



Complete, fold and seal
(see note 2 below)

Davis

Tamryn

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, fold over 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.
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1	Student Number	1804003
2	Title of Examination Paper	further science
3	Module Code	M4X01505
4	Date and Time of Examination	2015/19 12:00
5	Examination Venue	1Q
6	Seat Number	RG13
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use	
1	9	28
2	1	11
3	11	20
4	4	13
Total	~~28~~	72

(Gweler yr ochr arall am y fersiwn Cymraeg)

27

38 %



[Faint, illegible handwriting]

[Faint, illegible handwriting]

[Faint, illegible handwriting]

[Faint, illegible handwriting]

[Faint, illegible handwriting]

[Faint, illegible handwriting]

[Faint, illegible handwriting]

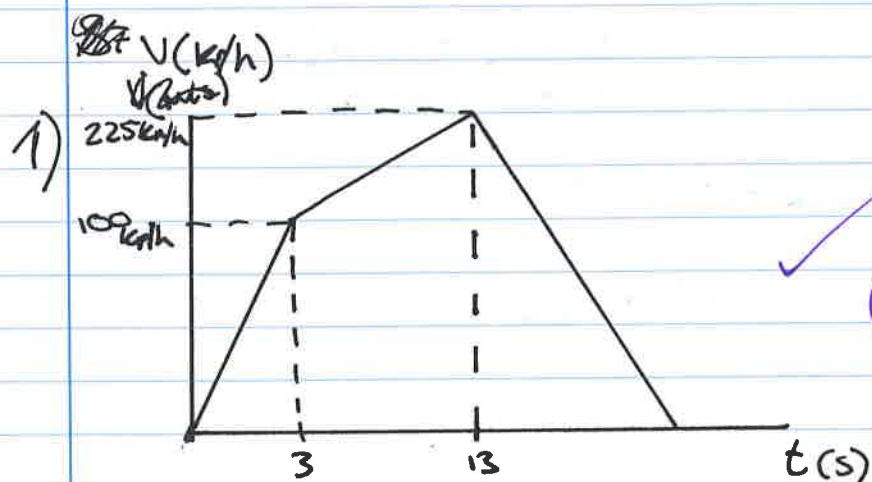
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[Faint, illegible handwriting]

$$V = u + at$$

~~$$V^2 = u^2 + 2at$$~~
$$V^2 = u^2 + 2at$$

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



a) $V = 0$
 $V = 100 \text{ km/h}$ ← Note base units.
 $t = 3$

$$V = u + at \quad a = \frac{V - u}{t} \quad (2)$$

$$a = \frac{100 - 0}{3}$$

$$a = \frac{100}{3}$$

$$a = 33.33$$

x.

b) $u = 100$
 $V = 225$
 $t = 10$

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

$$a = \frac{225 - 100}{10}$$

(1)

$$a = \frac{125}{10}$$

$$a = 12.5$$

x

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

c) $u = 225 \text{ km/h}$ $S = 65 \text{ m}$
 $v = 0$

$$65 = \frac{(0 + 225)t}{2}$$

$$65 = \frac{225 \times t}{2}$$

$$\cancel{65 = \frac{225t}{2}}$$

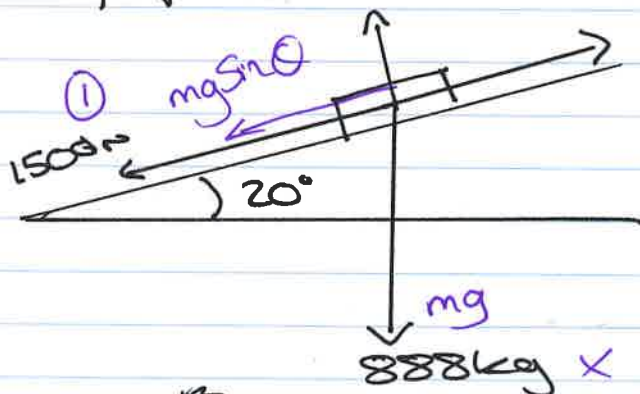
$$65 \times 2 = 225 \times t$$

$$\frac{65 \times 2}{225} = t$$

$$t = 0.58 \text{ s}$$

(1) for recovery

2) $P = Fv$



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

$$F = 1500 \text{ N}$$

$$\frac{P}{F} = v \quad \frac{150}{1500} = v$$

$$v = 0.1 \text{ m/s}$$

$$3) \quad \cancel{20000 \text{ rpm in } 0.5 \text{ sec} \times \frac{2\pi}{60}} = \cancel{2094.40 \text{ rad/s}} \times 2$$

$$3) \quad 20,000 \text{ rpm in } 0.5 \text{ sec}$$

$$a) \quad 20,000 \times \frac{2\pi}{60} = 2094.40 \text{ rad/s} \quad \checkmark$$

$$2094.40 \times 2 = 4188.80 \text{ rad/s} \quad \checkmark$$

$$\alpha = 4188.80 \text{ rad/s}$$

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

$$T = I\alpha$$

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

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

$$I = 0.035$$

2dp? units?

(8)

$$b) \quad k^2 = \frac{d^2}{8}$$

$$I = mk^2$$

$$d = 260 \text{ mm}$$

$$I = 0.035$$

$$k^2 = \frac{260^2}{8}$$

Base units.

$$k^2 = 8450$$

(1)

$$I = mk^2$$

$$0.035 = m \times 8450$$

$$m = \frac{I}{k^2}$$

$$m = \frac{0.035}{\sqrt{8450}}$$

$$m = \frac{0.035}{91.932}$$

$$m = 3.81 \times 10^{-4}$$

x

~~$$P = T\omega$$~~

~~$$T = 145 \text{ nm}$$~~

~~$$\omega = 4188.80 \text{ rads/s}$$~~

~~$$P = 607376 \text{ W}$$~~

~~$$P = 607376 \text{ W}$$~~

~~d)~~

$$c) P = T\omega$$

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

$$\omega = 2094.4 \text{ radians}$$

$$P = 303688 \text{ W} \quad (2)$$

~~K~~

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

~~$$0 + (4188.8) \times 0.5$$~~

$$0 + (4188.8 \times 0.5) = 2094.4$$

$$d) K.E = \frac{1}{2} I \omega^2$$

$$K.E = \frac{1}{2} \times 0.035 \times 2094.4^2$$

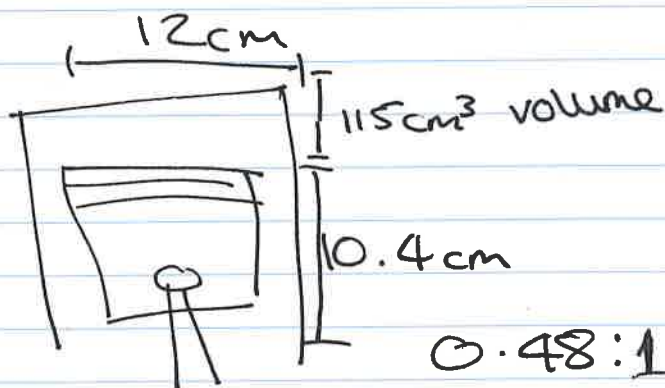
$$K.E = 36.65$$

4)

$$12 \times 10.4 = 124.8$$

Nope!

a)



$$124.8 + 115 = 239.8 \text{ cm}^3$$

$$0.48 : 1$$

$$0.48 : 1$$

$$115 \div 239.8 = 0.48$$

b)

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

~~115~~

$$P_1 = 95 \text{ kN/m}^2$$

$$T_1 = 30^\circ\text{C} + 273 = 303 \text{ K}$$

$$V_1 = 115 \text{ cm}^3$$

$$P_2 = ?$$

$$T_2 = 450^\circ\text{C} + 273 = 723 \text{ K}$$

$$V_2 = 115 \text{ cm}^3$$

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

$$= \frac{95 \times 115 \times 723}{303 \times 115}$$

$$P_2 = \frac{7898775}{34845}$$

Carried errors.

$$P_2 = 226.69 \text{ kN/m}^2.$$

Question No.

Examiner C

Arholwr yn unig

y Cwestiwn

Question No.

Examiner On

Question No.

