



Complete, fold and seal
(see note 2 below)

SURNAME: Hill

FORENAME(S): Wesley

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	TCA1
3	Module Code	PCEE4000/ PCPO4000
4	Date and Time of Examination	25/1/23 4PM
5	Examination Venue	Pembrokeshire College
6	Seat Number	
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
1	0
2	13
3	6
4	9
5	9
6	9
7	3
8	2
9	8
Total	59 ✓

second Marker
SD/DC
02/02/23

e b
F d
a b
c d

a e
C F
a b
c d

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

$$\left(\frac{1}{2}\right) f_{res} = \sqrt{\frac{k}{m}}$$

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

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

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

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

$$= -7x - 5 + 4 + 15 = 0$$

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

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

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

$$x = -2 \quad \times$$

$$2ii) \frac{a}{2}x^2 - \frac{b}{5}x - \frac{c}{3} = 0$$

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-(-5) \pm \sqrt{5^2 - 4 \times 2 \times -3}}{2 \times 2} = -0.5 \quad \checkmark$$

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

$$2iii) 7.5 \times 10^{x-5} = 255$$

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

$$x-5 = \log(34) = 1.53 \quad \checkmark$$

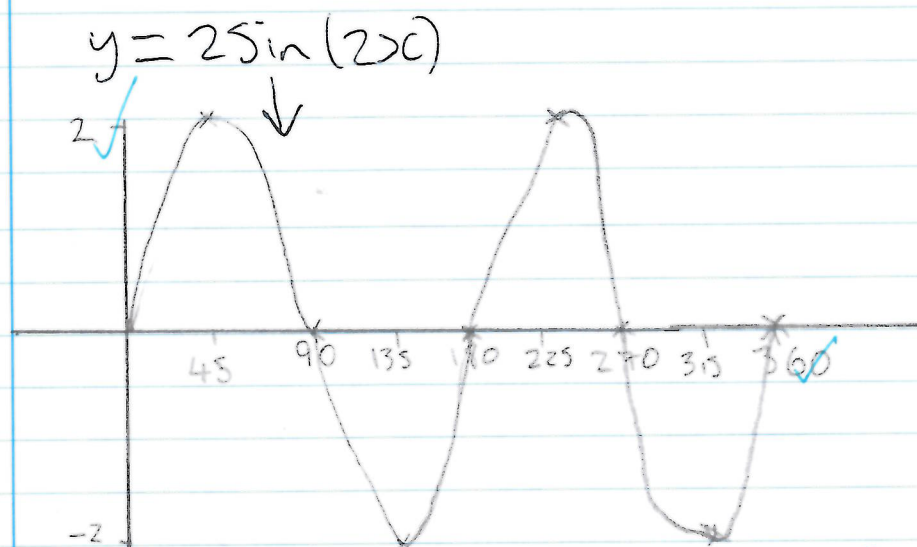
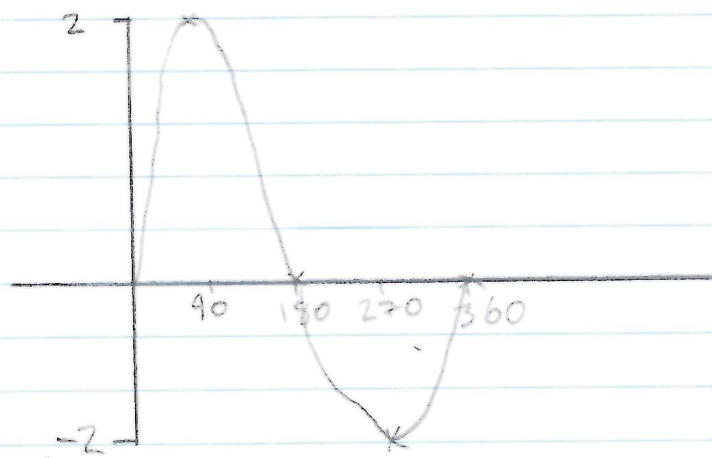
$$x-5 = 1.53$$

