

NAME.....INDEX NUMBER.....

121/1

MATHEMATICS PAPER 1.

PRE-MOCK 2022.

2 ½ Hours

SUKELLEMO

Instructions to Candidates

- (a) Write your name and index number in the spaces provided below
- (b) Sign and write the date of examination in the spaces provided above.
- (c) The paper consists of **TWO** sections: **Section I** and **Section II**.
- (d) Answer **ALL** questions in **Section I** and **ONLY** five from **Section II**.
- (e) All answers and working must be written on the question paper in the spaces provided below each question.
- (f) **Show all the steps in your calculations, giving your answers at each stage in the spaces below each question**
- (f) Marks may be given for correct working even if the answer is wrong.
- (g) **Non – programmable** silent calculators and KNEC Mathematical tables may be used except where stated otherwise.
- (g) **The paper consists 14 printed pages.**

For Examiner’s use only

Section I

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total

Section II

GRANT

TOTAL

17	18	19	20	21	22	23	24	Total

SECTION 1 (50 MARKS)

Answer all the questions in the space provided below each question

1. Find the equation of a straight line passing through the points A (1,-3) and B (-2, 5). Express your answer in the form $ax + by = c$ where a, b and c are integers. (3marks)

$$\text{Gradient} = \frac{5 - (-3)}{-2 - 1} = \frac{-8}{3} \checkmark$$

M1

$$\frac{y - 5}{x + 2} = \frac{-8}{3} \checkmark$$

M1

$$3(y - 5) = -8(x + 2)$$

A1

$$3y - 15 = -8x - 16$$

$$3y + 8x = -1 \checkmark$$

3

2. Evaluate without using mathematical tables or calculator $\frac{-10 \div 2 + 6 \times 4 - 8 \times 5}{-5 + (-12) \div 3 \times 2}$ (3marks)

$$\text{Numerator} = -5 + 24 - 40$$

$$= -21 \checkmark$$

B1

$$\text{Denominator} = -5 - 8$$

$$= -13 \checkmark$$

B1

$$\frac{-21}{-13}$$

$$= 1 \frac{8}{13} \checkmark$$

B1
3

3. Solve for x in the equation $\frac{\cos(2x-30)^\circ}{\sin(3x+10)^\circ} = \tan 45^\circ$ (3marks)

$$\cos(2x-30)^\circ = \sin(3x+10)^\circ$$

$$\cos(2x-30)^\circ = \cos(90 - (3x+10)) \checkmark$$

M1

$$2x - 30 = 90 - (3x + 10) \checkmark$$

M1

$$2x - 30 + (3x + 10) = 90$$

$$5x - 20 = 90$$

$$5x = 110$$

$$x = 22 \checkmark$$

A1
3

4. Two taps P and Q together can fill a water tank in 6 minutes. Tap P alone takes 5 minutes longer than tap Q. How many minutes does it take tap P alone to fill the tank? (3marks)

$$\frac{1}{x+5} + \frac{1}{x} = \frac{1}{6} \quad \checkmark$$

$$6(x+x+5) = x(x+5)$$

$$6x + 6x + 30 = x^2 + 5x$$

$$x^2 - 7x - 30 = 0$$

$$x^2 - 10x + 3x - 30 = 0$$

$$x(x-10) + 3(x-10) = 0$$

$$(x+3)(x-10) = 0 \quad \checkmark$$

$$x = -3 \text{ or } 10$$

Tap P = 5 + 10 = 15 minutes \checkmark

M1
M1
A1
3

5. Given that, $27^{5x-2y} = 243$ and $81^{2x-y} = 3$, Calculate the values of x and y. (3marks)

$$3^{3(5x-2y)} = 3^5$$

$$3(5x-2y) = 5$$

$$15x - 6y = 5$$

$$\frac{4}{3}(2x-y) = \frac{1}{3}$$

$$4(2x-y) = 1$$

$$(15x - 6y = 5) \times 4$$

$$(8x - 4y = 1) \times 6$$

$$60x - 24y = 20$$

$$48x - 24y = 6$$

$$\hline 12x = 14$$

$$x = 1\frac{1}{6}$$

$$8x \times \frac{7}{6} - 4y = 1$$

$$\frac{56}{6} - 4y = 1$$

$$8\frac{1}{3} - 4y = 1$$

$$2\frac{1}{3} = 4y$$

$$2\frac{1}{12} = y \quad \checkmark$$

M1
M1
A1
3

6. A point P is mapped onto P' by a negative quarter turn about the origin. P' is mapped onto P'' by a translation represented by the vector $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$. If P'' has coordinates (11, -5) determine the coordinates of P.

p.

$$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} y \\ x \end{pmatrix}$$

$$\begin{pmatrix} y \\ x \end{pmatrix} + \begin{pmatrix} -2 \\ 3 \end{pmatrix} = \begin{pmatrix} 11 \\ -5 \end{pmatrix}$$

$$y - 2 = 11$$

$$y = 13$$

$$x + 3 = -5$$

$$x = -8$$

P(-8, 13) \checkmark

M1
M1
A1
3

7. A metallic pipe which is 21 meters long has an internal radius of 13 cm and an external radius of 15 cm. if the density of the metal is 8620 kg/m³, find its mass. (3marks)

