



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Examination Answer Books

12 Pages

Instructions to Candidates

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.

1	Student Number	1701794
2	Title of Examination Paper	Engineering Science 1
3	Module Code	M4X00385
4	Date and Time of Examination	16/1/19 12:00
5	Examination Venue	Vivian Hall
6	Seat Number	G043
7	Number of Answer Books handed in	

Complete, fold and seal
(see note 2 below)

SURNAME:

Williams

FORENAME(S):

Sam Alun

List the numbers of the questions you have attempted	Office Use	
1	28	28
2	17	17
3	20	20
4	9	9
5	18	18
6	12	12
7	13	13
8	10	10
Total	127	127

Omitting Q3b)

$$\frac{122}{122} = 100\%$$

Mark Agreed

W. O.

7/5/19

100%

Great work
Sam!

all right

all right

all right

all right

all right

all right

all right

all right

all right

all right

$$1. \quad u_1 = 0 \text{ m/s}$$

$$v_1 = 100 \text{ km/h} \div 3.6 = 27.78 \text{ m/s}$$

$$t_1 = 3 \text{ s}$$

$$u_2 = 27.78 \text{ m/s}$$

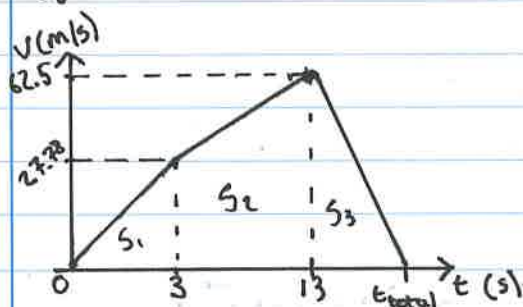
$$v_2 = 225 \text{ km/h} \div 3.6 = 62.5 \text{ m/s}$$

$$t_2 = 10 \text{ s}$$

$$u_3 = 62.5 \text{ m/s}$$

$$v_3 = 0 \text{ m/s}$$

$$s_3 = 65 \text{ m}$$



$$a) \quad v = u + at$$

$$a = \frac{v - u}{t} = \frac{27.78 - 0}{3} = 9.26 \text{ m/s}^2$$

$$b) \quad v = u + at$$

$$a = \frac{v - u}{t} = \frac{62.5 - 27.78}{10} = 3.47 \text{ m/s}^2$$

$$c) \quad s = \frac{(v + u)t}{2}$$

$$t = \frac{2s}{(v + u)} = \frac{2 \times 65}{(0 + 62.5)} = 2.08 \text{ s}$$

$$d) \quad s_1 = \frac{(v + u)t}{2} = \frac{(27.78 + 0) \times 3}{2} = 41.67 \text{ m}$$

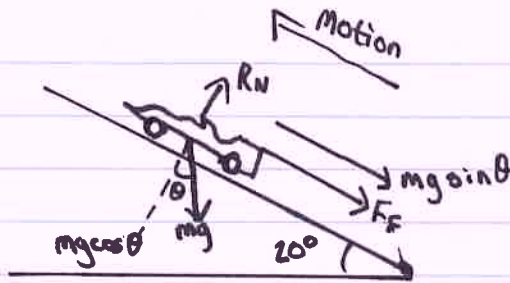
$$s_2 = \frac{(v + u)t}{2} = \frac{(62.5 + 27.78) \times 10}{2} = 451.4 \text{ m}$$

$$s_{\text{total}} = s_1 + s_2 + s_3$$

$$= 41.67 + 451.4 + 65$$

$$= 558.07 \text{ m}$$

2



$$\theta = 20^\circ$$

$$R_N = mg \cos \theta$$

$$v = 140 \text{ km/h} \div 3.6 = 38.89 \text{ m/s}$$

$$m = 888 \text{ kg}$$

$$P = 150 \times 10^3 \text{ W}$$

$$P = Fv$$

$$F = \frac{P}{v} = 3857.03 \text{ N}$$

$$F = F_f + mg \sin \theta$$

$$3857.03 = \mu mg \cos \theta + mg \sin \theta$$

$$3857.03 = \mu (888 \times 9.81 \times \cos 20^\circ) + (888 \times 9.81 \times \sin 20^\circ)$$

$$3857.03 = \mu 8185.93 + 2979.43$$

$$\mu = \frac{3857.03 - 2979.43}{8185.93}$$

$$\mu = 0.11$$

✓ Rounding errors!

3. $\omega_1 = 0 \text{ rad/s}$

$$\omega_2 = 20,000 \text{ rpm} \times \frac{2\pi}{60} = 2094.40 \text{ rad/s}$$

$$t = 0.5 \text{ s}$$

$$T = 145 \text{ Nm}$$

a) $\omega_2 = \omega_1 + \alpha t$

$$\alpha = \frac{\omega_2 - \omega_1}{t} = \frac{2094.40 - 0}{0.5} = 4188.8 \text{ rad/s}^2$$

$$T = I\alpha$$

$$I = \frac{T}{\alpha} = \frac{145}{4188.8} = 0.035 \text{ kgm}^2$$

b) $d = 0.26 \text{ m}$

$$k^2 = \frac{d^2}{8} = 8.45 \times 10^{-3} \text{ m}^2$$

$$I = mk^2$$

$$m = \frac{I}{k^2} = \frac{0.035}{8.45 \times 10^{-3}} = 4.14 \text{ kg}$$

c) $P = T\omega$

$$P = 145 \times 2094.40 = 303682 \text{ W} = 303.69 \text{ kW}$$

d) $KE = \frac{1}{2} I \omega^2$

$$= 0.5 \times 0.035 \times 2094.40^2$$

$$= 76763.95 \text{ J}$$

$$= 76.76 \text{ kJ}$$

$$4 \quad T_1 = 35^\circ\text{C} + 273 = 308 \text{ K}$$

$$p_1 = 200 \text{ bar}$$

$$V_1 = 5$$

↑

$$T_2 = 15^\circ\text{C} + 273 = 288 \text{ K}$$

$$p_2 = ?$$

$$V_2 = 4$$

↑

Volume of gas has been reduced by a fifth

$$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$$

$$p_2 = \frac{p_1 V_1 T_2}{T_1 V_2} = \frac{200 \times 5 \times 288}{308 \times 4} = 233.77 \text{ bar}$$



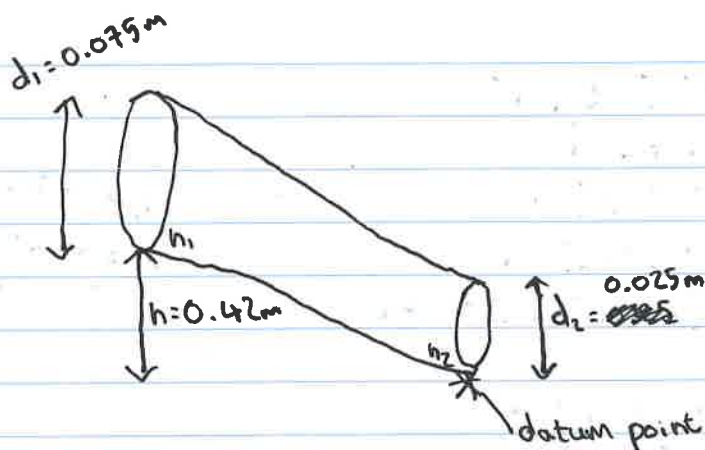
5. $\rho = 885 \text{ kg/m}^3$

$\Delta h = 0.42 \text{ m}$

$d_1 = 0.075 \text{ m}$

$d_2 = 0.025 \text{ m}$

$p_1 - p_2 = 3.5 \times 10^3 \text{ Pa}$



$d_1^2 v_1 = d_2^2 v_2$

$5.625 \times 10^{-3} v_1 = v_2$

6.25×10^{-4}

$v_2 = 9 v_1$

~~$\therefore v_2 = 9 \text{ m/s}$ and $v_1 = 1 \text{ m/s}$~~

$Q = A v$

~~$gh_1 + \frac{p_1}{\rho} + \frac{v_1^2}{2} = gh_2 + \frac{p_2}{\rho} + \frac{v_2^2}{2}$~~

~~9.81×0.42~~

~~$gh_1 + \frac{p_1}{\rho} - \frac{p_2}{\rho} = \frac{v_2^2}{2} - \frac{v_1^2}{2}$~~

~~$(9.81 \times 0.42) + \frac{3.5 \times 10^3}{885} = \frac{v_2^2}{2} - \frac{1^2}{2}$~~

~~$4.12 + 3.95 =$~~

~~$A_1 = \frac{\pi d_1^2}{4} = 4.42 \times 10^{-3} \text{ m}^2$~~

~~$A_2 = \frac{\pi d_2^2}{4} = 4.91 \times 10^{-4}$~~

~~$Q_1 = A_1 v_1 = 4.42 \times 10^{-3} \times 1 = 4.42 \times 10^{-3} \text{ kg m}^3/\text{s}$~~

~~$Q_2 = A_2 v_2 = 4.419 \times 10^{-3}$~~

$$5. \rho = 885 \text{ kg/m}^3$$

$$h = 0.42 \text{ m}$$

$$d_1 = 0.075 \text{ m}$$

$$d_2 = 0.025 \text{ m}$$

$$p_1 - p_2 = 3.5 \times 10^3 \text{ Pa}$$

$$A_1 = \frac{\pi \times 0.075^2}{4} = 4.42 \times 10^{-3} \text{ m}^2$$

$$A_2 = \frac{\pi \times 0.025^2}{4} = 4.91 \times 10^{-4}$$

$$d_1^2 v_1 = d_2^2 v_2$$

$$\frac{5.625 \times 10^{-3}}{6.25 \times 10^{-4}} v_1 = v_2$$

$$9v_1 = v_2$$

$$\leftarrow \text{Substitute}$$

$$gh_1 + \frac{p_1}{\rho} + \frac{v_1^2}{2} = gh_2 + \frac{p_2}{\rho} + \frac{9v_1^2}{2}$$

$$gh_1 + \frac{p_1 - p_2}{\rho} = \frac{9v_1^2 - v_1^2}{2}$$

$$(9.81 \times 0.42) + \frac{3.5 \times 10^3}{885} = \frac{8v_1^2}{2}$$

$$4.12 + 3.95 = 4v_1^2$$

$$\frac{8.07}{4} = v_1^2$$

$$7.99 \times 10^{-3}$$

$$v_1^2 = 2.02$$

$$v_1 = \sqrt{2.02}$$

$$v_1 = 1.42 \text{ m/s}$$

~~$$Q = A_1 v_1 = 4.42 \times 10^{-3} \times 1.42$$~~

$$9v_1 = v_2 \therefore v_2 = 1.42 \times 9 = 12.78 \text{ m/s}$$

$$Q_1 = A_1 v_1 = 4.42 \times 10^{-3} \times 1.42 = 6.28 \times 10^{-3}$$

$$Q_2 = A_2 v_2 = 4.91 \times 10^{-4} \times 12.78 = 6.27 \times 10^{-3}$$

ANSWER is C



6. ~~$A = 800 \times 450 = 360 \times 10^3 \text{ m}^2$~~ $\leftarrow$ wrong units on exam $U = \frac{K}{x}$

$$T_1 = 62^\circ\text{C} + 273 = 335\text{K}$$

$$T_2 = 22^\circ\text{C} + 273 = 295\text{K}$$

$$A = 0.8 \times 0.45 = 0.36\text{m}^2$$

$$x_b = 0.003\text{m}$$

$$x_a \text{ and } x_c = 0.0015\text{m}$$

$$K_b = 0.05\text{ W/mK}$$

$$K_a \text{ and } K_c = 280\text{ W/mK}$$

$$U = \frac{K}{x}$$

$$U_b = \frac{0.05}{0.003} = 16.67\text{ W}^2/\text{mK}$$

$$U_{a/c} = \frac{280}{0.0015} = 186666.67\text{ W}^2/\text{mK}$$

$$\frac{1}{U} = \frac{1}{U_a} + \frac{1}{U_b} + \frac{1}{U_c}$$

$$\frac{1}{U} = \frac{2}{186666.67} + \frac{1}{16.67}$$

$$\frac{1}{U} = 0.06$$

$$U = \frac{1}{0.06} = 16.67$$

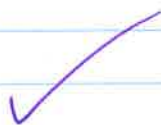
$$Q = -UA(T_2 - T_1)$$

$$Q = (-16.67 \times 0.36)(295 - 335)$$

$$Q = (-6)(-40)$$

$$Q = 240\text{ W}$$

ANSWER IS A



7 ~~123~~ $h = 0.4 \text{ m}$

$$L = 100 \text{ mm} = 0.1 \text{ m}$$

$$\text{thickness} = 0.025 \text{ m}$$

$$A = 0.4 \times 0.025 = 0.01 \text{ m}^2$$

$$F = 250 \text{ N}$$

$$G = 44 \times 10^9 \text{ N/m}^2$$

$$\tau = \frac{F}{A} = \frac{250}{0.01} = 25000 \text{ N/m}^2 = 25 \text{ kN/m}^2$$

$$G = \frac{\tau}{\gamma} = \frac{\tau L}{x}$$

$$x = \frac{\tau L}{G} = \frac{25000 \times 0.1}{44 \times 10^9} = 56.82 \times 10^{-9} \text{ m}$$


