



Complete, fold and seal
(see note 2 below)

SURNAME: Gray

FORENAME(S): Ailee Doyle

12 Pages

1. Please give the information requested in the boxes below
2. Enter your name in the space provided to the right, for the invigilator to see, and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can choose to ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. **Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.**

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

Q1

a)

$$I = \int_0^L r^2 dm$$

$$\frac{dm}{m} = \frac{dr}{L}$$

$$I = \int_0^L r^2 \frac{dr}{L} m$$

$$dm = \frac{dr}{L} m$$

$$I = \frac{m}{L} \int_0^L r^2 dr$$

$$I = \frac{m}{L} \times \left[\frac{r^3}{3} \right]_0^L$$

$$I = \frac{m}{L} \times \left[\frac{L^3}{3} - 0 \right]$$

$$I = \frac{m}{L} \times \frac{L^3}{3}$$

$$I = \frac{mL^2}{3}$$

$$I = \frac{4 \times 3^2}{3}$$

$$I = 12.00 \text{ to 2 dp. } \underline{\underline{\text{kg m}^2}}$$

units

9

9

Q 1

b

i)

$$E_p = mgh$$

$$= 0.9 \times 9.8 \times 7.5$$

$$= 66.15 \text{ J}$$

$$= 66.15 \text{ J to 2 dp}$$

$$E_k = \frac{1}{2} mv^2$$

$$66.15 = \frac{1}{2} \times 0.9 \times v^2$$

$$v^2 = 147$$

$$v = 12.12 \text{ ms}^{-1} \text{ to 2 dp.}$$

b)

ii)

$$E_w = F \times d$$

$$66.15 = F \times 0.1$$

$$F = 661.50 \text{ N to 2 dp.}$$

eq

4
(6)5
(5)18
(18)

Q2

a)

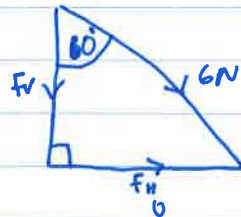
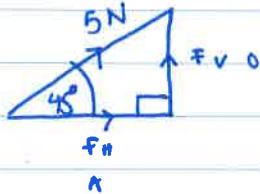
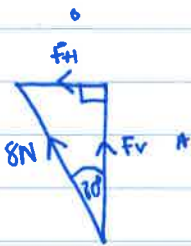
$$\text{RPM} = \frac{\omega}{2\pi} \times 60$$

$$f = \frac{\omega}{2\pi} \times 60$$

$$\omega = 0.73 \text{ rad s}^{-1} \text{ to 2 dp.}$$

Q2

b)



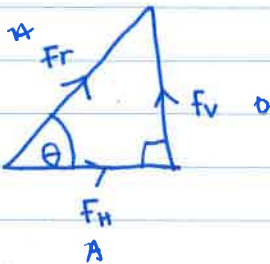
$$\uparrow +ve \rightarrow +ve$$

$$F_H = -8\sin 30 + 5\cos 45 + 6\sin 60$$

$$= 4.73 \text{ N to 2 dp (right)}$$

$$F_V = 8\cos 30 + 5\sin 45 - 6\cos 60$$

$$= 7.46 \text{ N to 2 dp (up)}$$



$$F_R = \sqrt{F_H^2 + F_V^2}$$

$$= \sqrt{(4.73^2) + (7.46^2)}$$

$$= 8.83 \text{ N to 2 dp}$$

$$\tan \theta = \frac{\text{Opp}}{\text{Adj}} = \frac{F_V}{F_H}$$

$$\theta = \tan^{-1} \left(\frac{7.46}{4.73} \right)$$

$$\theta = 57.62^\circ \text{ to 2 dp}$$

$$F_R = 8.83 \text{ N at } 57.62^\circ$$

4
44
44
44
44
4

20

a)

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{1}{293} = \frac{2}{T_2}$$

$$T_2 = 586 \text{ K}$$

~~NO CHANGE~~

~~$$PV = nRT$$~~

~~$$P = \frac{2 \times 8.31 \times 586}{2}$$~~

~~$$= 4869.66 \text{ Pa}$$~~

~~$$= 4869.66 \text{ Pa to 2 dp}$$~~

~~$$= 4869.66 \text{ Pa to 2 dp}$$~~

~~$$PV = nRT$$~~

~~$$P = \frac{2 \times 8.31 \times 586}{2}$$~~

~~$$= 4869.66 \text{ Pa to 2 dp}$$~~

~~$$\Delta Q = \Delta U$$~~

~~$$\Delta W = C_m \Delta T$$~~

~~$$C_m \Delta T = C_m \Delta T$$~~

~~$$293 \text{ K} = 293 \text{ K}$$~~

energy conserved

Q3

b)

