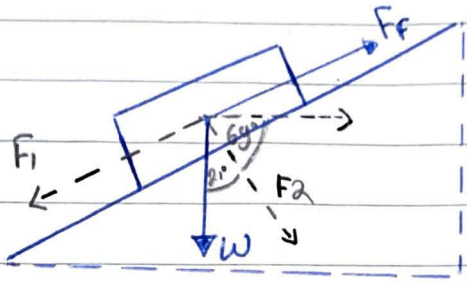
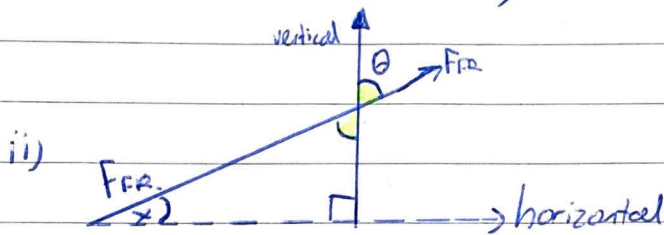


# Coursework - Science

## Question 1:



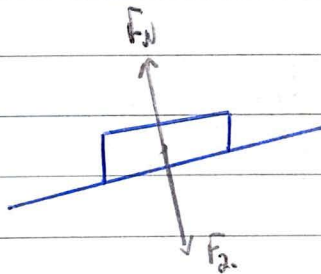
ai)  $275 \cdot \cos(69)$   
 $= 98.6 \text{ N (3 s.f.)}$



$$x = 90 - 69 = 21^\circ$$

$$\theta = 90 - 21 = 69^\circ$$

iii)



$$F_N = F_2$$

$$F_N = 275 \cdot \cos(21)$$

$$= 256.73$$

$$= 257 \text{ N (3 s.f.)}$$

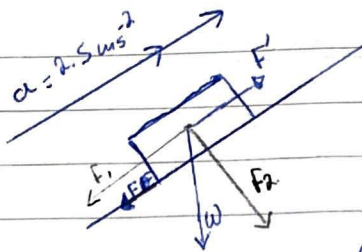
b) Momentum: mass  $\times$  velocity

i)  $p = m \cdot v$

ii)  $\frac{\text{kg} \cdot \text{m}}{\text{s}}$  or  $\text{kgms}^{-1}$

c)

i)

~~254 m/s^2~~

$$F_F + F_i - F' = ma \quad \text{Resistant force.}$$

$$W = mg \rightarrow m = \frac{W}{g} = \frac{275}{9.81} = m = 28.0 \text{ kg}$$

$$(275 \times \cos(69)) + (275 \cdot \cos(69)) - F' = \left(\frac{275}{9.81}\right)(2.5)$$

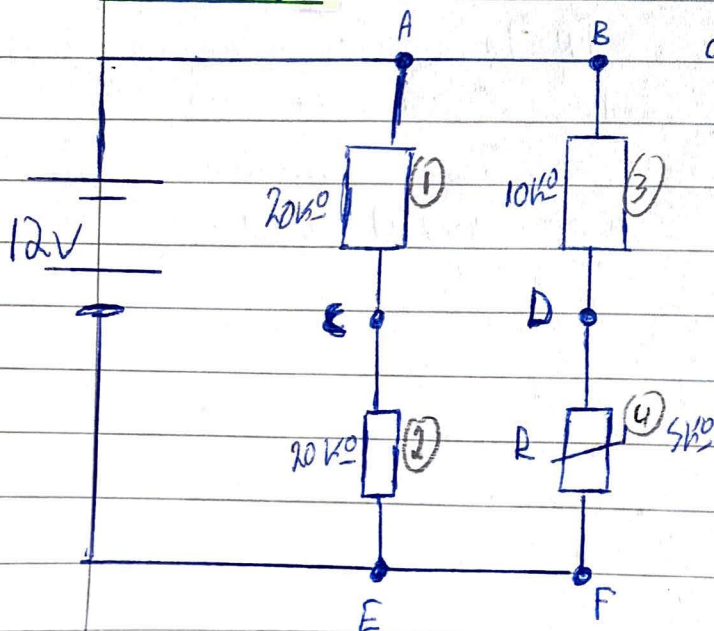
$$F' = 2(275 \cdot \cos(69)) - \left(\frac{275}{9.81} \times 2.5\right)$$

$$F' = 127 \text{ N (3 s.f.)}$$

$$\text{ii) } (28.0 \text{ kg} \cdot 7.5 \text{ ms}^{-1}) - (28.0 \text{ kg} \cdot 0 \text{ ms}^{-1}) \\ = 210 \text{ kgms}^{-1}$$

$$\text{iii) } F = \frac{5 \text{ kg}(7.5 \text{ ms}^{-1} - 0 \text{ ms}^{-1})}{3.2 \text{ s}}$$

$$F = 11.7 \text{ N (3 s.f.)}$$

Question 2:

$$\text{ai) Resistance across AC} = R_1 + R_2 = 20\text{k}\Omega + 20\text{k}\Omega = 40\text{k}\Omega$$

