



Examination Answer Book

24 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 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	1705149
2	Title of Examination Paper	
3	Module Code	
4	Date and Time of Examination	15/02/2018 14:15
5	Examination Venue	MH411
6	Seat Number	

7	Number of Answer Books handed in	
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List the numbers of the questions you have attempted	Office Use
1	8/4/18 ✓
2	6/6 ✓
3	3/16 ✓
4	6 1/4/9 ✓
5	7/8 ✓
6	7/7 ✓
7	5/7 ✓
8	0/8 ✓
Total	43/ ✓

54/180/

Please complete this section and SEAL before the examination starts.

Surname Cross Forename(s) Callum (Block Capitals)

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

PULL & TEAR

FOR ADMINISTRATIVE USE ONLY, CAREFULLY REMOVE PERFORATED STRIP

~~AB~~ = $\begin{bmatrix} C1 \end{bmatrix}$

$$A = \begin{bmatrix} 1 & -3 & 2 \\ 4 & 0 & 2 \\ 5 & 1 & 1 \end{bmatrix} \quad B = \begin{bmatrix} 2 & 1 & -3 \\ 0 & -1 & -1 \\ 4 & 2 & 1 \end{bmatrix}$$

$$AB = \begin{bmatrix} (1 \times 2) + (-3 \times 0) + (2 \times 4) \\ (4 \times 1) + (0 \times -1) + (2 \times 2) \\ (5 \times 2) + (1 \times -1) + (1 \times 1) \end{bmatrix}$$

i) $AB = \begin{bmatrix} (2) + (-3) + (8) \\ (4) + (-1) + (4) \\ (-10) + (-1) + (1) \end{bmatrix} = \begin{bmatrix} 7 \\ 7 \\ -10 \end{bmatrix} - 15$ X 0/6

ii) $A - B = \begin{bmatrix} (1-2) + (-3-1) + (2-3) \\ (4-0) + (0--1) + (2--1) \\ (5-4) + (1-2) + (1-1) \end{bmatrix}$

$$= \begin{bmatrix} -1 & -4 & -1 \\ 4 & 1 & 3 \\ 1 & -1 & 0 \end{bmatrix}$$

$$= \begin{bmatrix} -1 & -4 & -1 \\ 4 & 1 & 3 \\ 1 & -1 & 0 \end{bmatrix} \cdot \begin{matrix} 3\frac{1}{2} \\ 4 \end{matrix}$$

$$A+B=$$

$$A = \begin{bmatrix} 1 & -3 & 2 \\ 4 & 0 & 2 \\ 5 & 1 & 1 \end{bmatrix}$$

$$B = \begin{bmatrix} 2 & 1 & -3 \\ 0 & -1 & -1 \\ 4 & 2 & 1 \end{bmatrix}$$

$$\text{iii) } A+B = \begin{bmatrix} (1+2) + (-3+1) + (2+(-3)) \\ (4+0) + (-1+(-1)) + (2+(-1)) \\ (5+4) + (1+2) + (1+1) \end{bmatrix}$$

$$= \begin{bmatrix} 3 + -2 + -1 \\ 4 + -1 + 1 \\ 9 + 3 + 2 \end{bmatrix} = \begin{bmatrix} 0 \\ 4 \\ 14 \end{bmatrix}$$

$$\text{iv) } B^T = \begin{bmatrix} 1 & 4 & 5 \\ -3 & 0 & 1 \\ 2 & 2 & 1 \end{bmatrix}$$

$$Q1 = 8 \frac{1}{2} / 18$$

$$\frac{8 \frac{1}{2}}{18}$$

2) ~~IF~~

$$\begin{bmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 2 \\ 0 & 0 & 1 & 3 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 2 \\ 4 \\ 6 \\ 1 \end{bmatrix} =$$

$$T.P = \begin{bmatrix} (1 \times 2) + (0 \times 4) + (0 \times 6) + (1 \times 1) \\ (0 \times 2) + (1 \times 4) + (0 \times 6) + (2 \times 1) \\ (0 \times 2) + (0 \times 4) + (1 \times 6) + (3 \times 1) \\ (0 \times 2) + (0 \times 4) + (0 \times 6) + (1 \times 1) \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 0 & 0 & 1 \\ 0 & 4 & 0 & 2 \\ 0 & 0 & 6 & 3 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 3 \\ 6 \\ 9 \\ 1 \end{bmatrix}$$