Extrenal volume - ^{both} Internal volume

$$\frac{22}{7} \times 15^2 \times 2100 - \frac{22}{7} \times 13^2 \times 2100$$

$$\frac{22}{7} \times 2100 (225 - 169)$$

$$\frac{22}{7} \times 2100 \times 56$$

$$369,600 \text{ cm}^3$$

$$0.3696 \text{ m}^3 \quad \checkmark$$

$$\text{Mass} = 8620 \times 0.3696$$

$$= 8,620 \times \frac{3696}{1000}$$

$$3,185.952$$

$$3,186 \text{ kg} \quad \checkmark$$

M1
M1
A1
30

8. Using logarithms evaluate $\sqrt[3]{82.73 \times 0.2943^2}$
613.5

(3marks)

NO.	Log
0.2943^2	T. 4688 x 2
	$\bar{2}.9376$
82.73	1.9177+
	0.8553
613.5	2.7878-
	$\bar{2}.0675$ ✓
	$\bar{2}.0675 = \frac{\bar{2}}{3} + \frac{1.0675}{3} = T + 0.3558$
0.2269 ✓	T. 3558

M1
M1
A1
(3)

9. A proper fraction is such that the denominator exceeds the numerator by 3. If 2 is subtracted from both the numerator and denominator, the fraction formed is $\frac{1}{8}$ less. Determine the original fraction. (3 marks)

$$\frac{x}{y}$$

$$y - x = 3$$

$$y = 3 + x$$

$$\frac{x-2}{y-2} = \frac{x}{y} - \frac{1}{8}$$

$$\frac{x-2}{3+x-2} = \frac{x}{3+x} - \frac{1}{8}$$

$$\frac{x-2}{x+1} = \frac{x}{x+3} - \frac{1}{8}$$

$$(x-2)(x+3)8 = x(x+1)8 - ((x+1)(x+3))$$

$$(x^2 + x - 6)8 = 8x^2 + 8x - (x^2 + 4x + 3)$$

$$8x^2 + 8x - 48 = 8x^2 + 8x - x^2 - 4x - 3$$

$$0 = -x^2 - 4x + 45$$

$$x^2 + 4x - 45 = 0$$

$$x^2 + 9x - 5x - 45 = 0$$

$$x(x+9) - 5(x+9) = 0$$

$$(x-5)(x+9) = 0$$

$$x = 5 \text{ or } -9 \text{ fraction}$$

When x=5
y=8
 $\frac{5}{8}$ ✓ M1
M1
A1
(3)

10. Given that $OM = 2i + 3j - 6k$ and $ON = -3i + 5j + k$. Find the magnitude of MN to 2 decimal places. (3marks)

$$MN = \sqrt{(-3-2)^2 + (5-3)^2 + (1-6)^2}$$

$$= \sqrt{25 + 4 + 49}$$

$$= \sqrt{78}$$

$$= 8.832$$

$$= 8.83$$

M1
M1
A1
(3)

11. Find the range of the integral values of x in the inequality $10 < 3(x+2) < 35$, giving your answer in the form $a \leq x \leq b$. (3marks)

$$10 < 3(x+2)$$

$$10 < 3x+6$$

$$4 < 3x$$

$$1\frac{1}{3} < x$$

$$3x+6 < 35$$

$$3x < 29$$

$$x < 9\frac{2}{3}$$

$$\begin{array}{c} | & | & | & | & | \\ 1 & 2 & 9 & 9\frac{2}{3} & \end{array}$$

$$2 \leq x \leq 9$$

4

M1
M1
A1
(3)

12. Simplify completely $\frac{2-2x}{6x^2-x-12} \div \frac{x-1}{2x-3}$ (3marks)

$$\frac{2(1-x)}{6x^2-9x+8x-12}$$

$$\frac{-2(x-1)}{3x(2x-3)+4(2x-3)}$$

$$\frac{-2(x-1)}{(3x+4)(2x-3)} \checkmark$$

$$\frac{-2(x-1)}{(3x+4)(2x-3)} \times \frac{2x-3}{(x-1)} \checkmark$$

$$\frac{-2}{3x+4} \checkmark$$

M1
M1
A1
3

13. The marked price of a recliner sofa set in a furniture store was ksh 400,000. A customer bought the recliner at 10% discount. The dealer still made a profit of 20%, Calculate the amount of money the dealer paid for the recliner. (3marks)

