

8 Pages

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right and seal 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	Class Test 1
3	Module Code	PSDE 4003
4	Date and Time of Examination	18/12/17 14:30-16:00
5	Examination Venue	Rm = G9
6	Seat Number	
7	Number of Answer Books handed in	1

[illegible]

Please complete this section and SEAL before the examination starts.

Surname Lynch (Block Capitals) Forename(s) James Thomas

(Gweler yr ochr arall am y fersiwn Cymraeg)

PATENT PENDING

$$1. \frac{n(E - Ir)}{R + nIr} = IR \frac{(E - Ir)}{(E - Ir)}$$

② ✓

$$\begin{aligned} nE - nIr &= IR \\ nE &= I(R + nIr) \end{aligned}$$

① ✓

Idea is correct
error in factoring!

$$I = \frac{nE}{R + nIr}$$

① ✓

Still have I in this!

5/8

⑤

2.

3.
(i) $15x + 20 - 8x + 2x = 65$ ✓ (2) ✓
 $7x + 64 = 65$ ✗ (cancel here!) *multisay*
 $7x = 65 - 64$ (1) ✓ *correct*
 $x = 1/7$ ✗ (1) ✓ *though.*

(ii) $\log_{10} 10^{(3x-4)} = \log_{10} (1822)$ ✓
 $(3x-4) \log_{10} 10 = \log_{10} (1822)$ ✓
 $3x-4 = \log_{10} (1822)$ ✓ (2) ✓
 $3x = \log_{10} (1822) + 4$ ✓
 $x = \frac{\log_{10} (1822) + 4}{3}$ ✓
 $x = 2.42$ (to 2 d.p.) ✓ (2) ✓

4.
(i) $2 \times \begin{bmatrix} 5 & 1 \\ 3 & 2 \end{bmatrix} = \begin{bmatrix} 10 & 2 \\ 6 & 4 \end{bmatrix}$ ✓ (2) ✓
(ii) $3A = \begin{bmatrix} 15 & 3 \\ 9 & 6 \end{bmatrix}$ ✓
 $2B = \begin{bmatrix} 4 & -6 \\ 4 & 8 \end{bmatrix}$ ✓
 $3A - 2B = \begin{bmatrix} 11 & 9 \\ 5 & -2 \end{bmatrix}$ ✓ (2) ✓

(iii) $AC = \begin{bmatrix} 5 & 1 \\ 3 & 2 \end{bmatrix} \times \begin{bmatrix} 2 & -3 \\ 2 & 4 \end{bmatrix} = \begin{bmatrix} (5 \times 2 + 1 \times 2) & (5 \times -3 + 1 \times 4) \\ (3 \times 2 + 2 \times 2) & (3 \times -3 + 2 \times 4) \end{bmatrix}$ ✓
 $= \begin{bmatrix} 12 & -11 \\ 10 & -1 \end{bmatrix}$ ✗

(iv) $BA = \begin{bmatrix} 2 & -3 \\ 2 & 4 \end{bmatrix} \times \begin{bmatrix} 5 & 1 \\ 3 & 2 \end{bmatrix} = \begin{bmatrix} (2 \times 5 + -3 \times 3) & (2 \times 1 + -3 \times 2) \\ (2 \times 5 + 4 \times 3) & (2 \times 1 + 4 \times 2) \end{bmatrix}$ ✓
 $BA = \begin{bmatrix} 1 & -4 \\ 22 & 10 \end{bmatrix}$ ✓ (4) ✓

(v) $AB = \begin{bmatrix} 5 & 1 \\ 3 & 2 \end{bmatrix} \times \begin{bmatrix} 2 & -3 \\ 2 & 4 \end{bmatrix} = \begin{bmatrix} (5 \times 2 + 1 \times 2) & (5 \times -3 + 1 \times 4) \\ (3 \times 2 + 2 \times 2) & (3 \times -3 + 2 \times 4) \end{bmatrix}$ ✓
 $AB = \begin{bmatrix} 12 & -11 \\ 10 & -1 \end{bmatrix}$ ✓

as $BA = \begin{bmatrix} 1 & -4 \\ 22 & 10 \end{bmatrix}$ we can see that they are not the same. (4) ✓

5. $T_2 = \begin{bmatrix} 1 & 0 \\ 1/6 & 1 \end{bmatrix}$ ✓ $T_2 = \begin{bmatrix} 1 & 50 \\ 0 & 1 \end{bmatrix}$ ✓

$\begin{bmatrix} E_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1/6 & 1 \end{bmatrix} \times \begin{bmatrix} 1 & 50 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 110 \\ 4 \end{bmatrix} \leftarrow E_2$ ✓
 $\begin{bmatrix} 110 \\ 4 \end{bmatrix} \leftarrow I_2$ (3) ✓

$\begin{bmatrix} E_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} (1 \times 1 + 0 \times 0) & (1 \times 50 + 0 \times 1) \\ (1/6 \times 1 + 1 \times 0) & (1/6 \times 50 + 1 \times 1) \end{bmatrix} \begin{bmatrix} 110 \\ 4 \end{bmatrix}$ ✗

$\begin{bmatrix} E_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} 1 & 50 \\ 1/6 & 1.769 \end{bmatrix} \begin{bmatrix} 110 \\ 4 \end{bmatrix}$ ✓
(3dp)

$\begin{bmatrix} E_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} (1 \times 110 + 50 \times 4) \\ (1/6 \times 110 + 1.769 \times 4) \end{bmatrix}$ ✓ (5) ✓

$\begin{bmatrix} E_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} 310 \\ 8.768 \end{bmatrix}$ ✓ (4) ✓

6.
(i) x_2, y_2 x_2, y_2
 $(1, -1)$ and $(3, 7)$

$y = mx + c$ → $y_1 = 2x_1 + c$
 $y = 10x + c$ → $y_2 = 2x_2 + c$
constant

(14)

(12)

$$\begin{aligned}(x_1, y_1): -1 &= 1 + C \\ (x_2, y_2): 7 &= 3 + C\end{aligned}$$

$$-1 - 1 = C$$

$$7 - 3 = C$$

$$(x_1, y_1): C = -2$$

$$(x_2, y_2): C = 4$$

$$(ii) x = 2, y = 11$$

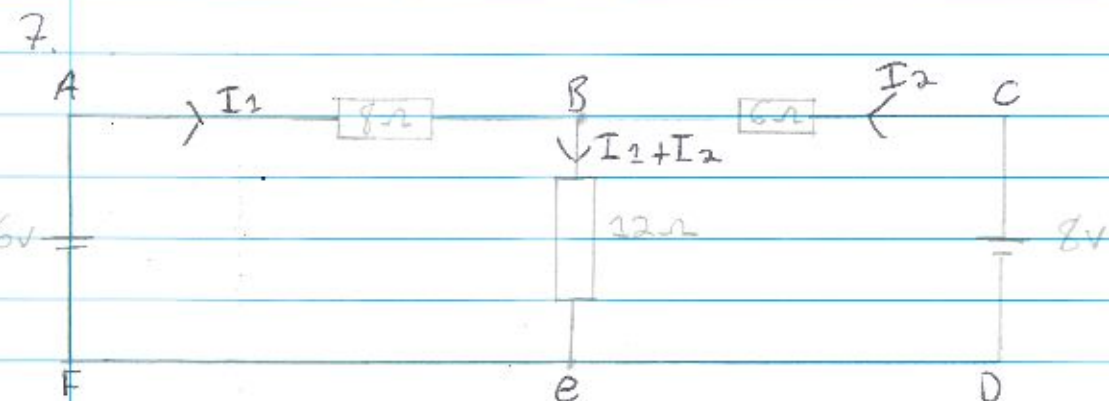
$$y = -\frac{1}{m}x + C$$

$$11 = -\frac{1}{m}(2) + C$$

Cramer's rule

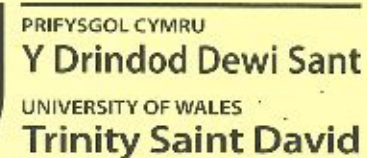
$$I_1 = \begin{bmatrix} a & e \\ c & f \end{bmatrix} = \begin{bmatrix} 12 & 8 \\ 20 & 6 \end{bmatrix}$$

