Basic Momentum and Impulse Answers (Level 1)

1)

a) GIVEN:

$m = 1.0\ kg$

$v_i = -2.0\ \frac{m}{s}$

$v_f = +1.6\ \frac{m}{s}$

$\Delta p = ?$

TAKE DOWN TO BE NEGATIVE AND UP TO BE POSITIVE.

$$\Delta p = m\Delta v$$
$$= m(v_f - v_i)$$
$$= (1.0)(1.6 - (-2.0))$$
$$= +3.6\ kg\ \frac{m}{s}$$

$\rightarrow$ 3.6 $kg\ \frac{m}{s}$ UP

b) GIVEN:

$\Delta p = 3.6\ kg\ \frac{m}{s}$

$t = 0.060\ s$

$F_N = ?$

$$\Delta p = F_{NET}\Delta t$$
$$F_{NET} = \frac{\Delta p}{\Delta t}$$
$$= \frac{3.6}{0.060}$$
$$= 60.\ N$$

$$F_{NET} = F_N - F_g$$
$$F_N = F_{NET} + F_g$$
$$= F_{NET} + mg$$
$$= 60. + (1.0)(9.8)$$
$$= 70.\ N\ \text{UP}$$

2)

GIVEN:

$m = 0.144\ kg$

$v_i = +38\ \frac{m}{s}$

$v_f = -38\ \frac{m}{s}$

IMPULSE = ?

TAKE INITIAL DIRECTION TO BE POSITIVE AND FINAL DIRECTION TO BE NEGATIVE

$$\text{IMPULSE} = m\Delta v$$
$$= m(v_f - v_i)$$
$$= (0.144)(-38 - (+38))$$
$$= -11\ Ns$$

$\rightarrow$ 11 Ns in the DIRECTION OF THE FINAL VELOCITY

3)

GIVEN:

$m = 1200\ kg$

$v_i = 35\ \frac{km}{h}$

$a = 12.5\ \frac{m}{s^2}$

$t = 3.25\ s$

$\Delta p = ?$

$\Delta p = F_{NET} \Delta t$

$= ma\Delta t$

$= (1200)(12.5)(3.25)$

$= 49\,000\ kg\ \frac{m}{s}$

EAST (ASSUMING THE ACCELERATION IS IN THE SAME DIRECTION AS THE INITIAL VELOCITY OF THE DRAGSTER.)

4)

GIVEN:

$m = 40.0\ kg$

$F_A = 65\ N$

$t = 5.0\ s$

$v_i = 1.5\ \frac{m}{s}$

$v_f = ?$

$$F_{NET}\Delta t = m\Delta v$$

$$F_A \Delta t = m(v_f - v_i)$$

$$mv_f = mv_i + F_A \Delta t$$

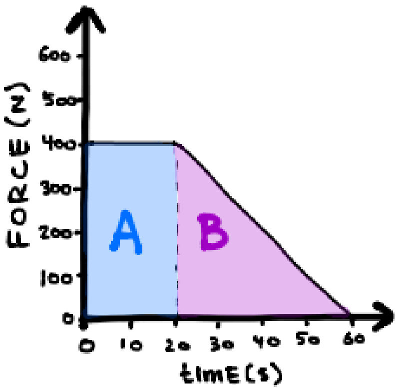
$$v_f = \frac{mv_i + F_A \Delta t}{m}$$

$$= v_i + \frac{F_A \Delta t}{m}$$

$$= 1.5 + \frac{(65)(5.0)}{40.0}$$

$$= 9.6\ \frac{m}{s}$$

5)



IMPULSE = AREA UNDER F-t GRAPH

$= AREA_A + AREA_B$

$= (20)(400) + \frac{1}{2}(40)(400)$

$= 8000 + 8000$

$= 16000$ Ns

GIVEN:

IMPULSE = 16000 Ns

m = 1750 kg

$V_i = 0$

$V_f = ?$

$IMPULSE = m\Delta v$

$= m(V_f - \cancel{V_i})$ 0

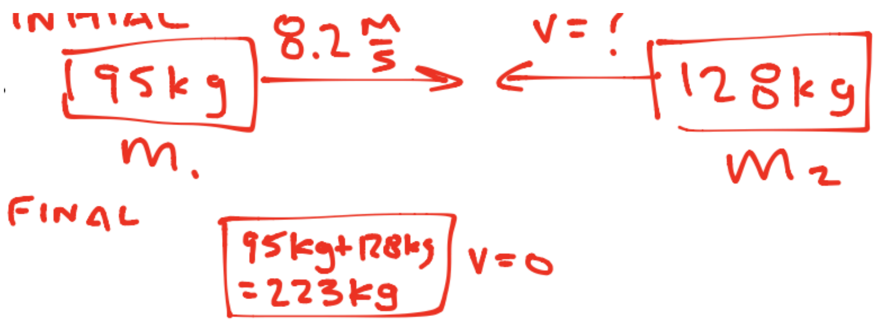
$= mV_f$

$V_f = \frac{IMPULSE}{m}$

$= \frac{16000}{1750}$

$= \boxed{9.1 \frac{m}{s}}$

6)