$$100\% \rightarrow 400,000$$

$$90\% \rightarrow \frac{90 \times 400,000}{100}$$

$$= 360,000 \checkmark$$

$$120\% \rightarrow 360,000$$

$$100\% \rightarrow \frac{100 \times 360,000}{120} \checkmark$$

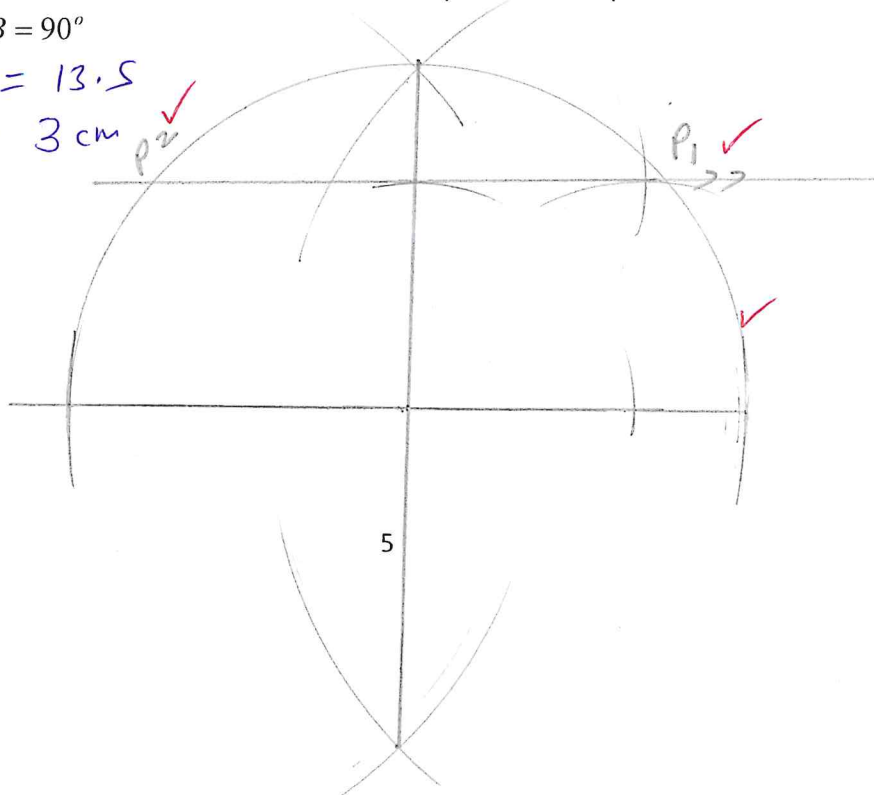
$$= 300,000 \checkmark$$

M1
M1
A1
3

14. Draw a line AB of length 9 cm. On one side of line AB construct the locus of a point P such that the area of triangle ABC is 13.5 cm^2 . On this locus locate two positions of a point P1 and P2 such that $\angle AP_1B = \angle AP_2B = 90^\circ$