8. $D = 0.15 \text{ m}$

$T = 1200 \text{ Nm}$

$\gamma = 65 \times 10^6 \text{ N/m}^2$

$r = \frac{D}{2} = 0.075 \text{ m}$

$\frac{T}{J} = \frac{\gamma}{r}$

$J = \frac{Tr}{\gamma} = \frac{1200 \times 0.075}{65 \times 10^6} = 1.38 \times 10^{-6} \text{ m}^4$

$J = \frac{\pi (D^4 - d^4)}{32}$

$32J = \pi (D^4 - d^4)$

$(D^4 - d^4) = \frac{32J}{\pi}$

$0.15^4 - d^4 = \frac{(32 \times 1.38 \times 10^{-6})}{\pi}$

$5.06 \times 10^{-4} - d^4 = 1.41 \times 10^{-6}$

$d^4 = 5.06 \times 10^{-4} - 1.41 \times 10^{-6}$

$d^4 = 5.05 \times 10^{-4}$

$d = \sqrt[4]{5.05 \times 10^{-4}} = 0.15 \text{ m}$ ok

Question No.

Examiner Only

Question No.

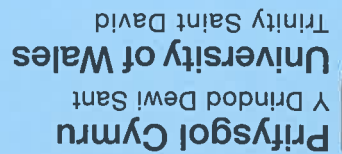
Examiner Only

Question No.

Examiner On

Arholwr yn unig

Arholwr yn unig



12 Tudalen

1. Rhwch yr holl wybodaeth y gofynnir amdani yn y blychau isod.
2. Rhwch eich enw yn y lle a ddarparwyd ar y dde, plygwch eî a'i selio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.

3. Rhaid i'r atebion fod mewn llawysgrifen ddarllenadwy. Gall yr Arholwyr naill ai anwybyddu sgrïpt annarllenadwy, neu drefnu iddi gael ei theipio a chael yr ymgeisydd i dalu.

4. Ysgrifennwch eich atebion mewn inc.

5. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnu llinell drwyddynt.

6. Ni ddylid rhwgo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.

7. Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwylwlr/gwylwyr.

8. Rhaid dychwelyd pob llyfr. Ni chaniateir mynd â llyfrau atebion, wedi eu defnyddio neu heb eu defnyddio, allan o'r lleoliad arholi o dan unrhyw amgylchiadau.

7	Nifer y Llyfrau Atebion a gyflwynwyd	
6	Rhif Sedd	
5	Lleoliad yr Arholiad	
4	Dyddiad ac Amser yr Archoliad	
3	Cod y Modwl	
2	Teitl y Papur Arholiad	
1	Rhif Myfyriwr	

Rhestrwch nïau'r cwestiynau a ymgysyllwyd gyda gennych	
At Dibenion y Swyddfa	

(See the other side for English version)

Lienwch, plygwch a seliwch
(gweler nodyn 2 isod)

CYFENW:

ENW(AU) CYNTAF:

ENW(AU) CYNTAF:



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

SURNAME: Wilcox

FORENAME(S): Daniel

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1	28	28
2	~~14~~ 8	17
3	19.5	20
4	9	9
5	18	18
6	12	12
7	6	13
8	8	10
	114.5	
Total	~~108.5~~	127

Omitting
Q3b.

$$\begin{array}{r} 113.5 \quad 93 \\ \underline{+ 07.5} = \underline{\underline{121}} \end{array}$$

Mark Agreed

P.T. Q.
7/5/19

90
85%
:



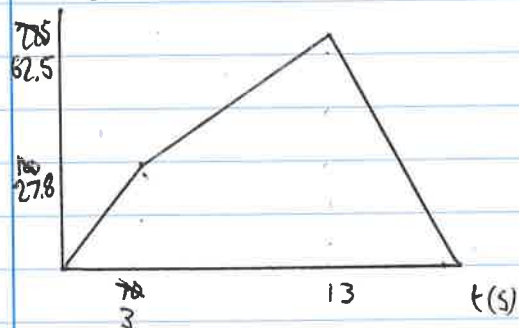
1 5

$$U \ 0 \text{ ms}^{-1}$$

$$V \ 100 \text{ km/h} \times \frac{1000}{3600} = 27.78 \text{ ms}^{-1}$$

a

b 3

 $V(\text{ms}^{-1})$ 

$$a \ v = u + at$$

$$\frac{27.78 - 0}{3} = a$$

$$a = 9.26 \text{ ms}^{-2}$$

$$b \ 225 \text{ km/h} \times \frac{1000}{3600} = 62.5 \text{ ms}^{-1}$$

$$\frac{62.5 - 27.78}{10} = a$$

$$a = 3.472 \text{ ms}^{-2}$$

$$c \ 5 \ 65 \text{ m}$$

$$U \ 62.5 \text{ ms}^{-1}$$

$$V \ 0 \text{ ms}^{-1}$$

a

t

$$S = \frac{1}{2}(u+v)t$$

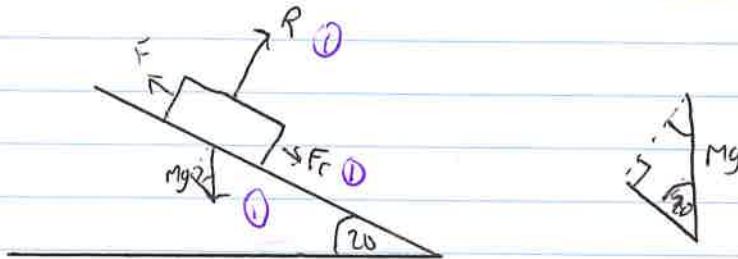
$$\frac{2 \times 65}{62.5} = t$$

$$t = 2.08 \text{ s}$$

d displacement: $\frac{1}{2} \times 27.78 \times 3 + \frac{1}{2} (27.78 + 62.5) \times 10 + 65$
 $= 41.67 \text{ m} + 451.4 \text{ m} + 65 \text{ m}$
 $= 558.07 \text{ m}$

✓ yay!

2



$$M = 888 \text{ kg}$$

$$V = 140 \text{ km/h} \times \frac{10}{36} = 38.88 \text{ ms}^{-1}$$

$$Mg = 8711.78 \text{ N}$$

$$R = 8711.78 \times \cos 20 = 8185.93 \text{ N}$$

$$\text{down hill} = 8711.78 \times \sin 20 = 2979.4 \text{ N}$$

$$P = 150 \text{ kW} = 150 \times 10^3 \text{ W}$$

$$\frac{P}{V} = F$$

$$F = 3857.1 \text{ N}$$

$$3857.1 - 2979.4 = F_f$$

$$F_f = 877.7 \text{ N}$$

$$\frac{877.7}{8711.78} = \mu$$

$$\mu = 0.1008$$

Rounding

$$3 \quad \omega_2 = 20,000 \text{ rpm} \times \frac{2\pi}{60} = 2094.4 \text{ rad s}^{-1}$$

$$t = 0.5 \text{ s}$$

$$T = 145 \text{ Nm}$$

$$a \quad I = \frac{T}{\alpha}$$

$$\frac{\omega_2 - \omega_1}{t} = \alpha$$

$$\frac{2094.4}{0.5} = \alpha$$

$$\alpha = 4188.8 \text{ rad s}^{-2}$$

$$I = \frac{145}{4188.8}$$

$$I = 0.03462 \text{ kg m}^2$$

$$b \quad d = 0.26 \text{ m}$$

$$K^2 = \frac{d^2}{8}$$

$$\frac{d^2}{8}$$

①

$$K^2 = 4.225 \times 10^{-3} \text{ m} \quad 8.45 \times 10^{-3} \text{ m}$$

$$\frac{I}{K^2} = m \quad \frac{0.03462}{8.45 \times 10^{-3}}$$

$$m = 4.097 \text{ kg}$$

$$c \quad P = T\omega$$

$$P = 145 \times 2094.4$$

$$P = 303.69 \text{ kW}$$

$$d \quad KE = \frac{1}{2} \times 0.03462 \times 2094.4^2$$

$$= 75.93 \text{ kJ}$$

Rounding.

-05

$$4 \quad T_1 = 35^\circ\text{C} = 308\text{K}$$

$$P_1 = 200\text{ bar} = 200 \times 10^5 \text{ Pa}$$

$$T_2 = 15^\circ\text{C} = 288\text{K}$$

$$V_1 = 5\text{ m}^3$$

$$V_2 = 4\text{ m}^3$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\frac{P_1 V_1 T_2}{T_1 V_2} = P_2$$

$$\frac{200 \times 10^5 \times 5 \times 288}{308 \times 4} = P_2$$

$$P_2 = \cancel{23377} \text{ Pa}$$

$$23.377 \times 10^6 \text{ Pa}$$



yes!

