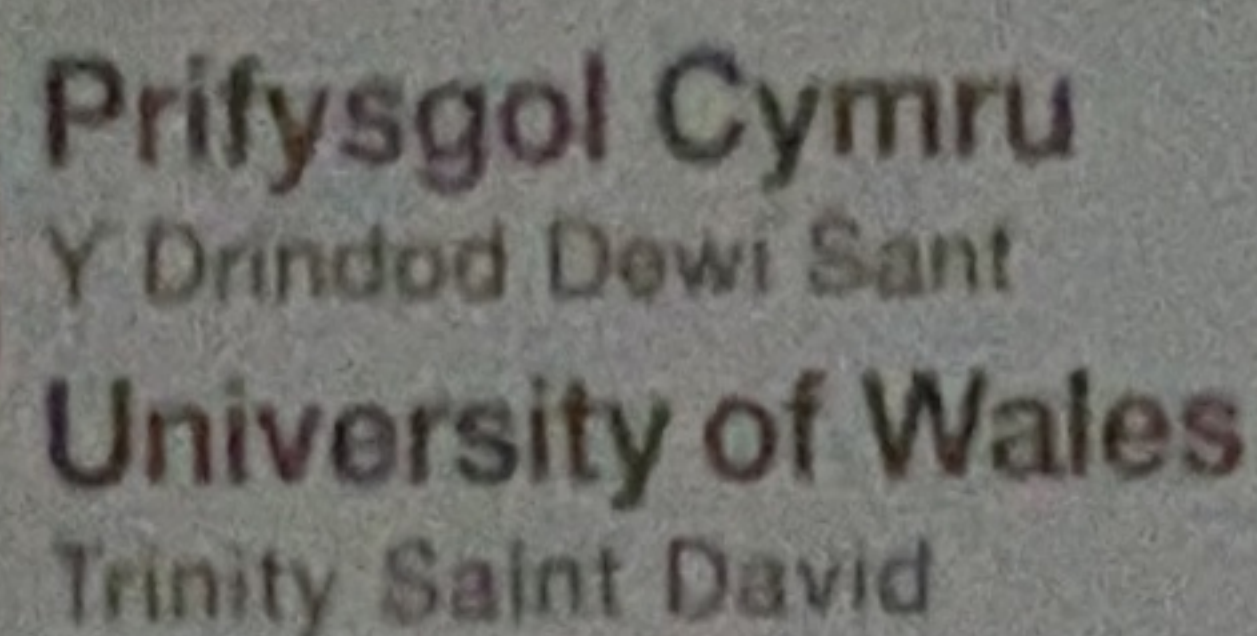




Complete, fold and seal
(see note 2 below)

SURNAME:

Hurley

FORENAME(S):

Andrew Robert

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	1906810
2	Title of Examination Paper	Mathematics
3	Module Code	ACDA4008
4	Date and Time of Examination	12/3/2020 09:30 am
5	Examination Venue	1Q 208
6	Seat Number	
7	Number of Answer Books handed in	

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

Q1: $f(x) = 6x^{-3} + 2$
 $f'(x) = \boxed{-18x^{-4}}$

7.5
 5

ii $f(x) = -4xe^{2x} - 9x$
 $f'(x) = \boxed{8xe^{2x} - 4e^{2x} - 9}$

$$\begin{aligned} u &= -4x & v &= e^{-2x} \\ u' &= -4 & v' &= -2e^{-2x} \\ & & & -4x(-2e^{-2x}) + e^{-2x}(-4) \\ & & & = 8xe^{-2x} - 4e^{-2x} \\ & & & = 8xe^{-2x} - 4e^{-2x} \end{aligned}$$

iii $f(x) = \sin(5x^3 + x^2)$
 $f'(x) = \boxed{(15x^2 + x)\cos(5x^3 + x^2)}$

5

iv $f(x) = \frac{(5x+3)^2}{3x^2+2x}$

$$\frac{25x^2 + 30x + 15x + 9}{3x^2 + 2x}$$

$$= \frac{25x^2 + 30x + 9}{3x^2 + 2x}$$

$u = 25x^2 + 30x + 9$

$u' = 50x + 30$

$v = 3x^2 + 2x$

$v' = 6x + 2$

$(3x^2 + 2x)(50x + 30) - (25x^2 + 30x + 9) \times (6x + 2)$

$(150x^3 + 90x^2 + 100x^2 + 60x) = v \frac{du}{dx}$
 $- (150x^3 + 50x^2 + 300x + 54x + 18) = u \frac{dv}{dx}$
 $100x^2$