Examiner's

Arholwr yn unig

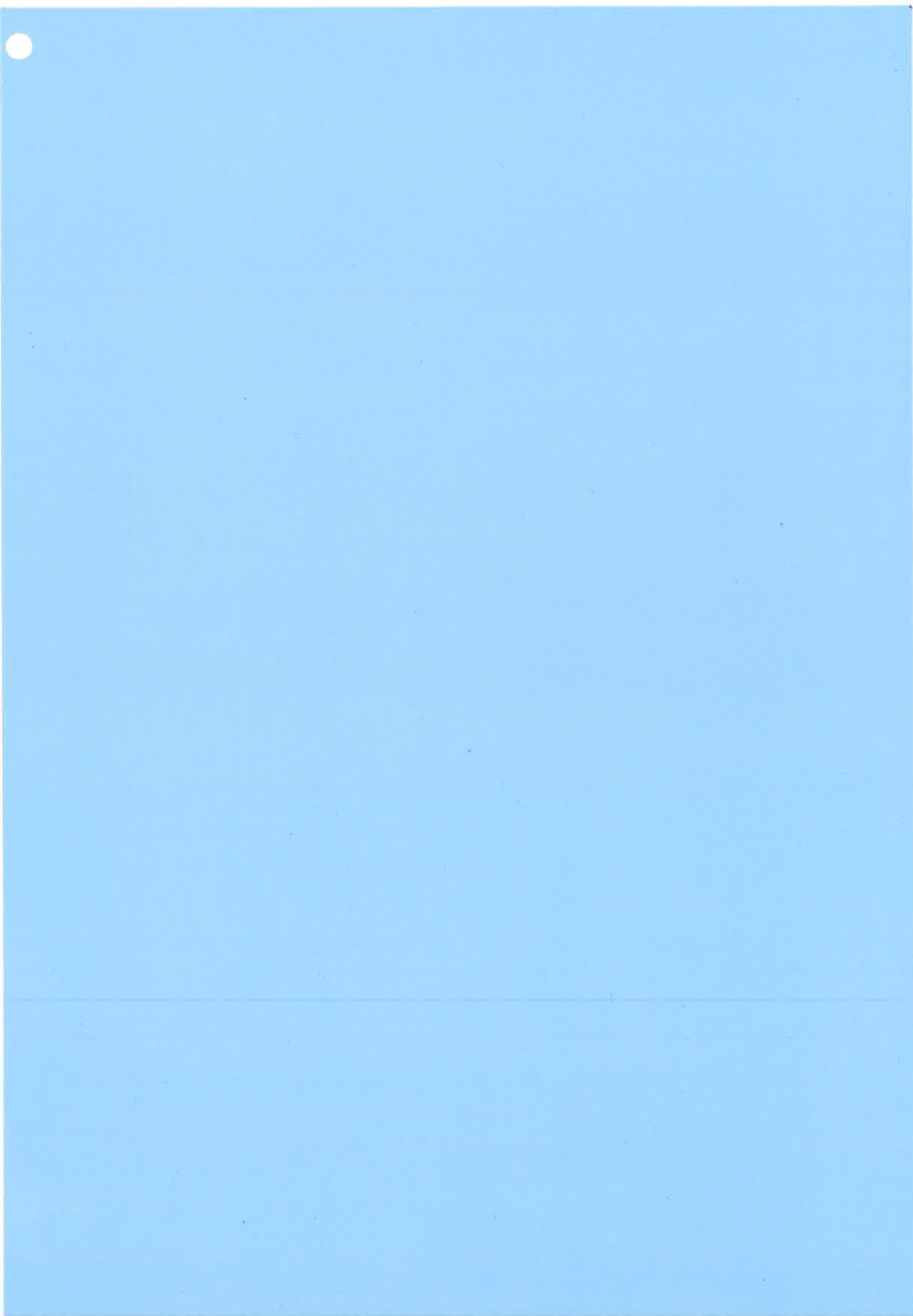
ff y Cwestiwn

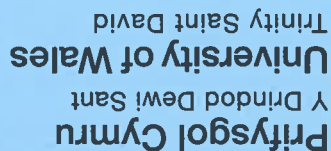
Question No.

Examiner O

Arholwr yn unig

y Cwestiwn





12 Tugđalen

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 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 sgrifft annarllennadwy, neu drefnu iddi gael ei theipio a chael yr ymgeisydd i dalu.

4. Ysgriptennwch eich atebion mewn inc.

5. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnwch 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 gwyllywr/gwylwyr.

8. Rhaid dychwelyd pob llyfr. Ni chaniateir mynd â llyfrau atebion, wedi eu defnyddio neu heb eu defnyddio, allan o'r lleoliad arthol 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 seliwh
(gweler nodyn 2 isod)

CYFENN:

ENW(AU) CYNTAF:

ENW(AU) CYNTAF:



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

SURNAME: Bates

FORENAME(S): Harry, Robert

12 Pages

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1	Student Number	1800078
2	Title of Examination Paper	Further Science For engineering
3	Module Code	M4X01505
4	Date and Time of Examination	20/05/19 12:00
5	Examination Venue	1Q 301B
6	Seat Number	
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use	
1	12	28
2	4	11
3	12	20
4	4	13
Total	32	72

44%

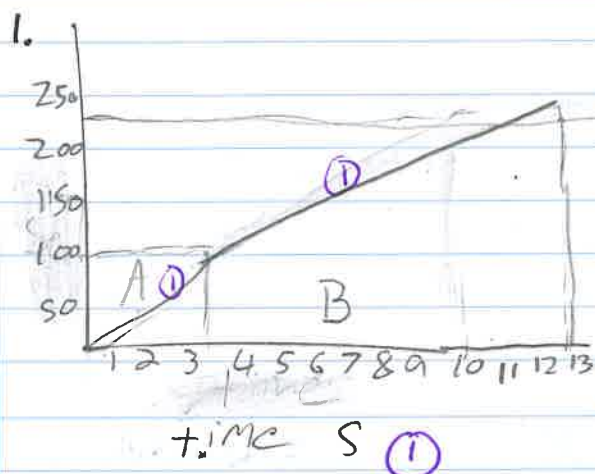
(Gweler yr ochr arall am y fersiwn Cymraeg)



$$\begin{aligned} V &= U + at \\ V^2 &= U^2 + 2as \\ S &= Ut + \frac{1}{2}at^2 \\ S &= \frac{(U+V)t}{2} \end{aligned}$$

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

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



Rest of
Question one
on Page 7

3/5

$S = 65$
 $U = 225$
 $V = 0$
 $a = ?$
 $t = ?$

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

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

$$2S = (U+V)t$$

$$2S - (U+V)t = 0$$

$$\begin{aligned} V^2 &= U^2 + 2as \\ V^2 &= U^2 \end{aligned}$$

A!
 S
 $U = 0 \text{ km/h}$
 $V = 100 \text{ km/h}$
 a
 $t = 3 \text{ s}$

$$V = U + at$$

$$\frac{V-U}{t} = a$$

$$\frac{100-0}{3} = a$$

acceleration 0-100 km/h is 33.34 km/h

$$S = \frac{1}{2}(V^2 - U^2)$$

$$\frac{1}{2}(100^2 - 0)$$

B.S =

$$U = 100$$

$$V = 225$$

$$a =$$

$$t = 10$$

$$V = U + at$$

$$\frac{V - U}{t} = a$$

$$\frac{225 - 100}{10} = 12.5$$

acceleration From 100 km/h to 225 km/h
is 12.5 km/h

$$C : S : 65$$

$$U : 225$$

$$V : 0$$

$$a :$$

$$t : 105$$

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

$$t = \frac{2S - (u - v)}{a}$$

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

$$v^2 = u^2$$

$$\frac{225}{100}$$

$$\frac{225}{25 - 10} =$$

Time taken is $\frac{1055}{100}$

$$d \frac{\frac{1}{2}(100^2)}{33.74} = 149.97m$$

$$\frac{\frac{1}{2}(225^2 - 100^2)}{12.5} = 1625$$

$$12.5$$

or

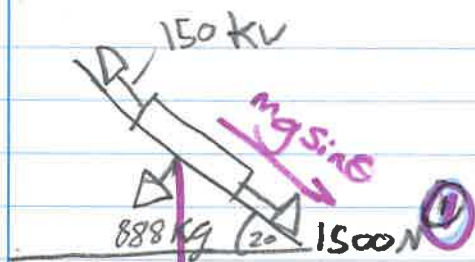
$$149.97 + 1625 + 65 = 1839.97m$$

2

3

Examiner Only

2:



$$\sin \frac{O}{H}$$

$$1500 \text{ N} + 888 \text{ kg} \times 9.81 \sin 20^\circ = 3242.26 \text{ kg/N}$$

$$P = Fv$$

$$\frac{P}{F} = v \quad \frac{150 \times 10^3}{3242.26} = 150.32 \text{ m/s}$$

$$K: 260$$

$$W_1: 0$$

$$W_2: 2000 \times \frac{2\pi}{60} = 2094.40 \text{ Rad/s}$$

$$I: 145$$

$$E: 0.5$$

$$\theta$$

$$\alpha: 4188.8$$

$$W_2 \neq W_1 + \alpha t$$

$$\frac{W_2 - W_1}{t} = \alpha \quad \frac{2094.40 - 0}{0.5} = 4188.8 \quad \text{units?}$$

$$A \quad I = I \alpha \quad \frac{I}{\alpha} = \frac{145}{4188.8} = 0.035$$

$$I = 0.035$$

units?
2dp.