$$\text{Resistance across BF} = R_3 + R_4 = 10\text{k}\Omega + 5\text{k}\Omega = 15\text{k}\Omega$$

$$\text{Total Resistance} = R_T$$

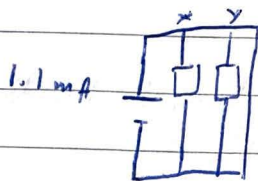
$$\frac{1}{R_T} = \frac{1}{40\text{k}\Omega} + \frac{1}{15\text{k}\Omega}$$

$$R_T = 10.9 \text{ k}\Omega \text{ (3 s.f.)}$$

$$ii) R = \frac{V}{I}$$

$$I = \frac{V}{R} = \frac{12}{10.9 \times 10^3} = 1.1 \times 10^{-3} A = 1.1 \text{ mA}$$

$$iii) \begin{array}{l} P = IV \\ R = V/I \end{array} \left. \begin{array}{l} P = I(IR) = I^2 R \\ P = (V/R)V = \frac{V^2}{R} \end{array} \right\}$$



$$I_x = I_T \cdot \left( \frac{I_y}{I_x + I_y} \right)$$

$$I_{AE} = I_{AC} = I_T \left[ \frac{15k\Omega}{40k\Omega + 15k\Omega} \right]$$

$$I_{AC} = 1.1 \text{ mA} \times \frac{15}{40+15} = 0.41 \text{ mA}$$

$$I_{BF} = 1.1 \text{ mA} \times \left[ \frac{15k\Omega}{40k\Omega + 15k\Omega} \right] = 0.3 \text{ mA}$$

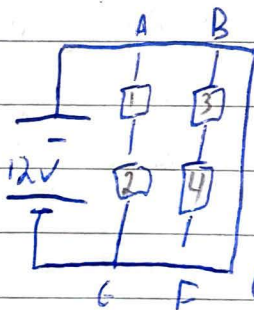
$$\begin{array}{l} I_{AC} = I_{AE} = I_{CE} = 0.41 \\ I_{BF} = I_{BD} = I_{DF} = 0.3 \end{array} \left. \begin{array}{l} \\ \end{array} \right\} \text{Ae in series}$$

$$P_{AC} = (0.41 \times 10^{-3})^2 \times (20 \times 10^3) = 3.36 \times 10^{-3} W = 3.36 \text{ mW}$$

$$P_{CE} = (0.41 \times 10^{-3})^2 \times (20 \times 10^3) = 3.36 \times 10^{-3} W = 3.36 \text{ mW}$$

$$P_{BD} = (0.3 \times 10^{-3})^2 \times (10 \times 10^3) = 9 \times 10^{-4} W$$

$$P_{DF} = (0.3 \times 10^{-3})^2 \times (5 \times 10^3) = 4.5 \times 10^{-4} W$$



$$V_T = V_{AC} = V_{BF} \text{ because they are parallel}$$

$$V_{out} = V_T \left( \frac{R_1}{R_1 + R_2} \right)$$

$$(i) V_{AC} = 12 \left( \frac{20}{20+20} \right) = 6V$$

$$(ii) V_{DF} = 12 \left( \frac{5}{10+5} \right) = 4V$$

$$(iii) V_{CD} =$$

$$2V$$

3a) Moment of a force is equal to the force acting multiplied by the perpendicular distance of that force from the point

→ moment = Force  $\times$  distance (⊥ to point of action)

→  $M = F \times d$

b) i) Moment of force  $\times = M_x$

$$M_x = 250\text{ N} \times 48\text{ mm} = 12000\text{ Nmm} = 12\text{ Nm}$$

ii) since is at equilibrium  $\sum \text{moment clockwise} = \sum \text{moment anticlockwise}$

$$M_x = M_y \rightarrow F_y \times d = 12\text{ Nm}$$

$$F_y = \frac{12\text{ Nm}}{27 \times 10^{-3}} = 444\text{ N}$$

iii) iv)  $F = kx$

$$x = 15\text{ mm} = 0.015\text{ m}$$

$$k = \frac{F}{x} = \frac{444\text{ N}}{0.015\text{ m}}$$

$$k = 29,600\text{ Nm}^{-1} \quad (3 \text{ s.f.})$$

v)  $W = F \times d$

$$W = 444 \times 0.015\text{ m}$$

$$W = 6.67\text{ Nm} = 6.67\text{ J} //$$

c)

$$i) \text{ Power} = \frac{\text{Energy}}{\text{Time}} = \frac{J}{s} = W$$

$$ii) P = \frac{W}{t} = \frac{6.67\text{ J}}{2.2} = 3.03\text{ W}$$

iii) Energy total = 3.2 kJ

Energy per squeeze 6.67 J

$$\text{Number of squeezes} = \frac{3.2 \times 10^3\text{ J}}{6.67\text{ J}}$$

$$N = 479.76$$

$N = 480$  so Trigger is pulled 480 times //