$(150x^3 + 90x^2 + 60x - 150x^3 - 230x^2 - 114x - 18)$
 $= -40x^2 - 54x - 18$

7.5

$v^2 = (3x^2 + 2x)(3x^2 + 2x)$
 $= 9x^4 + 6x^3 + 6x^3 + 4x^2$

$f'(x) = \boxed{\frac{-40x^2 - 54x - 18}{9x^4 + 12x^3 + 4x^2}}$

25
 30

Q2

$$y = 2x^3 - 9x^2 + 12x$$

$$y' = 6x^2 - 18x + 12$$

$$6x^2 - 18x + 12 = 0 \quad (\text{gradient} = 0 \therefore \text{min/max of curve})$$

$$\sqrt{-18^2 - 4 \times 6 \times 12} = \sqrt{324 - 288} = \sqrt{36}$$

$$\frac{18 \pm \sqrt{36}}{12} = 2 \text{ or } 1$$

$$\frac{10}{10}$$

$$\text{Min } x = 1$$

$$\text{Max } x = 2$$

$$(1, 5)$$

$$(2, 4)$$

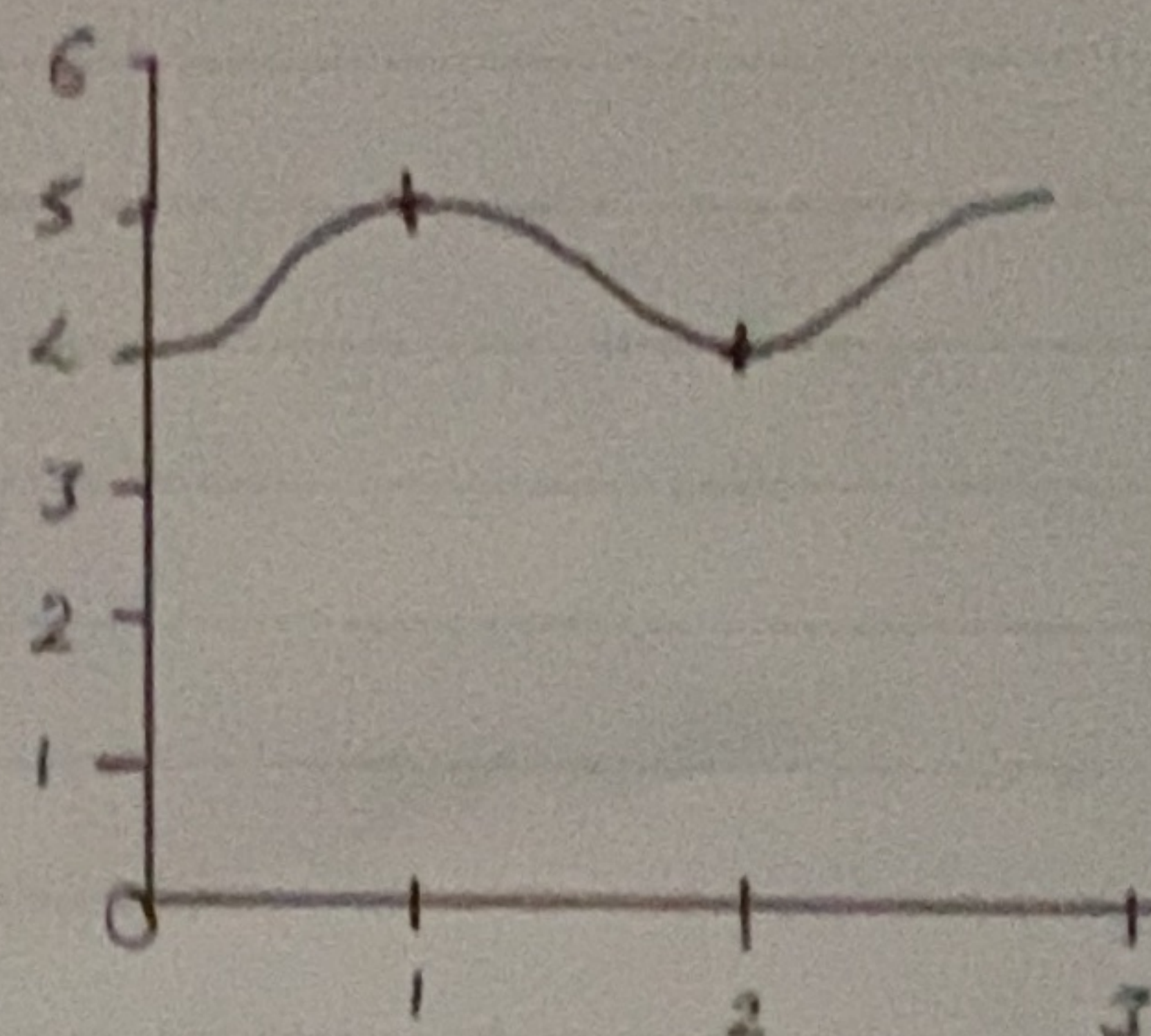
$$\text{Max Point} = (1, 5)$$

$$\text{Min Point} = (2, 4)$$

$$y = 2(1)^3 - 9(1)^2 + 12(1)$$

$$y = 5$$

$$y = 2(2)^3 - 9(2)^2 + 12(2) = 4$$



Q3 i $\int (12x^3 - 4x^{-2}) dx$