$$\frac{1}{2} \times 9 \times h = 13.5$$

$$h = 3 \text{ cm} \checkmark$$



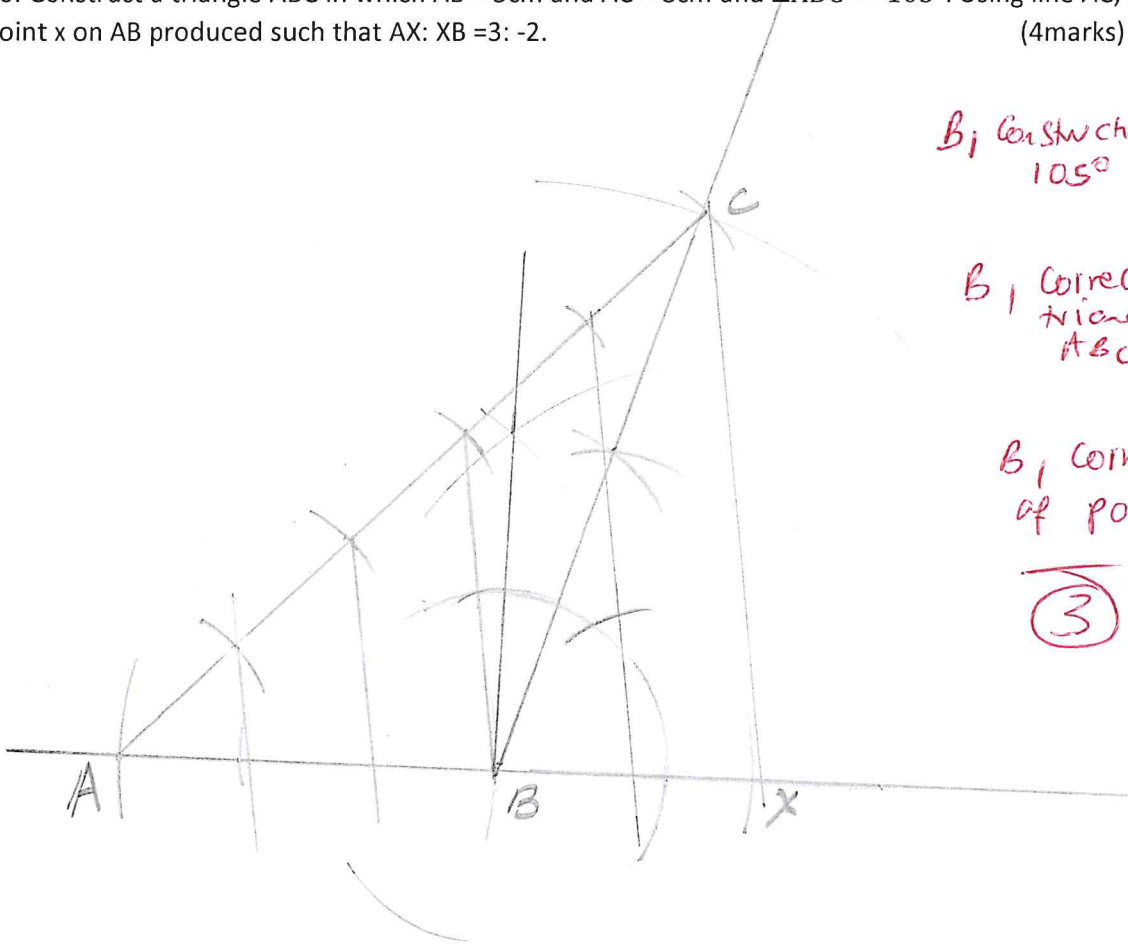
B1
B1
B1
3

15. Given that the area of an image is four times the area of the object under a transformation whose matrix is $\begin{pmatrix} x & x-4 \\ x+8 & x \end{pmatrix}$, find the possible value of x . (3 marks)

$$\begin{aligned}
 x^2 - (x-4)(x+8) &= 4 \checkmark \\
 x^2 - (x^2 + 4x - 32) &= 4 \\
 x^2 - x^2 - 4x + 32 &= 4 \checkmark \\
 -4x &= -28 \\
 x &= 7 \checkmark
 \end{aligned}$$

M1
M1
A1
3

16. Construct a triangle ABC in which AB = 5cm and AC = 8cm and $\angle ABC = 105^\circ$. Using line AC, locate point x on AB produced such that AX:XB = 3:-2. (4marks)



B1 Construction of 105°

B1 Correct triangle ABC

B1 Correct location of point X

3

SECTION II (50 MARKS)

Answer only five questions in this section

17. The table below shows the weekly salary (k£) paid to workers in a school.

Salary (k£)	$50 \leq x \leq 100$	$100 \leq x \leq 150$	$150 \leq x \leq 250$	$250 \leq x \leq 350$	$350 \leq x \leq 500$
No. of Workers	25	27	30	26	24

a) Calculate the differences between the mean and the median.

(6 marks)

0-50	f	$\sum x$	$\sum fx$	cf	fd
50-100	25	75	1875	25	0.5
100-150	27	125	3375	52	0.54
150-250	30	200	6000	82	0.3
250-350	26	300	7800	108	0.26
350-500	24	425	10,200	132	0.16
500-650		575			
	$\sum f$		$\sum fx$		
	=132		=29,250		

$$\text{Mean} = \frac{29250}{132} = 221.60$$

$$\text{Median} = 66^{\text{th}} \text{ position}$$

$$150 + 82 -$$

$$150 + \frac{(66-52) \times 100}{200}$$

$$157$$

$$221.60 - 157$$

$$64.60$$

M1

M1

M1

M1

M1

A1

b) Draw a frequency polygon to illustrate the above information.

(4marks)



