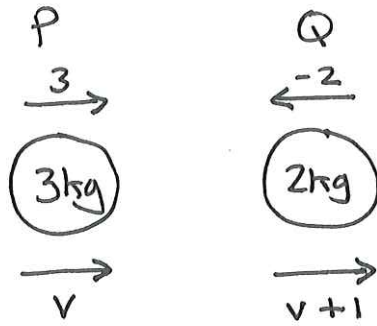


Q1.

(a)



$$\text{CLM: } 3(3) + 2(-2) = 3v + 2(v+1)$$
$$9 - 4 = 3v + 2v + 2$$

$$5v = 3$$

$$v = \frac{3}{5}$$

$$Q = 1.6 \text{ ms}^{-1}$$

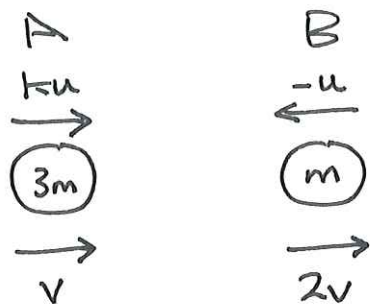
$$P = 0.6 \text{ ms}^{-1}$$

(b) P momentum before $3 \times 3 = 9$
after $0.6 \times 3 = 1.8$

$$\text{Impulse on P} = 9 - 1.8 = \underline{\underline{7.2 \text{ Ns}}}$$

Q2.

(a)



$$B \text{ impulse} = \frac{3}{2}mu$$

$$B \text{ momentum before} = um$$

$$\text{after} = 2vm$$

$$CLM: 2vm - (-u)m = \frac{3}{2}mu$$

$$2v + u = \frac{3}{2}u$$

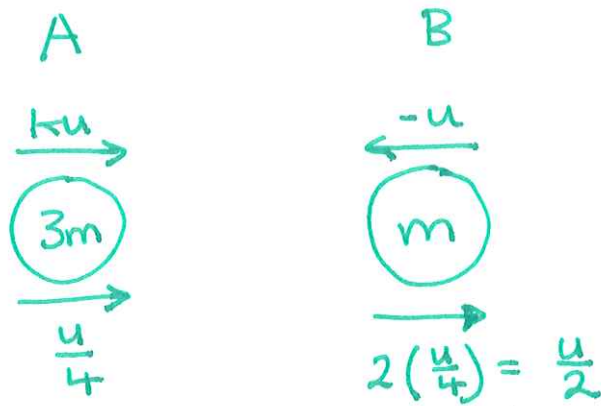
$$4v + 2u = 3u$$

$$4v = u$$

$$v = \frac{u}{4}$$

Q2

(b)



$$\text{CLM: } 1ku(3m) + m(-u) = 3m\left(\frac{u}{4}\right) + \frac{u}{2}(m)$$

$$3kmu - mu = \frac{3mu}{4} + \frac{um}{2}$$

$$12kmu - 4mu = 3mu + 2um$$

$$12k - 4 = 3 + 2$$

$$12k = 9$$

$$k = \frac{3}{4}$$



$$\text{CLM: } 3kum + (m)(-u) = 3m\left(-\frac{u}{4}\right) + m\left(\frac{u}{2}\right)$$

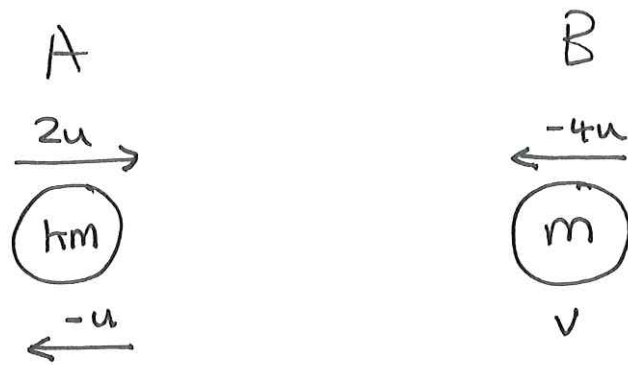
$$12kum - 4mu = -3mu + 2mu$$

$$12k - 4 = -3 + 2$$

$$12k = 3$$

$$k = \frac{1}{4}$$

Q3.



(a) CM: $2ukm - 4um = -ukm + mv$

$$2uk - 4u = -ku + v$$

$$v = 3ku - 4u$$

$$v = u(3k - 4)$$

(b) $2k < 3$

$$\therefore 3k - 4 > 0$$

$$\therefore u(3k - 4) > 0$$

so it will change direction

(c) $k = \frac{7}{3}$ $v = u(3(\frac{7}{3}) - 4) = 3u$

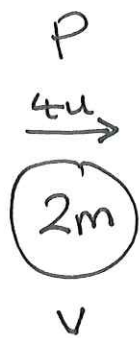
B momentum before = $-4um$

after = $3um$

Impulse = $3um - -4um$

$$= \underline{\underline{7um}}$$

Q4



(a)