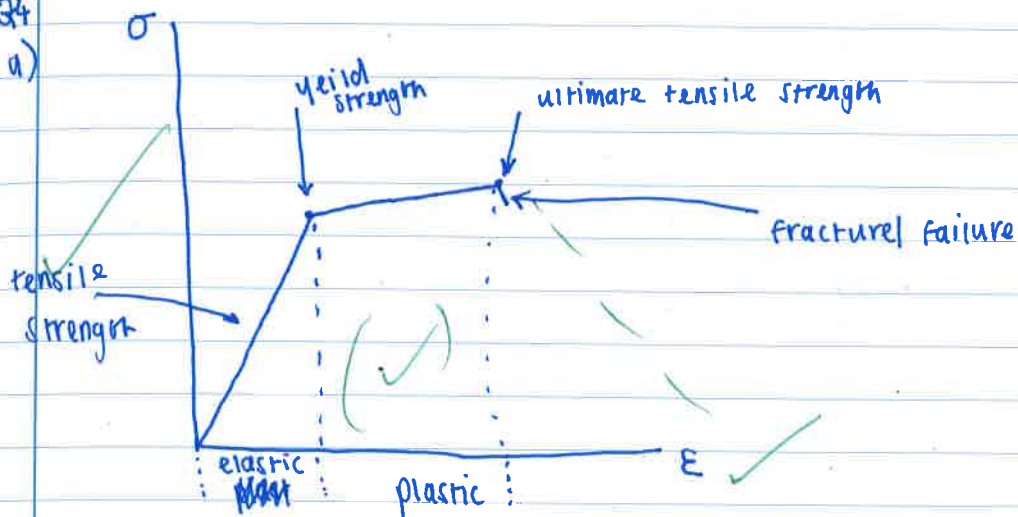
$$\Delta Q = \Delta U + \Delta W$$

$$250 = C_m \Delta T + 50$$

$$250 = 900 \times 0.04 \times \Delta T + 50$$

$$\Delta T = 5.56 \text{ K to 2 dp}$$

3 @ overleaf

Q4
a)

Ductile material

Q4
b)

$$E = \frac{\Delta L}{L_0}$$

$$0.02 = \frac{7 \times 10^{-3}}{L_0}$$

$$L_0 = 0.35 \text{ m}$$

Q4
c)

$$E = 450 \times 10^9 \text{ Pa}$$

$$A = 0.4 \text{ cm}^2$$

$$L_0 = 4.5 \text{ m}$$

$$m = 100 \text{ kg}$$

$$\sigma = \frac{F}{A}$$

$$= \frac{100 \times 9.8}{0.4 \times 10^{-3}}$$

$$= 2.45 \times 10^8 \text{ Pa}$$

$$E = \frac{\sigma}{\epsilon}$$

$$450 \times 10^9 = \frac{2.45 \times 10^8}{\epsilon}$$

$$E = 0.00054 \text{ mm/mm} \\ = 5.4 \times 10^{-4}$$

Q5

a)

$$\dot{q} = \epsilon \sigma T^4$$

$$= 0.9 \times 5.67 \times 10^{-8} \times 1673^4$$

$$= 399769.201 \text{ W/m}^2$$

$$399769.201 \frac{\text{W}}{\text{m}^2} \times 2 \text{ m}^2$$

$$= 799538.40 \text{ W to 2 dp}$$

Q5

b)

$$L(T) = L(T_0) \times [1 + \alpha(T - T_0)]$$

$$L(T) = 0.5 \times [1 + 5 \times 10^{-4} (393 - 303)]$$

$$L(T) = 0.5 \times [1 + 5 \times 10^{-4} (90)]$$

$$L(T) = 0.5225 \text{ m}$$

Q5

c)

$$P = \frac{E}{T}$$

$$= \frac{5}{8 \times 10^{-6}}$$

$$= 6.25 \times 10^5 \text{ W}$$

Q3

a)

$$\cancel{m} = \cancel{m}$$

$$m = 2 \times 8.31$$

$$= 16.62 \text{ J K}^{-1} \text{ mol}^{-1}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{1}{293} = \frac{2}{T_2}$$

$$T_2 = 586 \text{ K}$$

$$\Delta T = 293 \text{ K}$$

$$\Delta Q = \Delta W$$

$$n \Delta T = n \Delta T$$

$$16.62 \times 293 = 16.62 \times 293$$

$$\Delta W = \underline{\underline{4869.66 \text{ J}}}$$

oh

Marked