$$\Sigma p_i = \Sigma p_f$$

$$p_{1_i} + p_{2_i} = p_f$$

$$m_1 v_{1_i} + m_2 v_{2_i} = M v_f$$

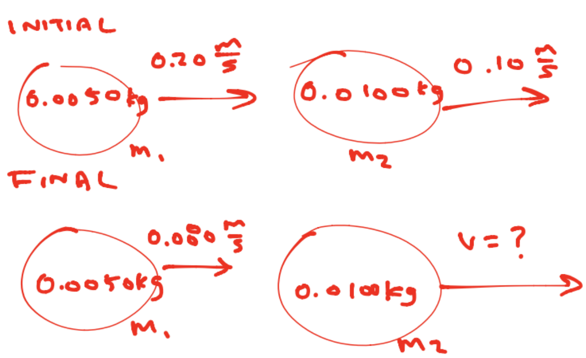
$$v_{2_i} = \frac{M v_f - m_1 v_{1_i}}{m_2}$$

$$= \frac{(223)(0) - (95)(8.2)}{128}$$

$$= -6.1 \frac{m}{s}$$

$6.1 \frac{m}{s}$

7)



$$\Sigma p_i = \Sigma p_f$$

$$p_{1i} + p_{2i} = p_{1f} + p_{2f}$$

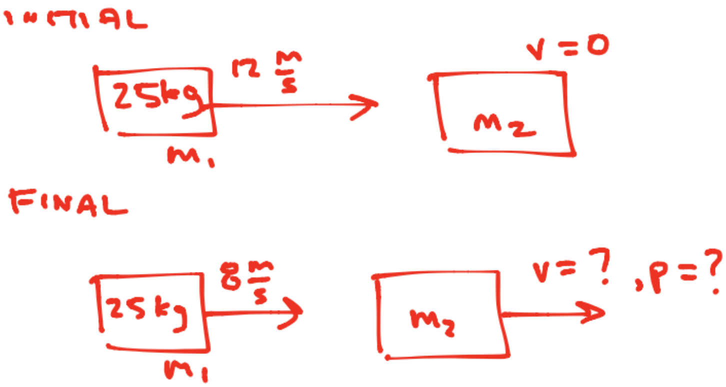
$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

$$v_{2f} = \frac{m_1 v_{1i} + m_2 v_{2i} - m_1 v_{1f}}{m_2}$$

$$= \frac{(0.0050)(0.20) + (0.010)(0.10) - (0.0050)(0.080)}{0.010}$$

$= 0.16 \frac{m}{s}$ or $16 \frac{cm}{s}$ to the right

8)



$$\sum p_i = \sum p_f$$

$$p_{1i} + p_{2i} = p_{1f} + p_{2f}$$

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + p_{2f}$$

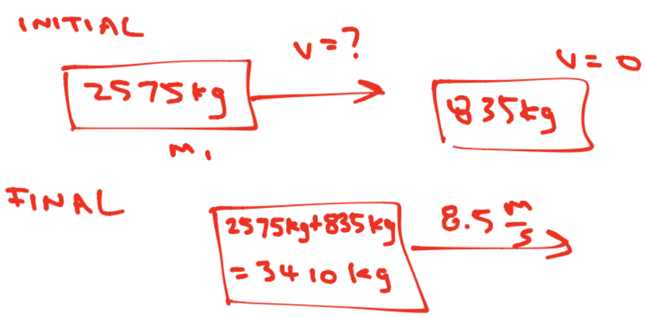
$$p_{2f} = m_1 v_{1i} + m_2 v_{2i} - m_1 v_{1f}$$

$$= (25)(12) + \cancel{m_2(0)} - (25)(8)$$

$$= 100\ kg\frac{m}{s}\ \text{RIGHT}$$

NOTICE HOW WE DO NOT NEED m_2 TO SOLVE FOR p_{2f}.

9)



$$\sum p_i = \sum p_f$$

$$p_{1i} + p_{2i} = p_f$$

$$v_{1i} + m_2 v_{2i} = M v_f$$

$$v_{1i} = \frac{M v_f - m_2 v_{2i}}{m_1}$$

$$= \frac{(3410)(8.5) - \cancel{(835)(0)}}{2575}$$

$$= 11\ \frac{m}{s}$$

10)

INITIAL

$0.015\,kg$ (m_1) $\xrightarrow{v=?}$ $\boxed{5.085\,kg}$ (m_2) $v=0$

FINAL

$\boxed{0.015\,kg + 5.085\,kg = 5.100\,kg}$ $\xrightarrow{v=1.0\frac{m}{s}}$

$$\Sigma p_i = \Sigma p_f$$

$$P_{1i} + P_{2i} = P_f$$

$$m_1 v_{1i} + m_2 v_{2i} = M v_f$$

$$v_{1i} = \frac{M v_f - m_2 v_{2i}}{m_1}$$

$$= \frac{(5.100)(1.0) - \cancel{(5.085)(0)}}{0.015}$$

$$= 340\frac{m}{s}$$ RIGHT

(SAME DIRECTION AS THE BLOCK)