



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

Complete, fold and seal
(see note 2 below)

SURNAME: GREY

FORENAME(S): BYRON

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.

1	Student Number	
2	Title of Examination Paper	TCA 1
3	Module Code	PLEE4000 / PCP04000
4	Date and Time of Examination	25/1/23 16:00
5	Examination Venue	PEMBROKE SHIRE 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	15
5	15
6	14
7	12
8	4
9	8
Total	98 ✓

second Marker
SDP
02/02/23

(Gweler yr ochr arall am y fersiwn Cymraeg)

$$1. \quad f_{res} = \frac{1}{2} \sqrt{\frac{k}{m}}$$

$$2f_{res} = \sqrt{\frac{k}{m}}$$

$$4f_{res}^2 = \frac{k}{m} \quad \checkmark$$

$$m = \frac{k}{4f_{res}^2} \quad \checkmark$$

(4)

2.

$$i) \quad 5x - 5 - 12x + 4 + 15 = 0$$

$$14 - 7x = 0 \quad \checkmark$$

$$-7x = -14 \quad \checkmark$$

$$x = 2 \quad \checkmark$$

(4)

$$ii) \quad a = 2 \quad b = -5 \quad c = -3$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad \checkmark$$

$$x = \frac{5 \pm \sqrt{(-5)^2 - (4 \times 2 \times -3)}}{2 \times 2} \quad \checkmark$$

$$x = 3 \quad \checkmark$$

$$x = -\frac{1}{2} \quad \checkmark$$

(6)

iii)

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

$$10^{x-5} = 34 \quad \checkmark$$

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

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

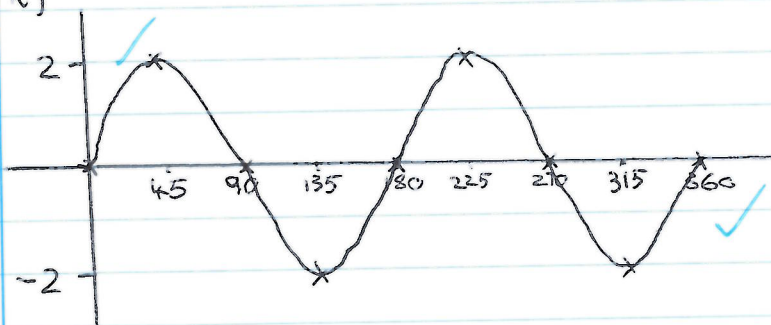
$$x = -3.47 \quad \times$$

(4)

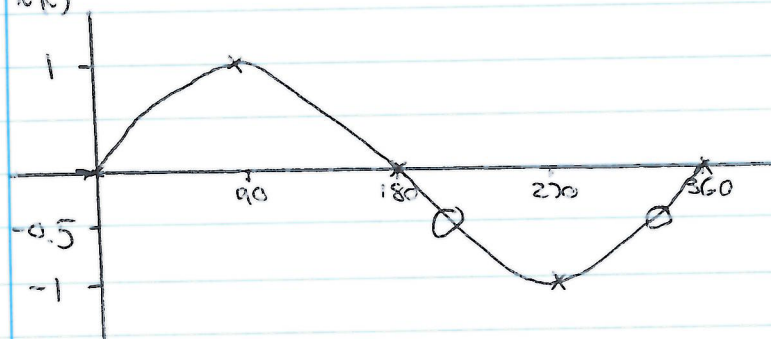
SDP

3.

i)



ii)



$$\theta = \sin^{-1}(-0.5) = -30 + 360 = 330 \quad \checkmark$$

$$180 + 30 = 210 \quad \checkmark$$

$$2x = 210, 330, 210 + 360, 330 + 360 \quad \checkmark$$

$$2x = 210, 330, 570, 690$$

$$x = 105^\circ, 165^\circ, 285^\circ, 345^\circ \quad \checkmark$$

4.

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

$$= -6 - j \quad \checkmark$$

$$ii) (-1 + j2)(5 + j3) = -5 - j3 + j10 + j^2 6 \quad \checkmark$$

$$= -5 + j7 + (-1)6 \quad \checkmark$$

$$= -5 + j7 - 6 \quad \checkmark$$

$$z_2 = -11 + j7 \quad \checkmark$$

5.