$Q2 = 6$

6

3a)

$$\begin{bmatrix} x \cos A - y \sin A & 0 & 0 & 0 \\ x \sin A + y \cos A & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

2 Axis
4 Dimensions

3as

$\frac{3}{6}$

$3b = \frac{0}{2}$

$3c = \frac{0}{8}$

$$Q3 = \frac{3}{16}$$

$\frac{3}{16}$

$$a = (2, 1, 3) \quad b = (3, 2, -3)$$

4a)

$$a \cdot b = (2 \cdot 3) + (1 \cdot 2) + (3 \cdot -3)$$

$$= 6 + 2 + -9$$

$$= -1$$

Cross Product

$$a \times b = (4, -3, -9)$$

$$a \times b = (1 \cdot -3) - (3 \cdot 2) = -3 - 6 = -9$$

$$(3 \cdot 3) - (2 \cdot -3) = 9 + 6 = 15$$

$$(2 \cdot 2) - (1 \cdot 3) = 4 - 3 = 1$$

$$= v = (-9, 15, 1)$$

4b)

$$a \cdot v = (2 \cdot -9) + (1 \cdot 15) + (3 \cdot 1)$$

$$= -18 + 15 + 3$$

$$= 0$$

$$|a| = \sqrt{2^2 + 1^2 + 3^2}$$

$$|a| = \sqrt{2^2 + 1^2 + 3^2}$$

$$= 6$$

$$|v| = \sqrt{-9^2 + 15^2 + 1^2}$$

$$=$$

$$a = (2, 1, 3)$$

4a)

$$b = (3, 2, -3)$$

$$a \times b = ((1 \times -3) - (3 \times 2)) = 9$$

$$((3 \times 3) - (2 \times -3)) = 15$$

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

$$a \times b = (9, 15, 1)$$

$$V = (-9, 15, 1)$$

4b)

$$a \cdot V = (2 \times 9) + (1 \times 15) + (3 \times 1)$$

$$= 18 + 15 + 3$$

$$= 36$$

$$|a| = \sqrt{2^2 + 1^2 + 3^2}$$

$$|a| = 3.74$$

$$|V| = \sqrt{18^2 + 15^2 + 3^2}$$

$$|V| = 23.62$$

$$\cos(\phi) = \frac{36}{3.74 \times 23.62} = \frac{36}{88.22}$$

$$= 0.40$$

$$88.22$$

$$\cos(0.40) = 0.99$$

its perpendicular
90°
4650
2466
9

5)

$$a = (3, 4, 0)$$

$$b = (8, 6, 0)$$

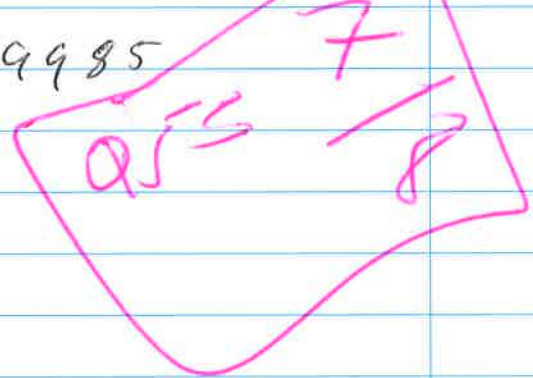
$$\begin{aligned} a \cdot b &= (3 \cdot 8) + (4 \cdot 6) + (0 \cdot 0) \\ &= 24 + 24 + 0 \\ &= 48 \end{aligned}$$

$$\begin{aligned} |a| &= \sqrt{3^2 + 4^2 + 0^2} \\ &= 5 \end{aligned}$$

$$\begin{aligned} |b| &= \sqrt{8^2 + 6^2 + 0^2} \\ &= 10 \end{aligned}$$

$$\cancel{60} \quad |a| \cdot |b| \cdot \cos \theta = \frac{48}{5 \cdot 10} = \frac{48}{50} = \frac{24}{25} = 0.96$$

