



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, 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.
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: Davies

FORENAME(S): Samuel Rhys

1	Student Number	
2	Title of Examination Paper	TEAI
3	Module Code	PL EE 4000 / PL PO 4000
4	Date and Time of Examination	25/01/2023 16:00
5	Examination Venue	Pembrokeshire College
6	Seat Number	
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
1	4
2	14
3	12
4	10
5	15
6	6
7	5
8	4
9	8
Total	78

Second Marker
SM/LE
08/02/23

1

$$f_{res} = \frac{1}{2} \sqrt{\frac{K}{M}}$$

$$2f_{res} = \sqrt{\frac{K}{M}} \quad \checkmark$$

$$4f_{res}^2 = \frac{K}{M} \quad \checkmark$$

$$\leftarrow M \cdot 4f_{res}^2 = K$$

$$\boxed{M = \frac{K}{4f_{res}^2}} \quad \checkmark$$

4

JDP

2) i) $5(x-1) - 4(3x-1) + 15 = 0$

$$5x - 5 - 12x + 4 + 15 = 0$$

$$-7x + 14 = 0$$

$$-7x = -14$$

$$x = \frac{-14}{-7}$$

$$x = 2$$

$$x = -2$$

ii) $2x^2 - 5x - 3 = 0$

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$a = 2, b = -5, c = -3$

$$\frac{+5 \pm \sqrt{(-5)^2 - 4(2)(-3)}}{4} = \frac{5 \pm \sqrt{49}}{4}$$

$$\frac{5 \pm 7}{4}$$

+

$$= \frac{5+7}{4} = 3$$

-

$$= \frac{5-7}{4} = -0.5$$

iii) $7.5 \times 10^{x-5} = 255$

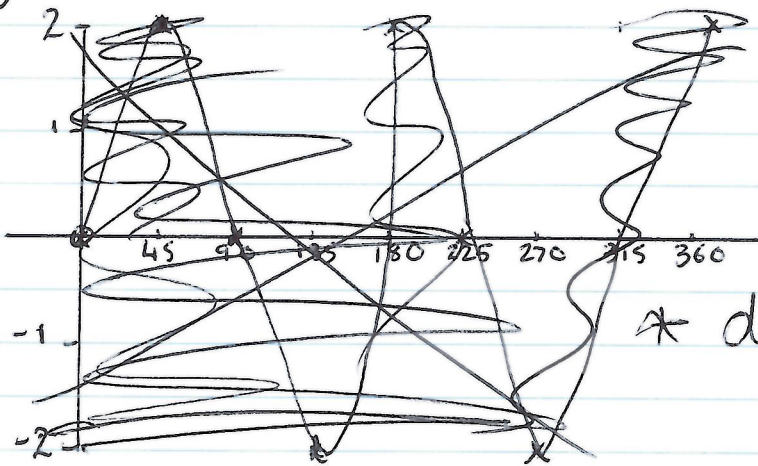
$$10^{x-5} = \frac{255}{7.5}$$

$$10^{x-5} = 34$$

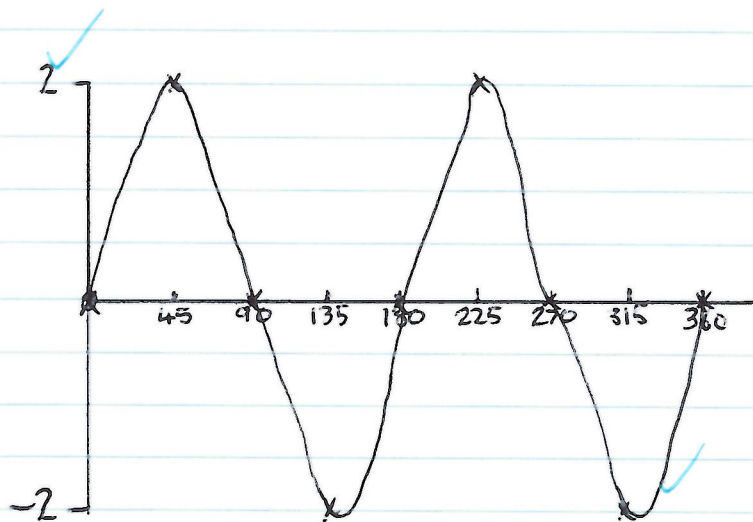
$$x-5 = \log_{10} 34$$

$$x = \log_{10}(34) + 5 = 6.53$$

3) i) $y = 2\sin(2x)$



* do not mark



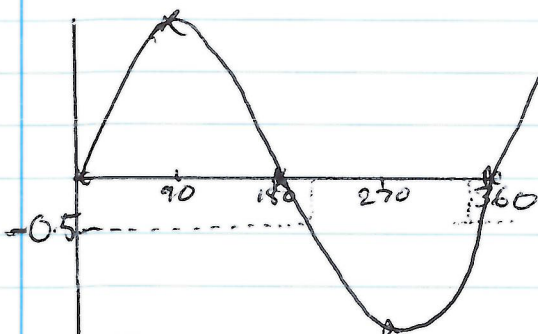
$y = 2\sin(2x)$ for $0 \leq x \leq 360$

6

ii) $\sin 2x = -0.5$
 $2x = \sin^{-1}(-0.5)$
 $\sin^{-1}(-0.5) = -30$ ✓
 $360 + -30 = 330$ ✓
 $180 + 30 = 210$ ✓

$2x = 330, 210, 360 + 330, 210 + 360$ ✓

$x = 165, 105, 345, 285$ ✓



6

SDP

$$4) \quad z_1 = -1 + j2 \quad z_2 = 5 + j3$$

$$i) \quad z_1 - z_2$$

$$\begin{aligned} & -1 + j2 - 5 + j3 \\ & = -6 - j1 \end{aligned}$$