fd ✓
S₁
P₁
C₁

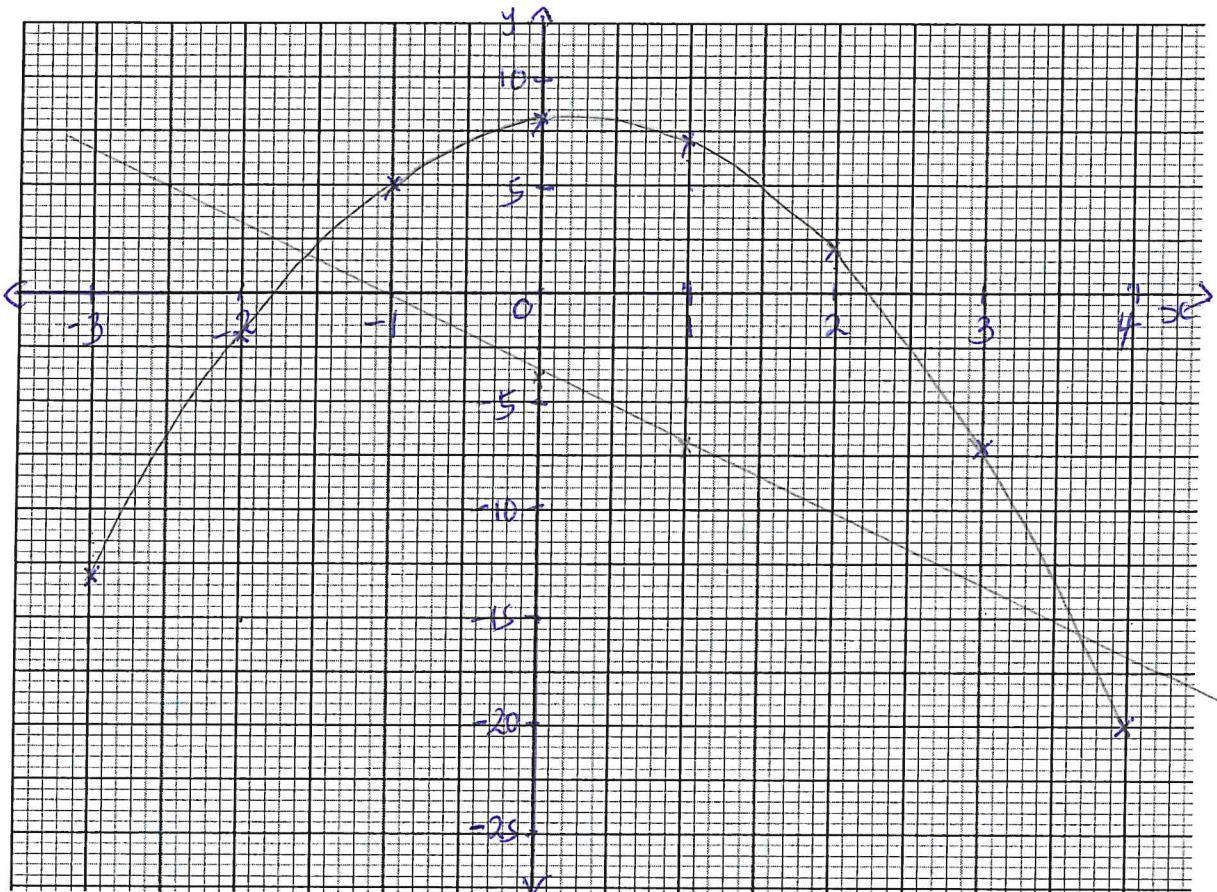
10

18. a) Complete the table of values for the equation, $y = -2x^2 + x + 8$. (2marks)

x	-3	-2	-1	0	1	2	3	4
y	-13	-2	5	8	7	2	-7	-20

B2

b) Use the values above to draw the graph of $y = -2x^2 + x + 8$. (3marks)



S1
P1
C1
L1

c) Using the graph drawn above Solve the equations:-

(i) $2x^2 = x + 8$ (2marks)

$$\begin{aligned} -2x^2 + x + 8 &= 0 \\ -2x^2 + x + 8 &= y \\ \hline 0 &= y \end{aligned}$$

$$\begin{aligned} x &= -1.78 \text{ or} \\ x &= 2.2 \end{aligned}$$

B1
B1

(ii) $-2x^2 + 4x + 12 = 0$ (3marks)

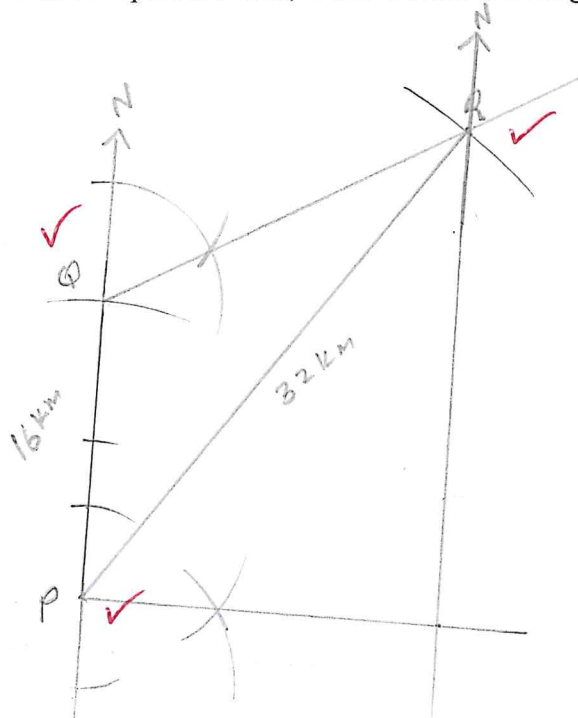
$$\begin{aligned} -2x^2 + x + 8 &= y \\ \hline -3x - 4 &= y \end{aligned} \checkmark$$

M1
B1

$$\begin{aligned} x &= -1.55 \\ x &= 3.67 \end{aligned} \} \checkmark$$

19. Three towns P, Q and R are such that Q is 16 km north of P and the distance of R is 32 km from P and on a bearing of 60° from Q.

a). Using a scale of 1 cm to represent 4 km, Make a scale drawing showing the relative positions of the three towns. (3marks)



B1

B1

B1

b) Using the scale drawing above, find the

i) Distance of R from Q.

(1mark)

$5.3 \text{ cm} = 5.3 \times 4 = 21.2 \text{ km} \checkmark \quad 21 \pm 0.4$

B1

ii) Bearing of P from Q.