$$5 \quad \rho = 885 \text{ kg/m}^3$$

$$h_1 = 0.42 \text{ m}$$

$$h_2 = 0 \text{ m}$$

$$d_1 = 0.075 \text{ m}$$

$$d_2 = 0.075 \text{ m}$$

$$P_2 - P_1 = 3.5 \times 10^3 \text{ Pa}$$

$$\frac{0.075^2 \times V_1}{0.075^2} = V_2$$

$$\cancel{9.81 \times 0.42} +$$

$$gh + \frac{V_1^2}{2} - \frac{V_2^2}{2} = P(P_2 - P_1)$$

$$\frac{gh + \frac{1}{2}(V_1^2 - V_2^2)}{\rho} = P_2 - P_1$$

$$5 \quad \frac{9.81 \times 0.42 + \frac{1}{2} \left(v^2 - \left(\frac{0.075^2 \times v}{0.025^2} \right)^2 \right)}{885} = 3.5 \times 10^3$$

$$\frac{4.1202 + \frac{1}{2} \left(v^2 - \frac{3.164 \times 10^{-5} v^2}{3.906 \times 10^{-7}} \right)}{885} = 3.5 \times 10^3$$

$$v^2 - \frac{3.164 \times 10^{-5} v^2}{3.906 \times 10^{-7}} = 1.504 \times 10^6$$

$$3.906 \times 10^{-7} v^2 - 3.164 \times 10^{-5} v^2 = 0.5873$$

$$+0.03164 v^2 = 0.5873$$

$$v^2 = 18.562 \text{ (ms}^{-1}\text{)}^2$$

$$v_1 = 4.308 \text{ ms}^{-1}$$

$$\text{area of } d_1 = \frac{\pi \times 0.075^2}{4}$$

$$A_1 = 4.418 \times 10^{-3} \text{ m}^2$$

$$\text{Flowrate} = A_1 \times v_1$$

$$= 0.02 \text{ m}^3/\text{s}$$

C



$$6 \quad 800\text{mm} \times 450\text{mm} = 0.8\text{m} \times 0.45\text{m}$$

$$T_1 = 62^\circ\text{C} + 273 = 335\text{K}$$

$$T_2 = 22^\circ\text{C} + 273 = 295\text{K}$$

$$U = \frac{k}{x}$$

$$k_2 = 0.05 \text{ W/mK}$$

$$x_2 = 0.003\text{m}$$

$$k_1 = 280 \text{ W/mK}$$

$$x_1 = 0.0015\text{m}$$

$$U_1 = 186.7 \times 10^3 \text{ W/m}^2\text{K}$$

$$U_2 = 16.7 \text{ W/m}^2\text{K}$$

$$\frac{1}{U} = 2\left(\frac{1}{186.7 \times 10^3}\right) + \frac{1}{16.7}$$

~~Q~~

$$U = 16.697 \text{ W/m}^2\text{K}$$

$$A = 360 \times 10^3 \text{ m}^2 \quad \leftarrow \text{large engine bay}$$

$$Q = 16.697 \times 360 \times 10^3 (335 - 295)$$

$$Q = 240.44 \times 10^6 \text{ W}$$

$$Q = 240.44 \times 10^3 \text{ kW}$$

~~Q~~

$$A = 0.36 \text{ m}^2$$

$$Q = 16.697 \times 0.36 (335 - 295)$$

$$Q = 240.44 \text{ W}$$

a



7 b

$$400 \text{ mm} \pm 0.4 \text{ m} \quad (1)$$

$$100 \text{ mm} = 0.1 \text{ m} \quad (1)$$

$$25 \text{ mm} = 0.025 \text{ m} \quad (1)$$

$$F = 250 \text{ N}$$

$$G = 44 \times 10^9 \text{ N/m}^2 \quad (1)$$

$$\tau = \frac{F}{A} \quad (1) \quad \text{don't know which area force applied on.}$$

$$= \frac{250}{0.1 \times 0.025}$$

hard knows we did it in class last week!

$$c = 100 \times 10^3 \text{ N/m}^2$$

$$y = \frac{100 \times 10^3}{44 \times 10^9}$$

$$y = \frac{\tau}{G}$$

$$y = 2.273 \times 10^{-6} \quad y = \frac{x}{c} \quad (1)$$

$$2.273 \times 10^{-6} \times 0.4 = x$$

$$x = 909.1 \times 10^{-9} \text{ m}$$

$$8 \quad D = 0.15 \text{ m}$$

$$T = 1200 \text{ NM}$$

$$\tau_{\text{max}} = 65 \times 10^6 \text{ N/m}^2 \quad \checkmark$$

$$J = \frac{T r}{\tau}$$

$$r = 0.075 \text{ m}$$

$$\frac{1200 \times 0.075}{65 \times 10^6} = J$$

$$J = 1.3846 \times 10^{-6} \text{ m}^4 \quad \checkmark$$

$$\frac{1.3846 \times 10^{-6} \times 32}{\pi} = (D^4 - d^4)$$

$$0.15^4 - \frac{1.3846 \times 10^{-6} \times 32}{\pi} = d^4$$

$$d^4 = 4.921 \times 10^{-6} \text{ m}^4$$

$$d = \sqrt[4]{4.9 \times 10^{-6}} \text{ m}$$

$$d = 0.0228 \text{ m}$$

shame!

(-2)

Question No.

Examiner Only

Question No.

Examiner On

Arholwr yn unig

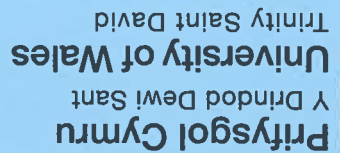
Arholwr yn unig

Question No.

Examiner On

Arholwr yn unig

ff y Cwestiwn



12 Tudalen

1. Rhwch yr holl wybodaeth y gofynnir amdani yn y blychau isod.
2. Rhwch eich enw yn lle a ddarparwyd ar y dde, plygwch ef a'i selio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.

3. Rhaid i'r atebion fod mewn llawysgriften ddarllenadwy. Gall yr Arholwyr naill ai anwybyddu sgrifft annarllenadwy, neu drefnu iddi gael ei threipio a chael yr ymgeisydd i dalu.

4. Ysgrifennwch eich atebion mewn inc.

5. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnu llinell drwyddynt.

6. Ni ddylid rhwgo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.

7. Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwylwyr/gwylwyr.

8. Rhaid dychwelyd pob llyfr. Ni chaniateir mynd â llyfrau atebion, wedi eu defnyddio neu heb eu defnyddio, allan o'r lleoliad arholi o dan unrhyw amgylchiadau.

7	Nifer y Llyfrau Atebion a gyflwynwyd	
6	Rhif Sedd	
5	Lleoliad yr Arholiad	
4	Dyddiad ac Amser yr Archoliad	
3	Cod y Modwl	
2	Teitl y Papur Arholiad	
1	Rhif Myfyriwr	

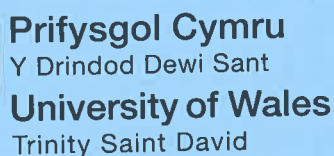
[illegible]

(See the other side for English version)

Llenwch, plygwrch a selwch
(gweler nodyn 2 isod)

CYFENN:

ENW(AU) CYNTAF:



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

SURNAME: SKOCZYLAS

FORENAME(S): MATEUSZ
DANIEL

Instructions to Candidates

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold cover 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 with string available from the invigilator(s).
8. Every book must be handed in. In any case, all books, whether used or unused, be taken out of the examination venue.

1	Student Number	17
2	Title of Examination Paper	Engineering Science 1
3	Module Code	M4X00385
4	Date and Time of Examination	16/1/2019 12:00
5	Examination Venue	Vivian Hall Dylan Thomas
6	Seat Number	~~6~~ G010
7	Number of Answer Books handed in	

the of the you attempted	Office Use	
Q1	28	28
Q2	10	17
Q3	14	20
Q4	5	9
Q5	0	18
Q6	0	12
Q7	6	13
Q8	2	10
	65	127
Total	84 full ques	

Omitting
Q3b

$$\frac{64}{122} = 52\%$$

Mark Agreed

Per An-

07/05/19

~~52~~ 51%.

$$\begin{aligned}
 v &= u + at \\
 v^2 &= u^2 + 2as \\
 s &= \frac{(u+v)t}{2} \\
 s &= ut + \frac{1}{2}at^2
 \end{aligned}$$

$$\begin{aligned}
 \omega_2 &= \omega_1 + \alpha t \\
 \omega_2^2 &= \omega_1^2 + 2\alpha\theta \\
 \theta &= \frac{(\omega_1 + \omega_2)t}{2} \\
 \theta &= \omega_1 t + \frac{1}{2}\alpha t^2
 \end{aligned}$$

Q1 a)

$$u = 0 \text{ m/s}$$

$$v_1 = 100 \times \frac{1000}{3600} = 27.7 \text{ m/s}$$

$$t_1 = 3 \text{ s}$$

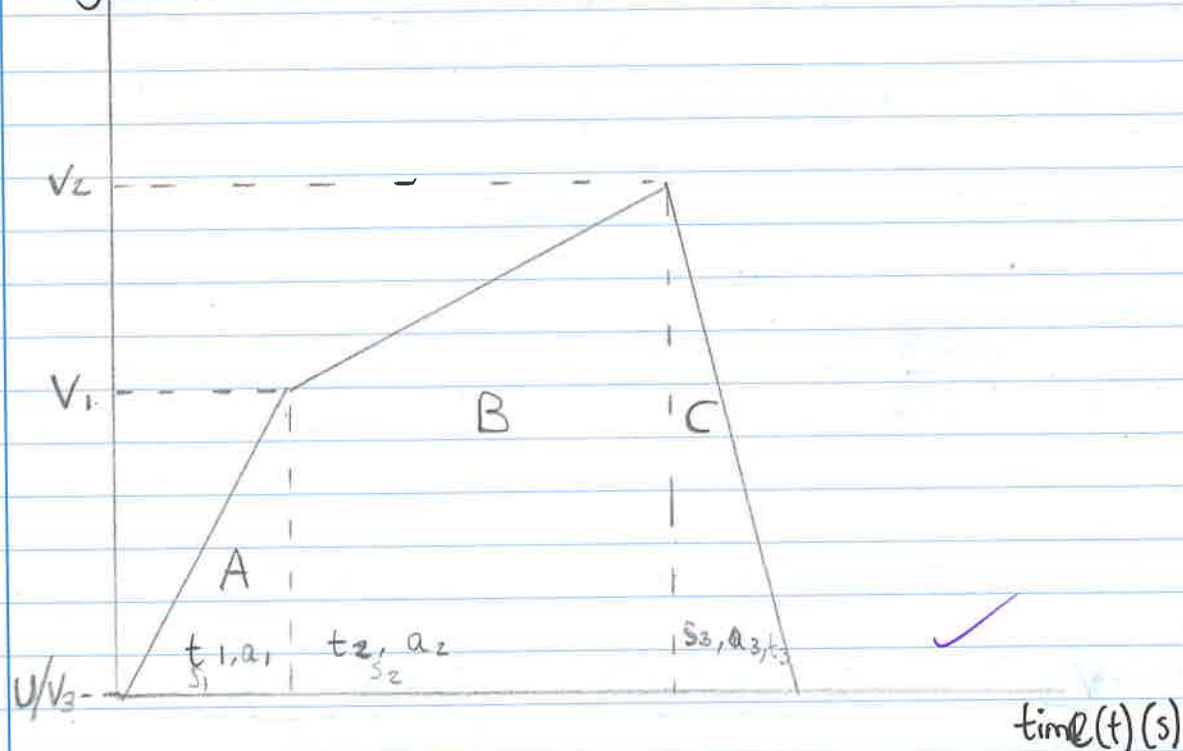
$$v_2 = 225 \times \frac{1000}{3600} = 62.5 \text{ m/s}$$

$$t_2 = 10 \text{ s}$$

$$s_3 = 65 \text{ m}$$

$$v_3 = 0 \text{ m/s}$$

velocity (v) (m/s)



$$\begin{aligned}
 a) \quad v &= u + at \\
 \frac{v-u}{t_1} &= a_1
 \end{aligned}$$

looking @ t

$$\frac{27.7-0}{3} = \underline{\underline{9.23 \text{ m/s}^2}}$$

Q1 b) $v = u + at$

$$a_2 = \frac{v_2 - v_1}{t_2}$$

looking @ B

$$a^2 = \frac{62.5 - 27.7}{10} = \underline{\underline{3.48 \text{ m/s}^2}}$$



Q1 c) $v^2 = u^2 + 2as$
 $v^2 - u^2 = 2as$

$$\frac{v^2 - u^2}{2s} = a$$

looking @ C

$$\frac{v_3^2 - v_2^2}{2s_3} = a_3 = \frac{(0)^2 - (62.5)^2}{2 \times (65)} = -30.05 \text{ m/s}^2$$