$$= 3x^4 - \frac{4x^{-1}}{-1}$$

$$= \boxed{3x^4 + 4x^{-1} + C}$$

8

ii $\int \left(\frac{e^x}{1+e^x} \right) dx$ $\int (e^x (1+e^x)^{-1}) dx$

$$= \frac{e^x + C}{1x + e^x + C}$$

$$= \boxed{1/x}$$

0

10
30

iii $\int \left(\frac{3}{x} + 4 + (\ln 3) \right) dx$

$$\int (2x^{-1} + 4 + (\ln 3))$$

$$= \frac{2x^{-2}}{-2} + 4x + x^0 (\ln 3 x^0 - x^0) + C$$

$$= \boxed{-x^{-2} + 4x + (\ln 3) + C}$$

2

Q.4

$$I = \int_3^6 (3x^2 + x^3) dx$$

$$3x^3 + \frac{x^4}{4}$$

$$\left[6^3 + \frac{6^4}{4} \right] - \left[3^3 + \frac{3^4}{4} \right] = I$$

$$540 - 47.25 = I$$

$$I = \boxed{492.75}$$

$$\frac{10}{10}$$

Q51

$$Z_1 = \frac{3-2j}{2+j}$$

$$Z_2 = \frac{3+2j}{1-2j}$$

$$Z = Z_1 - Z_2$$

$$Z_1 = \frac{3-2j}{2+j} \times \frac{2-j}{2-j}$$

$$= \frac{6-3j-4j+2j^2}{4-2j+2j-j^2}$$