$215^\circ \checkmark \quad 214 \pm 1$

(1mark) B1

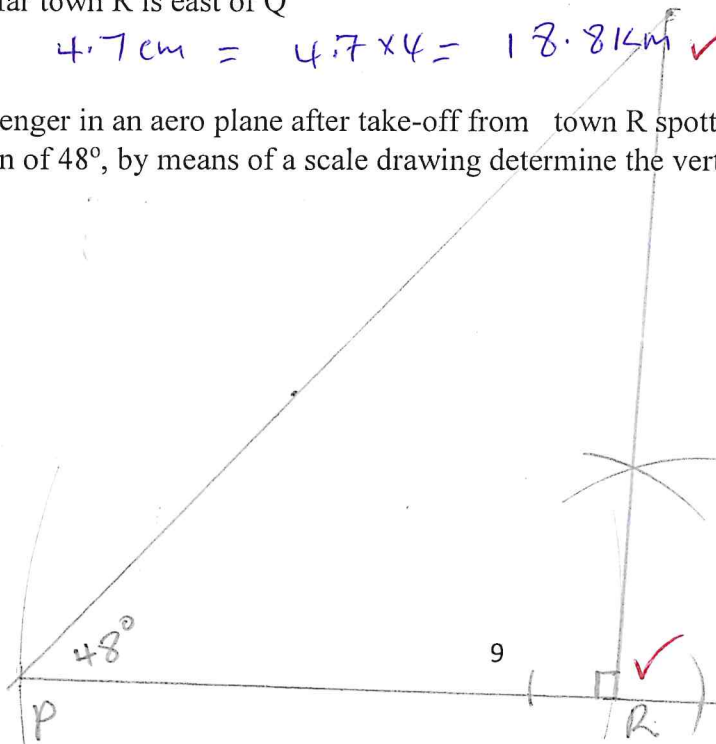
iii) How far town R is east of Q

(1mark)

$4.7 \text{ cm} = 4.7 \times 4 = 18.8 \text{ km} \checkmark \quad 18.1 \pm 0.4$

B1

c) A Passenger in an aero plane after take-off from town R spotted town P at an angle of depression of 48° , by means of a scale drawing determine the vertical height of the plane at town R. (3marks)



B1 correct location of position of plane
 Height 90° at R & 48° at P
 36.4 km
 or $36400 \text{ m} \checkmark$

35.5 ± 0.4
 or 3550 ± 400

10

20. a) The equation of a straight line L_1 is of the form $3y + 2x = 5$. L_1 is perpendicular to L_2 and meets it at the point where $X = -2$, determine the equation of L_2 in the form $y = mx + c$ where m and c are constants. (5marks)

$$3y = -2x + 5$$

$$y = -\frac{2}{3}x + \frac{5}{3} \checkmark$$

$$m_1 = -\frac{2}{3}$$

$$m_2 = \frac{3}{2} \checkmark$$

at $x = -2$

$$y = \frac{4}{3} + \frac{5}{3} = \frac{9}{3} = 3$$

$$(-2, 3) \checkmark$$

$$\frac{y-3}{x+2} = \frac{3}{2} \checkmark$$

$$2y-6 = 3x+6$$

$$2y = 3x+12$$

$$y = \frac{3}{2}x + 6 \checkmark$$

M1
A1
B1
M1
A1

b) L_3 is parallel to the line L_2 and passes through the point $(-3,2)$, find the equation of L_3 , leaving your answer in its double intercept form. (3marks)

$$\frac{y-2}{x+3} = \frac{3}{2} \checkmark$$

$$3(x+3) = 2(y-2)$$

$$3x+9 = 2y-4$$

$$3x-2y = -13 \checkmark$$

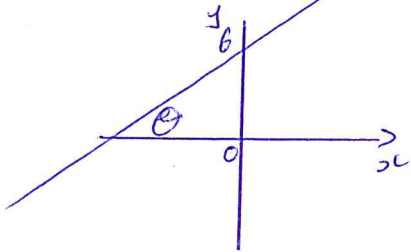
$$\frac{3x}{-13} + \frac{2y}{13} = 1$$

$$\frac{x}{-\frac{13}{3}} + \frac{y}{\frac{13}{2}} = 1 \quad M1$$

$$\frac{x}{-4\frac{1}{3}} + \frac{y}{6\frac{1}{2}} = 1 \checkmark \quad M1$$

$$A1$$

c) Determine the angle of inclination of L_2 to the Y-axis. (2marks)



$$\tan \theta = \frac{3}{2}$$

$$\theta = 56.31^\circ \checkmark$$

$$90 - 56.31^\circ = 33.69^\circ$$

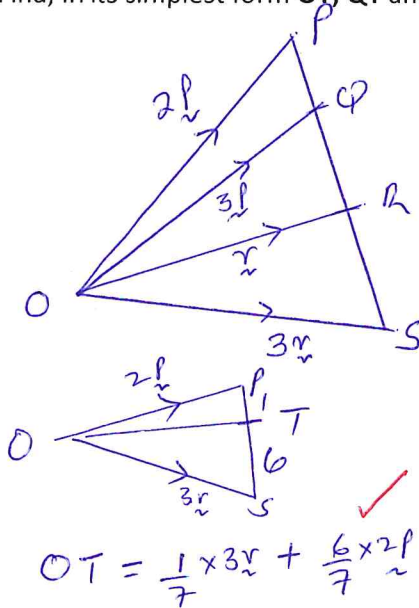
angle 33.69° or $146.31^\circ \checkmark$ B1
B1

10

21. The points **P**, **Q**, **R** and **S**, have position vectors $2\mathbf{p}$, $3\mathbf{p}$, \mathbf{r} and $3\mathbf{r}$ respectively, relative to an origin **O**. A point **T** divides **PS** internally in the ratio 1:6.

a) Find, in its simplest form **OT**, **QT** and **TR** in terms of **p** and **r**.