(deacceleration of 30.05 m/s^2)



$$v = u + at$$

60s

$$\frac{v - u}{a} = t$$

$$t_3 = \frac{v_2 - v_3}{a_3} = \frac{62.5}{30.05} = \underline{\underline{2.08 \text{ s}}}$$



Q1 d)

looking at @ A

$$s = \frac{(u + v)t}{2}$$

$$s_1 = \frac{(u + v_1)t_1}{2}$$

$$s_1 = \frac{(0 + 27.7) \times 3}{2}$$

$$s_1 = 41.55 \text{ m}$$

looking @ B

$$s_2 = \frac{(v_1 + v_2)t_2}{2}$$

$$s_2 = \frac{(27.7 + 62.5) \times 10}{2}$$

$$s_2 = 451 \text{ m}$$

looking @ C

$$s_3 = \frac{(v_2 + v_3)t_3}{2}$$

$$s_3 = \frac{(62.5 + 0) \times 2.08}{2}$$

$$s_3 = 65 \text{ m}$$

$$S_{\text{total}} = s_1 + s_2 + s_3$$

$$S_{\text{total}} = 41.55 + 451 + 65 = \underline{557.55 \text{ m}}$$

easier to read $\rightarrow (557.55 \text{ m})$

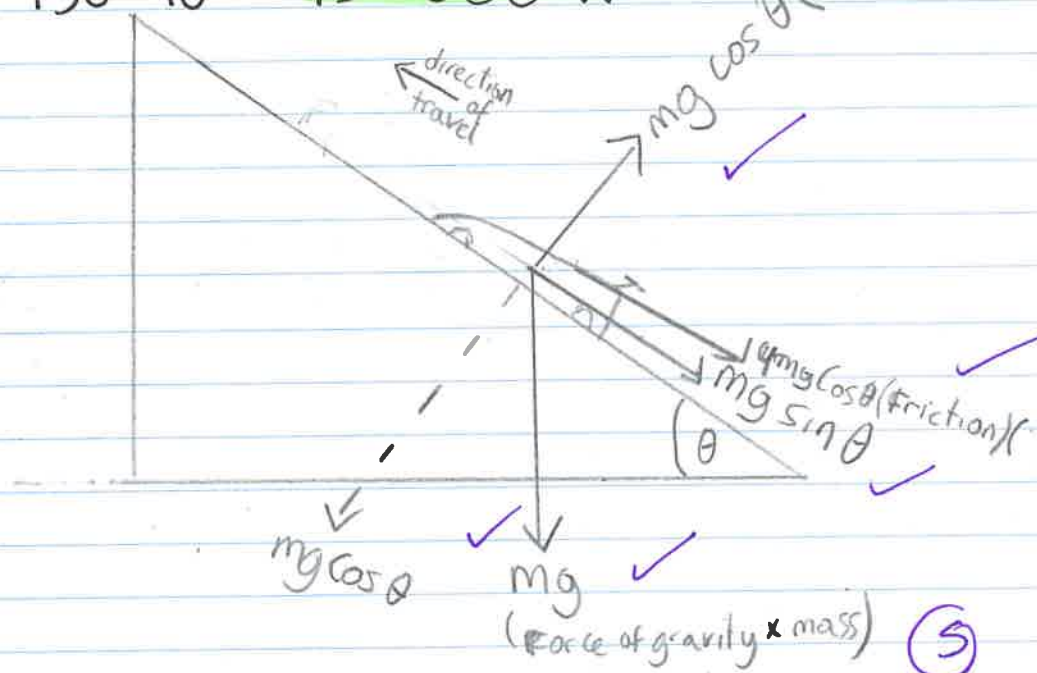
$$(557.55 \text{ m})$$

Q2) $\theta = 20^\circ$

$$v = 140 \times \frac{1000}{3600} = 38.8 \text{ m/s}$$

$$m = 888 \text{ kg}$$

$$P = 150 \times 10^3 = 150000 \text{ W}$$



$$R = mg \cos \theta$$

$$R = (888 \times 9.81) \times \cos(20)$$

$$R = 8185.93 \text{ N}$$

step 2

$$F = \mu R$$

$$\frac{F}{R} = \mu$$

$$\mu = \frac{3865.98}{8185.98} = \underline{\underline{0.47}}$$

step 1

$$P = Fv$$

$$\frac{P}{v} = F$$

$$F = \frac{150000}{38.8} = 3865.98 \text{ N}$$

Q3)a) $\omega_1 = 0 \text{ rad/s}$
 $\omega_2 = 20000 \times \frac{2\pi}{60} = 2094.40 \text{ rad/s}$
 $t_1 = 0.5 \text{ s}$
 $T = 145 \text{ Nm}$

$$I = mk^2$$

$$T = I\alpha$$

$$KE = \frac{1}{2} I \omega^2$$

$$P = T\omega$$

$$\omega_2 = \omega_1 + \alpha t$$

$$\frac{\omega_2 - \omega_1}{t_1} = \alpha$$

$$\alpha = \frac{2094.40 - 0}{0.5} = 4188.8$$

$$\alpha = 4188.8 \text{ rad/s}^2$$

$$T = I\alpha$$

$$\frac{T}{\alpha} = I = \frac{145}{4188.8} = \underline{\underline{0.03 \text{ kgm}^2}}$$

~~NOTE:~~
~~THIS QUESTION~~

NOTE ^{no time to redo}
 ERROR IN QUESTION BOOKLET
 CALCULATIONS
 ASSUME WHATS ON THE QUESTION PAPER
radius of rotor, not diameter

3)b) $k = 260 \times 10^{-3} = 0.26 \text{ m}$

$$I = mk^2$$

$$\frac{I}{k^2} = m = \frac{0.03}{(0.26)^2} = \underline{\underline{0.44 \text{ kg}}}$$

①

X

Paradi

⑧

3)c) $P = T\omega$

$$P = 145 \times 2094.40 = 303688 \text{ W}$$

$$303688 \times 10^{-3} = \underline{303.69 \text{ kW}} \quad (3)$$

3)d) $KE = \frac{1}{2} I \omega^2$

$$KE = \frac{1}{2} \times 0.03 \times (2094.40)^2 = \cancel{31142 \times 10^3} 65797.67 \text{ J}$$

$$\cancel{31142 \times 10^3} 65797.67 \times 10^{-3} = \underline{65.80 \text{ kJ}} \quad (2)$$

Rounding

4) ~~4)~~

$$T_1 = 35 + 273 = 308 \text{ K} \quad (1)$$

$$P_1 = 200 \times 10^5 = 20 \times 10^6 \text{ Pa} \quad (1)$$

$$T_2 = 15 + 273 = 288 \text{ K} \quad (1)$$

$$V_2 = \frac{V_1}{5}$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \quad (1)$$

$$\frac{P_1 V_1 T_2}{T_1 V_2} = P_2 \quad (1)$$

$$P_2 = \frac{(20 \times 10^6) \times 1 \times 288}{308 \times (\frac{1}{5})} = \boxed{93506493.51 \text{ Pa}}$$

(93.51 × 10⁶ Pa)

x.

$$5) \rho = 885 \text{ kg/m}^3$$

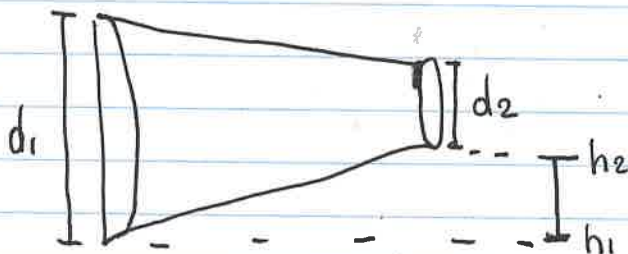
$$h_1 = 0 \text{ m}$$

$$h_2 = 420 \times 10^{-3} = 0.42 \text{ m}$$

$$d_1 = 75 \times 10^{-3} = 0.075 \text{ m}$$

$$d_2 = 25 \times 10^{-3} = 0.025 \text{ m}$$

$$p_2 - p_1 = 3.5 \times 10^3 = 3500 \text{ Pa}$$



$$gh_1 + \frac{p_1}{\rho} + \frac{V_1^2}{2} = \frac{p_2}{\rho} + \frac{V_2^2}{2} + gh_2$$

$$d_1^2 v_1 = d_2^2 v_2$$

$$\frac{V_1^2}{2} = \frac{p_2}{\rho} + \frac{V_2^2}{2} - gh_1 - \frac{p_1}{\rho} + gh_2$$

$$\frac{V_1^2}{2} - \frac{V_2^2}{2} = \frac{p_2}{\rho} - gh_1 + gh_2 - \frac{p_1}{\rho}$$

$$V_1^2 - V_2^2$$

Answer is A $(4.51 \text{ m}^3/\text{s})$

2

Q6) (this question was carried out assuming error on the question booklet - values ~~specified~~ ^{to} are assumed to be given values in mm, not m.)

$$(a) B = 800 \times 10^{-3} = 0.8 \text{ m}$$

$$(y) D = 450 \times 10^{-3} = 0.45 \text{ m}$$

$$t_1 = 62 + 273 = 335 \text{ K}$$

$$t_2 = 22 + 273 = 295 \text{ K}$$

$$\text{(glass fibre)} \\ U_a = \frac{0.05}{3}$$

$$U_b = \frac{280}{1.5}$$

$$U_c = U_b = \frac{280}{1.5}$$

$$U = \left(1 \div \left(\frac{280}{1.5}\right)\right) + \left(1 \div \left(\frac{280}{1.5}\right)\right) + \left(1 \div \left(\frac{0.05}{3}\right)\right)$$

$$U = 60.01 \text{ ~~W/m}^2\text{K}~~ \text{ W/m}^2\text{K}$$

$$Q = UA(T_1 - T_2)$$

$$A = B \times D$$

$$A = 0.8 \times 0.45 = 0.36 \text{ m}^2$$

$$Q = 60.01 \times 0.36 \times (335 - 295)$$

$$Q = 864.14 \text{ W}$$

$$864 \times 10^{-3} = 0.864 \text{ kW}$$

doesn't match
Answer €
0.864 W?

X

Q7) $B = 400 \times 10^{-3} = 0.4 \text{ m}$
 $L = 100 \times 10^{-3} = 0.1 \text{ m}$
 thickness $= 25 \times 10^{-3} = 0.025 \text{ m}$
 $F = 250 \text{ N}$
 $G = 44 \times 10^9 = 44 \times 10^9 \text{ N/m}^2$ (1)

$$\gamma = \frac{Ax}{l}$$

$$G = \frac{\tau}{\gamma}$$

$$\tau = \frac{250}{(0.4 \times 0.1)}$$

Shame. (2)

$$\tau = \frac{F}{A}$$
 (1)

$$\tau = 6250 \text{ N/m}^2$$

$$G = \frac{\tau}{\gamma}$$

$$\frac{(44 \times 10^9)}{6250} = \gamma$$

$$\frac{G}{\tau} = \gamma$$

$$\gamma \times l = x$$
 (2)

$$\gamma = 7040000$$

$$7040000 \times 400 = x$$

Q8) $D = (150 \times 10^{-3}) \text{ m}$ (1)

$T = 1200 \text{ Nm}$

$\tau = (65 \times 10^{-6}) \text{ N/m}^2$ (1)

Question No.

Examiner's Or

Arholwr yn unig

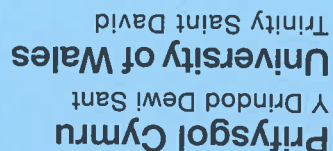
hif y Cwestiwn

Question No.

Examiner O

Arholwr yn unig

itf y Cwestiwn



12 Tudalen

1. Rhwch yr holl wybodaeth y gofynnir amdani yn y blychau isod.
2. Rhwch eich enw yn y lle a ddarparwyd ar y dde, plygwch et a'i selio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.