7.5

$$B \quad \frac{I}{K^2} = \frac{0.035}{260^2} = 2365 \text{ g}$$

x.

$$C: \quad p = \tau \omega \quad 145 \times 2094.40 = 303685 \text{ W}$$

$$\frac{145}{145}$$

$$P = 303685 \text{ W}$$

2

3

5

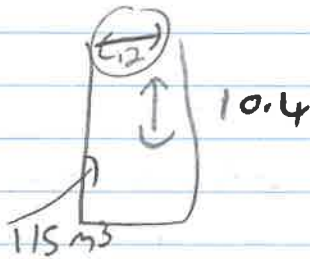
Examiner Only

$$d: \frac{1}{2} \times 0.035 \times 2094.40^2 \checkmark$$

(2.5)

$$KE = 76,763.95 \text{ J} \checkmark \text{ Carried rounding error.}$$

4
4: (5)



$$12 \text{ cm} \times 10.4 \text{ cm} - 115 \text{ cm}^3 = 0.8$$

1/0.8 compression Ratio Ratio

$$0^\circ \text{C} = -273^\circ \text{K}$$

(3)

$$P_1 = 95 \text{ kN/m}^2$$

$$V_1 = 0.8$$

$$T_1 = 30^\circ \text{C} = 303^\circ \text{K}$$

$$P_2 = 2221.50 \text{ kN/m}^2$$

$$V_2 = 1$$

$$T_2 = 450^\circ \text{C} = 723^\circ \text{K}$$

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

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

$$\frac{95 \times 0.8 \times 723}{303 \times 1} = 2221.50 \text{ kN/m}^2$$

1

S

0 m/s

$$V \text{ } 100 \text{ km/h} = 277.78 \text{ m/s} \quad \times \text{ Shame.}$$

9

6 34

$$\text{km/h} = \frac{\times 1000}{3600}$$

$$v = u + at \quad (1)$$

1A:

$$\frac{277.78 - 0}{3} =$$

$$\frac{v - u}{t} = a \quad (1)$$

$$75.93 \text{ m/s}^2 \quad + \quad \text{Carried error.}$$

0.5

1B

S

277.78 m/s

625 m/s

34.73 m/s²

+ 109

$$\frac{v - u}{t} = a \quad (1)$$

$$\frac{625 - 277.78}{10} = 34.73 \text{ m/s}^2$$

0.5

x Carried error.

$$34.73 \text{ m/s}^2$$

C: $S: 65 \text{ m}$
 $u: 0 \text{ m/s}$
 $v: 625 \text{ m/s}$
 $a: 6$
 $t: 4.81 \text{ s}$

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

①

$$t = 2S - (u+v)$$

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

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

②

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

$$t = \frac{(625 + 0)}{2 \times 65} = 4.81 \text{ s}$$

$$t = 4.81 \text{ s}$$

D. $0 - 277.78$
 $\frac{1}{2}(v^2)$

$$0 - 277.78$$

$$S = 416.67$$

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

$$v = 277.78 \text{ m/s}$$

$$a =$$

$$t = 3$$

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

②

①

$$S = 416.67$$

$$S \quad 4513.9 \text{ m}$$

$$u \quad 277.78 \text{ m/s}$$

$$v \quad 625 \text{ m/s}$$

$$a$$

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

$$S = \frac{(277.78 + 625) 10}{2}$$

x .

$$4513.9 \text{ m}$$

$$65$$

$$416.67$$

①

DISPLACEMENT OF Car

x .

$$4995.57 \text{ m}$$

Question No.

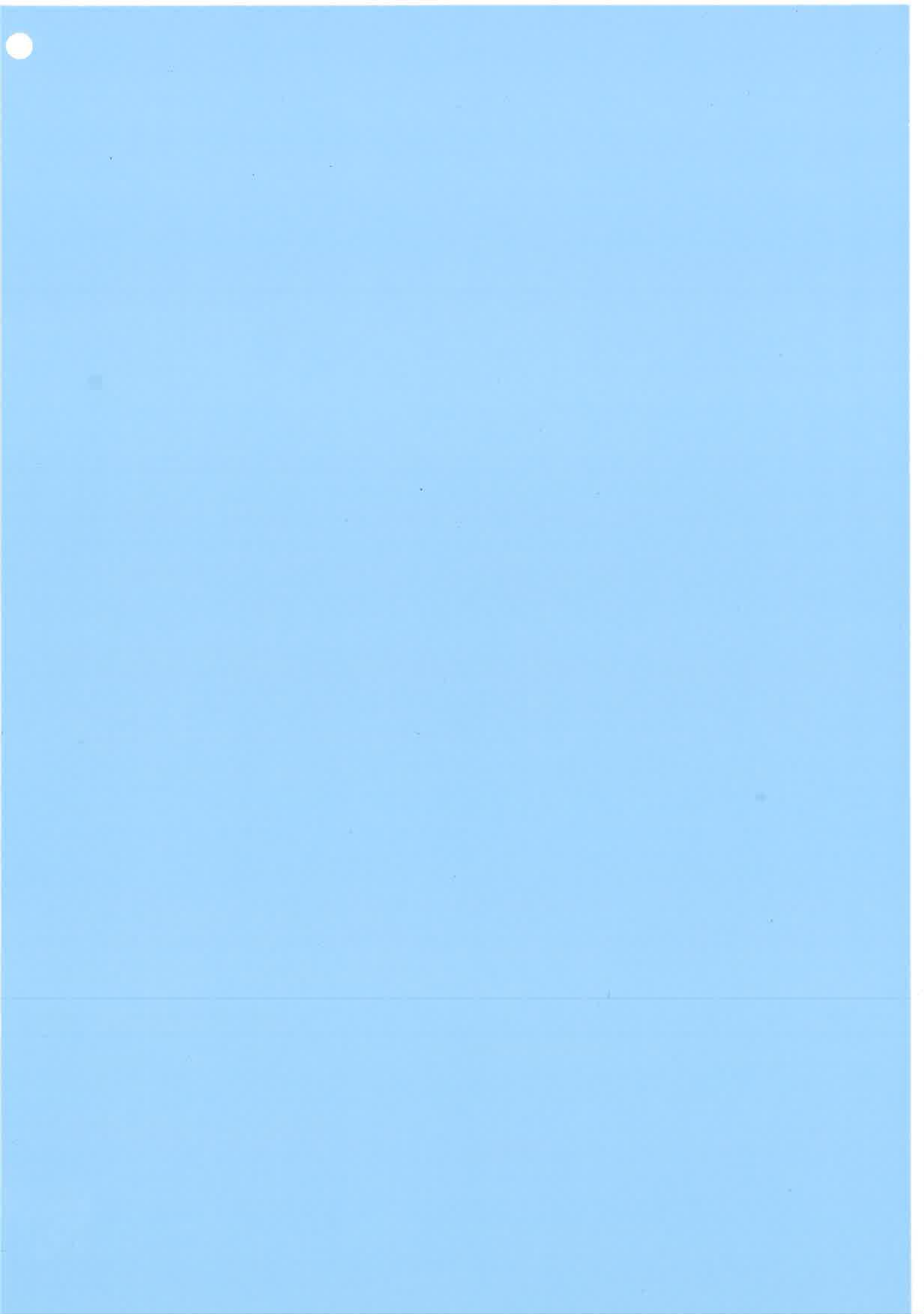
Examiner Or

Arholwr yn unig

ff y Cwestiwn

Question No.

Examiner O





Complete, fold and seal
(see note 2 below)

SURNAME: Clement

FORENAME(S): Gwydion Gwyn

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1	Student Number	1804252
2	Title of Examination Paper	Further Science for engineering
3	Module Code	M4X01505
4	Date and Time of Examination	20/5/19 12:00
5	Examination Venue	IQ 103
6	Seat Number	R017
7	Number of Answer Books handed in	2

List the numbers of the questions you have attempted	Office Use	
Question 1	26.5	28
Question 2	~~3~~	11
Question 3	7.	20
Question 4	4	13
Total	~~40.5~~	72

41.5

58%

~~56%~~

$$v = u + at$$

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

$$s = ut + \frac{1}{2}at^2$$

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

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

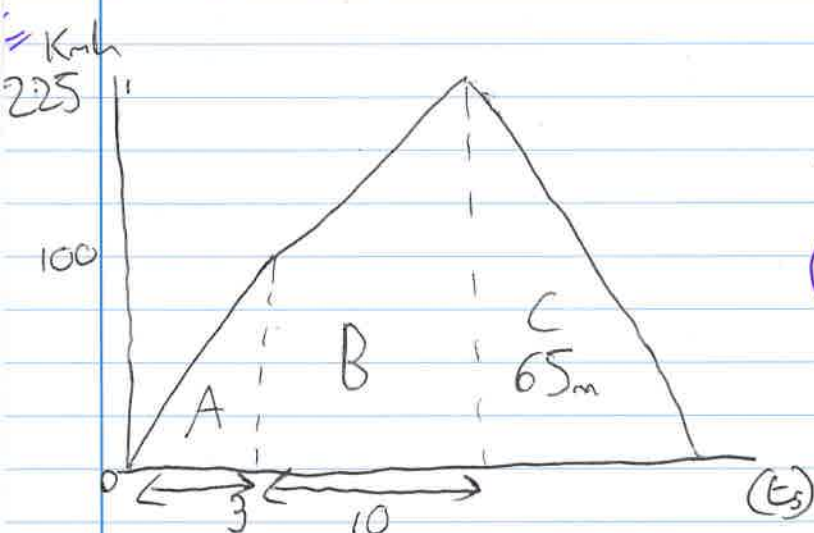
$$\omega_2^2 = \omega_1^2 + 2\alpha s$$

$$\theta = \omega t + \frac{1}{2}\alpha t^2$$

$$\theta = \frac{(\omega_2 + \omega_1)t}{2}$$

$$\frac{p_1 v_1}{t_1} = \frac{p_2 v_2}{t_2}$$

Question one



a) looking at A

$$^A u = 0 \quad (1)$$

$$^A v = 100 \text{ km/h} \div 3.6 = 27.78 \text{ m/s} \quad (0.5)$$

$$^A s = ?$$

$$^A t = 3 \text{ s}$$

$$^A a = ?$$

$$v = u + at \quad (1) = \frac{v - u}{t} = a \quad (1) \checkmark$$

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

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

①

acceleration for (A)