(2)

$$ii) \quad z_1 z_2$$

$$j^2 = -1$$

$$(-1 + j2)(5 + j3)$$

$$-5 - j3 + j10 + j^2 6$$

$$-5 + j7 + (-1)6$$

$$= -11 + j7$$

(3)

$$iii) \quad \frac{z_1}{z_2}$$

$$\frac{(-1 + j2)(5 - j3)}{(5 + j3)(5 - j3)}$$

$$\frac{-5 + j3 + j10 - j^2 6}{25 - j15 + j15 - j^2 9}$$

$$\frac{-5 + j13 - (-1)6}{25 - (-1)9} = \frac{-5 + j13 + 6}{25 + 9} = \frac{1 + j13}{34}$$

$$= \frac{1}{34} + j\frac{13}{34}$$

(5)

JDP

$$5) \quad A = \begin{bmatrix} 1 & 0 \\ -2 & 5 \end{bmatrix} \quad B = \begin{bmatrix} 6 & -3 \\ 3 & -1 \end{bmatrix}$$

$$i) \quad 4B - 2A$$

$$4B = \begin{bmatrix} 24 & -12 \\ 12 & -4 \end{bmatrix}$$

and

$$2A = \begin{bmatrix} 2 & 0 \\ -4 & 10 \end{bmatrix}$$

$$4B - 2A = \begin{bmatrix} 24 & -12 \\ 12 & -4 \end{bmatrix} - \begin{bmatrix} 2 & 0 \\ -4 & 10 \end{bmatrix} = \begin{bmatrix} 22 & -12 \\ 16 & -14 \end{bmatrix} \checkmark$$

3

$$ii) \quad AB =$$

$$\begin{array}{cc} & \begin{matrix} c_1 & c_2 \end{matrix} \\ \begin{matrix} r_1 \\ r_2 \end{matrix} & \begin{bmatrix} 1 & 0 \\ -2 & 5 \end{bmatrix} \begin{bmatrix} 6 & -3 \\ 3 & -1 \end{bmatrix} \end{array}$$

~~$\begin{bmatrix} 1 \times 6, 0 \times 3 & 1 \times -3, 0 \times -1 \\ -2 \times 6, 5 \times 3 & -2 \times -3, 5 \times -1 \end{bmatrix}$~~

$$AB = \begin{bmatrix} 6 & -3 \\ 3 & 1 \end{bmatrix} \checkmark$$

3

$$iii) \quad BA =$$

$$\begin{array}{cc} & \begin{matrix} c_1 & c_2 \end{matrix} \\ \begin{matrix} r_1 \\ r_2 \end{matrix} & \begin{bmatrix} 6 & -3 \\ 3 & -1 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ -2 & 5 \end{bmatrix} \end{array}$$

$\begin{bmatrix} 6 \times 1, -3 \times -2 & 6 \times 0, -3 \times 5 \\ 3 \times 1, -1 \times -2 & 3 \times 0, -1 \times 5 \end{bmatrix}$

PTO

JDP

$$BA = \begin{bmatrix} 12 & -15 \\ 5 & -5 \end{bmatrix} \quad \checkmark \quad \text{Therefore } AB \neq BA. \quad \checkmark$$

