



**Complete, fold and seal
(see note 2 below)**

SURNAME: PERRY

FORENAME(S): KENNETH JAMES

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 either 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.**

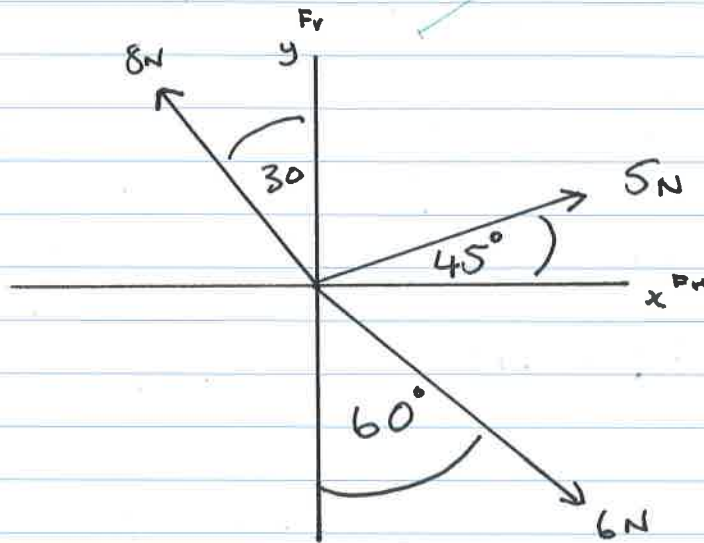
List the numbers of the questions you have attempted	Office Use
1	~~5~~ 5
2	10
3	7
4	10
5	12
Total	44

(Gweler yr ochr arall am y fersiwn Cymraeg)

2a) 66.84 rad s $\times$ $(7 \times 60 = 420)$
 $420 / 2\pi = 66.84 \text{ to 2 d.p.}$ $\times$

0

b)



$F_v = 8N \cos 30^\circ + 5N \cos 45^\circ + 6N \cos 60^\circ$?

$F_H = 8N \cos 60^\circ + 5N \cos 45^\circ + 6N \cos 30^\circ$

$F_v = -6 \cos 60 + 5 \cos 45 - 8 \cos 30$:
 $3 + 3.53 - 6.93 = -0.4N$

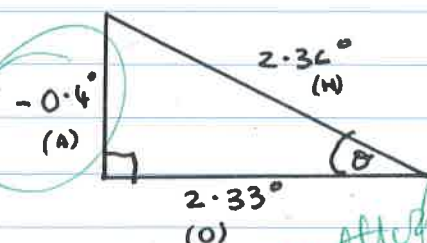
$F_H = -8 \cos 60 + 5 \cos 45 - 6 \cos 30$:
 $4 + 3.53 - 5.20 = 2.33N$

$F_R = \sqrt{(-0.4)^2 + (2.33)^2}$
 $= 2.36N$

$\sin \theta = \frac{O}{H}$
 $= \frac{2.33}{2.36}$
 $= 0.99^\circ \text{ to 2 dp}$

$\sin^{-1} \theta = \left(\frac{O}{H} \right)$
 $= \left(\frac{2.33}{2.36} \right)$

$= 80.85^\circ \text{ to 2 dp}$



2

10

Question No.

3a)

moles gas - 2

 V_1 initial volume 1 m^3 V_2 new volume 2 m^3 temperature 293 K

$$Pv = nRT$$

$$Pv = 2(8.31) 293$$

(i)

0
0

3b)

250J heat energy
 (0.4 kg) 40g mass
 900 J kg⁻¹ K⁻¹ (C)