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

✓

①

b) Looking at (B)

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

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

$$a = ?$$

$$s = ?$$

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

$$v = u + at$$

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

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

acceleration for section (B) is:

$$a = 3.47 \text{ m/s}^2$$

✓ (A.S.)

c) The braking time looking at section (C)

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

$$v = 0$$

$$a =$$

$$t = ?$$

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

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

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

$$t = \frac{(65)(2)}{0+62.5}$$

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

✓ (4)

d) Total displacement of car

For (A)

$$u = 0$$

$$v = 27.78 \text{ s}$$

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

$$s = ?$$

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

For (B)

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

$$v = 62.5 \text{ s}$$

$$a = 3.47 \text{ m/s}^2$$

$$s = ?$$

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

(A)

$$s = \frac{(27.78+0)3}{2}$$

$$s = 41.67 \text{ m}$$

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

(B)

$$s = \frac{(62.5+27.78)10}{2}$$

$$s = 451.4$$

$$d) A_s + B_s + C_s = \text{Total displacement} = s$$

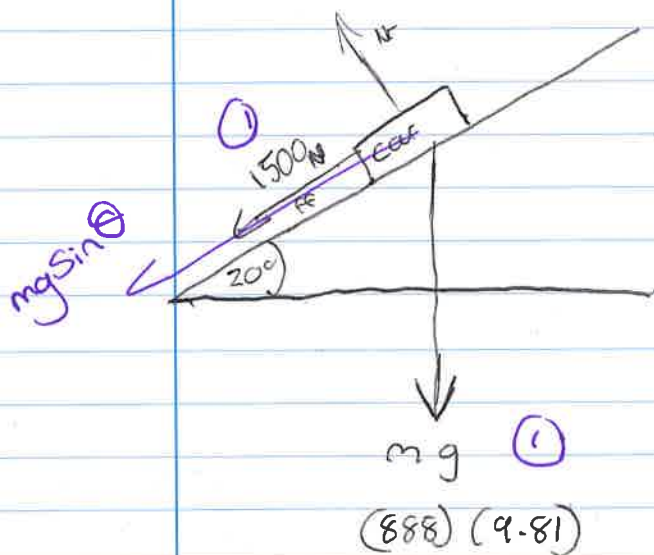
$$s = 41.67 + 431.4 + 65$$

$$s = 558.07 \text{ m}$$



④

Question Two



$$P = Fv$$

$$\frac{P}{F} = v \quad \text{①}$$

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

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

$$F = mg + 1500 \text{ N} + \sin 20^\circ$$

Shame!

$$F = (888)(9.81) + 1500 + 0.34 \quad 1500 + (mg \sin \theta)$$

$$F = 10,211.62 \text{ N}$$

$$\frac{P}{F} = \frac{150,000}{10,211.62}$$

①

$$v = 14.69 \text{ s}$$

Question Three

$$\alpha = 20000 \times \frac{2\pi}{60} = 2094.4 \text{ rad/s}$$

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

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

to

②

a) moment of inertia

$$\tau = I \alpha$$

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

$$\frac{145}{2094.4}$$

$$I = 0.069$$

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

Share!

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

$$I = m k^2$$

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

$$(d^2)(8) = k^2$$

$$(0.26)(8) = 2.08^2$$

$$\sqrt{k} = 1.44 \text{ m}$$

$$I = m k^2$$

$$\frac{I}{k^2} = m = \frac{0.069}{1.44} = 0.048 \text{ kg}$$

$$c) P = T\omega$$

$$P = (145) (2094.4)$$

$$P = 303,688 \text{ J}$$

(2)

Now
your
calling
it is!

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

$$KE = (0.5) (0.069) (2094.4)^2$$

$$KE = 151,334.64$$

(2)
Carried errors.

Question four

$$a) \text{ compression ratio} = \frac{v_1}{v_2} \quad (1)$$

$$12 \times 10.4 = 124.8$$

~~1)~~

6)

$$p_1 = 95 \text{ kN m}^2$$

 V_1

$$T_1 = 30^\circ + 273 = 303 \text{ K} \quad (1)$$

 p_2 V_2

$$T_2 = 450^\circ + 273 = 723 \text{ K} \quad (1)$$

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

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

(1)



Question No.

Examiner O

Arholwr yn unig

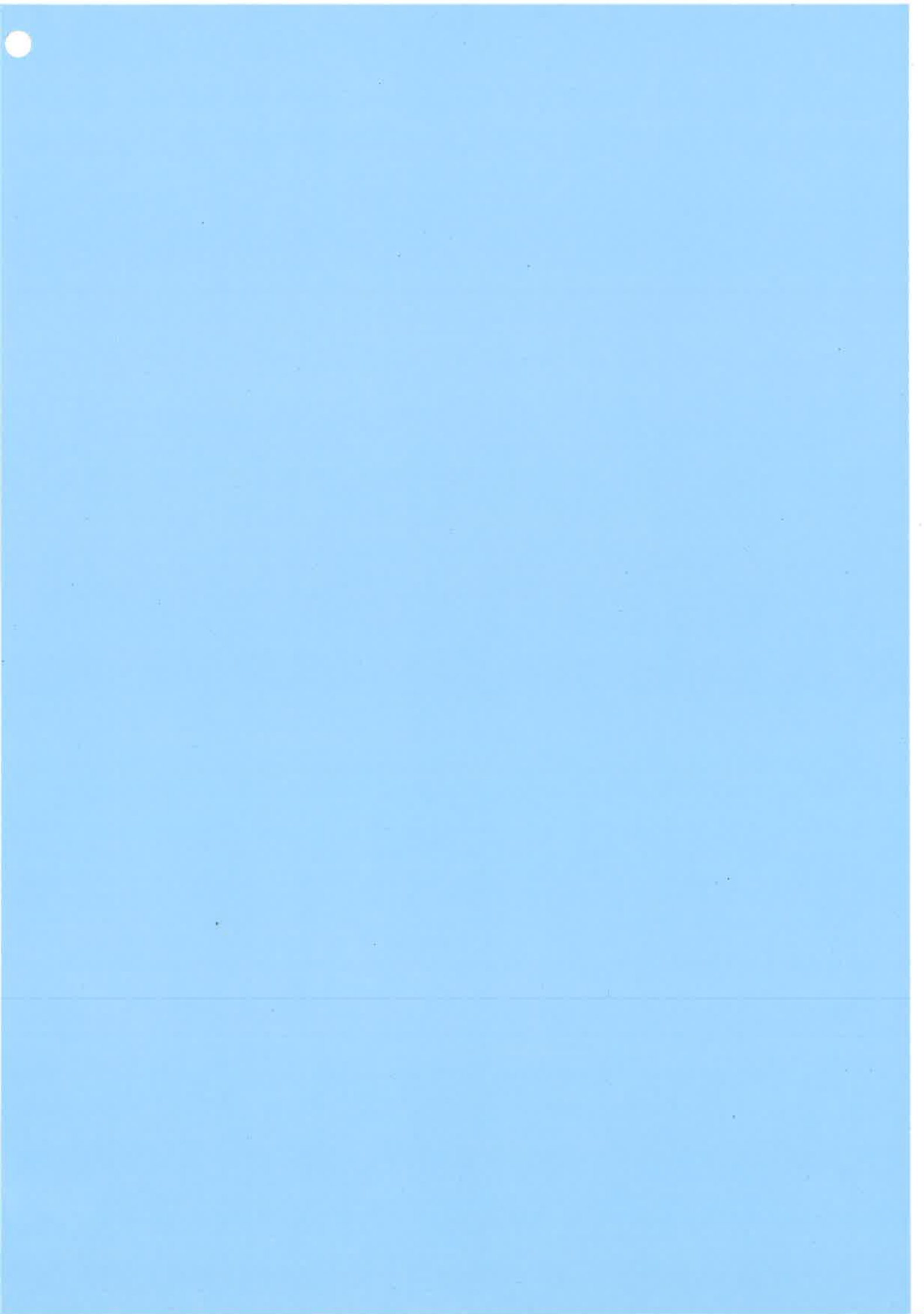
f y Cwestiwn

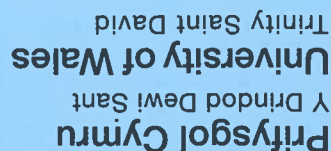
Question No.