$$Z_2 = \frac{3+2j}{1-2j} \times \frac{1+2j}{1+2j}$$

$$= \frac{3+6j+2j+4j^2}{1+2j-2j-4j^2}$$

$$Z_2 = \frac{-1+8j}{5}$$

$$Z_1 = \frac{4-7j}{5}$$

~~$$Z = \frac{4-7j}{5} - \frac{-1+8j}{5}$$~~

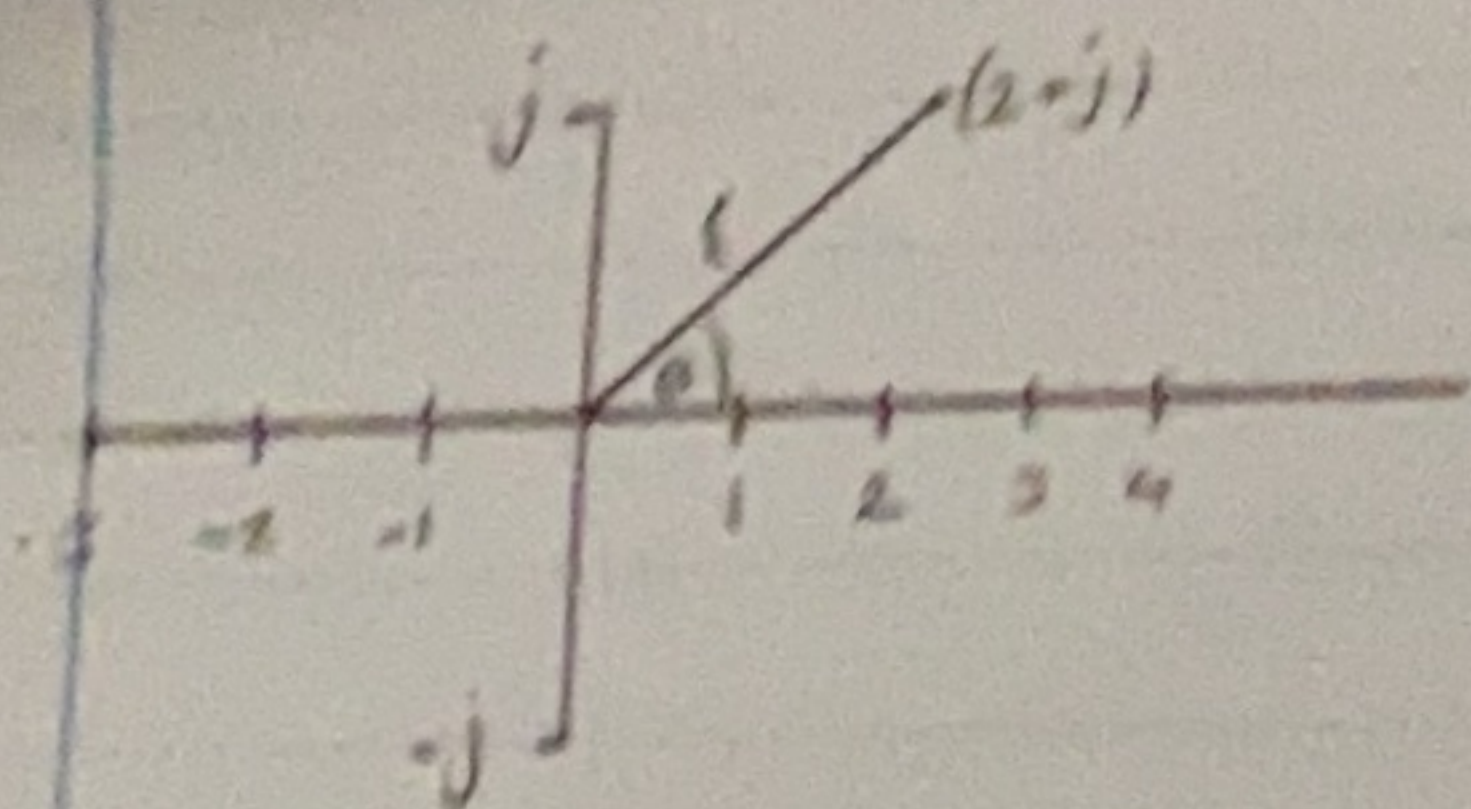
~~$$= \frac{4-7j-(-1+8j)}{5}$$~~

~~$$= \frac{5-15j}{5}$$~~

$$Z = \frac{4-7j}{5} - \frac{-1+8j}{5}$$

$$Z = \frac{3+j}{5}$$

II $Z_1 = 2+j$ $Z_2 = 3-2j$

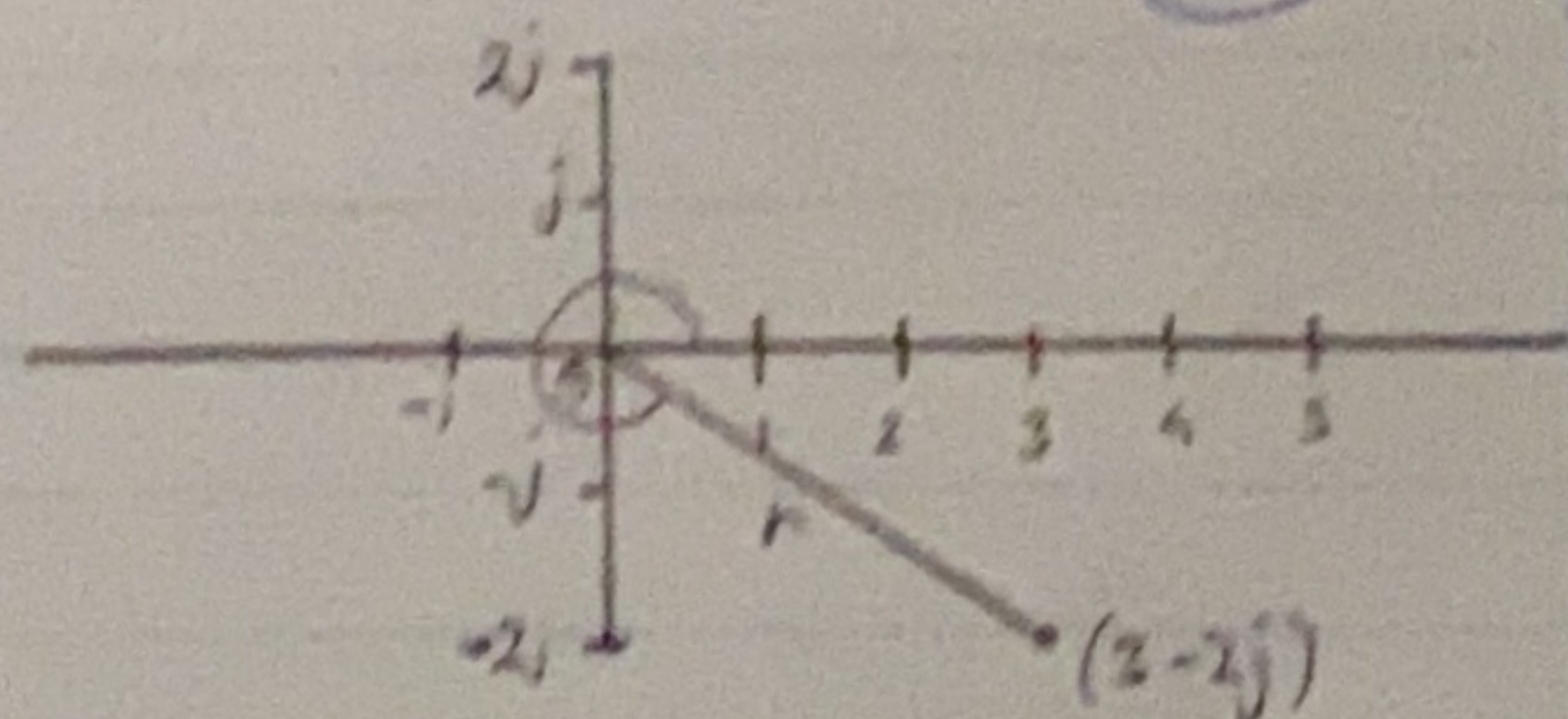


$$Z_1 r = \sqrt{2^2+1^2}$$

$$= \sqrt{5}$$

$$\theta = \tan^{-1} \frac{1}{2}$$

$$= 26.5^\circ$$



$$Z_2 r = \sqrt{3^2+2^2}$$

$$= \sqrt{13}$$

$$\theta = \tan^{-1} \frac{-2}{3}$$

$$= -35.5^\circ \text{ or } 324^\circ$$

5 III

$$Z = (\sqrt{3} + j)^8$$

$$r^2 = \sqrt{3}^2 + 1^2 = 4$$

$$r = 2$$

$$\theta = \tan^{-1} \frac{1}{\sqrt{3}}$$

$$\theta = 30^\circ$$

