

1) a)  $I = Ft$   
 $I = 5 \times 0.4 = 2 \text{ Ns}$

b) Assuming  $u = 0 \Rightarrow v = at$

$F = ma$

$\frac{I}{m} = \frac{Ft}{m} = \frac{mat}{m} = at = v$

final speed of ball

c) Impulse = change in momentum

$2 \text{ Ns} = m \times 8 - m \times 0$

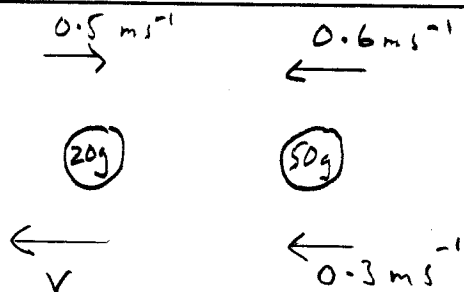
$\frac{1}{4} = m$

$m = \frac{1}{4} \text{ kg}$

Momentum =  $mv$

$= \frac{1}{4} \times 8 = 2 \text{ kgms}^{-1}$

2)



PCLM ← +ve

$0.02 \times (-0.5) + 0.05 \times 0.6$

$= 0.02v + 0.05 \times 0.3$

$-0.01 + 0.03 = 0.02v + 0.015$

$-0.01 + 0.03 - 0.015 = 0.02v$

$v = \frac{0.005}{0.02} = 0.25 \text{ ms}^{-1}$

lighter marble travels at  $0.25 \text{ ms}^{-1}$  in opposite direction to that of its original travel

b) Impulse = change in mom

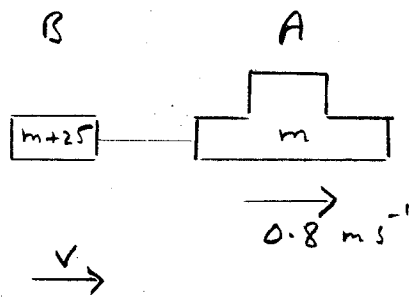
$0.02 \times 0.25 - 0.02(-0.5)$

$= 0.015 \text{ Ns}$  Right to left

c) No resistance due to friction

3)

a)



Change in momentum of A

$= m(0 - 0.8)$

$= -0.8m \text{ Ns}$

Change in momentum of B

$= +0.8m = (m + 0.025)(v - 0)$

$v = \frac{0.8m}{m + 0.025} \text{ ms}^{-1}$

FM UNIT TEST 1 IMPULSE AND MOMENTUM

35) For heavier car, stops within 0.1m

$$v^2 = u^2 + 2as$$

$$0 = \left(\frac{0.8m}{m+0.025}\right)^2 + 2a \times 0.1$$

$$-0.2a = \left(\frac{0.8m}{m+0.025}\right)^2$$

$$a = -5 \left(\frac{0.8m}{m+0.025}\right)^2$$

$$F = ma$$

$$-20 = (m+0.025) \left(-5 \left(\frac{0.8m}{m+0.025}\right)^2\right)$$

$$4 = \frac{0.64m^2}{m+0.025}$$

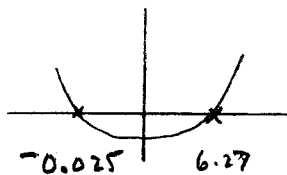
for stopping on contact

$$4 > \frac{0.64m^2}{m+0.025}$$

it stops before impact

$$4m + 0.1 > 0.64m^2$$

$$0.64m^2 - 4m - 0.1 < 0$$



$$m < 6.27 \text{ kg}$$

4) Ball speed when it reaches apple = v

a)

$$v^2 = u^2 + 2as$$

$$v^2 = 7^2 - 19.6 \times 1.8$$

$$v = \frac{7\sqrt{7}}{5} \text{ or } 3.704 \text{ ms}^{-1} \text{ upwards}$$

Change in momentum

$$= m(v-u)$$

$$= 0.1(1 - -3.704)$$

$$= 0.4704 \text{ kg ms}^{-1}$$

Impulse on apple = 0.4704 Ns

$$I = Ft$$

$$0.4704 = F \times 0.8$$

$$F = \frac{0.4704}{0.8}$$

Force on apple = 0.588 N

$$0.588 > 0.5$$

∴ apple will be dislodged

b)

Initial momentum of apple

$$= 0.4704 \text{ kg ms}^{-1}$$

$$mu = 0.4704$$

$$0.25u = 0.4704$$

## FM UNIT TEST 1 IMPULSE AND MOMENTUM

4b )  
cont )

$$u = \frac{0.4704}{0.25}$$

$$u = 1.8816$$

At highest point  $v = 0$ 

$$v^2 = u^2 + 2as$$

$$0 = 1.8816^2 - 19.6x$$

$$19.6x = 1.8816^2$$

$$x = \frac{1.8816^2}{19.6}$$

$$x = 0.18 \text{ m to 2 s.f.}$$