(6 marks)



$$OT = \frac{3}{7}\mathbf{r} + \frac{12}{7}\mathbf{p} \checkmark$$

M1
A1

$$\begin{aligned} QT &= QO + OT \\ &= -3\mathbf{p} + \frac{3}{7}\mathbf{r} + \frac{12}{7}\mathbf{p} \checkmark \\ &= \frac{3}{7}\mathbf{r} - \frac{9}{7}\mathbf{p} \checkmark \end{aligned}$$

M1
A1
M1

$$\begin{aligned} TR &= TO + OR \\ &= -\frac{3}{7}\mathbf{r} - \frac{12}{7}\mathbf{p} + \mathbf{r} \checkmark \\ &= \frac{4}{7}\mathbf{r} - \frac{12}{7}\mathbf{p} \checkmark \end{aligned}$$

A1

b) Show that the points **Q**, **T** and **R**, are collinear.

(3marks)

$$QT = \frac{3}{7}(\mathbf{r} - 3\mathbf{p})$$

M1

$$TR = \frac{4}{7}(\mathbf{r} - 3\mathbf{p})$$

M1

$$\frac{4}{7}QT = \frac{3}{7}TR \checkmark$$

A1

$$4QT = 3TR \checkmark$$

$QT \parallel TR$ \checkmark both
and share C.P.T hence collinear

c) Determine the ratio in which **T** divides **QR**.

(1mark)

$$\frac{QT}{TR} = \frac{3}{4}$$

B1

$$QT : TR = 3 : 4 \checkmark$$

10

22. In the figure below, O_1 and O_2 are the centers of the circles whose radii are 5 cm and 8 cm respectively. The circles intersect at A and B and angle $AO_1O_2 = 64^\circ$.

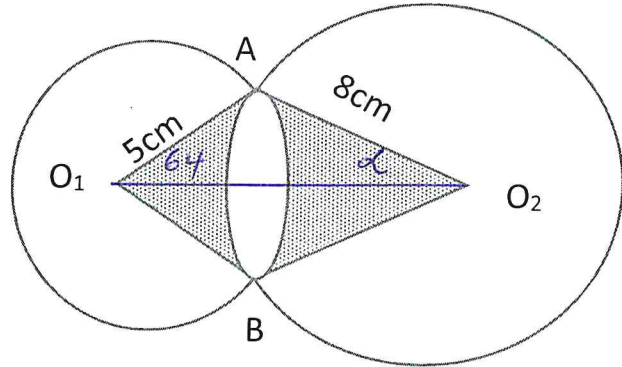
Calculate the area of the:-

a) Sector

i) AO_1B (2marks)

$$\frac{128}{360} \times \frac{22}{7} \times 25 \checkmark$$

$$27.94 \checkmark$$



M1
A1

ii) AO_2B (3 marks)

$$\frac{8}{\sin 64} = \frac{5}{\sin \alpha} \checkmark$$

$$\sin \alpha = \frac{5 \times \sin 64}{8}$$

$$\sin \alpha = 0.5617$$

$$\alpha = 34.18^\circ$$

$$2\alpha = 68.36^\circ$$

$$\frac{68.36}{360} \times \frac{22}{7} \times 64 \checkmark$$

$$38.19 \checkmark$$

M1
M1
A1

b) Intersecting region. (3marks)

$$\left(27.94 - \frac{1}{2} \times 25 \times \sin 128 \right) + 38.19 - \frac{1}{2} \times 64 \times \sin 68.36$$

$$27.94 - 9.850 \qquad 38.19 - 29.74$$

$$18.09 \checkmark + 8.45 \checkmark$$

$$26.54 \checkmark$$

B1
B1
B1

c) The shaded region. (2marks)

$$9.850 + 29.74 - 26.54 \checkmark$$

$$39.59 - 26.54$$

$$13.05 \checkmark$$

M1
A1
10

23. a) Find the x-intercept of the curve $y = (x+2)(x-1)^2$.

(1mark).

$$(x+2)(x-1) = 0$$

$$x = 1 \text{ or } -2$$

B1

b) Find the gradient function of the curve $y = (x+2)(x-1)^2$

(2marks)

$$y = (x+2)(x^2 - 2x + 1)$$

$$y = x^3 - 2x^2 + 2x^2 + x - 4x$$

$$y = x^3 - 3x$$

M1

A1

$$\frac{dy}{dx} = 3x^2 - 3$$

c) Find the co-ordinates of the turning point. Hence sketch the curve $y = (x+2)(x-1)^2$.

(4 marks)

$$3(x^2 - 1) = 0$$

$$3(x-1)(x+1) = 0$$

$$x = 1 \text{ or } -1$$

When $x = 1, y = 0$

$(1, 0)$

$$\frac{d^2y}{dx^2} = 6x \text{ at } x = 1$$

$$\frac{d^2y}{dx^2} = 6$$

$(1, 0)$ Minima

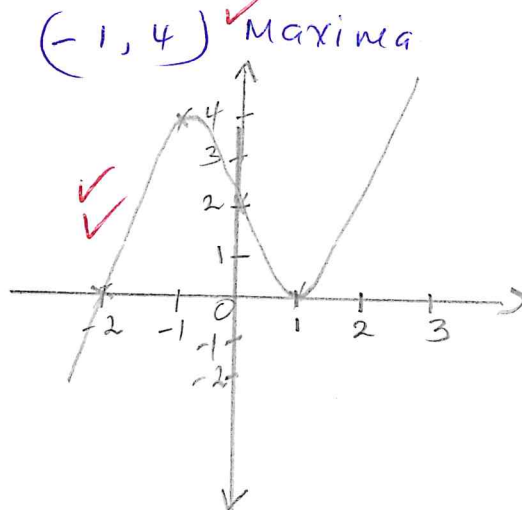
When $x = -1$

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

$$y = 4$$

$(-1, 4)$

$$\frac{d^2y}{dx^2} = 6x \text{ at } x = -1, \frac{d^2y}{dx^2} = -6$$



B1

B1

B2

d) Calculate the exact area enclosed by the curve and the x-axis

(3marks)

$$\int_{-2}^1 (x^3 - 3x)$$

$$\left[\frac{x^4}{4} - \frac{3}{2}x^2 \right]_{-2}^1$$

$$\left(\frac{1}{4} - \frac{3}{2} \right) - \left(\frac{16}{4} - \frac{3 \times 4}{2} \right)$$

$$-1.25 - (-2)$$

M1

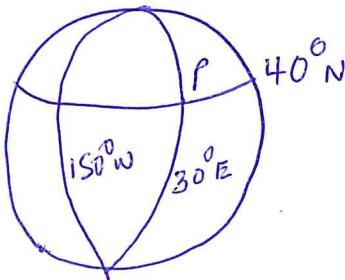
M1

A1

$$0.75$$

24. P and Q are two points on latitude 40°N . Their longitudes are 30°E and 150°W respectively. Find to one decimal place : (Take the radius of the earth = 6370km and $\pi = \frac{22}{7}$)

a) The distance in km between P and Q along the parallel of latitudes. (2marks)



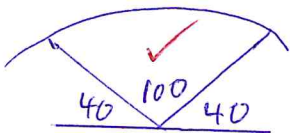
differences in longitude = 180°

$$\frac{180}{360} \times \frac{22}{7} \times 2 \times 6370 \times \cos 40^{\circ}$$

$$15336.2$$

M1
A1

b) The shortest distance along the earth's surface between P and Q in km. (3marks)

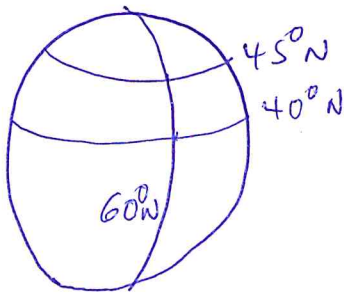


$$\frac{100}{360} \times \frac{22}{7} \times 2 \times 6370$$

$$8272.7$$

B1
M1
A1

c) A weather forecaster reports that the center of a cyclone at $(40^{\circ}\text{N}, 60^{\circ}\text{W})$ is moving due north at 24 knots. How long will it take to reach a point $(45^{\circ}\text{N}, 60^{\circ}\text{W})$. (2marks)



differences in latitude = $45 - 40 = 5^{\circ}$

$$\Delta = 5 \times 60 = 300 \text{ NM}$$

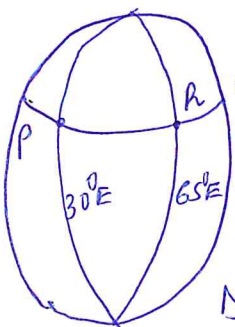
$$\text{Time} = \frac{300}{24}$$

$$12.5 \text{ hrs}$$

M1
A1

d) A plane leaves P at 2.15 pm at a speed of 350 knots to town R $(40^{\circ}\text{N}, 65^{\circ}\text{E})$. Determine the time at R when the plane arrived. (3marks)

differences in longitudes = $65 - 30 = 35^{\circ}$



$$\frac{35 \times 24}{360} \rightarrow 360^{\circ}$$

$$2 \text{ hrs } 20 \text{ min } 14$$

$$\text{Distance} = 35 \times 60 \times \cos 40^{\circ}$$

$$= 1,608.7 \text{ NM}$$

$$\text{Time} = \frac{1608.7}{350}$$

$$= 4.596 \text{ hrs}$$

$$4 \text{ hrs, } 36 \text{ minutes}$$

$$\begin{array}{r} 2.15 \\ + 2.20 \\ \hline 4.35 \\ + 4.36 \\ \hline 8.71 \text{ P.M.} \end{array}$$

B1
B1
B1