$$\text{CLM: } 4u(2m) + (-3u)(3m) = 2mv + 3mu$$

$$8um - 9um = 2mv + 3mu$$

$$-um = 2mv + 3mu$$

$$-4um = 2mv$$

$$v = -2u$$

(b) reversed

$$\begin{aligned} \text{(c) } P \text{ momentum before} &= (4u)(2m) = 8um \\ \text{after} &= (-2u)(2m) = -4um \end{aligned}$$

$$-4um - 8um = -12um$$

$$\text{Impulse} = \underline{\underline{12um \text{ Ns}}}$$

Q5

(a)



$$5u(m) + (-u)15m = -2.5mu + 0.5u15m$$

$$10u - 15u = -2.5mu + 7.5mu$$

$$-5u = 5mu$$

$$1 = 5$$

(b)

P momentum before = $5um$

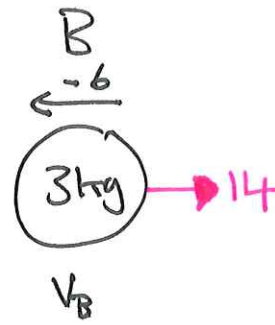
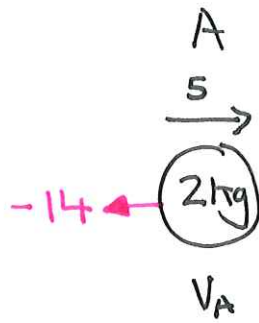
after = $-2.5um$

$$-2.5um - 5um = -7.5um$$

$$\text{Impulse} = \underline{\underline{7.5um \text{ Ns}}}$$

Q6

a)



$$2V_A - 10 = -14$$

$$V_A = -2$$

$$\therefore 2\text{ms}^{-1}$$

b)

$$3V_B - 18 = 14$$

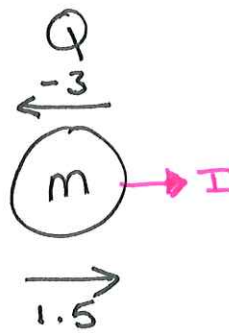
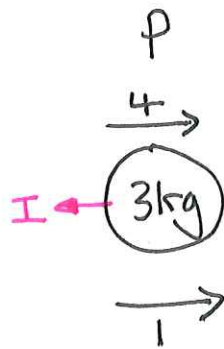
$$3V_B + 18 = 14$$

$$3V_B = -4$$

$$V_B = -\frac{4}{3}$$

$$\therefore \frac{4}{3}\text{ms}^{-1}$$

Q7



(a) P momentum before $4(3) = 12$
 after $3(1) = 3$

$$\text{Impulse} = 3 - 12 = -9$$

$$\underline{\underline{9 \text{ Ns}}}$$

(b) Q

$$q = 1.5m - (-3)(m)$$

$$q = 1.5m + 3m$$

$$q = 4.5m$$

$$m = 2$$

Q8

$$I = mv - mu$$

$$(i) \quad -\lambda i + \lambda j = 0.5v - 0.5(8i)$$

$$-\lambda i + \lambda j = 0.5v - 4i$$

$$-2\lambda i + 2\lambda j = v - 8i$$

$$v = (-2\lambda + 8)i + 2\lambda j$$

$$\sqrt{(-2\lambda + 8)^2 + (2\lambda)^2} = 4\sqrt{10}$$

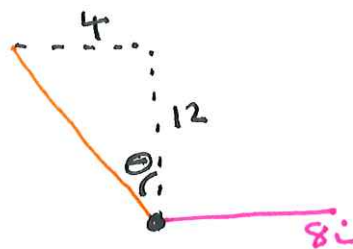
$$4\lambda^2 - 32\lambda + 64 + 4\lambda^2 = 160$$

$$8\lambda^2 - 32\lambda - 96 = 0$$

$$\lambda = 6$$

(ii) before $8i$

after $(-2\lambda + 8)i + 2\lambda j = -4i + 12j$



$$\tan \theta = \frac{4}{12}$$

$$\theta = 18.4$$

$$\begin{aligned} \text{Angle} &= 90 + 18.4 \\ &= \underline{\underline{108.4^\circ}} \end{aligned}$$

Q9.

$$(a) \quad I = mv - mu$$

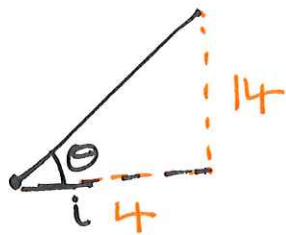
$$-4i + 7j = 0.5v - 0.5(12i)$$

$$-8i + 14j = v - 12i$$

$$4i + 14j = v$$

$$\text{Speed } \sqrt{4^2 + 14^2} = 2\sqrt{53} = \underline{\underline{14.6 \text{ ms}^{-1}}}$$

(b)



$$\tan \theta = \frac{14}{4}$$

$$\theta = \underline{\underline{74.1^\circ}}$$