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

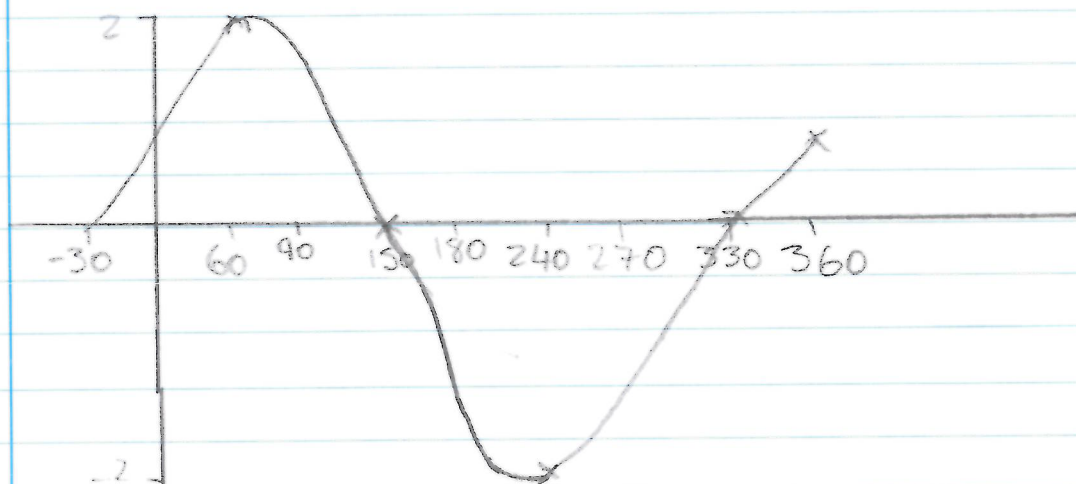
d/p

amplitude frequency

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



3ii) $\sin 2x = 0.5 \rightarrow \sin^{-1}(0.5) = 30$



$$360 - 30 = 330^\circ \quad \checkmark$$

1

$$270 =$$

KAC

4i) $Z_1 - Z_2$ $Z_1 = -1 + j2$ $Z_2 = 5 + j3$

$$\cancel{-1 + j2 - (5 + j3)} \quad \cancel{-1 + j2 - 5 + j3 = -6 + j3}$$

$$-1 + j2 - 5 + j3 = -6 + j2 + j3$$

$$-6 + j2 + j3 = -6 + j5 \quad \times$$

4ii) $Z_1 Z_2$

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

$$-5 - j3 + j10 + j^2 6 = -5 + j7 + j^2 6 \quad \checkmark$$

$$-5 + j7 + j^2 6 = -5 - j2 \quad \times$$

2

4iii) $\frac{Z_1}{Z_2}$

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

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

$$= \frac{-5 + j13 - j^2 6}{25 - j^2 9} \quad \checkmark$$

$$= \frac{-5 + j19}{25 - j^2 9} = \frac{-5 + j19}{34} = \frac{-5}{34} + \frac{j19}{34} \quad \times$$

3

SDP

$$4iv) (Z_2)^4 \quad Z_2 = 5 + j3$$

$$r = \sqrt{5^2 + 3^2} = \sqrt{34} \quad \checkmark$$

$$\theta = \tan^{-1}\left(\frac{3}{5}\right) = 30.96^\circ$$

$$\sqrt{34} \angle 30.96^\circ \times 4$$

$$(\sqrt{34})^4 \angle 30.96^\circ \times 4 = 1156 \angle 123.84^\circ \quad \checkmark$$

$$\text{real} = \cos$$

$$\text{imag} = \sin$$

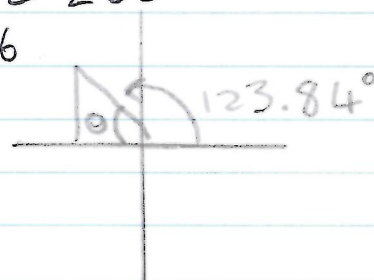
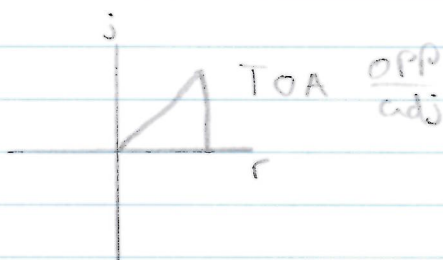
$$360 - 123.84^\circ = 236$$

$$180 - 123.84^\circ = 56.16$$

$$\text{real} = 1156 \cos(56.16) = 643.75 \quad \checkmark$$

$$\text{imag} = 1156 \sin(56.16) = 960.17 \quad \checkmark$$

$$-643.75 + j960.17$$



4

$$5i) 4B - 2A \quad A = \begin{pmatrix} 1 & 0 \\ -2 & 5 \end{pmatrix} \quad B = \begin{pmatrix} 6 & -3 \\ 3 & -1 \end{pmatrix}$$

$$4B = \begin{pmatrix} 1 \times 4 & 0 \times 4 \\ -2 \times 4 & 5 \times 4 \end{pmatrix} = \begin{pmatrix} 4 & 0 \\ -8 & 20 \end{pmatrix}$$

$$4B = \begin{pmatrix} 6 \times 4 & -3 \times 4 \\ 3 \times 4 & -1 \times 4 \end{pmatrix} = \begin{pmatrix} 24 & -12 \\ 12 & -4 \end{pmatrix}$$

$$2A = \begin{pmatrix} 1 \times 2 & 0 \times 2 \\ -2 \times 2 & 5 \times 2 \end{pmatrix} = \begin{pmatrix} 2 & 0 \\ -4 & 10 \end{pmatrix}$$

$$\begin{pmatrix} 24 & -12 \\ 12 & -4 \end{pmatrix} - \begin{pmatrix} 2 & 0 \\ -4 & 10 \end{pmatrix} = \begin{pmatrix} 22 & -12 \\ -8 & -14 \end{pmatrix}$$

2

SDP

5ii) AB

$$\begin{pmatrix} 1 & 0 \\ -2 & 5 \end{pmatrix} \begin{pmatrix} 6 & -3 \\ 3 & -1 \end{pmatrix}$$

	C1	C2
R1	$1 \times 6 + 0 \times 3$	$1 \times -3 + 0 \times -1$
R2	$-2 \times 6 + 5 \times 3$	$-2 \times -3 + 5 \times -1$

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

(3)

5iii) $AB \neq BA$

$$\begin{pmatrix} 6 & -3 \\ 3 & -1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ -2 & 5 \end{pmatrix}$$

	C1	C2
R1	$6 \times 1 + -3 \times -2$	$6 \times 0 + -3 \times 5$
R2	$3 \times 1 + -1 \times 2$	$3 \times 0 + -1 \times 5$

$$= \begin{pmatrix} 12 & -15 \\ 1 & -5 \end{pmatrix}$$

(2)

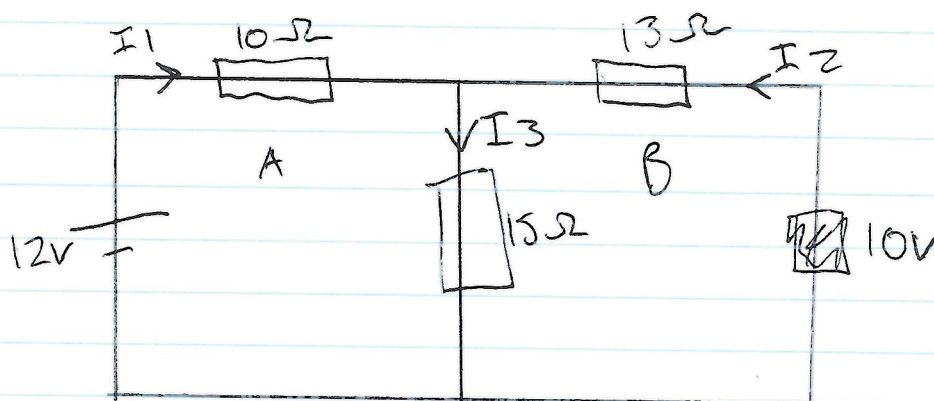
5iv)

$$\begin{pmatrix} 6 & -3 \\ 3 & -1 \end{pmatrix} = -15 \quad \times$$

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

2

6)