Examiner O

Arholwr yn unig

Y Cwestiwn





12 Tüdalen

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 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 sgript annarllennadwy, neu drefnu iddi gael ei theipio a chael yr ymgeisydd i dalu.

4. Vsgriennwch eich atebion mewn inc.

5. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw tras 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	Lleoiliad 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)

CYFENN:

ENW(AU) CYNTAF:

Llenwch, plygwch a seliwch
(gweler nodyn 2 isod)



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

SURNAME: GRUNDY

FORENAME(S): HARRY

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 over and seal down (using the label provided) to hide your name.
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List the numbers of the questions you have attempted	Office Use	
Q1	24.5	28
Q2	5.5	11
Q3	14.	20
Q4	3	13
Total	47	72

65 %

2000



$$s = ut + at^2$$

Q1) $S = ?$

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

$$v = 100 \text{ km/h} \div 3.6 =$$

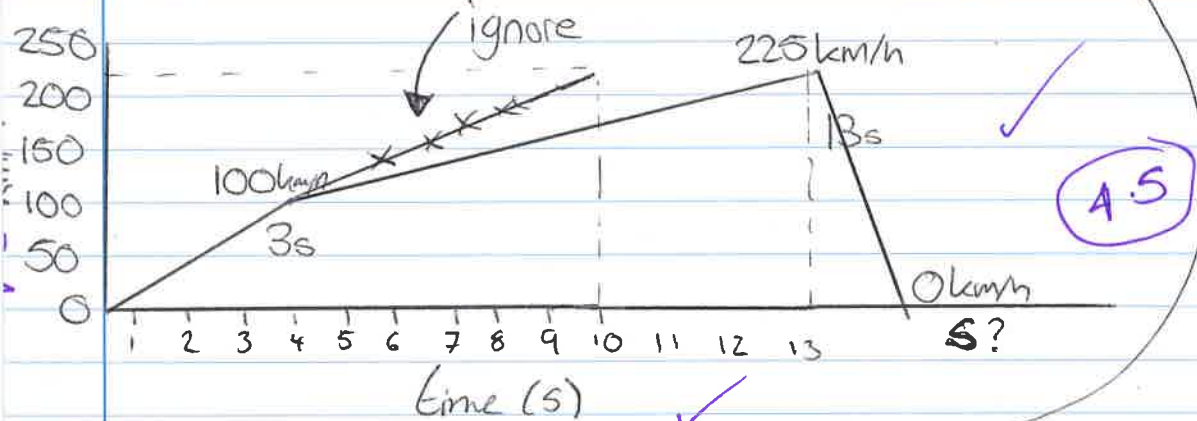
$$a = ?$$

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

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

$$\frac{100}{3.6} = 27.7 \text{ m/s}$$

20p.



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

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

acceleration to 100 km/h
 $= 9.23 \text{ m/s}^2$ Rounding errors. (5.5)

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

$$\frac{62.5 - 27.7}{10} = 3.48 \text{ m/s}^2$$
 Rounding! (4.5)

$$s =$$

$$u = 100 \div 3.6 = 27.7 \text{ m/s}^2$$

$$v = 225 \div 3.6 = 62.5 \text{ m/s}^2$$

$$a = ?$$

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

acceleration from 100 km/h
 to 225 km/h = 3.48 m/s^2

c)

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

$$u = 255 \div 3.6 = 62.5 \text{ m/s}^2$$

$$v = 0 \text{ m/s}^2$$

$$a = ?$$

$$t = ?$$

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

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

~~$$65 = \frac{(0 + 62.5)t}{2}$$~~

Time taken to decelerate $\frac{65 \times 2}{0 - 62.5} = -2.08 \text{ s}$ ✓ (4)

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

Q1 Stage 1
d) $S = 41.55\text{m}$

$$U = 0\text{m/s}^{-2}$$

$$V = 27.7\text{m/s}^{-2}$$

$$A = 9.23\text{m/s}^{-2}$$

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

Stage 2

$$S =$$

$$U = 27.7\text{m/s}^{-2}$$

$$V = 62.5\text{m/s}^{-2}$$

$$A = 3.48\text{m/s}^{-2}$$

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

Stage 3

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

$$U = 62.5\text{m/s}^{-2}$$

$$V = 0\text{m/s}^{-2}$$

$$A =$$

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

(S₁)

$$\frac{(27.7+0)3}{2} = 41.55\text{m}$$

Rounding
(2.5)

(S₂)

$$\frac{(62.5+27.7)10}{2} = 451\text{m}$$

Rounding
(2.5)

$$\text{Total D} = S_1 D + S_2 D + S_3 D$$

(1)

$$\therefore \text{TD} = 41.55 + 451 + 65 = 557.55\text{m}$$

Rounding

Total displacement is

$$= 557.55\text{m (2dp)}$$

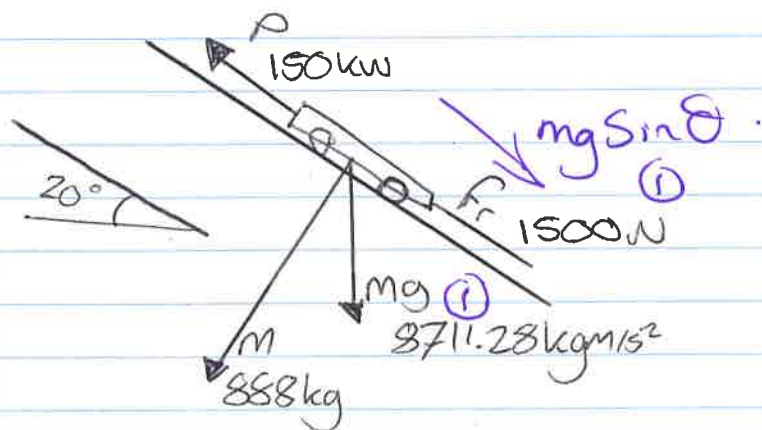
$$P = Fv \quad F = mgs \sin \theta + F_r$$

Question No.

Examiner Only

Q2

incline 20°



$$F_r = 1500 \text{ N}$$

$$M = 888 \text{ kg} \quad 888 \times 10^3$$

$$P_{\text{pull}} = 150 \text{ kW} \quad 150 \times 10^3 \text{ (1)}$$

$$Mg \sin \theta + F_r$$

$$(888 \times 10^3 \times 9.81 \times \sin(20)) + 1500 \quad \text{(1)}$$

$$= 2980933.234 \text{ N} \quad \text{Shame!}$$

$$P = Fv$$

$$\frac{P}{F} = v \quad \text{(1)}$$

$$\frac{150 \times 10^3}{2980933.234} = 0.05 \text{ m/s}^2$$

$$k^2 = \frac{md^2}{8}$$

$$KE = \frac{1}{2} m k^2 \times \omega_2$$

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

$$t = 0.5s$$

$$\omega_1 = 0 \text{ rpm}$$

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

$$\omega_2 = 20000 \times \frac{2\pi}{60}$$

$$k =$$

$$\rightarrow I =$$

$$\alpha =$$

Q3) $\omega_2 = \omega_1 + \alpha t$

a) $2094.395102 = 0 + ? \times 0.5$

$$\frac{\omega_2 - \omega_1}{0.5} = \alpha$$

$$\frac{2094.395102 - 0}{0.5} = 4188.79_{(2dp)} \quad \text{units?}$$

$$T = I \alpha$$

$$\frac{T}{\alpha} = I \quad \frac{145}{4188.79} = 0.03461 = 0.35 \text{ kg N/m}^2$$

0.04 2dp.

How?