$$\text{angle} = 0.9985$$



6)

$$a = (3, 2, 6)$$

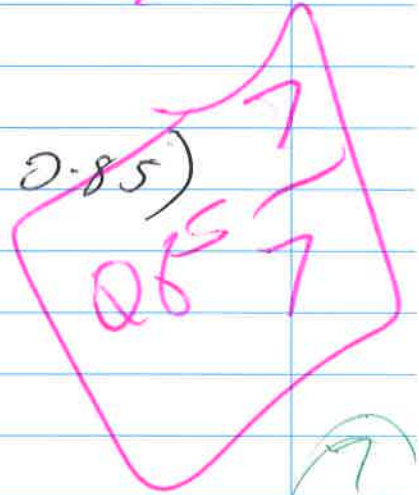
$$|a| = \sqrt{3^2 + 2^2 + 6^2}$$

$$|a| = 7$$

$$\hat{a} = (3/7, 2/7, 6/7)$$

$$= \frac{3}{7} = 0.42$$

$$\hat{a} = (0.42, 0.28, 0.85)$$



$$7) \quad A = \begin{bmatrix} 1 & 1 & 6 \\ 1 & 2 & 2 \\ 1 & 3 & -1 \end{bmatrix}$$

$$|A| = 1(2 \times -1) - (2 \times 3)$$

$$|A| = 1((2 \times -1) - (2 \times 3))$$

$$1((1 \times -1) - (2 \times 1))$$

$$6((1 \times 3) - (2 \times 1))$$

~~1(1)~~

$$1(-2 - 6) = 1(-8) = -8$$

$$1(-1 - 2) = 1(-3) = -3$$

$$6(3 - 2) = 6(1) = 6$$

$$|A| = [-8, -3, 6]$$

now add them

$$-8 = 5/7$$

$$\frac{5}{7}$$

8)