A:

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

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

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

B:

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

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

~~$$10 = 28I_1 + 15I_2$$~~

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

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

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

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

DOP

$$V = I \times R$$

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

† Cramers rule

$$\frac{\begin{bmatrix} e & a \\ f & c \end{bmatrix}}{\begin{bmatrix} a & b \\ c & d \end{bmatrix}}$$

$$I_1 = \frac{\begin{vmatrix} 12 & 15 \\ 10 & 28 \end{vmatrix}}{\begin{vmatrix} 25 & 15 \\ 15 & 28 \end{vmatrix}} = \frac{12 \times 28 - 15 \times 10}{25 \times 28 - 15 \times 15} = \frac{186}{475}$$

$$I_2 = \frac{\begin{vmatrix} 25 & 12 \\ 15 & 10 \end{vmatrix}}{\begin{vmatrix} 25 & 15 \\ 15 & 28 \end{vmatrix}} = \frac{25 \times 10 - 15 \times 12}{25 \times 28 - 15 \times 15} = \frac{14}{95}$$

$$I_1 = \frac{\begin{vmatrix} 12 & 28 \\ 10 & 15 \end{vmatrix}}{\begin{vmatrix} 25 & 15 \\ 15 & 28 \end{vmatrix}} = \frac{10 \times 15 - 25 \times 12}{25 \times 28 - 15 \times 15} = \frac{6}{19} \text{ A}$$

$$= 0.31 \text{ A}$$

$$I_2 = \frac{\begin{vmatrix} 12 & 15 \\ 10 & 28 \end{vmatrix}}{\begin{vmatrix} 25 & 15 \\ 15 & 28 \end{vmatrix}} = \frac{12 \times 28 - 10 \times 15}{25 \times 28 - 15 \times 15}$$

$$I_2 = \frac{\begin{vmatrix} 12 & 15 \\ 10 & 28 \end{vmatrix}}{\begin{vmatrix} 25 & 15 \\ 15 & 28 \end{vmatrix}} = \frac{12 \times 28 - 10 \times 15}{25 \times 28 - 15 \times 15} = \frac{4}{19} \text{ A} = 0.21 \text{ A}$$

$$I_3 = I_1 + I_2$$

$$I_3 = \frac{6+4}{19} = \frac{10}{19} \text{ A} = 0.52 \text{ A}$$

$$7i) \begin{matrix} x & y \\ (0, 3) & (2, -1) \end{matrix}$$

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

$$y = mx + c$$

$$y = -2x + c$$

$$\begin{aligned} 3 &= -2(0) + c \\ 3 &= c \\ c &= 3 \end{aligned}$$

$$7ii) \begin{matrix} x & y \\ (4, 3) \end{matrix}$$

$$m = -2$$

$$y = mx + c$$

$$\begin{aligned} 3 &= -2(4) + c \\ 3 &= -8 + c \\ 11 &= c \end{aligned}$$

9

3

SDP

$$8) a=23 \quad n=50 \quad d=2$$

$$a(n-1)d = 23 + (50-1) \times 2 = 121. \quad \checkmark$$

$$\text{average term} = \frac{\text{first} + \text{last}}{2} = 785.5 \quad \checkmark$$

$$785.50 \times 50 = 39275 \quad \checkmark$$

(2)

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

$$ar^{n-1} = 500$$

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

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

$$\frac{r^{4-1}}{r^{4-1}} = \frac{10}{10}$$

$$ar^{n-1} = 500$$

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

$$r^{n-1} = 10$$

$$r = \frac{10}{50} = \frac{1}{5} \quad 4^{-1}\sqrt{10} \quad \checkmark$$

$$r=3 = \frac{50}{3} \times 2.15^{3-1} = 232.04 \quad 232 \text{ rev/min} \quad \checkmark$$

$$r=2 = 50 \times 2.15^{2-1} = 107.72 \quad 108 \text{ rev/min} \quad \checkmark$$

(8)

SDP

2.154 43469

Question No.

Examiner Only