$$Q = m C \Delta T$$

~~250 = 0.4 \times 900 \times \Delta T~~

$$Q = m C \Delta T$$

need $Q = q_{in} + q_{out}$
 also

$$250 = 0.4 \times 900 \times (\Delta T)?$$

~~$$\Delta T = \frac{0.4 \times 900}{250}$$~~

~~$$\Delta T = \frac{360}{250} = 1.44 \text{ K to 2 dp}$$~~

$$\Delta T = \frac{250}{0.4 \times 900}$$

$$\Delta T = 0.69 \text{ K to 2 dp}$$

0

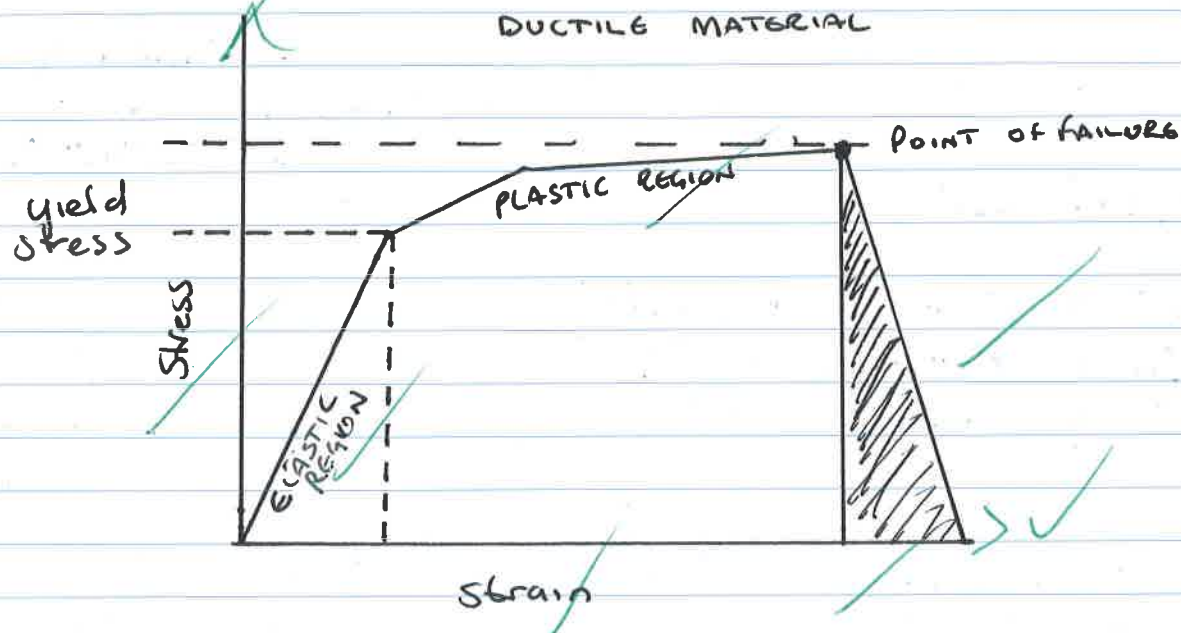
4

2

~~7~~
 7



4a)



b)

change in length $7 \times 10^{-3} \text{ m}$
 strain 0.02

$\epsilon = \text{extension} / \text{original length}$

$$0.02 = 7 \times 10^{-3} / ?$$

$$\text{original length} = \frac{7 \times 10^{-3}}{0.02}$$

$$= 0.35 \text{ m to 2 d.p.}$$

4c)

Modulus of elasticity
 $450 \times 10^9 \text{ Pa}$ Cross sectional area
 0.4 cm^2 natural length
 4.5 m mass 100 kg

$$\begin{aligned}\text{Stress} &= \text{force / unit area} \\ &= 100 / 0.4 \text{ units!} \\ &= 250\end{aligned}$$

$$\begin{aligned}\epsilon &= 450 \times 10^9 \times 4.5 \\ &= 2.025 \times 10^{12}\end{aligned}$$

(1)

0

10

5a)

surface area 2 m^2
 surface emissivity 0.9
 temperature ~~1400°C~~
 1673 K

$$\begin{aligned} q &= \epsilon \sigma T^4 \\ &= 0.9 \times 5.67 \times 10^{-8} \times 1673^4 \\ &= \end{aligned}$$

2

b)

Length 0.5 m
 temperature 303 K
 Coef linear expansion $5 \times 10^{-4} \text{ K}^{-1}$
 ΔTemp 393 K

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

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

$$L(393) = 0.5(303) [1 + 5 \times 10^{-4} (90)]$$

$$L(393) = 0.5(303) [1 + 0.045]$$

$$L(393) = 0.5(303) [1.045]$$

$$\begin{aligned} L &= \\ L(393) &= 0.5(303) [1.045] \\ L &= \underline{0.52 \text{ m}} \end{aligned}$$

6

6

5c)

total energy 5J
time 8 μ s
rectangular profile.
(constant)

$$\begin{aligned}\text{Power} &= \text{energy} / \text{time} \\ &= 5 / 8 \times 10^{-6} \\ &= 6.25 \times 10^{-7} \text{ Watts} \\ &\quad \text{KW}\end{aligned}$$

4
4

(12)

1a)

length 3 m
Mass 4 kg

$$I = \int r^2 dm$$

Marked

16) i)

Mass 0.9 kg
 height 7.5 m
 gravity 9.81 m/s²

$$E_p = mgh$$

$$= 0.9 \times 9.81 \times 7.5$$

$$= 66.225$$

$E_p = E_k$ by conservation of energy

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

$$66.22 = \frac{1}{2} 0.9 \times v^2$$

$$v^2 = \frac{66.22}{0.45}$$

$$v = \sqrt{147.15}$$

$$v = 12.13 \text{ m/s}$$

(5)

6