$$\frac{1}{5}$$

$$= 2^8 (\cos 8 \times 30 + j \sin 8 \times 30)$$

$$= -128 + -221.7j$$

$$Z = \boxed{-128 - 222j}$$

$$\text{IV } x^2 - 4x + 13 = 0$$

$$\sqrt{b^2 - 4ac} = \sqrt{16 - 52}$$

$$= \sqrt{-36}$$

$$\sqrt{-36} = \sqrt{36}j$$

$$\frac{4 \pm \sqrt{36}j}{2}$$

$$\frac{17}{20}$$

$$(2+3j)(2-3j) = 4 - 9j + 6j - 9j^2$$

$$= +13$$

$$x^2 - 4x + (2+3j)(2-3j) = 0$$

$$2+3j \quad r = \sqrt{2^2+3^2}$$

$$= \sqrt{13}$$

$$\theta = \tan^{-1} \frac{3}{2}$$

$$= 56.31^\circ$$

$$\sqrt{13} (\cos 56.31) + j \sqrt{13} (\sin 56.31)$$

$$2+3j = 2+3j \quad \checkmark$$

$$\sqrt{13} \angle 56.31$$

$$\sqrt{2+3^2} = \sqrt{13}$$

$$\theta = \tan^{-1} \frac{-3}{2}$$

$$\theta = -56.31$$

$$\therefore 2+3j = \sqrt{13} \angle 56.31$$

$$2-3j = \sqrt{13} \angle -56.31$$

$$\frac{1}{5}$$