3. Rhaid i'r atebion fod mewn llawysgriften ddarlennadwy. Gall yr Arholwyr naill ai anwybyddu sgript annarllennadwy, neu drefnu iddi gael ei theipio a chael yr ymgeisydd i dalu.

4. Ysgirfennwch eich atebion mewn inc.

5. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw ffras nodiadau yn y llyfr atebion a thynnu llinell drwyddynt.

6. Ni ddylid rhwygo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.

7. Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwyliwr/gwilywr.

8. Rhaid dychwelyd pob llyfr. Ni chaniateir mynd â llyfrau atebion, wedi eu defnyddio neu heb eu defnyddio, allan o'r lleoliad arholi o dan unrhyw amgylchiadau.

7	Nifer y Llyfrau Atebion a gyflwynwyd	
6	Rhif Sedd	
5	Lleoliad yr Arholiad	
4	Dyddiad ac Amser yr Arholiad	
3	Cod y Modwl	
2	Teitl y Papur Arholiad	
1	Rhif Myfyrwr	

[illegible]

(See the other side for English version)

Llenwch, plygwrch a seilwch
(gweler nodyn 2 isod)

CYFENN:

ENW(AU) CYNTAF:



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Examination Answer Books

12 Pages

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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.

1	Student Number	1702206
2	Title of Examination Paper	Engineering Science 1
3	Module Code	M4X00385
4	Date and Time of Examination	16/01/19 12:00
5	Examination Venue	Dylan Thomas
6	Seat Number	9032
7	Number of Answer Books handed in	7

Complete, fold and seal
(see note 2 below)

SURNAME: White

FORENAME(S): Hannah
Elizabeth

List the numbers of the questions you have attempted	Office Use	
1	16	28
2	4	17
3	16	20
4	2	9
5	0	18
6	12	12
7	0	13
8	5.5	10
Total	55.5	127

Omitting
Q36)

$$\frac{51.5}{122} = 42\%$$

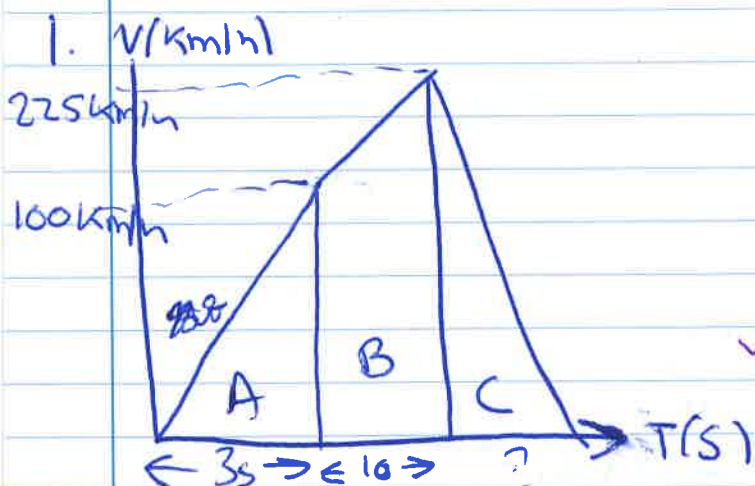
Mark Agreed

BT-D -

7/9/19

44%





a) $V = 100 \text{ km/h} \times \frac{1000}{3600} = 27.78 \text{ m/s}$

$u = 0$

$t = 3$

$a = ?$

$V = u + at$

$a = \frac{V - u}{t} = \frac{27.78}{3} = 9.26 \text{ m/s}^2$

$a = 9.26 \text{ m/s}^2$

b. $V = 225 \text{ km/h} \times \frac{1000}{3600} = 62.5 \text{ m/s}$

$u = 27.78 \text{ m/s}$

$t = 10 \text{ s}$

$a = ?$

$a = \frac{V - u}{t} = \frac{62.5 - 27.78}{10} = 3.472 \text{ m/s}^2$

$a = 3.472 \text{ m/s}^2$

C

$$v = 0$$

$$u = 62.5 \text{ m/s}$$

$$s = 65 \text{ m}$$

$$t = ?$$

~~any~~

~~$$s = \frac{(v - u)t}{2}$$~~

$$s = \frac{(v - u)t}{2} \quad \times$$

~~$$t = \frac{2s}{v - u}$$~~

$$t = \frac{(v + u)s}{s}$$

$$= \frac{0 + 62.5}{65}$$

$$= 0.965 \quad \times$$

d. $s = 0.5 \times b \times t$

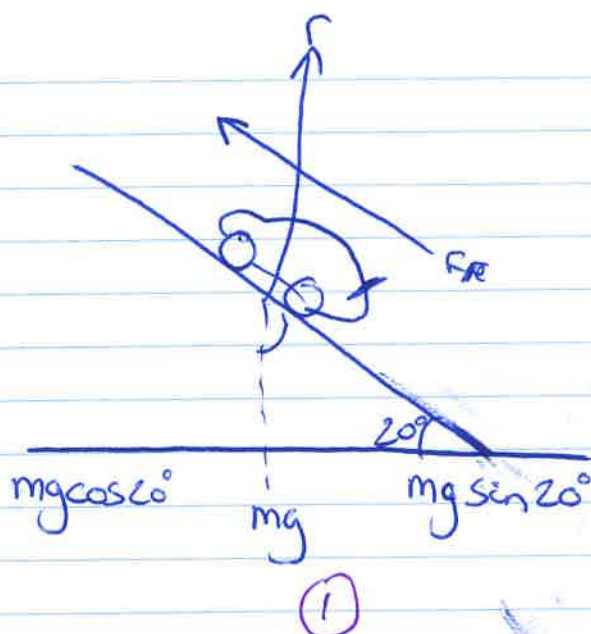
~~$$s = 0.5 \times b \times t$$~~

$$\text{Time total} = 13.96$$

$$s = 0.5 \times 13.96 \times 62.5$$

$$s = 436.25 \text{ m} \quad \times$$

2.



$$P = Fv$$

$$F = \frac{P}{v} = \frac{150000}{140}$$

$$P = 150 \text{ kW} = 150000$$

$$v = 140 \text{ km/h} \times \frac{1000}{3600} = 38.89 \text{ m/s}$$

$$R = \frac{P}{v} = \frac{150000}{38.89} = 3857.03 \text{ N}$$

$$R = \mu R$$

$$\mu = \frac{R}{F}$$

$$R = mg \sin 20^\circ + mg \cos 20^\circ$$

may

$$= 888 \times 9.81$$

$$R = mg - mg \cos 20^\circ \quad \times$$

$$= 888 \times 9.81 - mg \cos 20^\circ$$

$$= 525.35$$

$$\mu = \frac{525.35}{3857.03} = 0.136$$

$$\mu = 0.14$$

3. ~~10~~

a.

$$\omega_1 = 0$$

$$\omega_2 = 20000 \text{ rpm} \times \frac{2\pi}{60} = 2094.40 \text{ rad/s}$$

$$t = 0.55$$

$$\alpha = ?$$

$$T = 145 \text{ Nm}$$

$$\omega_2 = \omega_1 + \alpha t$$

$$\alpha = \frac{\omega_2 - \omega_1}{t} = \frac{2094.40}{0.5} = 4188.8 \text{ rad/s}^2$$

$$\alpha = 4188.8 \text{ rad/s}^2$$

$$T = I \alpha$$

$$I = \frac{T}{\alpha} = \frac{145}{4188.8} = 0.035 \text{ kgm}^2$$

b.

$$I = 0.035 \text{ kgm}^2$$

$$k = 260 \text{ mm} = 0.260 \text{ m}$$

$$I = mk^2 \Rightarrow m = \frac{I}{k^2} = \frac{0.035}{0.26^2} \quad (1)$$

$$m = 0.52 \text{ kg}$$

x

$$c. P = T\omega = 145 \times 2094.40 = 303688 \text{ W}$$

$$P = 30.36 \text{ kW}$$

✓ (3)

d.

$$KE = \frac{1}{2} I \omega^2 = 0.5 \times 0.035 \times 2094.40^2$$

$$KE = 76763.95 \text{ J}$$

$$= 76.76 \text{ kJ}$$

✓ (3)

4. $T_1 = 35^\circ\text{C} + 273 = 308\text{K} \checkmark$
 $P_1 = 200 \text{ bar} \times 100000 = 20000000 \text{ Pa}$
 $T_2 = 15^\circ\text{C} + 273 = 288\text{K} \checkmark$
 $V_1 = ?$

$$\frac{P_1 V_1}{T_1}$$

~~$$V_1 = \frac{P_1 T_1}{P_2} = \frac{20000000}{308} = 64935.06 \text{ m}^3$$~~

$$P_2 = ?$$

~~$$V_2 = \frac{64935.06}{5}$$~~

$$T_2 = 288$$

$$V_1 = P_1 \times T_1 = 20000000 \times 308 = 6.16 \times 10^9$$

$$P_2 = ?$$

$$V_2 = \frac{6.16 \times 10^9}{5} = 1.232 \times 10^9$$

$$T_2 = 288\text{K}$$

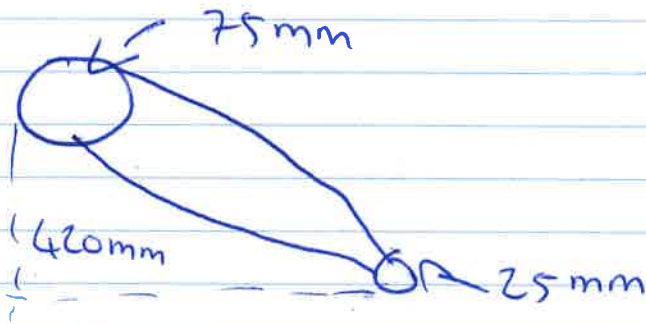
$$\frac{P_2 V_2}{T_2}$$

$$P_2 = \frac{V_2}{T_2} = \frac{1.232 \times 10^9}{288} =$$

$$P_2 = 4277777.778 \text{ Pa}$$

x

5.



$$\rho = 885 \text{ kg/m}^3$$

$$d_1 = 0.075 \text{ m}$$

$$d_2 = 0.025 \text{ m}$$

$$\rho = 885 \text{ kg/m}^3$$

$$V_1 = \frac{\pi d_1^2}{4} = \frac{\pi (0.075)^2}{4} = 4.41 \times 10^{-3}$$

$$V_2 = \frac{\pi (0.025)^2}{4} = 4.91 \times 10^{-4}$$

$$gh_1 + \frac{p_1}{\rho} + \frac{V_1^2}{2} = gh_2 + \frac{p_2}{\rho} + \frac{V_2^2}{2}$$

$$(9.81 \times 0.42) +$$

$$p_1 = \rho \left(gh_1 - \frac{V_2^2}{2} \right)$$

$$= 885 \left(9.81 \times 0.42 - \frac{4.91 \times 10^{-4}}{2} \right)$$

$$B. 0.00045 \text{ m}^3/\text{s}$$

8.

