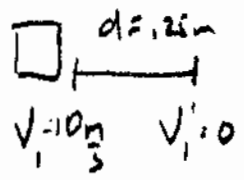
$$215 \text{ m} = v_B t$$

$$v_B = \frac{215 \text{ m}}{t}$$

$$m_1 v_1 + m_2 v_2 = m_1 v_1' + m_2 v_2'$$

$$0 = (225) v_1' + (4.5) \frac{215}{t}$$

4. A car moving at 10 m/s crashes into a barrier and stops in 0.25 m.



- a. Find the time required to stop the car.

$$d = \left(\frac{v_i + v_f}{2} \right) t$$

$$0.25 = \left(\frac{10 + 0}{2} \right) t$$

$$t = 5 \times 10^{-2} \text{ s}$$

$$v_1' = 4.3 \frac{m}{s}$$

$$v_1' = \frac{d}{t}$$

$$4.3 \frac{m}{s} = \frac{d}{t}$$

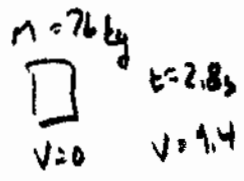
$$d = 4.3 \text{ m}$$

- b. If a 20 kg child were to be stopped in the same time as the car, what average force must be exerted?

$$F \Delta t = \Delta m v$$

$$F(0.05) = (20 \text{ kg})(-10 \frac{m}{s}) = -4 \times 10^3 \text{ N}$$

5. A sprinter with a mass of 76 kg accelerates from 0 to 9.4 m/s in 2.8 s. Find the average force acting on the runner.



$$v = v_i + at$$

$$9.4 = 0 + a(2.8)$$

$$a = 3.36$$

$$F = m a$$

$$= (76 \text{ kg}) 3.36 = 2.55 \times 10^2 \text{ N}$$

6. Small rockets are used to make small adjustments in the speed of satellites. One such rocket has a thrust of 35 N. If it is fired to change the velocity of a 72000 kg spacecraft by 63 cm/s, how long should it be fired?

$$F \Delta t = m \Delta v$$

$$35 \text{ N } t = (72000) (0.63)$$

$$t = 1.30 \times 10^3 \text{ s}$$

7. A 10000 kg freight car is rolling along a track at 3 m/s. Calculate the time needed for a force of 1000 N to stop the car.

$$F \Delta t = m \Delta v$$

$$1000 t = (10000) (-3)$$

$$t = 30 \text{ s} \quad 3.0 \times 10^1 \text{ s}$$