$$i) \quad 4 \begin{bmatrix} 6 & -3 \\ 3 & -1 \end{bmatrix} - 2 \begin{bmatrix} 1 & 0 \\ -2 & 5 \end{bmatrix} = \begin{bmatrix} 24 & -12 \\ 12 & -4 \end{bmatrix} - \begin{bmatrix} 2 & 0 \\ -4 & 10 \end{bmatrix}$$

$$= \begin{bmatrix} 22 & -12 \\ 16 & -14 \end{bmatrix} \quad \checkmark$$

(3)

$$ii) \quad \begin{matrix} & C1 & C2 \\ R1 & \begin{bmatrix} 1 & 0 \end{bmatrix} & \begin{bmatrix} 6 & -3 \end{bmatrix} \\ R2 & \begin{bmatrix} -2 & 5 \end{bmatrix} & \begin{bmatrix} 3 & -1 \end{bmatrix} \end{matrix} = \begin{matrix} & C1 & C2 \\ R1 & \begin{bmatrix} 1 \times 6 \\ 0 \times 3 \end{bmatrix} & \begin{bmatrix} 1 \times -3 \\ 0 \times -1 \end{bmatrix} \\ R2 & \begin{bmatrix} -2 \times 6 \\ 5 \times 3 \end{bmatrix} & \begin{bmatrix} -2 \times -3 \\ 5 \times -1 \end{bmatrix} \end{matrix}$$

$$= \begin{bmatrix} 6+0 & -3+0 \\ -12+15 & 6+-5 \end{bmatrix}$$

(3)

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

$$iii) \quad \begin{matrix} & C1 & C2 \\ R1 & \begin{bmatrix} 6 & -3 \end{bmatrix} & \begin{bmatrix} 1 & 0 \end{bmatrix} \\ R2 & \begin{bmatrix} 3 & -1 \end{bmatrix} & \begin{bmatrix} -2 & 5 \end{bmatrix} \end{matrix} = \begin{matrix} & C1 & C2 \\ R1 & \begin{bmatrix} 6 \times 1 \\ 3 \times -2 \end{bmatrix} & \begin{bmatrix} 6 \times 0 \\ 3 \times 5 \end{bmatrix} \\ R2 & \begin{bmatrix} 3 \times 1 \\ -1 \times -2 \end{bmatrix} & \begin{bmatrix} 3 \times 0 \\ -1 \times 5 \end{bmatrix} \end{matrix}$$

$$= \begin{bmatrix} 6+6 & 0+-15 \\ 3+2 & 0+-5 \end{bmatrix}$$

(3)

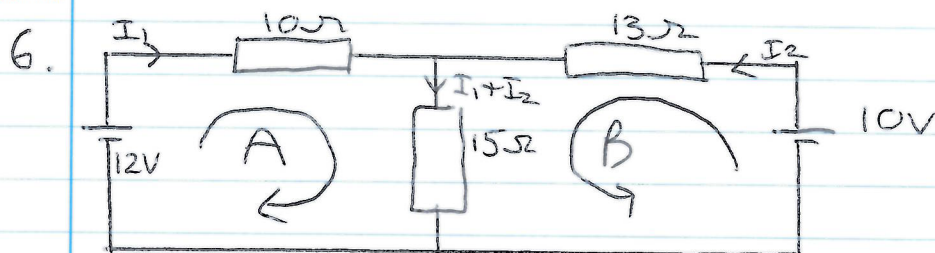
$$AB \neq \begin{bmatrix} 12 & -15 \\ 5 & -5 \end{bmatrix} \quad \checkmark$$

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

$$\det B = 6 \times -1 - -3 \times 3 = -6 - -9 = 3 \quad \checkmark$$

$$A^{-1} = \frac{1}{3} \begin{bmatrix} -1 & 3 \\ -3 & 6 \end{bmatrix} = \begin{bmatrix} -\frac{1}{3} & 1 \\ -1 & 2 \end{bmatrix} \quad \checkmark$$

(6)



$$V = IR$$

PART A

$$12 = I_1 \times 10 + (I_1 + I_2) \times 15$$

$$12 = 10I_1 + 15I_1 + 15I_2$$

$$12 = 25I_1 + 15I_2 \quad \checkmark$$

PART B

$$10 = I_2 \times 13 + (I_1 + I_2) \times 15$$

$$10 = 13I_2 + 15I_1 + 15I_2$$

$$10 = 15I_1 + 28I_2 \quad \checkmark$$

$$25I_1 + 15I_2 = 12$$

$$15I_1 + 28I_2 = 10 \quad \checkmark$$

$$\begin{bmatrix} 25 & 15 \\ 15 & 28 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 12 \\ 10 \end{bmatrix} \quad \checkmark$$

$$\det = 25 \times 28 - 15 \times 15 = 700 - 225 = 475 \quad \checkmark$$

$$\begin{bmatrix} 25 & 15 \\ 15 & 28 \end{bmatrix} \rightarrow \begin{bmatrix} 28 & -15 \\ -15 & 25 \end{bmatrix}$$

$$= \frac{1}{475} \begin{bmatrix} 28 & -15 \\ -15 & 25 \end{bmatrix} \begin{bmatrix} 12 \\ 10 \end{bmatrix} \quad \checkmark$$

$$= \frac{1}{475} \begin{bmatrix} 336 + -150 \\ -180 + 250 \end{bmatrix} \quad \checkmark$$

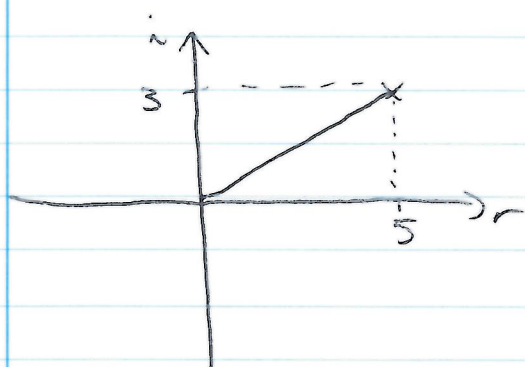
$$\text{iii) } \frac{-1+j2}{5+j3} \times \frac{5-j3}{5-j3} = \frac{-5+j3+j10-j^2 6}{25-j15+j15-j^2 9} \quad \checkmark$$

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

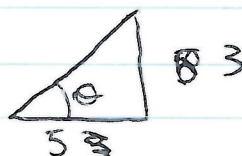
$$= \frac{1+j13}{34} \quad \checkmark = \frac{1}{34} + j \frac{13}{34} \quad \checkmark$$

(5)

$$\text{iv) } (5+j3)^4$$



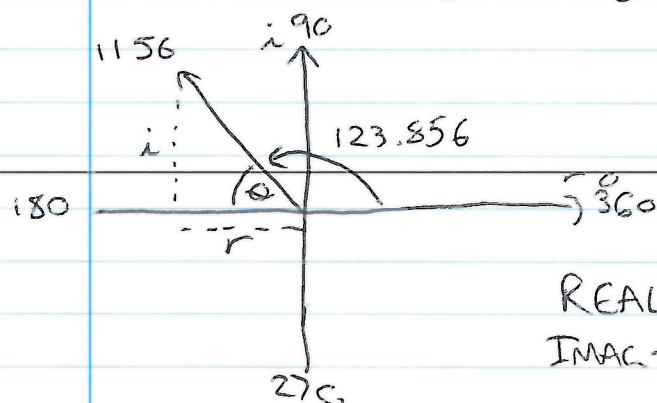
$$|Z| = \sqrt{5^2 + 3^2} \\ = \sqrt{25 + 9} \\ = \sqrt{34} \quad \checkmark$$



$$\theta = \tan^{-1} \left(\frac{3}{5} \right) = 30.964^\circ \quad \checkmark$$

$$\sqrt{34} \angle 30.964 \\ (\sqrt{34})^4 \angle 30.964 \times 4 \quad \checkmark$$

$$1156 \angle 123.856^\circ \quad \checkmark$$



$$\theta = 180 - 123.856 \\ \theta = 56.144^\circ \quad \checkmark$$

$$\text{REAL} \rightarrow 1156 \times \cos 56.144 = 644.02 \quad \checkmark$$

$$\text{IMAG} \rightarrow 1156 \times \sin 56.144 = 959.99 \quad \checkmark$$

$$(Z_2)^4 = -644.02 + j 959.99 \quad \checkmark$$

(5)

SDP

$$= \frac{1}{475} \begin{bmatrix} 186 \\ 70 \end{bmatrix}$$

$$\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} \frac{186}{475} \\ \frac{14}{95} \end{bmatrix} \therefore I_1 = \frac{186}{475} \quad I_2 = \frac{14}{95}$$

$$10\text{-}\Omega \text{ current is } \frac{186}{475} \text{ A}$$

$$13\text{-}\Omega \text{ current is } \frac{14}{95} \text{ A}$$

$$15\text{-}\Omega \text{ current is } \frac{186}{475} + \frac{14}{95} = \frac{256}{475} \text{ A}$$

(14)

7.

$$i) y = mx + c$$

$$m = \frac{\Delta y}{\Delta x} = \frac{3 - -1}{0 - 2}$$

$$y = -2x + c$$

$$-1 = -2(2) + c$$

$$-1 = -4 + c$$

$$c = 3$$

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

$$y = -2x + 3$$

(6)

$$ii) m = \frac{1}{2}$$

$$y = \frac{1}{2}x + c$$

$$3 = \frac{1}{2}(4) + c$$

$$3 = 2 + c$$

$$c = 1$$

$$y = \frac{1}{2}x + 1$$

(6)

$$8. \quad 23 + (49 \times 2) = 121 \quad \checkmark$$

$$Av = \frac{121 + 23}{2} = \cancel{124} 72$$

$$72 \times 50 = £3600 \quad \checkmark$$

$$9. \quad ar^{n-1} \quad a = 50$$

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

$$r^3 = 10$$

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

$$n=2 \rightarrow 50 \times (\sqrt[3]{10})^{2-1} = 108 \quad \checkmark$$

$$n=3 \rightarrow 50 \times (\sqrt[3]{10})^{3-1} = 232 \quad \checkmark$$

$$\text{Speed 1} = 50 \text{ rev/min}$$

$$\text{Speed 2} = 108 \text{ rev/min} \quad \checkmark$$

$$\text{Speed 3} = 232 \text{ rev/min} \quad \checkmark$$

$$\text{Speed 4} = 500 \text{ rev/min}$$