$$D = 150 \text{ mm} = 0.15 \text{ m} \quad (1)$$

$$T = 1200 \text{ Nmm}$$

$$\tau = 65 \text{ MN/m}^2 = 65 \text{ N/mm}^2 \times 10^6 \quad (1)$$

$$r = \frac{D}{2} = 0.075 \quad (1)$$

$$J = \frac{\pi D^4}{32}$$

$$\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{L}$$

$$\frac{T}{J} = \frac{\tau}{r}$$

$$J = \frac{T}{\frac{\tau}{r}} = \frac{65 \times 10^6}{0.075 \times 1200} =$$

$$J = \frac{T r}{\tau} = \frac{1200 \times 0.075}{65 \times 10^6} = 1.38 \times 10^{-6} \text{ units!} \quad (2.5)$$

$$J = 1.38 \times 10^{-6}$$

$$J = \frac{\pi (D^4 - d^4)}{32}$$

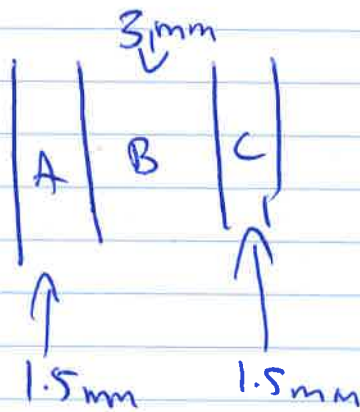
$$d^4 = \frac{\sqrt[4]{D^4 \times 32}}{\pi}$$

$$= \frac{\sqrt[4]{0.15^4 \times 32}}{\pi}$$

$$= 0.05 \text{ m}$$

X

6.



$$U = \frac{1}{u_1} + \frac{1}{u_2} + \frac{1}{u_3}$$

$$u_1 = u_3 = \frac{0.015}{k \times 280} = 4.2 \text{ W/mK}$$

$$u_2 = 0.03 \times 0.05 = 1.5 \times 10^{-3} \text{ W/mK}$$

$$\frac{1}{u} = \frac{1}{4.2} + \frac{1}{1.5 \times 10^{-3}} + \frac{1}{4.2} = 667.14$$

$$u = 1.49 \times 10^{-3} \text{ W/mK}$$

$$Q = uA (T_1 - T_2)$$

$$Q = u \times \frac{\pi d^2 L}{4} (T_1 - T_2)$$

$$= (1.49 \times 10^{-3}) \times \left(\frac{\pi \times 0.8^2 \times 0.45}{4} \right) \times ((62 + 273) - (22 + 273))$$

$$Q = 0.86 \text{ W} \quad \checkmark$$

Question No.

Examiner Only

Question No.

Examiner Onl

Arholwr yn unig

hif y Cwestiwn

Question No.

Examiner On

Arholwr yn unig

ity Cwestiwn

Cyfarwyddiadau i Ymgeiswyr

1. Rhwch yr holl wybodaeth y gofynnir amdani yn y blychau isod.
2. Rhwch eich enw yn y lle a ddarparwyd ar y dde, plygwch et a'i selio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.

3. Rhaid i'r atebion fod mewn llawysgriften ddarllenadwy. Gall yr Arholwyr naill ai anwybyddu sgrifft annarllenadwy, neu drefnu iddi gael ei theipio a chael yr ymgeisydd i dalu.

4. Ysgrifennwch eich atebion mewn inc.

5. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnu llinell drwyddynt.

6. Ni ddylid rhwgo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.

7. Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwylwlr/gwylwyr.

8. Rhaid dychwelyd pob llyfr. Ni chaniateir mynd â llyfrau atebion, wedi eu defnyddio neu heb eu defnyddio, allan o'r lleoliad arholi o dan unrhyw amgylchiadau.

1	Rhif Myfyriwr	
2	Telli y Papur Arholiad	
3	Cod y Modwl	
4	Dyddiad ac Amser yr Archoliad	
5	Lleoliad yr Arholiad	
6	Rhif Sedd	
7	Nifer y Llyfrau Atebion a gyflwynwyd	

Rhestrwch rifau'r cwestiyonau a ymgaiswyd gennyh	
At Ddbention y Swyddfa	

(See the other side for English version)

Llenwch, plygwch a seliwch
(gweler nodyn 2 isod)

CYFENN:

ENW(AU) CYNTAF:



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Examination Answer Books

12 Pages

Instructions to Candidates

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiner will 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.

Complete, fold and seal
(see note 2 below)

SURNAME: Mason

FORENAME(S): Lurie

1	Student Number	1700942
2	Title of Examination Paper	Engineering Science 1
3	Module Code	M4X00385
4	Date and Time of Examination	16/1/19
5	Examination Venue	Vivian Hall
6	Seat Number	G049
7	Number of Answer Books handed in	1

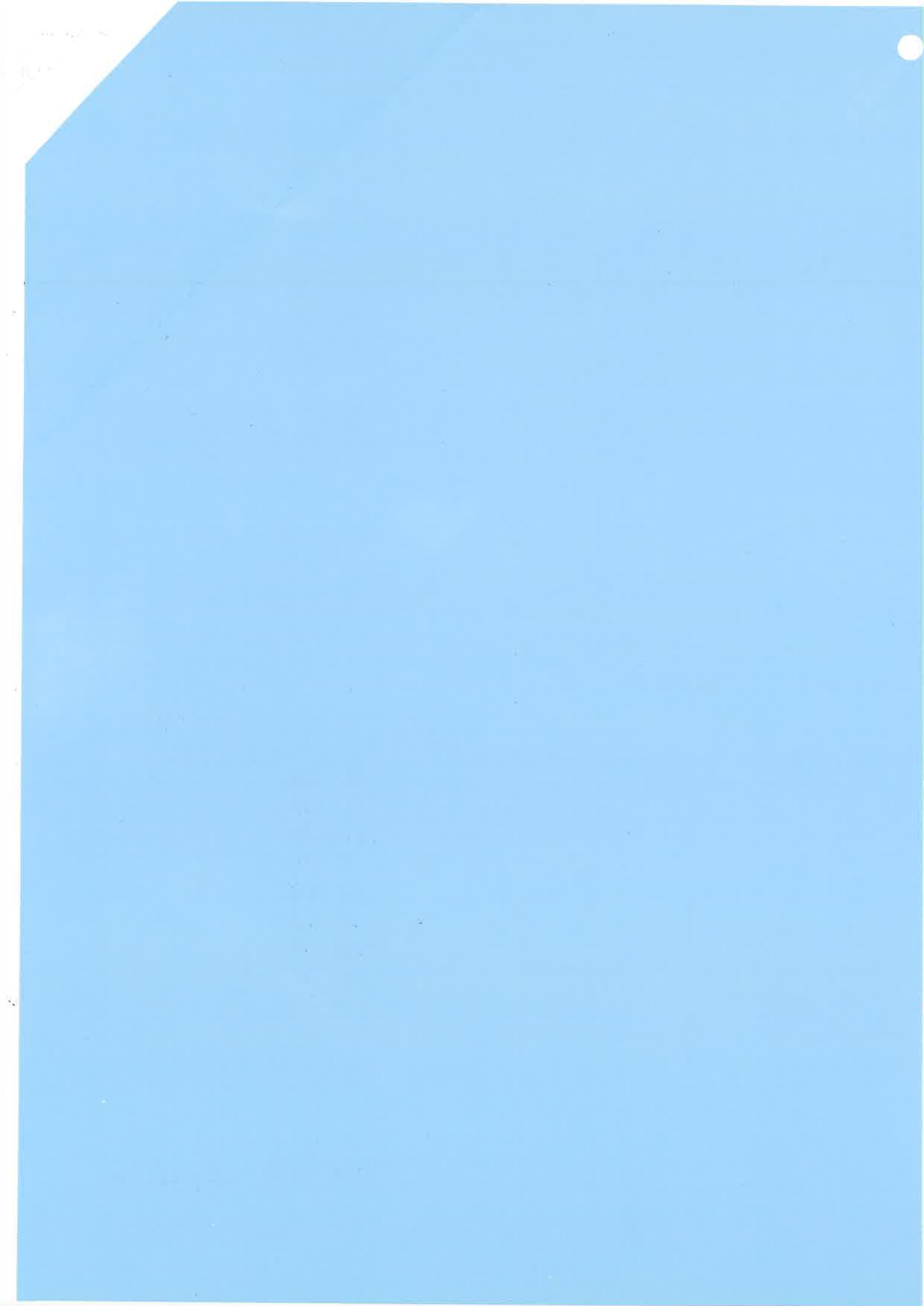
List the numbers of the questions you have attempted	Office Use	
1	12	28
2	9	17
3	14.5	20
4	3	9
5	0	18
6	12	12
7	0/13	13
8	10	10
Total	60.5	127

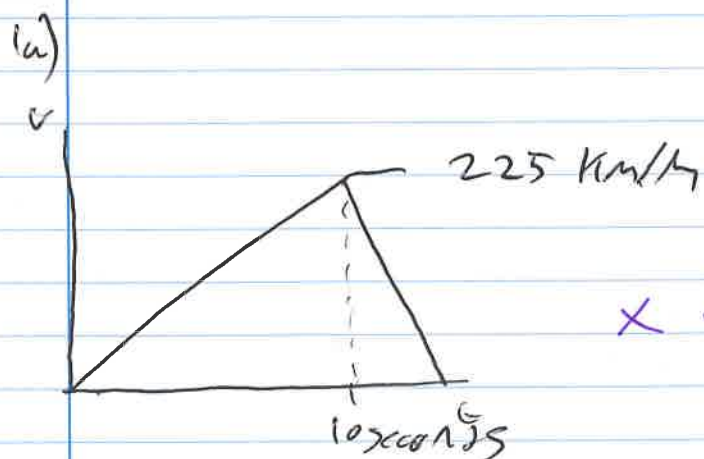
Omitting
Q3b

$$\frac{60.5}{122} = 50$$

Mark Agreed
P.T. On
7/5/19

47.6.%





$$v = u + at$$

$$a = \frac{v - u}{t}$$

$$v = 100 \times \frac{1000}{3600} = 27.778 \text{ m/s} \quad \checkmark$$

$$u = 0$$

$$t = 3$$

$$a = \frac{27.778}{3} = 9.26 \text{ m/s}^2 \quad \checkmark$$

(6)

b) $v = 225 \times \frac{1000}{3600} = 62.5 \text{ m/s}$

$$u = 27.778 \text{ m/s}$$

$$t = 7$$

$$a = \frac{62.5 - 27.778}{7}$$

$$= 4.96 \text{ m/s}^2$$

(2)

Shame.

c) $s = \frac{(v + u)}{2} t$

$$25 = vt$$

$$t = \frac{25}{v}$$

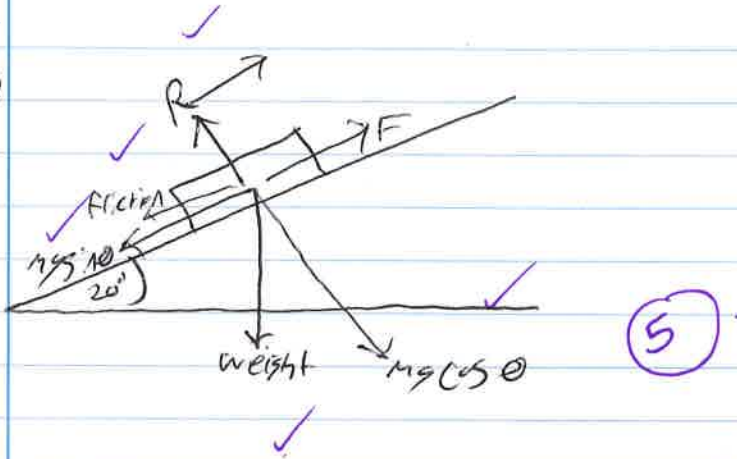
$$s = 85$$

$$u = 62.5$$

$$t = \frac{2 \times 85}{62.5} = 2.08 \text{ s} \quad \checkmark$$

(4)