3

iv) inverse matrix of B $\begin{bmatrix} 6 & -3 \\ 3 & -1 \end{bmatrix}$

$$(6 \times -1) - (-3 \times 3)$$

$$-6 - -9 = 3 \quad \checkmark \quad \frac{1}{3}$$

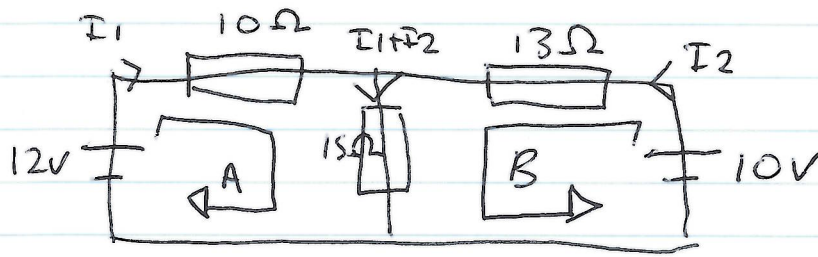
$$\begin{bmatrix} -1 & 3 \\ -3 & 6 \end{bmatrix} \rightarrow \begin{bmatrix} -1 & 3 \\ -3 & 6 \end{bmatrix} \rightarrow \begin{bmatrix} -1 & 3 \\ -3 & 6 \end{bmatrix}$$

$$= \begin{bmatrix} -\frac{1}{3} & 1 \\ -1 & 2 \end{bmatrix} \quad \checkmark$$

6

5DP

6)



$$V = I \times R$$

$$\begin{aligned} A) \quad 12 &= I_1 \times 10 + (I_1 + I_2) \times 15 \\ 12 &= I_1 \times 10 + I_1 \times 15 + I_2 \times 15 \\ 12 &= I_1 \times 25 + I_2 \times 15 \quad \checkmark \end{aligned}$$

$$\begin{aligned} B) \quad 10 &= I_2 \times 13 + (I_1 + I_2) \times 15 \\ 10 &= I_2 \times 13 + I_1 \times 15 + I_2 \times 15 \\ 10 &= I_2 \times 28 + I_1 \times 15 \quad \checkmark \end{aligned}$$

$$I_1 \times 25 + I_2 \times 15 = 12 \quad \begin{array}{r} 450 \\ = \\ \hline \end{array} \quad \begin{array}{r} 45 \\ = \\ \hline \end{array}$$

$$I_1 \times 15 + I_2 \times 28 = 10 \quad \begin{array}{r} 460 \\ = \\ \hline \end{array} \quad \begin{array}{r} 46 \\ = \\ \hline \end{array} \quad \checkmark$$

~~$$\begin{array}{r} 45 \\ 15 \\ \hline 3 \\ I_1 \end{array} \quad \begin{array}{r} 45 \\ 28 \\ \hline 16 \\ I_2 \end{array}$$~~

(6)

JDP

i)
 7) $y = mx + c$
 $(0, 3)$ & $(2, -1)$

$$m = \frac{3+1}{0-2}$$

$$m = \frac{4}{-2}$$

$$m = -2 \quad \checkmark$$

$$y = -2x + c$$

$$3 = 2x \times 0 + c$$

$$c = 3 \quad \checkmark$$

$$y = -2x + c$$

$$-1 = 2 \times 2 + c$$

$$-1 = -4 + c$$

$$-1 + 4 = c$$

$$c = 3 \quad \checkmark$$

ii) $(4, 3)$

$$m = -3 \quad \times$$

$$y = -3x + c$$

$$3 = -3 \times 4 + c$$

$$3 = -12 + c \quad \times$$

$$c = 15$$

8) 50m 1m = £23

23, 25, 27, 29, 31, 33, 35, 37, 39, 41

$$50^{th} m = 23 + (49 \times 2) = 121 \quad \checkmark$$

$$\frac{a + l}{2} \times n = \frac{23 + 121}{2} \times 50 = £3600 \quad \checkmark$$

4

9) 4 speeds 50 rev $\rightarrow$ 500 rev

$$ar^{n-1} \quad a = 50 \quad n = 4$$

$$50 \times r^{4-1} = 500$$

$$r^{4-1} = 500 / 50$$

$$r^3 = 10$$

$$r = \sqrt[3]{10}$$



1st term = 50 rev/min

$$2^{\text{nd}} \text{ term} = 50 \times \sqrt[3]{10}^{2-1} = 108 \text{ rev/min}$$



$$3^{\text{rd}} \text{ term} = 50 \times \sqrt[3]{10}^{3-1} = 232 \text{ rev/min}$$



$$4^{\text{th}} \text{ term} = 50 \times \sqrt[3]{10}^{4-1} = 500 \text{ rev/min.}$$

8

DDP