$$1x + \cancel{15} + 6z = 1$$

$$1x + \cancel{25} + 2z = \cancel{2}$$

$$1x + \cancel{35} + \cancel{12} = 4$$

~~Cancel out~~ x

$$\cancel{15} + 6z = 1$$

$$\cancel{25} + \cancel{2z} = 2$$

$$\cancel{35} + \cancel{12} = 4$$

~~15~~

$$1\overset{x2}{\cancel{5}} + 6\overset{x2}{z} = 1\overset{x2}{}$$

$$2\overset{x2}{\cancel{5}} + \cancel{12z} = 2$$

$$8) \quad 1x + 1y + 6z = 1$$

$$1x + 2y + 2z = 2$$

$$1x + 3y - 1z = 4$$

Cancel out x

~~1x~~

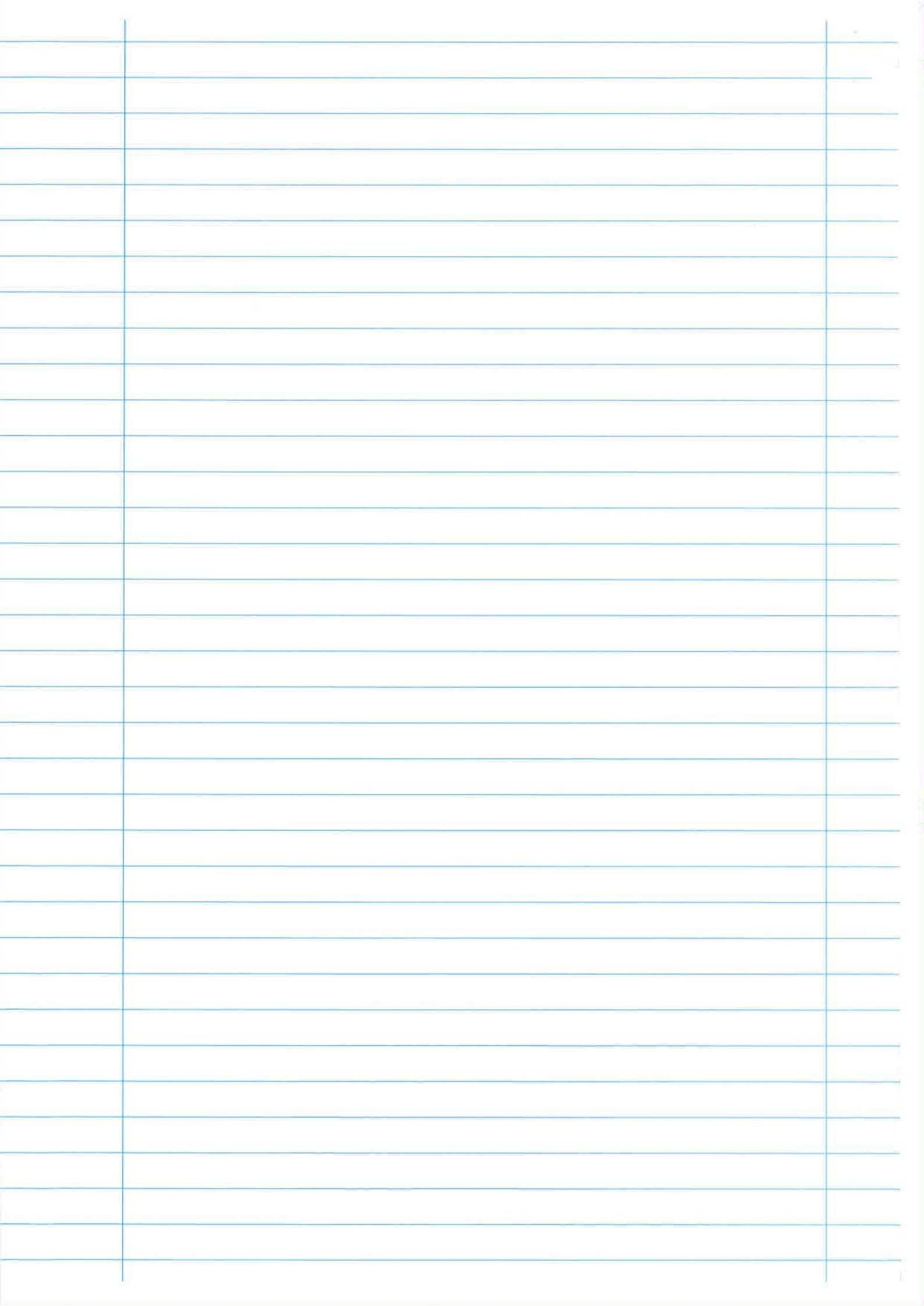
0/8

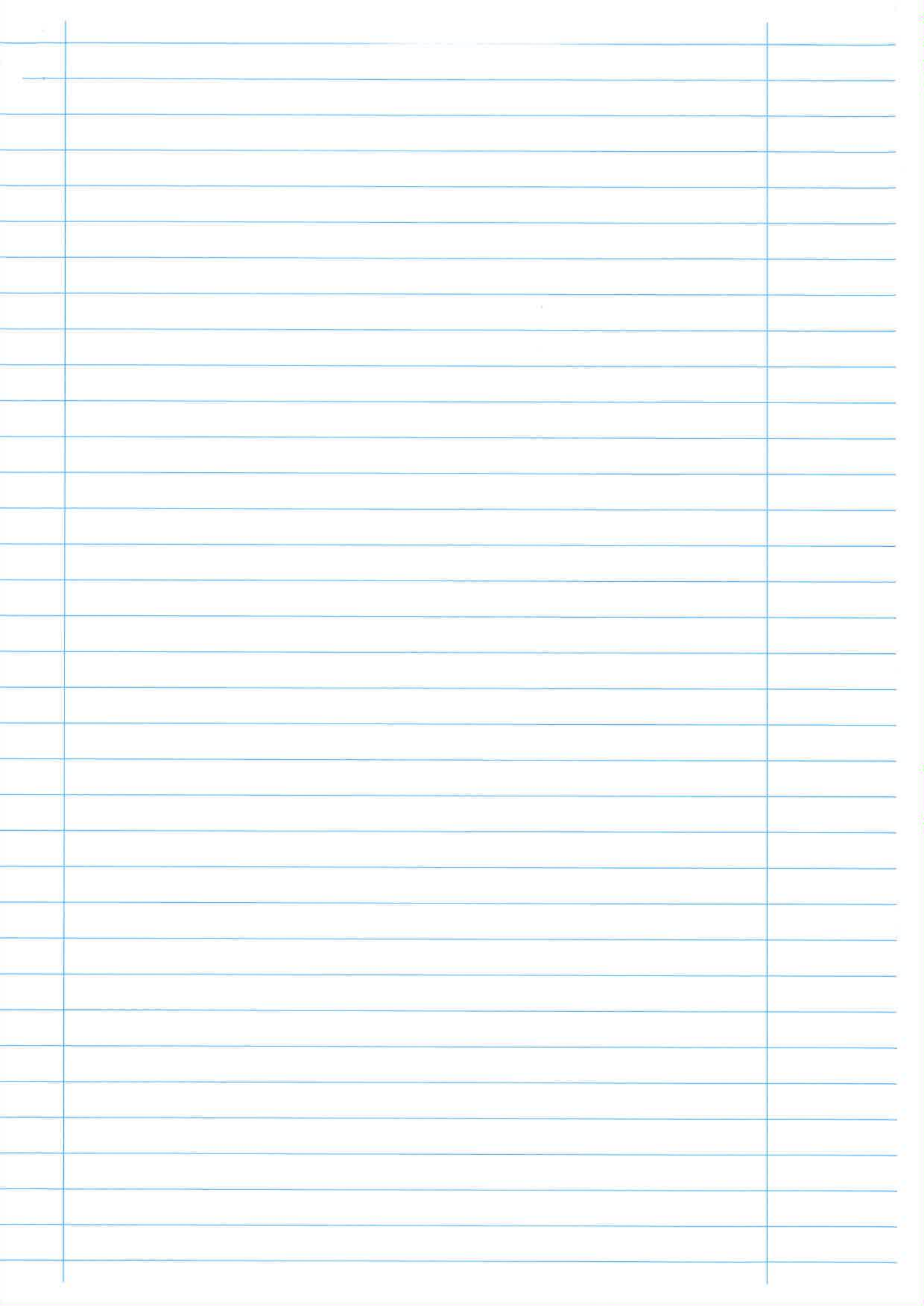
$$1y + 6z = 1$$

$$2y + 2z = 2$$

$$3y - 1z = 4$$

0/8





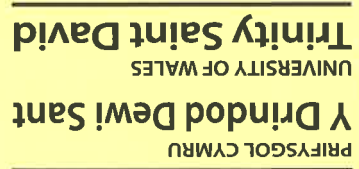
$$R_x = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos(\alpha) & \sin(\alpha) & 0 \\ 0 & \sin(\alpha) & \cos(\alpha) & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$$R_y = \begin{pmatrix} \cos(\gamma) & 0 & -\sin(\gamma) & 0 \\ 0 & 1 & 0 & 0 \\ \sin(\gamma) & 0 & \cos(\gamma) & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$$R_z = \begin{pmatrix} \cos(\beta) & \sin(\beta) & 0 & 0 \\ -\sin(\beta) & \cos(\beta) & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

AR GYFER DEFNYDD GWEINYDDOL YN UNIG, TYNNWCH Y STRIBYN TYLLOG I FFWRDD YN OFALUS

TYNNWCH
RHWYGWCH



24 Tudalen

1. Rhowch yr holl wybodaeth y gofynnir amdani yn y blychau isod.
2. Rhowch eich enw yn y lle a ddarperir i'r dde a seliwrch i guddio eich enw.
3. Rhaid i'r atebion fod mewn llawysgrifen **ddarlennadwy**. Gall yr Arholwyr naill ai anwybyddu sgript annarlennadwy, neu drefnu iddi gael ei theipio a chael yr ymgeisydd i dalu.

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.

[illegible]

A wnewch chi lenw'r rhan hon a'i SELLO cyn i'r arholiad ddechrau.

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