2)



$$P = Fv$$

$$F = \frac{P}{v}$$

$$= \frac{150 \times 10^3}{140 \times \frac{1000}{3600}}$$

$$= 3857.143 \text{ N}$$

$$R = Mg \cos \theta$$

$$\mu = \frac{F}{R}$$

$$= \frac{F}{Mg \cos \theta}$$

$$= \frac{3857.143}{888 \times 9.81 \times \cos 20}$$

$$= 0.47$$

$$3) \omega_2 = \omega_1 + \alpha t$$

$$\alpha = \frac{\omega_2}{t}$$

$$\omega_2 = 20000 \text{ rpm} = \frac{2094.40}{\cancel{34907}} \text{ ms}^{-1}$$

$$\alpha = \frac{2094.40}{\cancel{34907}} = \frac{0.9}{\cancel{4188.79}} \text{ ms}^{-2}$$

$$I = \frac{I}{\alpha}$$

$$= \frac{145}{\cancel{4188.79}}$$

$$= \cancel{2.08} 0.0346 \text{ units.}$$

(8.5)

$$c) P = \tau \omega$$

$$= 145 \times 2094.40$$

$$= 303.89 \text{ kW}$$

✓ (3)

$$2) \frac{1}{2} \times 0.0348 \times 2094.40^2$$

$$= 75.89 \text{ kJ}$$

✓ (3)

$$4) \frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$P_1 = 200 \text{ bar}$$

$$T_1 = 308 \text{ K}$$

$$T_2 = 288 \text{ K}$$

$$\frac{200}{308} = \frac{P_2}{288}$$

$$P_2 = \frac{200 \times 288}{308}$$

$$= 187.01 \text{ bar} \quad \times$$

$$5) \rho_1^2 V_1 = \rho_2^2 V_2$$

$$0.075^2 V_1 = 0.025^2 V_2$$

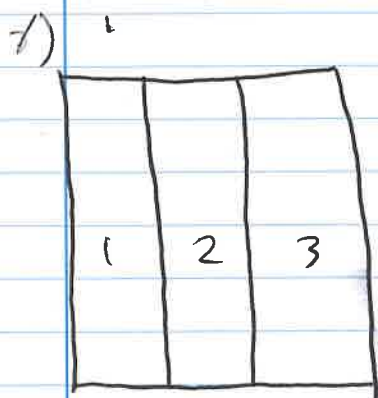
$$V_2 = 9 V_1$$

$$\rho = 885$$

$$P_1 - P_2 = 3500$$

$$\rho_2 = 0.42$$

$$\frac{P_1}{\rho} + \frac{V_1^2}{2} = 4.1202 + \frac{P_2}{\rho} + \frac{81 V_1^2}{2}$$



$$V = \frac{K}{x}$$

$$V_1 = \frac{280}{0.0015} + \frac{280}{0.003} + \frac{280}{0.0015} = \frac{0.015}{280} \frac{280}{0.0015}$$

$$V_1, 2, V_3$$

$$V_2 = \frac{0.005}{0.003} = \frac{0.005}{0.003}$$

$$\frac{1}{V} = \frac{280}{0.0015} + \frac{280}{0.003} + \frac{280}{0.0015} = \frac{0.0015}{280} + \frac{0.003}{280} + \frac{0.0015}{280}$$

$$\frac{1}{V} = 373.33 \times 0.008$$

$$V = \frac{1}{373.33 \times 0.008} = 16.664$$

$$Q = \frac{16.664}{2.878 \times 10^{-4}} \times (0.8 \times 0.45) \times (335 - 295)$$

$$= 240 \text{ W}$$

$$\delta, \text{ answer} = \underline{\underline{16.664 \text{ A}}}$$

$$8) \frac{T}{J} = \frac{\tau}{r}$$

$$\frac{T}{J} = \frac{\tau}{r}$$

$$r = \frac{0.15}{2} = 0.075$$

$$T = 1200$$

$$\tau = 285 \times 10^6$$

$$J = \frac{1200 \times 0.075}{285 \times 10^6}$$

$$= 1.385 \times 10^{-6}$$

$$D = 0.15$$

$$J = \frac{\pi(D^4 - d^4)}{32}$$

$$32J = \pi(D^4 - d^4)$$

$$\frac{32J}{\pi} = D^4 - d^4$$

$$d^4 = D^4 - \frac{32J}{\pi}$$

$$d = \sqrt[4]{D^4 - \frac{32J}{\pi}}$$

$$d = \sqrt[4]{0.15^4 - \frac{32 \times 1.385 \times 10^{-6}}{\pi}}$$

$$= 0.149 \text{ m}$$

✓ yay!

Question No.

Examiner On

Arholwr yn unig

ff y Cwestiwn

Question No.

Examiner On

Arholwr yn unig

llyf y Cwestiwn

Question No.

Examiner Only

Arholwr yn iu

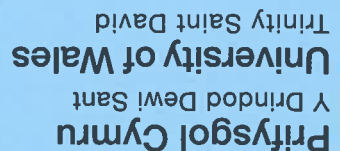
Rhif y Cwestiwn

Question No.

Examiner Or

Arholwr yn unig

y Cwestiwn



12 Tudalen

8. Rhaid dychwelyd pob llyfr. Ni chaniateir mynd â llyfrau atebion, wedi eu defnyddio neu heb eu defnyddio, allan o'r lleoliad arholi o dan unrhyw amgylchiadau.

[illegible]



Complete, fold and seal
(see note 2 below)

SURNAME: Lackyear

FORENAME(S): Joseph
Matthew.

Examination Answer Books

12 Pages

Instructions to Candidates

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1	Student Number	1701114
2	Title of Examination Paper	Engineering Science 1
3	Module Code	M4X00385
4	Date and Time of Examination	1200hrs 16/1/19.
5	Examination Venue	Vivian hall
6	Seat Number	6016.
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use	
1	23	28
2	16.5	17
3	4	20
4	5	19
5	0	18
6	0	12
7	0	13
8	3	10
Total	61.5	127

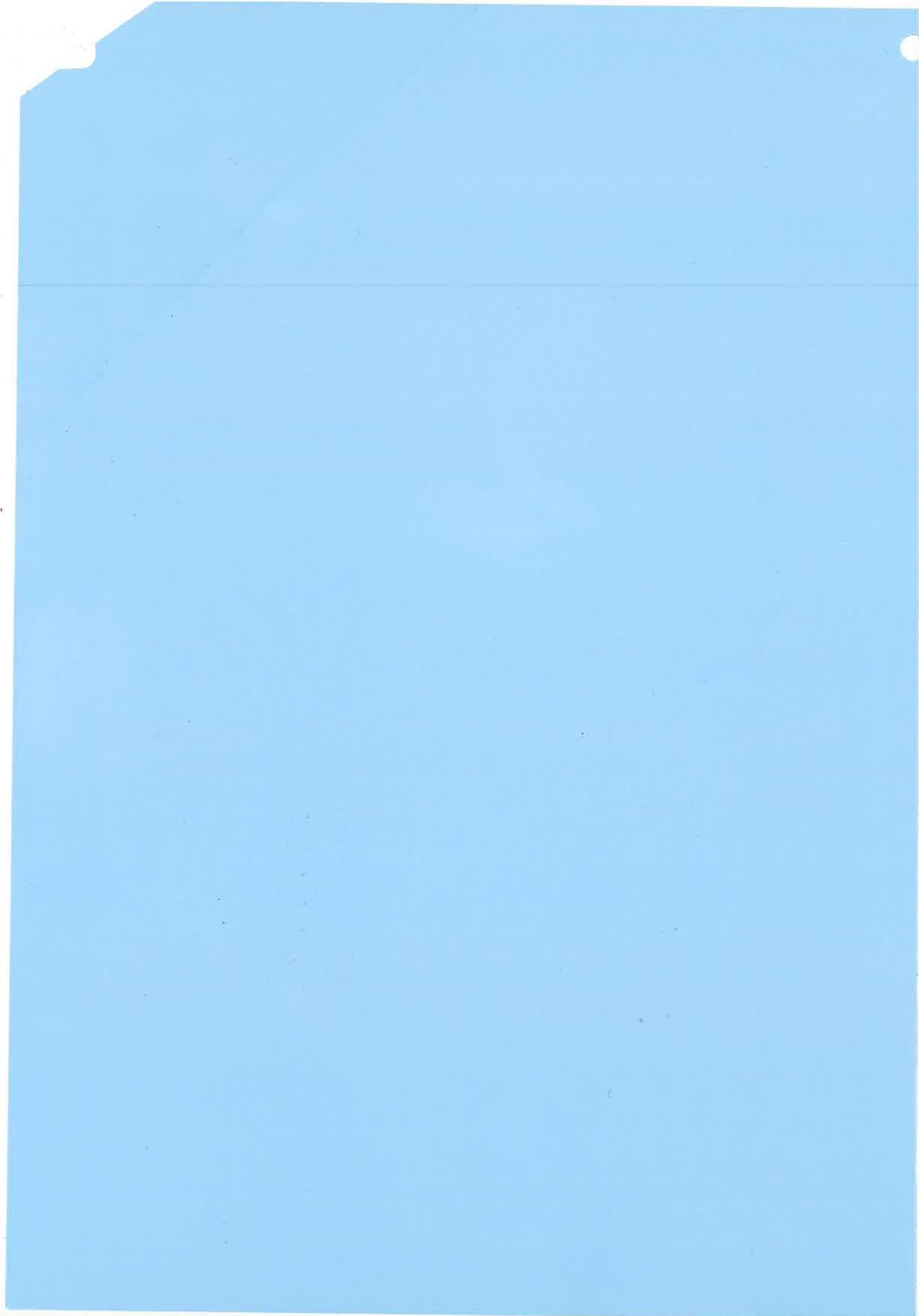
Omitting
Q3b)

$$\frac{51.5}{122} = 42$$

Mark Agreed

lt. O.

7/5/19



$$V = U + at$$

$$V^2 = U^2 + 2as$$

$$S = UT + \frac{1}{2}at^2$$

$$S = \frac{(V+U)t}{2}$$

$$\tau = \frac{F}{a}$$

$$\epsilon = \frac{x}{L}$$

Q1). $U_1 = 0$

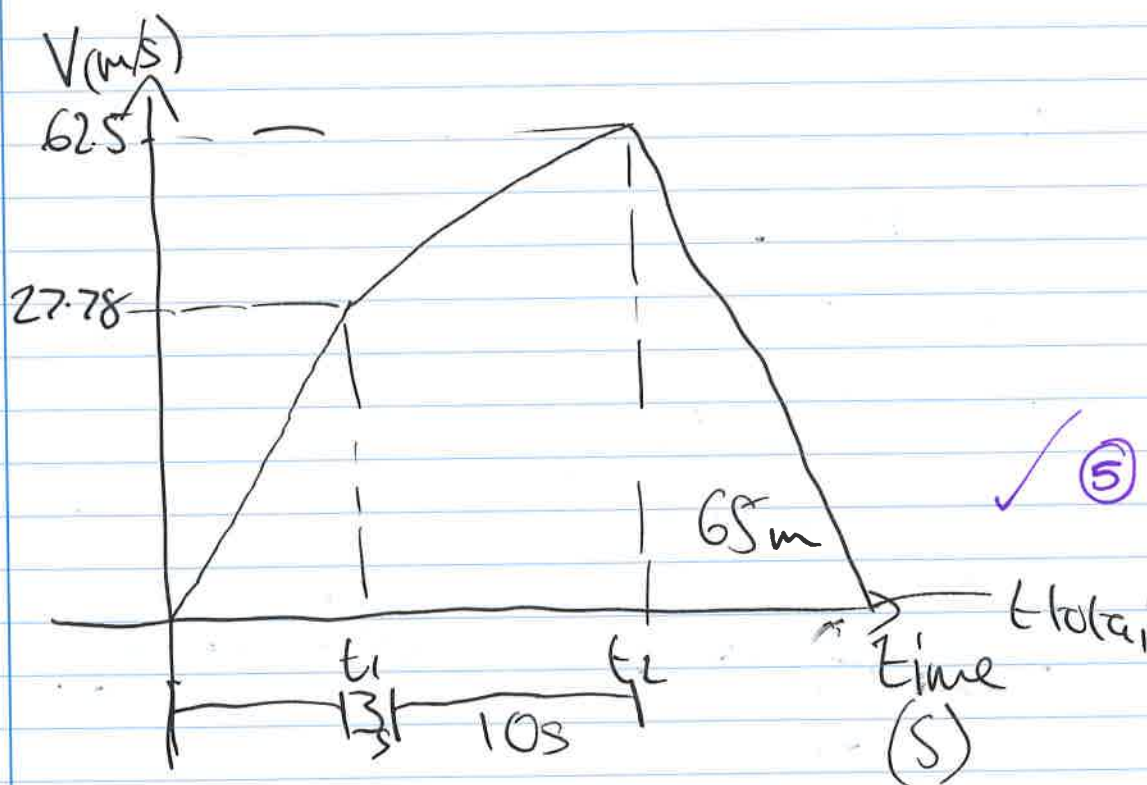
$$V_1 = 100 \text{ km/h} \times \frac{1000}{3600} = 27.78 \text{ m/s}$$

$$t_1 = 3 \text{ seconds}$$

$$V_2 = 225 \text{ km/h} \times \frac{1000}{3600} = 62.5 \text{ m/s}$$

$$t_2 = 10 \text{ s}$$

$$S_3 = 65 \text{ m}$$



✓ (5)

a) 1a).