(7)

b) Rotary Parts

$$I = m k^2$$

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

$$\frac{260^2}{8} = 32.5 = k^2 = 5.7$$

$$260 \text{ mm} \div 1000 = 0.26 \text{ m}$$

$$0.35 = ? \times 32.5$$

$$\frac{I}{k^2} = \frac{0.35}{32.5}$$

$$\frac{0.26^2}{8} = 8.45 \times 10^{-3} \text{ kg}^2$$

$$\frac{I}{k^2} = \frac{0.35}{8.45 \times 10^{-3}} = 41.42 \text{ kg}$$

Carried error

(5)

$$P = T\omega$$

$$C) 145 \times \left(20000 \times \frac{2\pi}{60} \right) = 303687.2898$$

$$KE = \frac{1}{2} M v^2 \times \omega_2$$

$$= 303687.29 \text{ W (2dp)}$$

✓ (2)

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

D)

$$KE = \frac{1}{2} m k^2 \times \omega_2^2$$

— The formulae was on the sheet

$$= \frac{1}{2} 41.42 \times 8.45 \times 10^{-3} \times 2094.395102$$

Shame.

$$= 366.518 \text{ J}$$

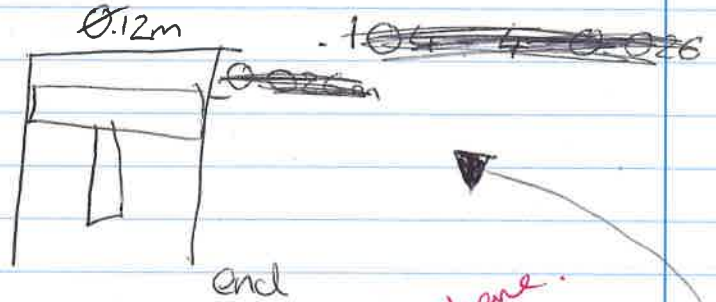
$$= \underline{\underline{366.52 \text{ J (2dp)}}}$$

Question No.

Stroke = 10.4 m. 104 m

0.12 m D

a)



$$\text{Ans} \times 100 = \underline{\underline{2.94 \text{ cm}^3}}$$

$$\frac{1.15}{0.48} = 2.4:1 \quad \text{CR} = 2.4:1$$

$$V_1 P_1 = V_2 P_2$$

$$\frac{V_1}{I_1} = \frac{V_2}{I_2}$$

$$\frac{V_1 \epsilon_2}{\epsilon_1} = V_2 \epsilon_1$$

$$\frac{V_1 \epsilon_2}{\epsilon_1} = V_2$$

$$V_1 = 95 \times 10^3 \text{ N/m}^2$$

$$T_1 = 30^\circ\text{C} + 273\text{ K} = 303\text{ K} \quad (1)$$

$\rho_z = ?$

$V_2 = ? 226683.17 \text{ N/m}^2$

$$T_2 = 450 + 273 \text{ K} = 723 \text{ K} \quad (1)$$

$$\frac{95 \times 10^3 \times 723}{303} = 226683.1683 \text{ N/m}^2$$

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

$$\frac{95 \times 10^3 \times 1.15}{22683.1663} = 0.4819 \text{ m}^3$$

$$= 0.48 \text{ m}^3$$

$$P_2 = 0.48 \text{ m}^3$$

Question No.

Examiner Only

Question No.

Examiner O

Question No.

Examiner O

Arholwr yn unig

y Cwestiwn

Question No.

Examiner Q

Arholwr yn unig

y Cwestiwn

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. 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 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	Tell y Papur Arholiad	
1	Rhif Myfyrwr	

[illegible]

(See the other side for English version)

Llenwch, plygwch a seliwch
(gweler nodyn 2 isod)

CYFENN:

ENW(AU) CYNTAF:

ENW(AU) CYNTAF:



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

SURNAME: Williamson - Gillie

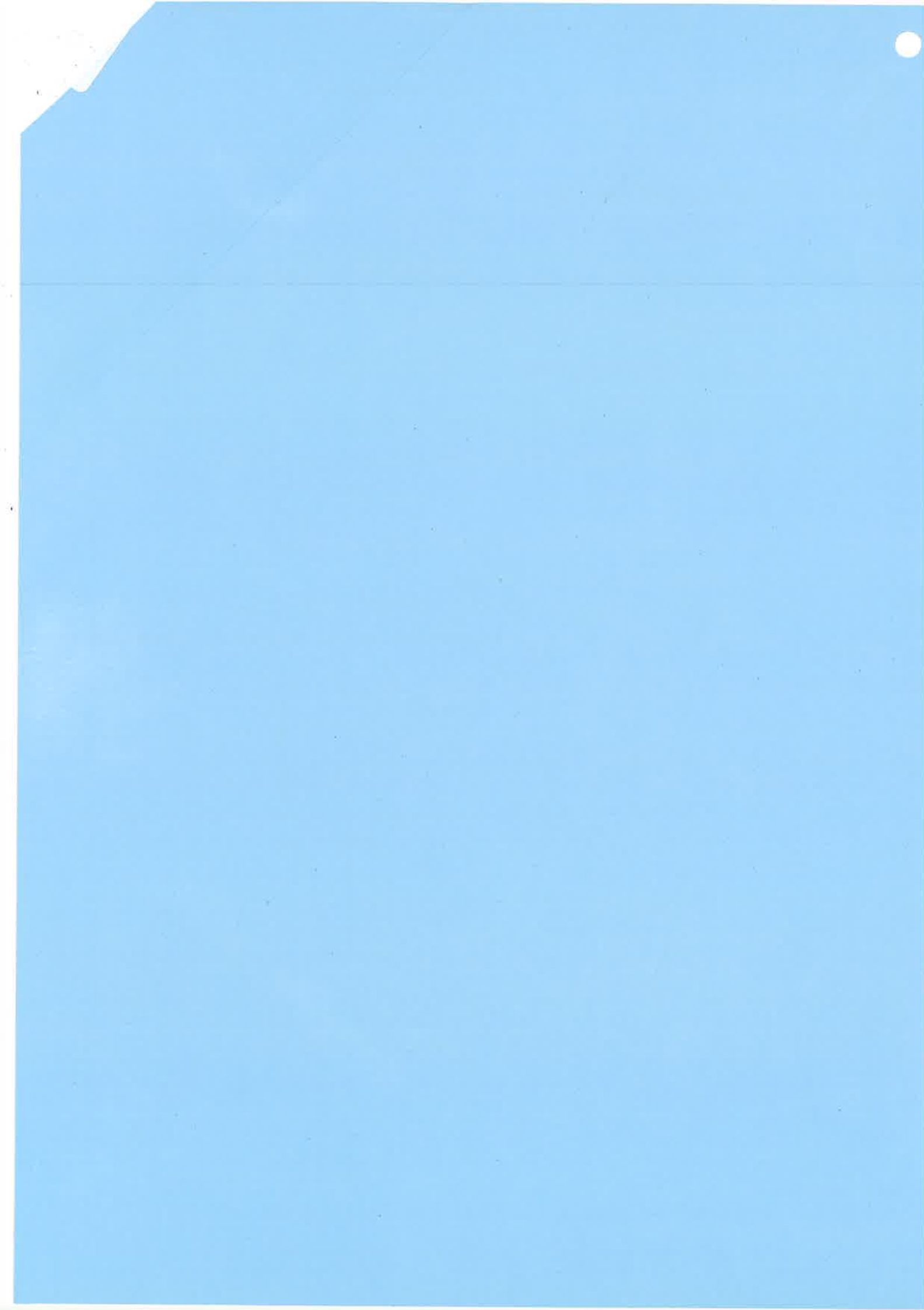
FORENAME(S): Robin

12 Pages

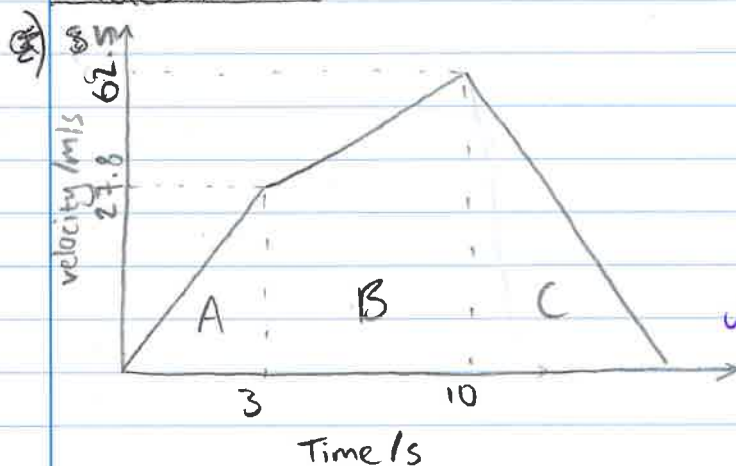
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List the numbers of the questions you have attempted	Office Use	
1	28	28
2	2	11
3	14.5	20
4	8	13
Total	52.5	72

73%



Question 1



Conversions:

$$100 \text{ km/h} \times \frac{1000}{3600} = 27.8 \text{ m/s}$$

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

a) $s = 1$

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

$v = 27.8 \text{ m/s}$

$a = ?$

$t = 3 \text{ s}$

$v = u + at$

$27.8 = 0 + a \cdot 3$

$a = \frac{27.8}{3}$

$a = \underline{\underline{9.27 \text{ m/s}^2}}$

b) $s = 1$

$u = 27.8 \text{ m/s}$

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

$a = ?$

$t = 10 \text{ s}$

$v = u + at$

$62.5 = 27.8 + a \cdot 10$

$\frac{(62.5 - 27.8)}{10} = a$

$a = \underline{\underline{3.47 \text{ m/s}^2}}$

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

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

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

$a = 1$

$t = ?$

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

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

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

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

d) Displacement for A:
 $s = ?$

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

$$v = 27.8 \text{ m/s}$$

$$a = 9.27 \text{ m/s}^2$$

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

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

$$s = \frac{(27.8)3}{2}$$

$$s = 41.7 \text{ m}$$

Displacement for B:

$$s = ?$$

$$u = 27.8 \text{ m/s}$$

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

$$a = 3.47 \text{ m/s}^2$$

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

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

$$s = \frac{(62.5 + 27.8)10}{2}$$

$$s = 451.5 \text{ m}$$

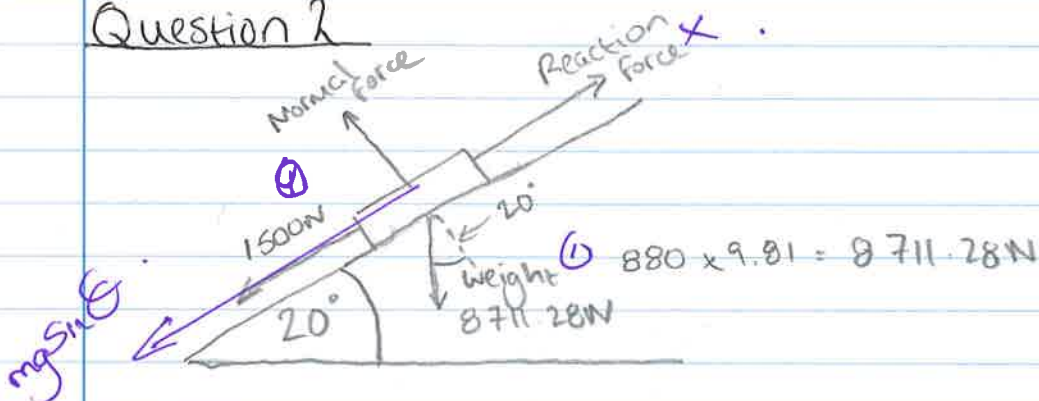
Displacement for C:

$$65 \text{ m}$$

$$\begin{aligned} \text{Total displacement} &= 41.7 \text{ m} + 451.5 + 65 \\ &= \underline{\underline{558.2 \text{ m}}} \end{aligned}$$

1
yay.

Question 2



$$\sin \theta =$$

$$\sin 20 =$$

Question 3a) $\theta = ?$

$$\omega_1 = 0$$

$$\omega_2 = 2000 \text{ rpm} \times \frac{2\pi}{60} = 209.44 \text{ rad/s}$$

$$\alpha = ?$$

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

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

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

Shame!

$$\alpha = \frac{209.44}{0.5} = 418.88$$

$$\frac{209.44}{0.5} = 418.88 \text{ rad/s}^2$$

$$T = I \alpha$$

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

$$I = ?$$

$$\alpha = 418.88 \text{ rad/s}^2$$

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

$$I = \frac{145}{418.88}$$

$$I = 0.346 \text{ Nm/rad/s}^2$$

Carried errors.

b) $k^2 = \frac{d^2}{8}$

$$k^2 = ?$$

$$d = 260 \text{ mm} = 0.26 \text{ m}$$

$$k^2 = \frac{0.26^2}{8}$$

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

$$k = \sqrt{8.45 \times 10^{-3}}$$

$$k = 0.092 \text{ m}$$

$$I = mk^2$$

$$I = 0.346 \text{ Nm/rad/s}^2$$

$$k = 0.092 \text{ m}$$

$$m = ?$$

$$m = \frac{I}{k^2}$$

$$m = \frac{0.346}{(0.092^2)}$$

$$m = 40.95 \text{ kg}$$

Carried errors.(5)

$$c) P = T\omega$$

$$P = ?$$

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

$$\omega = 2000 \times \frac{2\pi}{60} = 209.44 \text{ rad/s}$$

$$P = 145 \times 209.44$$

$$P = 30368.8 \text{ W}$$

$$P = 30368$$

$$P = \underline{\underline{30368.8 \text{ W}}}$$

(1.5)

Carried errors.

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

$$KE = ?$$

$$I = 0.346 \text{ Nm/rad/s}^2$$

$$\omega = 209.44 \text{ rad/s}$$

$$KE = \frac{1}{2} \times 0.346 \times (209.44)^2$$

$$KE = \underline{\underline{7588.66 \text{ Joules}}}$$

(2)

Carried errors.

Question 4

$$a) \text{ bore} = d$$

$$\text{stroke} = h$$

$$r = \frac{d}{2}$$

$$r = \frac{12}{2} = 6 \text{ cm}$$

$$r = 6 \text{ cm}$$

$$\pi r^2 h = V$$

$$\pi \times 6^2 \times 10.4 = V$$

$$V = 1176.21 \text{ cm}^3$$

✓

+ clearance volume

$$\frac{V_1}{V_2} = \frac{115 \text{ cm}^3}{1176.21}$$

$$= 1:10$$

(6)

$$b) \pi r^2 h = V$$

$$\pi 6^2 h = 115 \text{ cm}^3$$

$$\frac{115}{\pi 6^2} = h$$

$$h = 1.02 \text{ cm}$$

$$10.4 \text{ cm} + 1.02 = 11.42 \text{ cm}$$

$$\pi r^2 h = V$$

$$\pi 6^2 \times 11.42 = V$$

$$V = 1292.87 \text{ cm}^3$$

✓

$$\frac{V_2}{V_1} = \frac{1292.87}{115}$$

$$= 11$$

Rounding

$$\frac{V_2}{V_1} = \frac{1292}{115} = 11$$

b) $p_1 = 95 \text{ kN/m}^2$
 $T_1 = 30 + 273 = 303 \text{ K}$ ✓
 $p_2 = ?$
 $T_2 = 450 + 273 = 723 \text{ K}$ ✓
 $V_2 = 115 \text{ cm}^3$
 $V_1 = 1292.57 \text{ cm}^3$

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

$$\left(\frac{95 \times 1292.57}{303} \right) \times 723 = p_2$$

$$p_2 = 2545.89 \text{ kN/m}^2$$

Question No.

Examiner On

Arholwr yn unig

Arholwr yn unig

Question No.

Examiner Only

Arholwr yn unig

Rhif y Cwestiwn

Question No.

Examiner Only

Arholwr yn unig

Y Cwestiwn

Question No.

Examiner Only

Question No.

Examiner Only

Arholwr yn unig

Yn y Cwestiwn

Question No.

Examiner Only

Arholwr yn unig

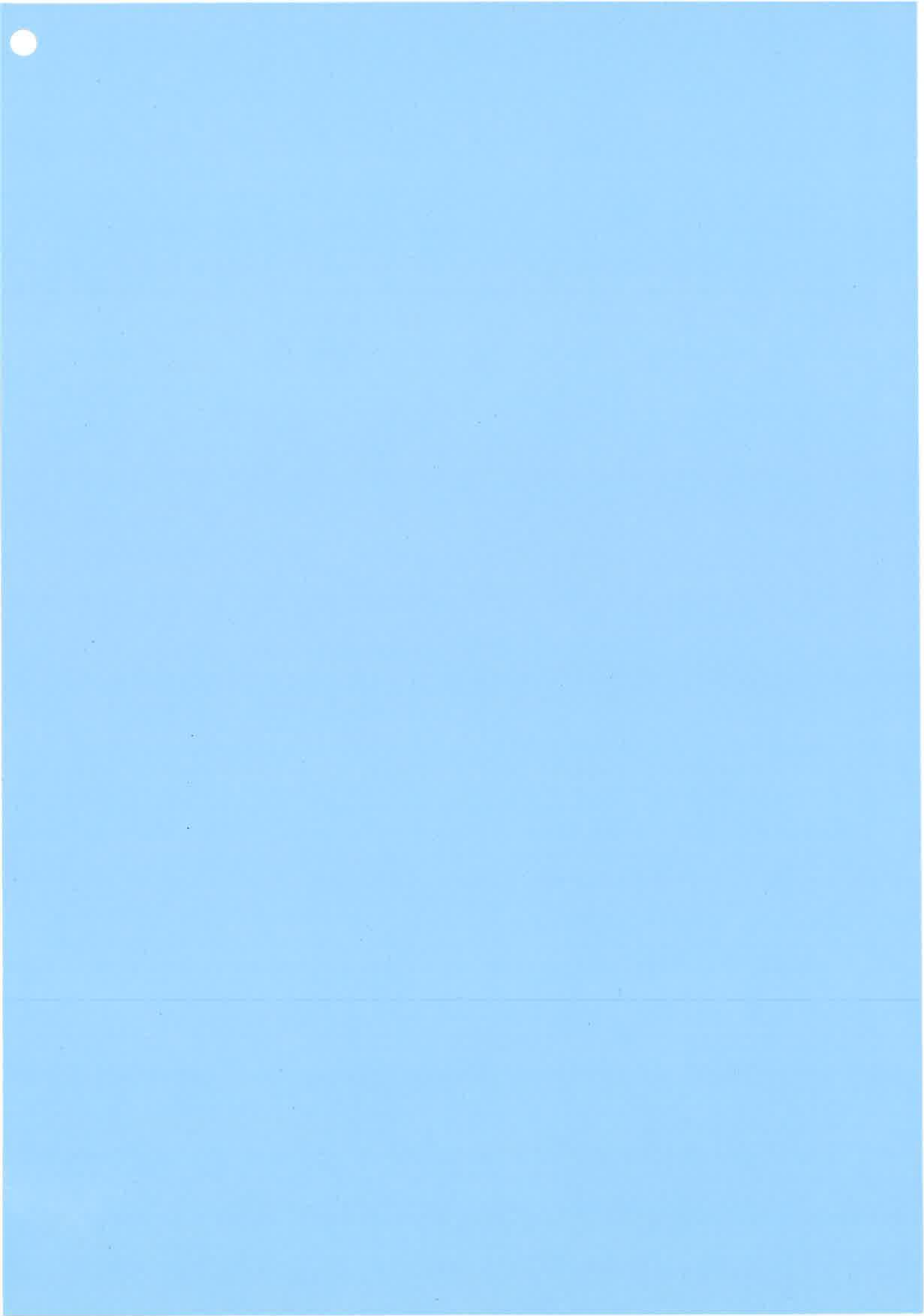
Rhif y Cwestiwn

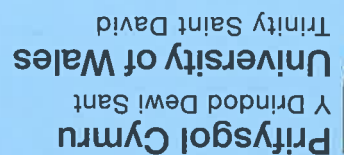
Question No.

Examiner On

Arholwr yn unig

hif y Cwestiwn





12 Tüdalen

ENW(AU) CYNTAF:

3. Rhaid i'r atebion fod mewn llawysgriften 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 rhwngo 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 gwyllwrr/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 amgylchladu.

[illegible]

(See the other side for English version)



Complete, fold and seal
(see note 2 below)

SURNAME: CROCKER

FORENAME(S): THOMAS

12 Pages

1. Please give the information requested in the boxes below.
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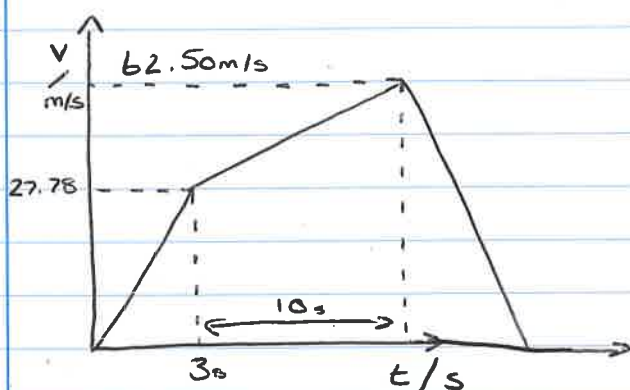
List the numbers of the questions you have attempted	Office Use	
1	28	28
2	10	11
3	18	20
4	8	13
Total	64	72

89%



1

a)



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

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

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

$$v_B = 225 \text{ km/h} \times \frac{1000}{3600} = 62.50 \text{ m/s}$$

$$v = u + at$$

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

b)

$$v = u + at$$

$$a = \frac{v - u}{t} = \frac{62.50 - 27.78}{10} = 3.52 \text{ m/s}^2$$

c)

$$u_c = 62.50 \text{ m/s}$$

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

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

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

$$t = \frac{2s}{(u + v)} = \frac{2 \times 65}{(62.50 + 0)}$$

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

1

d)

 s_A

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

 s_B

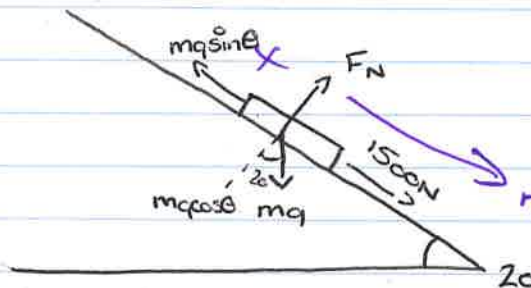
$$s = \frac{(u+v)t}{2} = \frac{(27.78 + 62.50) \times 10}{2} = 451.4\text{m}$$

 s_C

$$= 65\text{m}$$

$$s_T = 41.67 + 451.4 + 65 = 558.07\text{m}$$

2)



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

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

 $mg \sin \theta$

weight acts downhill

$$\begin{aligned} F &= mg \sin \theta + 1500 \\ &= (888 \times 9.81 \times \sin 20^\circ) + 1500 \\ &= 4479.43\text{N} \end{aligned}$$

$$P = Fv$$

$$v = \frac{P}{F} = \frac{150 \times 10^3}{4479.43} = 33.49\text{m/s}$$

yay!

10/11

3

a) $T = 145 \text{ Nm}$
 $\omega = 20,000 \text{ rpm} \times \frac{2\pi}{60} = 2094.4 \text{ rad/s}$ ✓
 $t = 0.5 \text{ s}$

$$T = I\alpha$$

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

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

$$\omega_1^2 = \omega_2^2 + 2\alpha\theta$$

$$\theta = \omega_2 t + \frac{1}{2}\alpha t^2$$

$$\theta = \frac{(\omega_1 + \omega_2)t}{2}$$

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

$$\alpha = \frac{\omega_1 - \omega_2}{t} = \frac{2094.4 - 0}{0.5} = 4188.8 \text{ rad/s}^2$$

$$I = \frac{T}{\alpha} = \frac{145}{4188.8} = 0.035 \text{ kg m}^2$$
 2dp. ✓

(8.5)

b) $d = 260 \text{ mm}$

$$r = 130 \times 10^{-3} \text{ m}$$

$$k^2 = \frac{d^2}{8} = \frac{(260 \times 10^{-3})^2}{8}$$

$$I = mk^2$$

$$k^2 = 8.45 \times 10^{-3} \text{ m}$$
 ✓

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

Rounding errors.

(5.5)

c) $P = T\omega$
 $= 145 \times 2094.4$
 $= 303,688 \text{ W}$ ✓ (2)

d) $KE = \frac{1}{2}I\omega^2 = \frac{1}{2} \times 0.035 \times 2094.4^2$

$$KE = 76,763.95 \text{ J}$$
 (2) Rounding error carried.

4

a) Bore = ~~12 cm~~ 12 cm = d $\therefore r = \frac{12}{2} = 6$ cm
 Stroke = 10.4 cm
 $V_c = 115 \text{ cm}^3 = V_2$

$$V_1 = \pi r^2 h = \pi \times 6^2 \times 10.4$$

$$= 1176.21 \text{ cm}^3$$

✓ + Clearance volume.

(3)

$$\frac{V_1}{V_2} = \frac{1176.21}{115} = 10.23$$

(1)

$$\text{Compression Ratio} = \frac{10.23}{1}$$

b) $p_1 = 95 \times 10^3 \text{ N/m}^2$

$$T_1 = 30^\circ\text{C} + 273 = 303 \text{ K}$$

✓ (1)

$$V_1 = 1176.21 \text{ cm}^3 = 1176.21 \times 10^{-2} \text{ m}^3$$

$$p_2 = ?$$

$$V_2 = 115 \text{ cm}^3 = 115 \times 10^{-2} \text{ m}^3$$

$$T_2 = 450^\circ\text{C} + 273 = 723 \text{ K}$$

✓ (1)

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

$$p_2 = \frac{p_1 V_1 T_2}{T_1 V_2} = \frac{(95 \times 10^3) \times (1176.21 \times 10^{-2}) \times (723)}{(303) \times (115 \times 10^{-2})}$$

$$p_2 = \del{2.32 \times 10^6} 2.32 \times 10^6 \text{ N/m}^2$$

x

Carried errors.

Question No.

Examiner On

Arholwr yn unig

y Cwestiwn

Question No.

Examiner Only

Arholwr yn unig

Rhif y Cwestiwn

Question No.

Examiner On

Arholwr yn unig

ff y Cwestiwn

Question No.

Examiner On

Arholwr yn unig

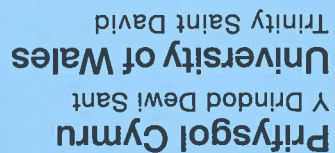
Arholwr yn unig

Question No.

Examiner On

Arholwr yn unig

ff y Cwestiwn



12 Tuden

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 seilio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.

CYFENN:

Llenwch, plygwch a seliwch
(gweler nodyn 2 isod)

(gwelel nodyn 2 isod)

1. Rhaid i'r atebion fod mewn llawysgrifen ddarllenadwy. Gall yr Arholwyr naill ai anwybyddu sgript annarllenadwy, neu drefnu iddi gael ei theipio a chael yr ymgeisydd i dalu.
2. Ysgrifennwch eich atebion mewn inc.
3. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnu llinell drwyddynt.
4. Ni ddylid rhwgo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.
5. Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwyllwr/gwylwyr.
6. 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	Teitl 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	

[illegible]

(See the other side for English version)