$$I_2 = \begin{bmatrix} e & b \\ f & d \end{bmatrix} = \begin{bmatrix} 8 & 18 \\ 6 & 12 \end{bmatrix}$$



$$\begin{aligned}E &= 12 \\ F &= 12\end{aligned}$$

$$\begin{aligned}8 &= 12I_1 + 18I_2 \\ 6 &= 20I_1 + 12I_2\end{aligned}$$



8 Pages

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right and seal 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		List the numbers of the questions you have attempted	Office Use
2	Title of Examination Paper	CLASS TEST 1	1	8
3	Module Code	PSDE 4003	3	11 ✓
4	Date and Time of Examination	18/12/17 14:30 To 16:00	4	18 ✓
5	Examination Venue	Rm G9	5	14 ✓
6	Seat Number		6	8 ✓
7	Number of Answer Books handed in	/	7	0
			Total	59 ✓

(Gweler yr ochr arall am y fersiwn Cymraeg)

PATENT PENDING

Please complete this section and SEAL before the examination starts.

Surname MORGAN (Block Capitals) Forename(s) JONATHAN

8/8
8

6/6

5/6

1) $n = \frac{IR}{E - Ir}$ Make I the Subject.

$$n(E - Ir) = IR$$

$$nE - nIr = IR$$

$$nE = IR + nIr$$

$$nE = I(R + nr)$$

$$\frac{nE}{R + nr} = I$$

$$I = \frac{nE}{R + nr}$$

8/8
(8)

2)

3) (i) $5(3x + 4) - 4(2x - 6) = 65$

$$15x + 20 - 8x + 24 = 65$$

$$15x - 8x = 65 - 20 - 24$$

$$\frac{7x}{7} = \frac{21}{7}$$

$$x = 3$$

6/6

(ii) $10^{(3x-4)} = 1822$

$$(3x - 4) \log 10 = \log 1822$$

$$3x - 4 = \frac{\log 1822}{\log 10}$$

$$3x - 4 = 3.26$$

$$3x = 3.26 + 4$$

$$\frac{3x}{3} = \frac{7.26}{3}$$

$$x = 2.42$$

5/6

(11)

4)

$$A = \begin{bmatrix} 5 & 1 \\ 3 & 2 \end{bmatrix} \quad B = \begin{bmatrix} 2 & -3 \\ 2 & 4 \end{bmatrix} \quad C = \begin{bmatrix} 2 & 3 & 3 \\ 4 & 3 & 1 \end{bmatrix}$$

$$(i) 2A = \begin{bmatrix} 10 & 2 \\ 6 & 4 \end{bmatrix}$$

$$(ii) 3A - 2B = \begin{bmatrix} 15 & 3 \\ 9 & 6 \end{bmatrix} - \begin{bmatrix} 4 & -6 \\ 4 & 8 \end{bmatrix} = \begin{bmatrix} 11 & 9 \\ 5 & -2 \end{bmatrix}$$

$$(iii) AC = \begin{bmatrix} 5 & 1 \\ 3 & 2 \end{bmatrix} \begin{bmatrix} 2 & 3 & 3 \\ 4 & 3 & 1 \end{bmatrix} = \begin{bmatrix} 14 & 18 & 20 \\ 14 & 15 & 18 \end{bmatrix}$$

$(5 \times 2) + (1 \times 4) = 10 + 4 = 14$
 $(5 \times 3) + (1 \times 3) = 15 + 3 = 18$
 $(5 \times 3) + (1 \times 1) = 15 + 1 = 16$
 $(3 \times 2) + (2 \times 4) = 6 + 8 = 14$
 $(3 \times 3) + (2 \times 3) = 9 + 6 = 15$
 $(3 \times 3) + (2 \times 1) = 9 + 2 = 11$

$$(iv) BA = \begin{bmatrix} 2 & -3 \\ 2 & 4 \end{bmatrix} \begin{bmatrix} 5 & 1 \\ 3 & 2 \end{bmatrix}$$

$$\begin{bmatrix} (2 \times 5) + (-3 \times 3) & (2 \times 1) + (-3 \times 2) \\ (2 \times 5) + (4 \times 3) & (2 \times 1) + (4 \times 2) \end{bmatrix}$$

$$\begin{bmatrix} 10 + (-9) & 2 + (-6) \\ 10 + 12 & 2 + 8 \end{bmatrix}$$

$$\begin{bmatrix} 1 & -4 \\ 22 & 10 \end{bmatrix}$$

$$\begin{bmatrix} 1 & -4 \\ 22 & 10 \end{bmatrix}$$

to show

(v) $AB \neq BA$

$$AB = \begin{bmatrix} 5 & 1 \\ 3 & 2 \end{bmatrix} \begin{bmatrix} 2 & -3 \\ 2 & 4 \end{bmatrix}$$

$$\begin{bmatrix} (5 \times 2) + (1 \times 2) & (5 \times -3) + (1 \times 4) \\ (3 \times 2) + (2 \times 2) & (3 \times -3) + (2 \times 4) \end{bmatrix}$$

$$\begin{bmatrix} 10 + 2 = 12 & -15 + 4 = -11 \\ 6 + 4 = 10 & -9 + 8 = -1 \end{bmatrix}$$

$$AB = \begin{bmatrix} 12 & -11 \\ 10 & -1 \end{bmatrix}$$

$$BA = \begin{bmatrix} 1 & -4 \\ 22 & 10 \end{bmatrix}$$

: $AB \neq BA$

5)

$$\begin{bmatrix} E_1 \\ I_1 \end{bmatrix} = T_2 \cdot T_1 \begin{bmatrix} E_2 \\ I_2 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 0 \\ \frac{1}{65} & 1 \end{bmatrix} \begin{bmatrix} 1 & 50 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 110 \\ 4 \end{bmatrix}$$

$$\begin{bmatrix} (1 \times 1) + (0 \times 0) & (1 \times 50) + (0 \times 1) \\ (\frac{1}{65} \times 1) + (1 \times 0) & (\frac{1}{65} \times 50) + (1 \times 1) \end{bmatrix}$$

$$\begin{bmatrix} 1 + 0 = 1 & 50 + 0 = 50 \\ \frac{1}{65} + 0 = \frac{1}{65} & \frac{50}{65} + 1 = \frac{23}{13} \end{bmatrix}$$

$$\begin{bmatrix} 1 & 50 \\ \frac{1}{65} & \frac{23}{13} \end{bmatrix} \begin{bmatrix} 110 \\ 4 \end{bmatrix}$$

$(1 \times 110) + (50 \times 4)$
 $(\frac{1}{65} \times 110) + (\frac{23}{13} \times 4)$

cont....

$$\begin{bmatrix} 1 & 50 \\ \frac{1}{65} & \frac{23}{13} \end{bmatrix} \cdot \begin{bmatrix} 100 \\ 4 \end{bmatrix}$$

$$\begin{aligned} & (1 \times 100) + (50 \times 4) \\ & \left(\frac{1}{65} \times 100\right) + \left(\frac{23}{13} \times 4\right) \end{aligned}$$

$$= \frac{100}{65} + \frac{200}{13} = \begin{bmatrix} 300 \\ 8.62 \end{bmatrix} \quad E_1 = 300V, \quad I_1 = 8.62V$$

$$\begin{bmatrix} 1 & 50 \\ \frac{1}{65} & \frac{23}{13} \end{bmatrix} \cdot \begin{bmatrix} 110 \\ 4 \end{bmatrix}$$

$$\begin{aligned} & (1 \times 110) + (50 \times 4) \\ & \left(\frac{1}{65} \times 110\right) + \left(\frac{23}{13} \times 4\right) \end{aligned}$$

$$= 110 + 200 = \begin{bmatrix} 310 \\ 8.77 \end{bmatrix} \quad E_1 = 310V, \quad I_1 = 8.77A$$

6. (i) $\begin{pmatrix} 1 \\ -1 \end{pmatrix} \begin{pmatrix} 3 \\ 7 \end{pmatrix}$

$$y = mx + c$$

$$x = 3 - 1 = 2$$

$$y = 7 - (-1) = 8$$

$$m = 4$$

$$y = (4x) + c$$

$$y = 4 + c$$

$$-1 = 4 + c$$

$$-1 - 4 = c$$

$$c = -5$$

$$y = x - 5$$

$$y = mx + c$$

$$y = (4 \times 3) + c$$

$$y = 12 + c$$

$$7 = 12 + c$$

$$7 - 12 = c$$

$$c = -5$$

$$y = x - 5$$

(ii) $\begin{pmatrix} 2 \\ 11 \end{pmatrix}$ in parallel.

$$y = mx + c$$

$$y = (4 \times 2) + c$$

$$11 = 8 + c$$

$$11 - 8 = c$$

$$c = 3$$

$$y = 4x + 3$$

7) $20I_1 + 12I_2 = 6V$ (i) $\times 18$

$12I_1 + 18I_2 = 8V$ (ii) $\times 12$

$$360I_1 + 216I_2 = 108$$
 (iii)

$$144I_1 + 216I_2 = 96$$
 (iv)

$$= \frac{216I_1}{216} = \frac{12}{216}$$

$$I_1 = 0.0555$$

$$I_1 = 0.06A$$

$$20I_1 + 12I_2 = 6V$$

$$(20 \times 0.06) + 12I_2 = 6V$$

$$1.2 + 12I_2 = 6V$$

$$12I_2 = 6 - 1.2$$

$$\frac{12I_2}{12} = \frac{4.8}{12}$$

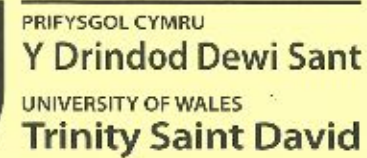
$$I_2 = 0.4A$$

Ashed to solve
By Cramer's Rule
not Substitution

$$I_1 \text{ through } 8\Omega \text{ resistor} = 0.06 \text{ A}$$

$$I_2 \text{ through } 6\Omega \text{ resistor} = 0.4 \text{ A}$$

$$I_1 + I_2 \text{ through } 10\Omega \text{ resistor} = 0.46 \text{ A}$$



8 Pages

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right and seal 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.**

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

Please complete this section and SEAL before the examination starts.

Surname

Younger

WILLIAM

ALEXANDER.

Complete section, remove strip, fold as indicated and SEAL.

PATENT PENDING
© INFOSAFE®

$$1. \quad (E - Ir) = IR$$

$$n = \frac{IR}{E - Ir}$$

$$n \times (-r) = \frac{IR}{E - I} \quad \times$$

$$-I(n \times (-r)) = \frac{IR}{E} \quad \times$$

✓
0/8

$$2 \quad z_1 = 2 + j5 \text{ AND } z_2 = 3 - j2$$



0/18
✓

$$3 \text{ i) } 5(3x + 4) - 4(2x - 6) = 65$$

$$15x + 20 - 8x + 24 = 65$$

$$7x + 44 = 65 - 44$$

$$7x = 21$$

$$x = 3 \quad \checkmark$$

6/✓

$$\text{iii } 10^{(3x-4)} = 18422$$

$$3x \log 4 = 1822 \quad \times$$

$$3x \frac{0.602}{0.602} = \frac{1822}{0.602}$$

$$\frac{3x}{3} = \frac{3026}{3}$$

$$x = 1008.76 \quad \times$$

$$4 \text{ i) } 2A \begin{pmatrix} 5 & 1 \\ 3 & 2 \end{pmatrix} = \begin{pmatrix} 10 & 2 \\ 6 & 4 \end{pmatrix} \quad \checkmark$$

$$\text{ii) } 3A \cdot \begin{pmatrix} 5 & 1 \\ 3 & 2 \end{pmatrix} = \begin{pmatrix} 15 & 3 \\ 9 & 6 \end{pmatrix}$$

$$2B \begin{pmatrix} 2 & -3 \\ 2 & 4 \end{pmatrix} = \begin{pmatrix} 4 & -6 \\ 4 & 8 \end{pmatrix}$$

$$\begin{pmatrix} 15 & 3 \\ 9 & 6 \end{pmatrix} - \begin{pmatrix} 4 & -6 \\ 4 & 8 \end{pmatrix} = \begin{pmatrix} 11 & 9 \\ 5 & -2 \end{pmatrix} \quad \checkmark$$

$$\text{iii) } \begin{pmatrix} 11 & 12 \\ 21 & 22 \end{pmatrix}$$

$$\begin{pmatrix} 5 & 1 \\ 3 & 2 \end{pmatrix} \times \begin{pmatrix} 2 & 3 & 3 \\ 4 & 3 & 1 \end{pmatrix} = \begin{pmatrix} 40 & 9 \\ 24 & 16 \end{pmatrix} \quad \times$$

$$11 \quad 5 \times 2 + 5 \times 3 + 5 \times 3 = 10 + 15 + 15 = 40$$

$$12 \quad 1 \times 4 + 1 \times 3 + 1 \times 1 = 5 + 3 + 1 = 9$$

$$21 \quad 3 \times 2 + 3 \times 3 + 3 \times 3 = 6 + 9 + 9 = 24$$

$$22 \quad 2 \times 4 + 2 \times 3 + 2 \times 1 = 8 + 6 + 2 = 16$$

$$\text{iv) } \begin{pmatrix} 2 & -3 \\ 2 & 4 \end{pmatrix} \times \begin{pmatrix} 5 & 1 \\ 3 & 2 \end{pmatrix} = \begin{pmatrix} 12 & -15 \\ 12 & 20 \end{pmatrix} \begin{pmatrix} 11 & 12 \\ 21 & 22 \end{pmatrix}$$

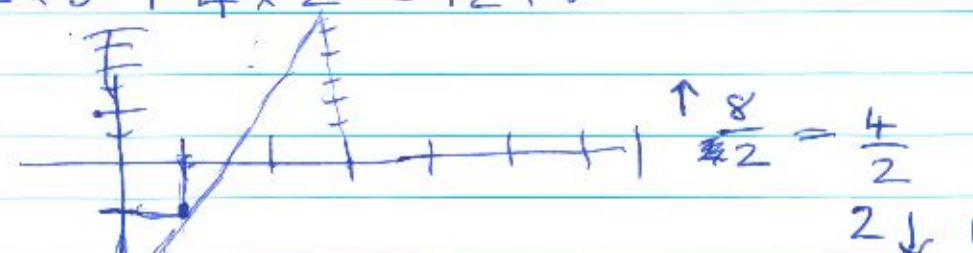
$$11 \quad 2 \times 5 + 2 \times 1 = 10 + 2 = 12 \quad \times$$

$$12 \quad -3 \times 3 + -3 \times 2 = -9 + -6 = -15$$

$$21 \quad 2 \times 5 + 2 \times 1 = 10 + 2 = 12$$

$$22 \quad 4 \times 3 + 4 \times 2 = 12 + 8 = 20$$

6 i)



$$y = mx + c$$

$$y = 2x - 2$$

$$y = 2x - 4$$

ii)

iii)

$$y - 1 = 2x$$

$$y = 2x + 1$$

$$5 \text{ i) } \begin{pmatrix} 1 & 0 \\ 6 & 5 \end{pmatrix} \begin{pmatrix} 1 & 50 \\ 0 & 1 \end{pmatrix} \quad \checkmark \quad \begin{pmatrix} 11 & 12 \\ 21 & 22 \end{pmatrix}$$

$$\begin{pmatrix} 51 & 0 \end{pmatrix} \quad \times$$

$$11 - 1 \times 1 + 1 \times 50 = 51$$

$$12 - 0 \times$$

$$n = \frac{IR}{E - IR}$$

$$\frac{nr}{R} = \frac{I}{E - I}$$

$$E - I \left(\frac{nr}{R} \right) = I$$

$$E \left(\frac{nr}{R} \right) = \frac{2I}{2}$$

$$\frac{1}{2} \left(\frac{nr}{R} \right) = I$$



8 Pages

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right and seal 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	CLASS TEST 1
3	Module Code	PSDE4003
4	Date and Time of Examination	
5	Examination Venue	
6	Seat Number	
7	Number of Answer Books handed in	

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

Please complete this section and SEAL before the examination starts.

Surname GOUGH (Block Capitals) Forename(s) JORDAN

Complete section, remove strip, fold as indicated and SEAL

PATENT PENDING

1.

$$n = \frac{IR}{E - Ir} \quad (I)$$

$$n(E - Ir) = IR$$

$$nE - nIr = IR$$

$$nE = nIr + IR$$

$$nE = I(nr + R)$$

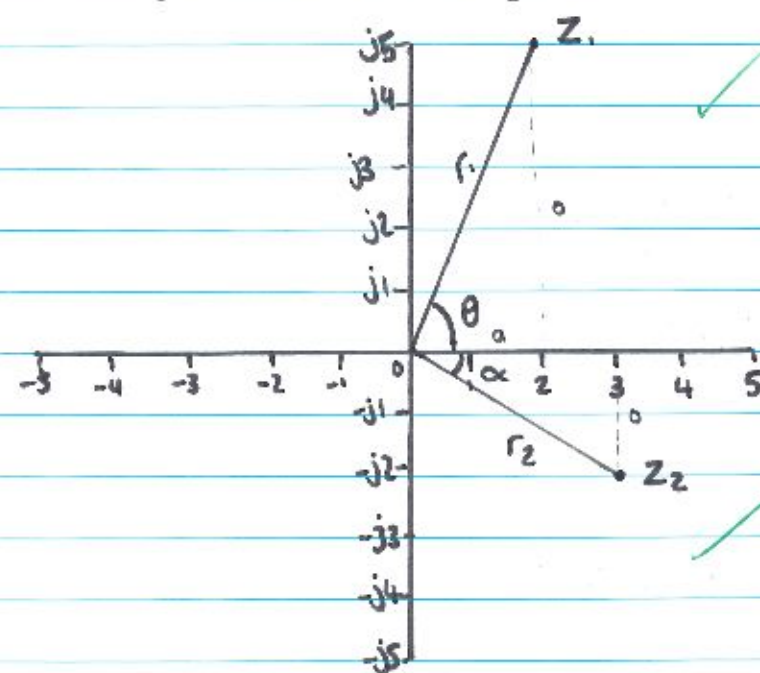
$$I = \frac{nE}{(nr + R)}$$

2.

$$Z_1 = 2 + j5$$

$$Z_2 = 3 - j2$$

(a)



$$r_1 = \sqrt{2^2 + 5^2}$$

$$r_1 = \sqrt{29}$$

$$r_1 = 5.39$$

$$\theta = \tan^{-1}\left(\frac{5}{2}\right)$$

$$\theta = \tan^{-1}\left(\frac{5}{2}\right) = 68.20^\circ$$

$$Z_1 = 5.39 \angle 68.20^\circ$$

2. ~~ZZZ~~

max

$$r_2 = \sqrt{3^2 + 2^2}$$

$$r_2 = \sqrt{13}$$

$$r_2 = 3.61$$

$$\tan \alpha = \left(\frac{-2}{3} \right) \quad \alpha = \tan^{-1} \left(\frac{-2}{3} \right) = -33.69^\circ$$

$$\begin{aligned} \text{(i)} \quad Z_1 Z_2 &= r_1 r_2 (\theta + \alpha) \\ &= (5.39 \times 3.61) (68.20 + (-33.69)) \\ &= 19.46 \angle 34.51^\circ \end{aligned}$$

$$\begin{aligned} \text{(ii)} \quad \frac{Z_1}{Z_2} &= \frac{r_1}{r_2} (\theta - \alpha) \\ &= \frac{5.39}{3.61} (68.20 + 33.69) \\ &= 1.49 \angle 101.89^\circ \end{aligned}$$

100

100

~~100~~

~~100~~

~~100~~

~~100~~

~~100~~

100

~~100~~

b) $Z_1 Z_2$

$$x = 19.46 \cos(34.51)$$

$$= 16.04$$

$$y = 19.46 \sin(34.51)$$

$$= 11.02$$

$$\therefore Z_1 Z_2 = 16 + j11$$

$\frac{Z_1}{Z_2}$

$$x = 1.49 \cos(101.89)$$

$$= -0.307$$

$$y = 1.49 \sin(101.89)$$

$$= 1.458$$

$$\therefore \frac{Z_1}{Z_2} = -0.307 + j1.458$$

3.

$$\text{(i)} \quad 5(3x + 4) - 4(2x - 6) = 65$$

$$15x + 20 - 8x + 24 = 65$$

$$7x = 21$$

$$x = \frac{21}{7} = 3$$

$$\text{(ii)} \quad 10^{(3x-4)} = 1822$$

$$3x - 4 = \log 1822$$

$$3x = \log 1822 + 4$$

$$x = \frac{\log 1822 + 4}{3} = 2.4201$$

4. $A = \begin{pmatrix} 5 & 1 \\ 3 & 2 \end{pmatrix}$, $B = \begin{pmatrix} 2 & -3 \\ 2 & 4 \end{pmatrix}$, $C = \begin{pmatrix} 2 & 3 & 3 \\ 4 & 3 & 1 \end{pmatrix}$

(i) $2A = 2 \begin{pmatrix} 5 & 1 \\ 3 & 2 \end{pmatrix} = \begin{pmatrix} 10 & 2 \\ 6 & 4 \end{pmatrix}$ ✓

(ii) $3A - 2B = 3 \begin{pmatrix} 5 & 1 \\ 3 & 2 \end{pmatrix} - 2 \begin{pmatrix} 2 & -3 \\ 2 & 4 \end{pmatrix}$
 $= \begin{pmatrix} 15 & 3 \\ 9 & 6 \end{pmatrix} - \begin{pmatrix} 4 & -6 \\ 4 & 8 \end{pmatrix}$
 $3A - 2B = \begin{pmatrix} 11 & 9 \\ 5 & -2 \end{pmatrix}$ ✓

(iii) $AC = \begin{pmatrix} 5 & 1 \\ 3 & 2 \end{pmatrix} \begin{pmatrix} 2 & 3 & 3 \\ 4 & 3 & 1 \end{pmatrix}$

$AC = \begin{pmatrix} C_{11} & C_{12} & C_{13} \\ C_{21} & C_{22} & C_{23} \end{pmatrix}$

$C_{11} = (5 \times 2) + (1 \times 4) = 14$

$C_{12} = (5 \times 3) + (1 \times 3) = 18$

$C_{13} = (5 \times 3) + (1 \times 1) = 16$

$C_{21} = (3 \times 2) + (2 \times 4) = 14$

$C_{22} = (3 \times 3) + (2 \times 3) = 15$

$C_{23} = (3 \times 3) + (2 \times 1) = 12$

$\therefore AC = \begin{pmatrix} 14 & 18 & 16 \\ 14 & 15 & 12 \end{pmatrix}$ ✓

(iv) $BA = \begin{pmatrix} 2 & -3 \\ 2 & 4 \end{pmatrix} \begin{pmatrix} 5 & 1 \\ 3 & 2 \end{pmatrix}$

$BA = \begin{pmatrix} C_{11} & C_{12} \\ C_{21} & C_{22} \end{pmatrix}$

$C_{11} = (2 \times 5) + (-3 \times 3) = 1$

$C_{12} = (2 \times 1) + (-3 \times 2) = -4$

$C_{21} = (2 \times 5) + (4 \times 3) = 22$

$C_{22} = (2 \times 1) + (4 \times 2) = 10$

$\therefore BA = \begin{pmatrix} 1 & -4 \\ 22 & 10 \end{pmatrix}$ ✓

(v) $AB = \begin{pmatrix} 5 & 1 \\ 3 & 2 \end{pmatrix} \begin{pmatrix} 2 & -3 \\ 2 & 4 \end{pmatrix}$

$AB = \begin{pmatrix} C_{11} & C_{12} \\ C_{21} & C_{22} \end{pmatrix}$

$C_{11} = (5 \times 2) + (1 \times 2) = 12$

$C_{12} = (5 \times -3) + (1 \times 4) = -11$

$C_{21} = (3 \times 2) + (2 \times 2) = 10$

$C_{22} = (3 \times -3) + (2 \times 4) = -1$ ✓

$\therefore AB = \begin{pmatrix} 12 & -11 \\ 10 & -1 \end{pmatrix}$ ✓

$\begin{pmatrix} 1 & -4 \\ 22 & 10 \end{pmatrix} \neq \begin{pmatrix} 12 & -11 \\ 10 & -1 \end{pmatrix}$

3
 $\begin{pmatrix} 16 \\ 18 \end{pmatrix}$

$$5. \begin{pmatrix} E_1 \\ I_1 \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 1/2 & 1 \end{pmatrix} \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 110 \\ 4 \end{pmatrix}$$

$$\begin{pmatrix} E_1 \\ I_1 \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 1/65 & 1 \end{pmatrix} \begin{pmatrix} 1 & 50 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 110 \\ 4 \end{pmatrix}$$

$$\begin{pmatrix} E_1 \\ I_1 \end{pmatrix} = \begin{pmatrix} C_{11} & C_{12} \\ C_{21} & C_{22} \end{pmatrix} \begin{pmatrix} 110 \\ 4 \end{pmatrix}$$

$$C_{11} = (1 \times 1) + (0 \times 0) = 1$$

$$C_{12} = (1 \times 50) + (0 \times 1) = 50$$

$$C_{21} = (1/65 \times 1) + (1 \times 0) = 1/65$$

$$C_{22} = (1/65 \times 50) + (1 \times 1) = 23/13$$

$$\begin{pmatrix} E_1 \\ I_1 \end{pmatrix} = \begin{pmatrix} 1 & 50 \\ 1/65 & 23/13 \end{pmatrix} \begin{pmatrix} 110 \\ 4 \end{pmatrix}$$

$$E_1 = (1 \times 110) + (50 \times 4) = 310V$$

$$I_1 = (1/65 \times 110) + (23/13 \times 4) = 8.77A$$

~~Incorrect~~

~~Incorrect~~

~~Incorrect~~

$$|A| = 1 - [(ad - bc)]$$

$$= 1 - [(1 \times 23/13) - (50 \times 1/65)]$$

$$= 1 - 1$$

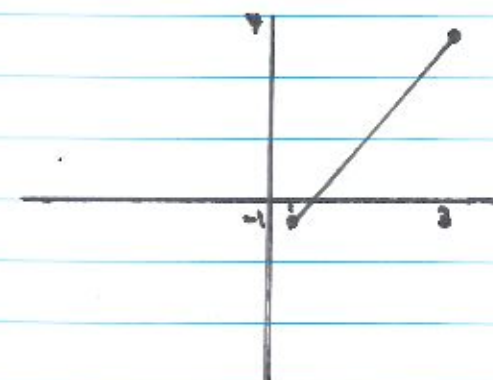
$$= 0$$

X.

$$\frac{14}{16}$$

$$6. (i) (1, -1) (3, 7)$$

$$\begin{aligned} \text{gradient} &= \frac{dy}{dx} \\ &= \frac{(7 - -1)}{2} \\ &= 4 \end{aligned}$$



$$y = mx + c$$

$$7 = (4 \times 3) + c$$

$$7 = 12 + c$$

$$c = -5$$

$$y = mx + c$$

$$-1 = (4 \times 1) + c$$

$$-1 = 4 + c$$

$$c = -5$$

$$y = 4x - 5 \quad \checkmark \quad \leftarrow \text{Equation of the line.}$$

$$(ii) \text{ Parallel} = \text{same gradient}$$

$$y = 4x + c$$

$$11 = 4(2) + c$$

$$11 = 8 + c$$

$$c = 3$$

$$\therefore \text{Equation of parallel line} = y = 4x + 3 \quad \checkmark$$

$$(iii) y = 4x - 5 \quad ①$$

$$y - 1 = 2x \quad ②$$

$$y - 4x + 5 = 0 \quad ①$$

$$y - 2x - 1 = 0 \quad ②$$

$$① - ②$$

$$-2x + 6 = 0$$

$$-2x = -6$$

$$x = 3 \quad \checkmark$$

$$y = 4x - 5$$

$$y = 4(3) - 5$$

$$y = 12 - 5$$

$$y = 7$$

∴ Point of intersection = (3, 7)

$$7. \quad 6 = 20I_1 + 12I_2$$

$$8 = 12I_1 + 18I_2$$

$$I_1 = \frac{\begin{vmatrix} k_1 & b_1 \\ k_2 & b_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}}} = \frac{\begin{vmatrix} 6 & 12 \\ 8 & 18 \end{vmatrix}}{\begin{vmatrix} 20 & 12 \\ 12 & 18 \end{vmatrix}}}$$

$$ad - bc = (6 \times 18) - (12 \times 8) = 12$$

$$= (20 \times 18) - (12 \times 12) = 216$$

$$I_1 = 0.056A$$

$$I_2 = \frac{\begin{vmatrix} a_1 & k_1 \\ a_2 & k_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}}} = \frac{\begin{vmatrix} 20 & 6 \\ 12 & 8 \end{vmatrix}}{\begin{vmatrix} 20 & 12 \\ 12 & 18 \end{vmatrix}}}$$

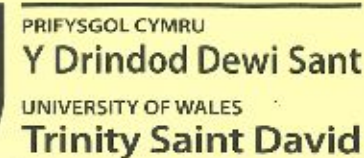
$$ad - bc = (20 \times 8) - (6 \times 12) = 88$$

$$I_2 = \frac{88}{216} = 0.41A$$

$$I_1 = 0.056A$$

$$I_2 = 0.41A$$

However current flow for I_2 is in the opposite direction to I_1 , so $I_2 = -0.41A$.



8 Pages

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right and seal 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	CLASS TEST 1
3	Module Code	PSDE4003
4	Date and Time of Examination	
5	Examination Venue	
6	Seat Number	
7	Number of Answer Books handed in	

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

Please complete this section and SEAL before the examination starts.

Surname THORNHILL

Complete section, remove strip, fold as indicated and SEAL.

PATENT PENDING

$$1. \quad n = \frac{IR}{E - Ir} \quad n(E - Ir) = IR \quad \checkmark 2$$

$$\cancel{n(E - Ir) = IR}$$

$$\frac{n(E - r - 1)}{R} = I \quad \times$$

$$\frac{2}{8}$$

$$2.a) \quad r = \sqrt{2^2 + 5^2} = 5.385$$

$$\theta = \tan^{-1}\left(\frac{5}{2}\right) = 68.199^\circ$$

$$\therefore Z_1 = 5.385 \angle 68.199^\circ \quad \checkmark$$

$$3$$

$$r = \sqrt{3^2 + 2^2} = 3.606$$

$$\theta = \tan^{-1}\left(\frac{2}{3}\right) = 33.69^\circ \quad \checkmark$$

$$2$$

$$\therefore Z_2 = 3.606 \angle 33.69^\circ \quad \times$$

$$i) \quad Z_1 Z_2 = 3.606 \times 5.385 \angle (33.69 + 68.199)$$

$$= 19.418 \angle 101.889^\circ$$

$$2$$

$$ii) \quad \frac{Z_1}{Z_2} = \frac{3.606}{5.385} \quad \checkmark$$

$$\frac{5.385}{3.606} \angle (68.199 - 33.69)$$

$$= 1.493 \angle 34.509^\circ$$

$$2$$

$$b) 19.418 \cos(101.889) = -4$$

$$19.418 \sin(101.889) = 19$$

$$\therefore 19.418 \angle 101.889^\circ = -4 + j19$$

$$1.493 \cos(34.509) = 1.23$$

$$1.493 \sin(34.509) = 0.846$$

$$\therefore 1.493 \angle 34.509^\circ = 1.23 + j0.846$$

$$3i) 15x + 20 - 8x + 24 = 65$$

$$7x + 44 = 65$$

$$7x = 21$$

$$x = 3$$

$$ii) 3x - 4 = \log 1822$$

$$3x = 3.261 + 4$$

$$x = 2.42$$

$$4) i) \begin{pmatrix} 10 & 2 \\ 6 & 4 \end{pmatrix}$$

$$ii) \begin{pmatrix} 15 & 3 \\ 9 & 6 \end{pmatrix} - \begin{pmatrix} 4 & -6 \\ 4 & 8 \end{pmatrix} = \begin{pmatrix} 11 & 9 \\ 5 & -2 \end{pmatrix}$$

$$iii) \begin{aligned} (5 \times 2) + (1 \times 4) &= 14 \\ (5 \times 3) + (1 \times 3) &= 18 \\ (5 \times 3) + (1 \times 1) &= 16 \\ (3 \times 2) + (2 \times 4) &= 14 \\ (3 \times 3) + (2 \times 3) &= 15 \\ (3 \times 3) + (2 \times 1) &= 11 \end{aligned}$$

$$\therefore AC = \begin{pmatrix} 14 & 18 & 16 \\ 14 & 15 & 11 \end{pmatrix}$$

$$iv) \begin{pmatrix} 2 \times 5 \\ 2 \times 1 \end{pmatrix} + \begin{pmatrix} -3 \times 3 \\ -3 \times 2 \end{pmatrix} = \begin{pmatrix} 1 \\ -4 \end{pmatrix}$$

$$(2 \times 1) + (-3 \times 2) = -4$$

$$(2 \times 5) + (4 \times 3) = 22$$

$$(2 \times 1) + (4 \times 2) = 10$$

$$\therefore BA = \begin{pmatrix} 1 & -4 \\ 22 & 10 \end{pmatrix}$$

$$v) \begin{pmatrix} 5 \times 2 \\ 5 \times -3 \end{pmatrix} + \begin{pmatrix} 1 \times 2 \\ 1 \times 4 \end{pmatrix} = \begin{pmatrix} 12 \\ -11 \end{pmatrix}$$

$$(5 \times -3) + (1 \times 4) = -11$$

$$(3 \times 2) + (2 \times 2) = 10$$

$$(3 \times -3) + (2 \times 4) = -1$$

$$AB = \begin{pmatrix} 12 & -11 \\ 10 & -1 \end{pmatrix} \therefore AB \neq BA$$

$$5) \begin{bmatrix} E \\ I \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1/65 & 1 \end{bmatrix} \begin{bmatrix} 1 & 50 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 110 \\ 4 \end{bmatrix}$$

$$(1 \times 1) + (0 \times 0) = 1$$

$$(1 \times 50) + (0 \times 1) = 50$$

$$(1/65 \times 1) + (1 \times 0) = 1/65$$

$$(1/65 \times 50) + (1 \times 1) = 23/13$$

$$\begin{bmatrix} 1 & 50 \\ 1/65 & 23/13 \end{bmatrix}$$

check determinant

$$(1 \times 23/13) - (50 \times 1/65) = 1$$

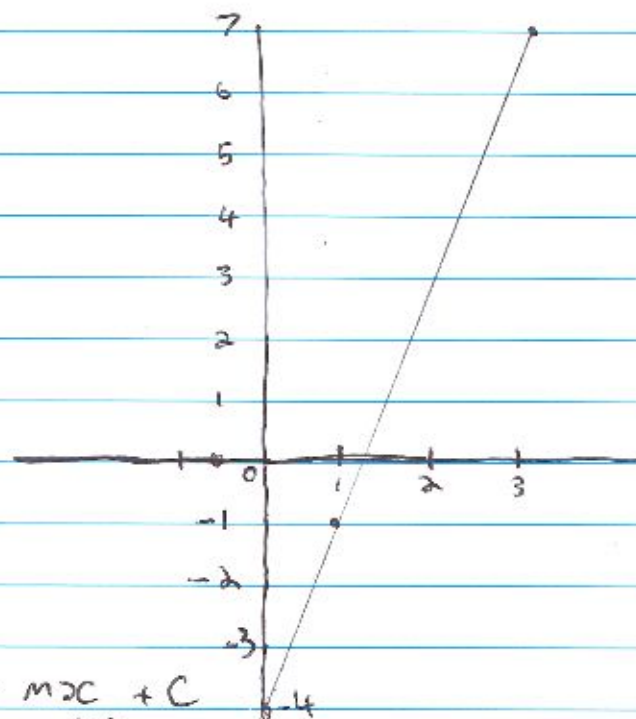
$$\frac{1}{1} \begin{bmatrix} 23/13 & -50 \\ -1/65 & 1 \end{bmatrix} = \begin{bmatrix} 23/13 & -50 \\ -1/65 & 1 \end{bmatrix}$$

$$\begin{bmatrix} E_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} \frac{23}{13} & -50 \\ -\frac{1}{65} & 1 \end{bmatrix} \begin{bmatrix} 110 \\ 4 \end{bmatrix}$$

$$\left(\frac{23}{13} \times 110\right) + (-50 \times 4) = -5.385 \text{ V} = E_1$$

$$\left(-\frac{1}{65} \times 110\right) + (1 \times 4) = 2.308 \text{ A} = I_1$$

6) i)



$$y = mx + c$$

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

$$-1 = m(1) - 4$$

$$3 = m(1)$$

$$3 \times 1 = m$$

$$m = 3$$

$$\therefore y = 3x - 4$$

ii) $y = 11$ $m = 3$ $x = 2$

$$11 = 3(2) + c$$

$$11 - (3 \times 2) = c$$

$$c = 5 \therefore y = 3x + 5$$

iii) $y - 1 = 2x$

Make $x = 1$

$$y - 1 = 2(1)$$

$$y = 2 + 1 = 3$$

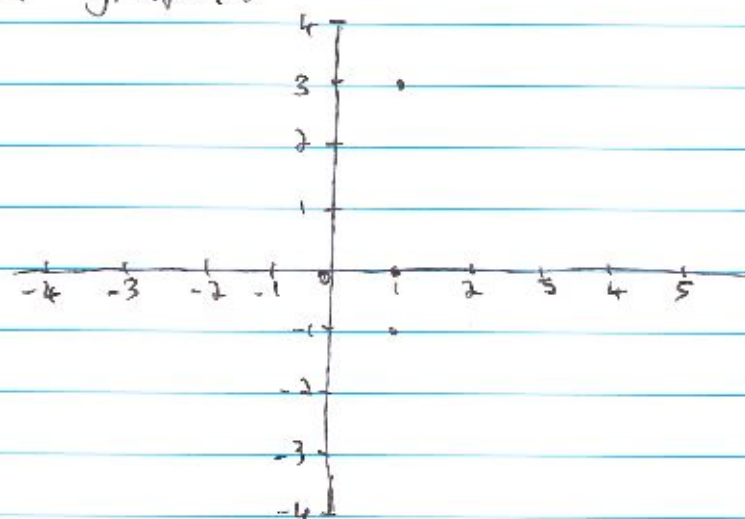
make $x = 1$ for line from part(i)

$$y = 3(1) + -4$$

$$y = 3 - 4$$

$$y = -1$$

plot graph:



0.

$\frac{4}{16}$

0.

4

$$7) \begin{aligned} 20I_1 + 12I_2 &= 6 \\ 12I_1 + 18I_2 &= 8 \end{aligned}$$

$$I_1 = \frac{\begin{vmatrix} k_1 & b_1 \\ k_2 & b_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}} = \frac{\begin{vmatrix} 6 & 12 \\ 8 & 18 \end{vmatrix}}{\begin{vmatrix} 20 & 12 \\ 12 & 18 \end{vmatrix}} = \frac{(6 \times 18) - (12 \times 8)}{(20 \times 18) - (12 \times 12)}$$

$$= 0.05 \text{ A}$$

$$I_2 = \frac{\begin{vmatrix} a_1 & k_1 \\ a_2 & k_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}} = \frac{\begin{vmatrix} 20 & 6 \\ 12 & 8 \end{vmatrix}}{\begin{vmatrix} 20 & 12 \\ 12 & 18 \end{vmatrix}} = \frac{(20 \times 8) - (6 \times 12)}{(20 \times 18) - (12 \times 12)}$$

$$= 0.407 \text{ A}$$

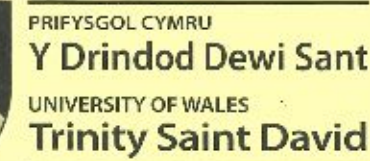
$$\frac{12}{12}$$

~~IRM~~

$$(80) I_{r1} = 0.05 \text{ A}$$

$$(60) I_{r2} = 0.407 \text{ A}$$

$$(20) I_{r3} = 0.457 \text{ A}$$



8 Pages

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right and seal 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	CLASS TEST 1
3	Module Code	PSDE4003
4	Date and Time of Examination	
5	Examination Venue	
6	Seat Number	
7	Number of Answer Books handed in	

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

Please complete this section and SEAL before the examination starts.

Surname JONES (Block Capitals) Forename(s) THOMAS WYN

Complete
section,
remove
strip, fold as
indicated
and SEAL

PATENT PENDING
 INFOSAFE®

$$3(i) \quad 5(3x+4) - 4(2x-6) = 65$$

$$15x + 20 - 8x + 24 = 65 \quad \checkmark$$

$$7x + 48 = 65$$

$$7x = 65 - 48$$

$$7x = 17$$

$$x = \frac{17}{7}$$

$$x = 2.43 \quad \times$$

2 ✓

2 ✓

$$ii) \quad 10^{(3x-4)} = 1822$$

$$\log 10^{(3x-4)} = 1822 \quad \times$$

$$3x - 4 = 1822 + 4 \quad \times$$

0. $\frac{4}{12}$

$$4(i) \quad 2A = 2 \begin{bmatrix} 5 & 1 \\ 3 & 2 \end{bmatrix} = \begin{bmatrix} 10 & 2 \\ 6 & 4 \end{bmatrix} \quad \checkmark$$

2 ✓

$$ii) \quad 3A - 2B$$

$$3A = 3 \begin{bmatrix} 5 & 1 \\ 3 & 2 \end{bmatrix} = \begin{bmatrix} 15 & 3 \\ 9 & 6 \end{bmatrix}$$

$$2B = 2 \begin{bmatrix} 2 & -3 \\ 2 & 4 \end{bmatrix} = \begin{bmatrix} 4 & -6 \\ 4 & 8 \end{bmatrix}$$

$$3A - 2B = \begin{bmatrix} 15 & 3 \\ 9 & 6 \end{bmatrix} - \begin{bmatrix} 4 & -6 \\ 4 & 8 \end{bmatrix} = \begin{bmatrix} 11 & 9 \\ 5 & -2 \end{bmatrix} \quad \checkmark$$

4 ✓

$$iii) AC = \begin{bmatrix} 5 & 1 \\ 3 & 2 \end{bmatrix} \begin{bmatrix} 2 & 3 & 3 \\ 4 & 3 & 1 \end{bmatrix} = \begin{bmatrix} (5 \times 2) + (1 \times 4) & (5 \times 3) + (1 \times 3) \\ (3 \times 2) + (2 \times 4) & (3 \times 3) + (2 \times 3) \end{bmatrix}$$

$$AC = \begin{bmatrix} 14 & 18 \\ 14 & 15 \end{bmatrix}$$

$$iv) BA = \begin{bmatrix} 2 & -3 \\ 2 & 4 \end{bmatrix} \begin{bmatrix} 5 & 1 \\ 3 & 2 \end{bmatrix} = \begin{bmatrix} (2 \times 5) + (-3 \times 3) & (2 \times 1) + (-3 \times 2) \\ (2 \times 5) + (4 \times 3) & (2 \times 1) + (4 \times 2) \end{bmatrix}$$

$$BA = \begin{bmatrix} 1 & -4 \\ 22 & 10 \end{bmatrix}$$

$$v) BA = \begin{bmatrix} 1 & -4 \\ 22 & 10 \end{bmatrix} \quad AB = \begin{bmatrix} 5 & 1 \\ 3 & 2 \end{bmatrix} \begin{bmatrix} 2 & -3 \\ 2 & 4 \end{bmatrix} = \begin{bmatrix} (5 \times 2) + (1 \times 2) & (5 \times -3) + (1 \times 4) \\ (3 \times 2) + (2 \times 2) & (3 \times -3) + (2 \times 4) \end{bmatrix}$$

$$AB = \begin{bmatrix} 12 & -11 \\ 10 & -1 \end{bmatrix}$$

$$AB = \begin{bmatrix} 12 & -11 \\ 10 & -1 \end{bmatrix}$$

AB is not equal to BA.

1) Transpose to make I the subject

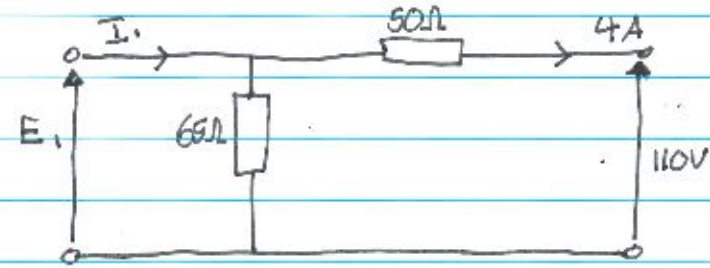
$$n = \frac{IR}{E - Ir}$$

$$n + Ir = \frac{IR}{E}$$

$$N + IrE = IR \quad N + IrE = IR$$

$$N + IR$$

5.



Shunt-Series circuit

$$\begin{bmatrix} E \\ I \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ \frac{1}{60} & 1 \end{bmatrix} \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 110 \\ 4 \end{bmatrix}$$

$$\begin{bmatrix} E \\ I \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ \frac{1}{60} & 1 \end{bmatrix} \begin{bmatrix} 1 & 60 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 50 \\ \frac{1}{60} \end{bmatrix}$$

2

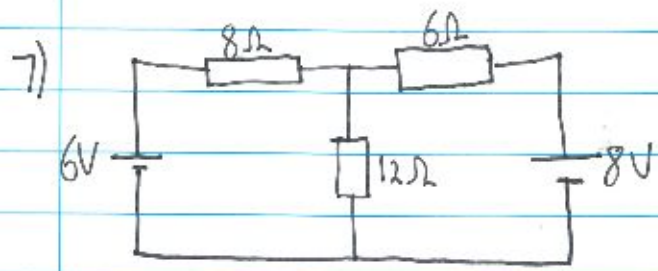
$\frac{2}{16}$

4

$\frac{16}{18}$

0

$\frac{0}{8}$



$$6 = 20I_1 + 12I_2$$

$$8 = 12I_1 + 18I_2$$

rearranged to:

$$\begin{matrix} (a) & (b) & (c) \\ 20I_1 + 12I_2 = 6 \\ 12I_1 + 18I_2 = 8 \end{matrix}$$

Cramer's rule states:

$$x(I_1) = \frac{\begin{vmatrix} k_1 & b_1 \\ k_2 & b_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}} \quad y(I_2) = \frac{\begin{vmatrix} a_1 & k_1 \\ a_2 & k_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}}$$

Substituted into:

$$I_1 = \frac{\begin{vmatrix} 6 & 12 \\ 8 & 18 \end{vmatrix}}{\begin{vmatrix} 20 & 12 \\ 12 & 18 \end{vmatrix}} = \frac{108 - 96}{360 - 144} = \frac{12}{216} \quad I_1 = 0.0694 \text{ A}$$

$$I_2 = \frac{\begin{vmatrix} 20 & 6 \\ 12 & 8 \end{vmatrix}}{\begin{vmatrix} 20 & 12 \\ 12 & 18 \end{vmatrix}} = \frac{160 - 72}{360 - 144} = \frac{88}{216} \quad I_2 = 0.396 \text{ A}$$

6)

$$\begin{matrix} x_1 & y_1 \\ (1, -1) \end{matrix} \text{ and } \begin{matrix} x_2 & y_2 \\ (3, 7) \end{matrix}$$

$$\frac{y - y_1}{x - x_1} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$\frac{y - (-1)}{x - 1} = \frac{7 - (-1)}{3 - 1} \quad \frac{8}{2} \quad x = 8 \quad y = 2 \quad x = 8$$

2) Z_1, Z_2

$$Z_1 = 2 + j5 \quad Z_2 = 3 - j2$$

$$\begin{aligned} (2 + j5)(3 - j2) &= 6 - j6 + j15 - j^2 10 \\ &= 6 + j11 - j^2 10 \\ &= 6 + j11 + 10 \\ &= j11 + 16 \end{aligned}$$



$$\frac{Z_1}{Z_2} = \frac{2 + j5}{3 - j2} \times \frac{3 + j2}{3 + j2} = \frac{6 + j4 + j15 + j^2 10}{9 + j6 - j6 - j^2 4} = \frac{6 + j19 + j9}{9 + j5}$$

$$= \frac{6 + j18}{9 + j5}$$

$$= 0.6 \quad j3.6$$

$$\frac{0}{18}$$

$$6a) y = mx + c$$

$$6b) \frac{y - y_1}{x - x_1} = \frac{y_2 - y_1}{x_2 - x_1} \quad y$$

$$(x_1, y_1) \text{ and } (x_2, y_2)$$