$$a_1? \quad V = u + at.$$

$$\frac{V - u}{t} = a.$$

$$a = \frac{27.78 - 0}{3} = \underline{9.26 \text{ m/s}^2}$$

b) $a_2?$

$$a = \frac{62.5 - 27.78}{10} = \underline{3.47 \text{ m/s}^2}$$

c) $t_3?$

$$s = \frac{(V - u)t}{2}$$

$$2s = (V - u)t$$

$$\frac{2s}{V - u} = t.$$

$$t = \frac{(2)(65)}{62.5} = \underline{2.08 \text{ s.}}$$

d) S total?

Shame!

$$S3 = 65m$$

$$S1 = \frac{(v+u)t}{2}$$

$$S1 = \frac{(27.78 - 0)3s}{2} = 41.67m \quad (3) \quad \checkmark$$

$$S2 = \cancel{62.5} \frac{(62.5 - 27.78)10}{2} = 173.6m \quad \times$$

$$S_{total} = 280.27m$$

Shame.

Q21).

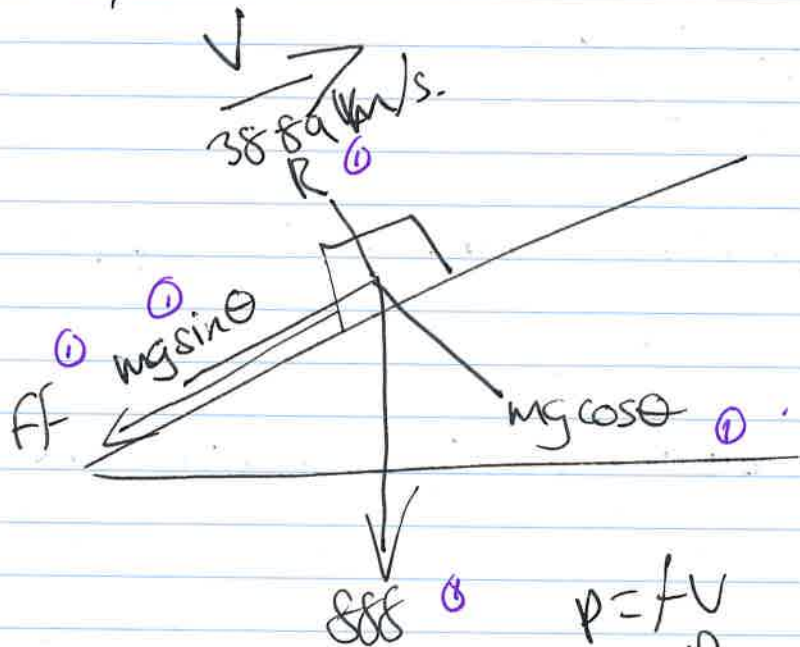
 20° incline.

$$V = 140 \text{ km/h} = 38.89 \text{ m/s.}$$

$$m = 888 \text{ kg}$$

$$P = 150,000 \text{ W}$$

N?



forces down =

$$P = FV$$

$$F = \frac{P}{V}$$

$$F = 3857.03 \text{ N}$$

$$mg \sin \theta + Ff$$

$$N = \frac{3857.03}{888 \cos 20} = 4.62 \times$$

$$F = mg \sin \theta + N mg \cos \theta$$

$$Fd = 888 \sin 20 + N mg \cos \theta$$

$$Fd = 888 \sin 20 + N 888 \cos 20 =$$

$$N \neq \frac{F}{mg \sin \theta}$$

$$F_d = mg$$

$$F = (mg \sin \theta) + N(mg \cos \theta)$$

$$N = \frac{F}{(mg \sin \theta)(mg \cos \theta)} = 0.015 \quad \text{X. shif}$$

Randoming error.

Noise.

$$P = FV$$

$$F = \frac{P}{V}$$

$$= \frac{150,000}{388 \text{ m/s}}$$

$$= 3857.03 \text{ N}$$

$$F = NR$$

$$N = \frac{F}{R}$$

$$N = \frac{mg \cos \theta}{3857.03}$$

$$4.62 \text{ X wrong.}$$

$$N = \frac{888 \cos 20}{3857.03} = \underline{\underline{0.22}}$$

Q3). $\omega_1 = 0$

(2)

$$\omega_2 = 20,000 \text{ rpm} = \frac{1.2\pi}{60} = 2094.40 \text{ Rad/s}$$

$$t = 0.55$$

$$T = 145 \text{ Nm}$$

don't know what $k =$

a) $I = ?$

$$I = mk^2$$

$$T = I\alpha$$

c) $P = T\omega$

$$P = 145 \times 2094.40 = 303688 \text{ W}$$

(2)

kw?

Q1)

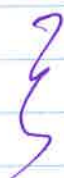
$$t_1 = 35^\circ\text{C} + 273 = 308\text{K} \quad \checkmark \quad 0$$

$$P = 200 \times 10^5 \text{ Pa} = 200 \text{ bar.} \quad \checkmark \quad ①$$

$$t_2 = 15^\circ\text{C} + 273 = 288 \quad \checkmark \quad ①$$

$$V_1 = 5$$

$$V_2 = 1$$



P2?

$$\frac{P_1 V_1}{t_1} = \frac{P_2 V_2}{t_2} \quad ①$$

$$P_1 V_1 t_2 = P_2 V_2 t_1$$

$$P_2 = \frac{P_1 V_1 t_2}{V_2 t_1} \quad \checkmark \quad ①$$

$$P_2 = \frac{(200 \times 10^5)(5)(288)}{(1)(308)}$$

Share.

$$P_2 = 935.06 \times 10^5 \text{ Pa}$$

$$935.06 \text{ bar.}$$

Q5)

$$\rho = 885 \text{ kg/m}^3$$

$$H_1 - H_2 = 42 \text{ mm}$$

$$d_1 = 0.075 \text{ m}$$

$$d_2 = 0.025 \text{ m}$$

$$p_1 - p_2 = 3.5 \text{ kPa.}$$

$$3500 \text{ Pa.}$$

$$V_1 = \frac{\pi d^2}{4}$$

$$V_1 = \frac{\pi (0.075)^2}{4} = 4.42 \times 10^{-3}$$

$$V_2 = \frac{\pi (0.025)^2}{4} = 4.91 \times 10^{-4}$$

$$d_1^2 V_1 = d_2^2 V_2$$

Can't Remember Q =

Answer (b) x

Q6)

$$A = 800 \text{ m} \times 450 \text{ m}$$

$$t_1 = 62^\circ$$

$$x_2 = 1.5 \text{ mm}$$

$$t_2 = 22^\circ \text{C}$$

$$x_{1+3} = 1.5 \text{ mm}$$

$$x = 1.5 \text{ mm}$$

$$U_2 = 280 \text{ W/mK}$$

$$A = 800 \times 450 \text{ m} = 360,000 \text{ m}^2$$

~~Q =~~

~~$$Q = U_2 A (t_1 - t_2)$$~~

~~Q =~~

~~$$Q = (280)(360,000)(40)$$~~

~~$$Q = 40.32 \times 10^8$$~~

Answer

C

X 1

Q7)

$$400 \times 100 \times 25 \text{ mm}$$

$$L = 100 \text{ mm}$$

$$F = 250 \text{ N}$$

$$\sigma = G = 44 \text{ GN/m}^2$$

$$x = ?$$

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

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

$$A = 0.4 \times 0.1 \times 0.025$$

$$\epsilon = \frac{x}{L}$$

$$r? \\ D = 150 \text{ mm} = 0.15 \text{ m} \stackrel{r}{=} 0.0075 \text{ m} \quad (2) \checkmark$$

$$T = 1200 \text{ Nm}$$

$$\tau = 65,000,000 \text{ N/m}^2 \quad (1)$$

$$J = \frac{\pi D^4}{32}$$

$$\frac{T}{J} = \frac{\tau}{r}$$

$$J = \frac{(65,000,000) \times (0.0075)^4}{1200} = 7,222,222.22$$

$$J = \frac{\pi (D^4 - d^4)}{32}$$

$$32J = \pi (D^4 - d^4)$$

$$d = 0.000162 \text{ m}$$

$$\frac{32J}{\pi} = D^4 - d^4$$

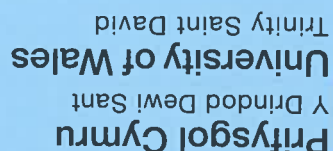
Shame.

$$32J(D^4 + d^4) = \pi$$

$$D^4 + d^4 = \frac{\pi}{32J}$$

$$= 1.62 \times 10^{-4}$$

$$d = \sqrt[4]{\frac{\pi - D^4}{32J}} \quad \times$$



12 Tudalen

1. Rhwch yr holl wybodaeth y gofynnir amdani yn y blychau isod.
2. Rhwch eich enw yn y lle a ddarparwyd ar y dde, plygwch ef a'i seilio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.

3. Rhaid i'r atebion fod mewn llawysgriften ddarlennadwy. Gall yr Arholwyr naill ai anwybyddu sgrïpt annarllennadwy, neu drefnu iddi! gael ei theipio a chael yr ymgeisydd i dalu.

4. Ysgriennwch eich atebion mewn inc.

5. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnu llinell drwyddynt.
6. Ni ddylid rhwgo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.

7. Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwyllwyr/gwyllwyr.

8. Rhaid dychwelyd pob llyfr. Ni chaniateir mynd â llyfrau atebion, wedi eu defnyddio neu heb eu defnyddio, allan o'r lleoliad arholi o dan unrhyw amgylchiadau.

7	Nifer y Llyfrau Atebion a gyflwynwyd	
6	Rhif Sedd	
5	Lleoliad yr Arholiad	
4	Dyddiad ac Amser yr Arholiad	
3	Cod y Modwl	
2	Teitl y Papur Arholiad	
1	Rhif Myfyrwr	

[illegible]

(See the other side for English version)

Llenwch, plygwh a selwch
(gweler nodyn 2 isod)

CYFENW:

ENW(AU) CYNTAF:

ENW(AU) CYNTAF: