SECTION I (50 marks)

*Answer **all** the questions in this section in the spaces provided*

1. Express $\cos 45^0$ in the form $\frac{\sqrt{a}}{b}$ where a and b are positive integers. Hence simplify $\frac{\sqrt{32}}{1-\cos 45^0}$ leaving the answer in the form $p + q\sqrt{r}$ Where p, q and r are integers. (4 marks)

$$\cos 45^0 = \frac{1}{\sqrt{2}}$$

Rationalizing, we have:

$$\frac{1(\sqrt{2})}{(\sqrt{2})(\sqrt{2})} = \frac{\sqrt{2}}{2} \checkmark \text{ B1}$$

Simplifying $\frac{\sqrt{32}}{1-\cos 45^0}$, we have;

$$\frac{4\sqrt{2}}{1-\frac{\sqrt{2}}{2}} = \frac{4\sqrt{2}}{\frac{2-\sqrt{2}}{2}}$$

$$= 4\sqrt{2} \div \frac{2-\sqrt{2}}{2}$$

$$= 4\sqrt{2} \times \frac{2}{2-\sqrt{2}}$$

$$= \frac{8\sqrt{2}}{2-\sqrt{2}}$$

Rationalizing;

$$= \frac{(8\sqrt{2})(2+\sqrt{2})}{(2-\sqrt{2})(2+\sqrt{2})}$$

$$= \frac{16\sqrt{2}+16}{4-2} \checkmark \text{ M1}$$

$$= \frac{16\sqrt{2}+16}{2}$$

$$= 8 + 8\sqrt{2} \checkmark \text{ A1}$$

2. Write down the first four terms of $(x + y)^9$ using binomial expansion in descending powers of x. If $y = -0.01$, use your expansion to evaluate $(9.99)^9$ to the nearest 10 (3 marks)

$x^9y^0 + x^8y^1 + x^7y^2 + x^6y^3 + \cdots$

Including coeffients, we have;

$x^9 + 9x^8y^1 + 36x^7y^2 + 84x^6y^3 + \cdots \checkmark$ B1

From $(x + y)^9$ and $(9.99)^9$

$x - 0.01 = 9.99$

$x = 10$

Substituting, we have;

$(10)^9 + 9(10)^8(-0.01)^1 + 36(10)^7(-0.01)^2 + 84(10)^6(-0.01)^3 + \cdots \checkmark$ M1

$1000000000 - 9000000 + 36000 - 84$

$= 991035916$

$= 991035920$ (To the nearest 10) $\checkmark$ A1

3. Find the value of x that satisfies the equation (3 marks)

$$\log(2x + 10) - \log 5x = \log\left(\frac{x}{2} - 1\frac{1}{10}\right)$$

$$\log(2x + 10) - \log(5x) = \log\left(\frac{x}{2} - 1\frac{1}{10}\right)$$

$$\log\left(\frac{2x + 10}{5x}\right) = \log\left(\frac{x}{2} - \frac{11}{10}\right) \checkmark \text{ M1}$$

Droping logs, we have;

$$\frac{2x + 10}{5x} = \frac{5x - 11}{10}$$

$$10(2x + 10) = 5x(5x - 11)$$

$$20x + 100 = 25x^2 - 55x$$

$$25x^2 - 55x - 20x - 100 = 0$$

$$25x^2 - 75x - 100 = 0$$

$$x^2 - 3x - 4 = 0$$

$$p = -4x^2$$

$$s = -3x$$

$$f = -4x \text{ and } x$$

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

$$x(x - 4) + 1(x - 4) = 0$$

$$(x + 1)(x - 4) = 0 \checkmark \text{ M1}$$

$$x = -1 \text{ or } x = 4.$$

$$x = 4 \checkmark \quad \text{A1}$$

4. A point $T(-3, 4)$ divides a line AB in the ratio 3:5. Find the coordinates of point A given that the coordinates of B is $(6, -5)$. (3 marks)

Let $A(x, y)$

$$\frac{n}{m + n}\mathbf{a} + \frac{m}{m + n}\mathbf{b} = \text{Point}$$

$$\frac{5}{8}\begin{pmatrix} x \\ y \end{pmatrix} + \frac{3}{8}\begin{pmatrix} 6 \\ -5 \end{pmatrix} = \begin{pmatrix} -3 \\ 4 \end{pmatrix} \checkmark \text{ M1}$$

$$\begin{pmatrix} \frac{5}{8}x \\ \frac{5}{8}y \end{pmatrix} + \begin{pmatrix} \frac{18}{8} \\ \frac{-15}{8} \end{pmatrix} = \begin{pmatrix} -3 \\ 4 \end{pmatrix}$$

$$\begin{pmatrix} \frac{5}{8}x \\ \frac{5}{8}y \end{pmatrix} = \begin{pmatrix} -3 \\ 4 \end{pmatrix} - \begin{pmatrix} \frac{18}{8} \\ \frac{-15}{8} \end{pmatrix}$$

$$\begin{pmatrix} \frac{5}{8}x \\ \frac{5}{8}y \end{pmatrix} = \begin{pmatrix} -\frac{21}{4} \\ \frac{47}{8} \end{pmatrix} \checkmark \text{ M1}$$

Relating corresponding elements;

$$\frac{5}{8}x = -\frac{21}{4}$$

$$x = -8.4$$

$$\frac{5}{8}y = \frac{47}{8}$$

$$y = 9.4$$

$$A(-8.4, 9.4) \checkmark \text{ A1}$$

5. Make x the subject of the formula. (3 marks)

$$\sqrt{y} = r\sqrt{2 - ax^2}$$

Squaring both sides, we have;

$$(\sqrt{y})^2 = \left(r\sqrt{2 - ax^2}\right)^2$$

$$y = r^2(2 - ax^2) \checkmark \text{ M1}$$

$$y = 2r^2 - ar^2x^2$$

$$ar^2x^2 = 2r^2 - y$$

$$x^2 = \frac{2r^2 - y}{ar^2} \checkmark \text{ M1}$$

$$x = \pm\sqrt{\left(\frac{2r^2 - y}{ar^2}\right)} \checkmark \text{ A1}$$

6. Two blends of tea costing sh. 140 and sh. 160 per kg respectively are mixed in the proportion of 2:3 by mass. The mixture is then sold at sh. 240 per kg. Find;

(a) The percentage profit. (2 marks)

Buying price of the mixture;

$$= \frac{(140 \times 2) + (160 \times 3)}{2 + 3} \checkmark \text{ M1}$$

$$= \frac{280 + 480}{5}$$

$$= \text{Khs. } 152$$

Percentage profit;

$$= \left(\frac{240 - 152}{152}\right) \times 100 \checkmark \text{M1}$$

$$= 57.89\%. \checkmark \text{ A1}$$

(b) In what ratio should the two blends be mixed to get a mixture that costs sh. 148 per kg. (2 marks)

Let the ratio mixed be x:y;

$$\frac{(140 \times x) + (160 \times y)}{x + y} = 148 \checkmark \text{M1}$$

$$140x + 160y = 148x + 148y$$

$$140x - 148y = 148y - 160y$$

$$-8x = -12y$$

$$\frac{x}{y} = \frac{12}{8}$$

$$\frac{x}{y} = \frac{3}{2}$$

$$x:y = 3:2 \checkmark \text{ A1}$$

7. Given that $2\cos 3\theta = 3\sin 3\theta$, find the value of θ where $0° \leq \theta \leq 180$ (3 marks)

$$\frac{\sin 3\theta}{\cos 3\theta} = \frac{2}{3}$$

But;

$$\frac{\sin 3\theta}{\cos 3\theta} = \tan 3\theta$$

$$\therefore \tan 3\theta = \frac{2}{3} \checkmark \text{ M1}$$

It is positive,

Therefore it is found in 1st and 3rd quard.

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

$$= 33.69° \checkmark \text{ A1}$$

$$3\theta = 33.69°, 213.69°, 393.69°$$

$$\theta = 11.23°, 71.23°, 131.23°. \checkmark \text{ B1}$$

8. Determine the quartile deviation of the following distribution: (3 marks)

3, 4, 9, 5, 4, 7, 6, 2, 1, 6, 7, 8, 9

Arranging in ascending order, we have;

$$1, 2, \left|\begin{matrix}3,4\\Q_1\end{matrix}\right|, 4, 5, \left|\begin{matrix}6\\Q_2\end{matrix}\right|, 6, 7, \left|\begin{matrix}7,8\\Q_3\end{matrix}\right|, 9, 9$$

$$Q_1 = \frac{3+4}{2}$$

$$= 3.5 \checkmark$$

$$Q_3 = \frac{7+8}{2}$$

$$= 7.5 \checkmark \quad \text{B1----For both Q1 and Q}$$

Quartile deviation;

$$= \frac{7.5 - 3.5}{2} \checkmark \text{ M1}$$

$$= 2. \checkmark \quad \text{A1}$$

9. Under a transformation whose matrix $y = \begin{bmatrix} x-2 & -2 \\ x & x \end{bmatrix}$, a triangle whose area is 13.5 cm² is mapped on a triangle whose area is 54 cm². Find two possible values of x. (3 marks)

$$\text{Det} = \{x(x-2)\} - \{-2x\}$$

$$x^2 - 2x + 2x = \frac{54}{13.5} \checkmark \text{ M1}$$

$$x^2 = 4$$

$$x = \sqrt{4} \checkmark \text{ M1}$$

$$x = \pm 2$$

$$x = 2 \text{ or } x = -2. \checkmark \quad \text{A1----For both}$$

10. Find a quadratic equation whose roots are $2+\sqrt{3}$ and $2-\sqrt{3}$, expressing it in the form $ax^2+bx+c=0$, where a, b and c are integers. (3 marks)

$x = 2+\sqrt{3}$ or $x = 2-\sqrt{3}$

$\{x-(2+\sqrt{3})\}\{x-(2-\sqrt{3})\} = 0$ ✓ M1

$(x-2-\sqrt{3})(x-2+\sqrt{3}) = 0$

$x(x-2+\sqrt{3}) - 2(x-2+\sqrt{3}) - \sqrt{3}(x-2+\sqrt{3})$

$x^2 - 2x + x\sqrt{3} - 2x + 4 - 2\sqrt{3} - x\sqrt{3} + 2\sqrt{3} + 3 = 0$

$x^2 - 2x - 2x + 4 - 3 = 0$ ✓ M1

$x^2 - 4x + 1 = 0.$ ✓ A1

11. A sum of sh. 6000 is invested at 8% p. a. compound interest. After how long will this sum amount to sh. 9350? (Give the answer to the nearest month). (3 marks)

$A = P\left(1+\frac{R}{100}\right)^n$

$6000\left(1+\frac{8}{100}\right)^n = 9350$ ✓ M1

$(1.08)^n = 1.5583$

Introducing Log on both sides, we have;

$\log(1.08)^n = \log 1.5583$

$n \log 1.08 = \log 1.5583$

$n = \frac{\log 1.5583}{\log 1.08}$ ✓ M1

$= 5.7639$ years

$= 69$ Months ✓ A1

12. Find the radius and centre of a circle whose equation is $3x^2 + 3y^2 + 18y - 12x - 9 = 0$. (3 marks)

Dividing through by 3, we have;

$x^2 + y^2 + 6y - 4x = 3$

$x^2 - 4x + y^2 + 6y = 3$

By completing square method, we have;

$x^2 - 4x + \left(-\frac{4}{2}\right)^2 + y^2 + 6y + \left(\frac{6}{2}\right)^2 = 3 + \left(-\frac{4}{2}\right)^2 + \left(\frac{6}{2}\right)^2$ ✓M1

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

$(x-2)^2 + (y+3)^2 = 16$ ✓ M1

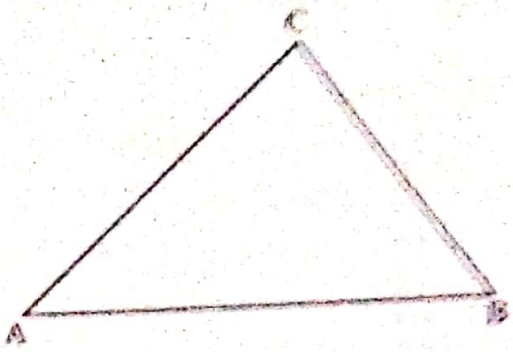
$(x-a)^2 + (y-b)^2 = r^2$

$r = |\sqrt{16}|$

$r = 4$units

Centre$(2, -3)$. ✓ A1 --for both Radius and centre

13. The figure below shows triangle ABC



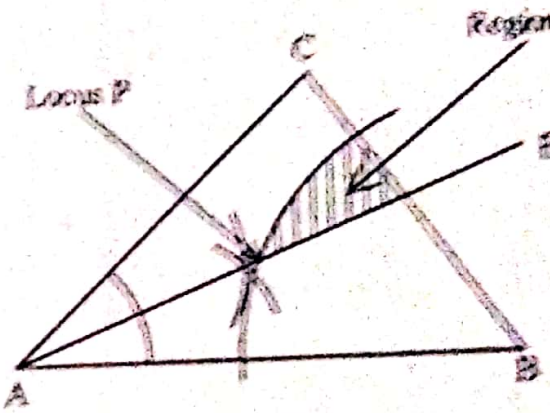
On the diagram;

(a) Construct the locus of a point P such that it is equidistant from lines AC and AB, and 3.5 cm from point B. (2 marks)

Construct angle bisector of < BAC

Draw an arc of length 3.5 cm from B

Intersecting sides BC and BA inside ΔABC.



B1—bisector a
arc 3.5 cm
from B.

B1—For locu

(b) Shade the region X to represent all points such that < CAX ≤< BAX and BX ≤ 3.5 cm (1 mark)

B1—for region X identified

14. Two taps A and B, when opened at the same time can fill a tank in 3 hours 36 minutes. Tap A working alone takes 3 hours longer than tap B to fill the tank. How many hours does it take tap A alone to fill the tank? (3 marks)

Let Tap A take x hrs

Let Tap B take y hrs

Tap B = (x − 3)hrs

Part of the tank filled by Tap A in 1 hr $= \frac{1}{x}$

Part of the tank filled by Tap B in 1 hr

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

Part of the tank filled by both taps in 1 hr;

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

$= \frac{x-3+x}{x(x-3)}$

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

Time taken to fill full tank:

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

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

$$\frac{x^2-3x}{2x-3} = 3\frac{3}{5} \checkmark \text{ M1}$$

$$\frac{x^2-3x}{2x-3} = \frac{18}{5}$$

Cross – multiplying;

$$5(x^2-3x) = 18(2x-3)$$

$$5x^2 - 15x = 36x - 54$$

$$5x^2 - 15x - 36x + 54 = 0$$

$$5x^2 - 51x + 54 = 0$$

$$x = \frac{51 \pm \sqrt{2601 - 1080}}{10} \checkmark \text{ M1}$$

$$x = \frac{51 \pm 39}{10}$$

$$x = \frac{90}{10}$$

$$= 9 \text{ hrs}$$

or

$$x = \frac{12}{10}$$

$$= 1\text{hr } 12 \text{ min}$$

But $x \neq 1$ hr 12 mini.

Therefore;

$x = 9$ hrs. ✓ A1

15. A model of the globe representing the earth has a radius of 0.2 m. Points A and B are located at (60°N, 140°E) and (60°N, 120°W) respectively. If O is the centre of the latitude 60°N. Find the area of the minor sector OBA in square metres (m^2). (3 marks)

Lonitude difference;

$$= 140° + 120°$$

$$= 260°$$

For minor sector, the required angle will be;

$360° - 260° = 100°$ ✓ B1

$$\text{Area} = \frac{\theta}{360} \pi r^2$$

But $r = R\cos\alpha$

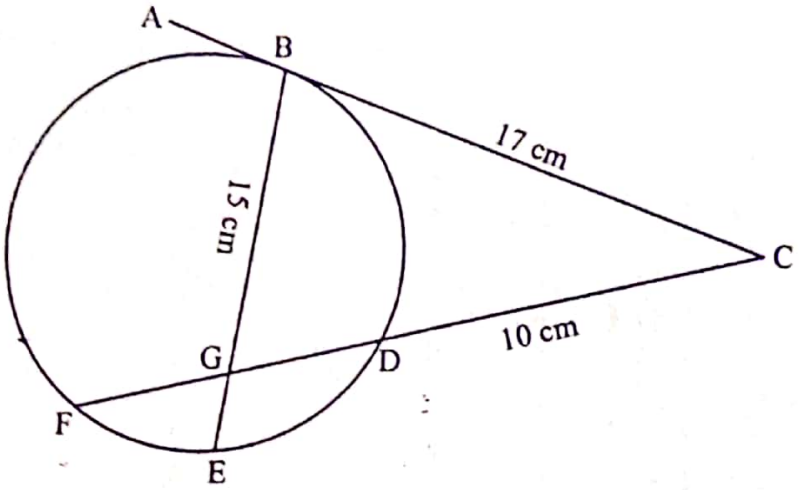
$$r = 0.2\cos 60°$$

$$= 0.1 \text{ m}$$

$$A = \frac{100}{360} \times \frac{22}{7} \times 0.1 \times 0.1 \checkmark \text{M1}$$

$= 0.0087302 \text{ m}^2$. ✓ A1

16. In the figure below, ABC is a tangent to the circle BDEF at B. BC = 17 cm, DC = 10 cm and BG = 15 cm. Chord FD intersects chord BE at G and FG: GD = 1: 5.



Find the length of:

(a) GD. (2 marks)

$(BC)^2 = FC \times DC$

$17^2 = (10 + x) \times 10$ ✓ M1

$289 = 100 + 10x$

$10x = 189$

$x = 18.9$

$GD = \frac{5}{6} \times 18.9$

$= 15.75$ cm. ✓ A1

(b) GE. (2 marks)

$FG \times GD = BG \times GE$

$FG = \frac{1}{6} \times 18.9$

$= 3.15$

$(3.15)(15.75) = 15 \times x$ ✓ M1

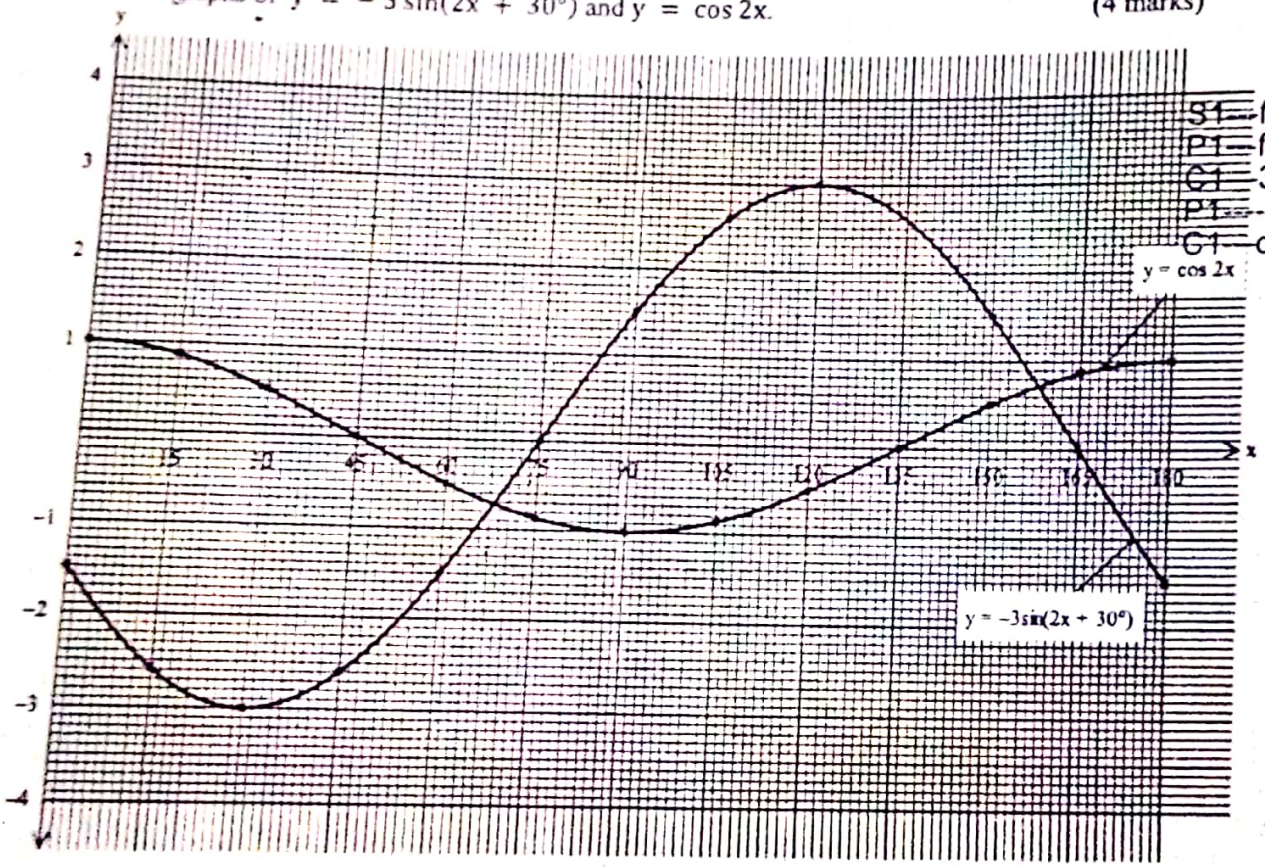
$x = \frac{3.15 \times 15.75}{15}$

$= 3.3075$ cm ✓ A1

18. a) Given the functions $y = -3\sin(2x + 30°)$ and $y = \cos 2x$, complete the table below for x values in the range $0° \leq x \leq 180°$. (2 marks)

$x°$	0	15	30	45	60	75	90	105	120	135	150	165	180
$-3\sin(2x + 30°)$	−1.5	−2.60	−3.0	−2.60	−1.5	0.0	1.5	2.60	3	2.60	1.5	0	−1.5
$\cos 2x$	1	0.87	0.5	0	−0.5	−0.87	−1	−0.87	−0.5	0	0.5	0.87	1.0

(b) Using the scale horizontal axis: 1cm represent 15°, vertical axis 1cm represent 1 unit, draw the graphs of $y = -3\sin(2x + 30°)$ and $y = \cos 2x$. (4 marks)



S1—for scale
P1—for 3sin(2x+3
C1—3sin(2x+30)
P1—cos2x
C1—cos2x

(c) Use your graph to solve the equation $\cos 2x + 3\sin(2x + 30°) = 0$. (1 mark)

Checking where the graph intersects, we have; | $x = 60.1°$ and $158.1°$ ✓ B1

(d) Using the graph above or otherwise, find:

(i) Amplitude of $y = -3\sin(2x + 30°)$ (1 mark)

Amplitude = 3 ✓ B1

(ii) Period and phase of the curve $y = -3\sin(2x + 30°)$ (1 mark)

Period $= \frac{360}{2}$ | $= 180°$ | Phase angle = 30° ✓

B1—Both

14. The table shows income tax rates.

Monthly taxable pay in sh.	Rate of tax in sh. Per KE
1 – – – – – 17400	2
17401 – – – – – 34600	3
34601 – – – – – 51800	4
51801 – – – – – 69000	5
69001 and above	5

Kamau earns monthly basic salary of ksh. 45000. He was given taxable allowances amounting to ksh. 20480 per month.

(a) Calculate Kamau's income tax per month. (4 marks)

Taxable income;

= 45,000 + 20,480
= Ksh. 65,480 p.m

1^{st} tax = $17400 \times \frac{2}{20}$
= Ksh. 1740 p.m.

2^{nd} tax = $17200 \times \frac{3}{20}$
Ksh. 2580 p.m.

3^{rd} tax = $17200 \times \frac{4}{20}$ ✓
Ksh. 3440 p.m.
M1—Exp First 3 slabs

Remaining tax = $13680 \times \frac{5}{20}$ ✓ M1
= Ksh. 3420 p.m
Income tax;
= 1740 + 2580 + 3440 + 3420 ✓ M1
= Ksh. 11180 p.m. ✓ A1

(b) Kamau is entitled a personal relief of sh. 1162 per month. Determine his net income per month. (2 marks)

= Income tax – Relief
= 11180 – 1162 ✓ M1

= Ksh. 10018 p.m. ✓ A1

(c) Kamau received a 50% increase on his basic salary. Calculate the corresponding percentage increase on his income tax. (4 marks)

New basic salary;

$= \frac{150}{100} \times 45000$

= Ksh. 67500 p.m.

New taxable income;

= 67500 + 20480

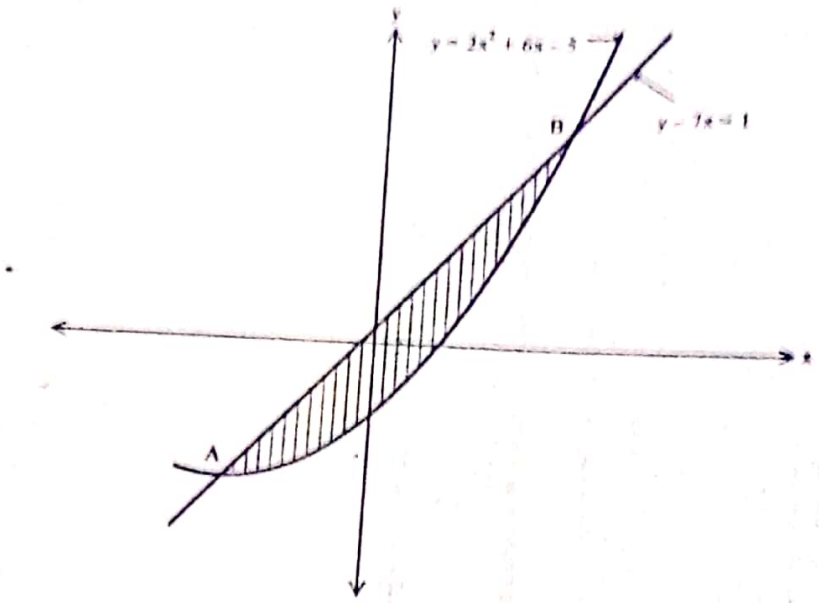
= Ksh. 87980

4^{th} tax = $17200 \times \frac{5}{20}$
Ksh. 4300 p.m.

Remaining tax = $18980 \times \frac{6}{20}$ ✓ M1
= Ksh. 5694 p.m
Income tax;
= 1740 + 2580 + 3440 + 4300 + 5694
= Ksh. 17754 p.m. ✓ A1

$\% = \left(\frac{17754 - 11180}{11180}\right) 100$ ✓ M1
= 58.80% ✓ A1

20. The diagram below shows the sketch of the curve $y = 2x^2 + 6x - 5$ and the line $y = 7x + 1$. The lines intersects the curve at points A and B as shown



(a) Find the coordinates of A and B. (2 marks)

At intersection, equations are equal;

From $y = 1 + 7x$ and $y = 2x^2 + 6x - 5$

$2x^2 + 6x - 5 = 1 + 7x$ ✓ M1

$2x^2 - x - 6 = 0$

$x = \frac{1 \pm \sqrt{1 + 48}}{4}$

$x = \frac{1 \pm 7}{4}$

$x = 2$ or $x = -1.5$

At $x = 2$

$y = 1 + 7(2)$

$= 15$

$B(2, 15)$

At $x = -1.5$

$y = 1 + 7(-1.5)$

$y = -9.5$ ✓

$A(-1.5, -9.5)$ A1---For both A & B

(b) Estimate the area of the shaded region using trapezium rule with 8 ordinates. (3 marks)

Number of trapezia;

$= 8 - 1$

$= 7$

$h = \frac{2 - -1.5}{7}$

$= \frac{2 + 1.5}{7}$

$= 0.5$

Let $y_1 = 2x^2 + 6x - 5$

Let $y_2 = 7x + 1$

x	-1.5	-1	-0.5	0	0.5	1	1.5	2
y_1	-9.5	-9	-7.5	-5	-1.5	3	8.5	15
y_2	-9.5	-6	-2.5	1	4.5	8	11.5	15
$\lvert y_1 - y_2 \rvert$	0	3	5	6	6	5	3	0

✓ B1

$$\text{Area} = \frac{h}{2}\{(\text{Sum of ends}) + 2(\text{Sum of middles})\}$$

$$= \frac{0.5}{2}\{(0+0) + 2(3+5+6+6+5+3)\}$$ ✓ M1

$$= \frac{0.5}{2} \times 56$$

$$= 14 \text{ sq. units}$$ ✓ A1

(c) By integration, determine the area of the shaded region. (3 marks)

$$A = \left\{\int_{-1.5}^{2} (7x+1)\,dx\right\} - \left\{\int_{-1.5}^{2} (2x^2 + 6x - 5)\,dx\right\}$$

$$= \left\{\left[\frac{7x^2}{2} + x\right]_{-1.5}^{2}\right\} - \left\{\left[\frac{2x^2}{3} + 3x - 5x\right]_{-1.5}^{2}\right\}$$ ✓ M1

$$= 9.625 - -4.666$$ ✓ M1

$$= 9.625 + 4.666$$

$$= 14.59 \text{ sq. units.}$$ ✓ A1

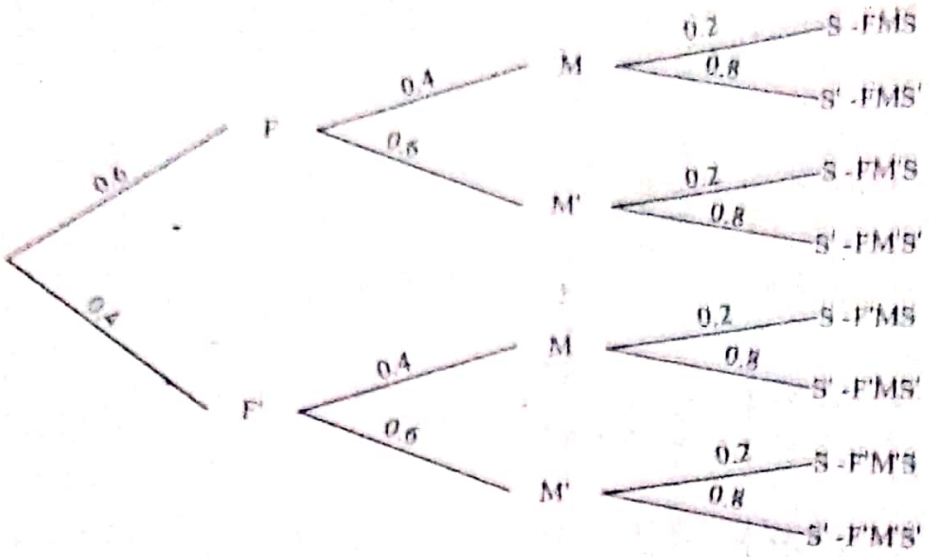
(d) Hence determine the percentage error in the area in (b) above. (2 marks)

$$\left(\frac{|14.29 - 14|}{14.29}\right)100$$ ✓ M1

$$= 2.0408\%$$ ✓ A1

21. A family comprises of a father, a mother and their son. They all compete in a game of darts. In a completion, the probabilits that the father, the mother and the son hit the bull's eye is 0.6, 0.4 and 0.2 respectively. Using a tree diagram or otherwise, find the likelihood that:

(a) The three hit the bull's eye. (2 marks)



P(FMS)

$$= \frac{6}{10} \times \frac{4}{10} \times \frac{2}{10} \checkmark \text{ M1}$$

$$= 0.048. \checkmark \quad \text{A1}$$

(b) None will hit the bull's eye. (2 marks)

$P(F^1M^1S^1)$

$$= \frac{4}{10} \times \frac{6}{10} \times \frac{8}{10} \checkmark \text{M1}$$

$$= 0.192 \checkmark \quad \text{A1}$$

(c) Only one will hit the bull's eye. (2 marks)

$P(FM^1S^1)$ or $P(F^1MS^1)$ or $P(F^1M^1S)$

$$= \left(\frac{6}{10} \times \frac{6}{10} \times \frac{8}{10}\right) + \left(\frac{4}{10} \times \frac{4}{10} \times \frac{8}{10}\right) + \left(\frac{4}{10} \times \frac{6}{10} \times \frac{2}{10}\right) \checkmark \text{ M1}$$

$$= \frac{36}{125} + \frac{16}{125} + \frac{6}{125}$$

$$= 0.464 \checkmark \text{ A1}$$

(d) At least one will hit the bull's eye. (2 marks)

$$1 - P(F^1M^1S^1)$$

$$= 1 - (0.192)\checkmark \quad M1$$

$$= 0.808\checkmark \quad A1$$

(e) At most two will hit the bull's eye. (2 marks)

$$1 - P(FMS)$$

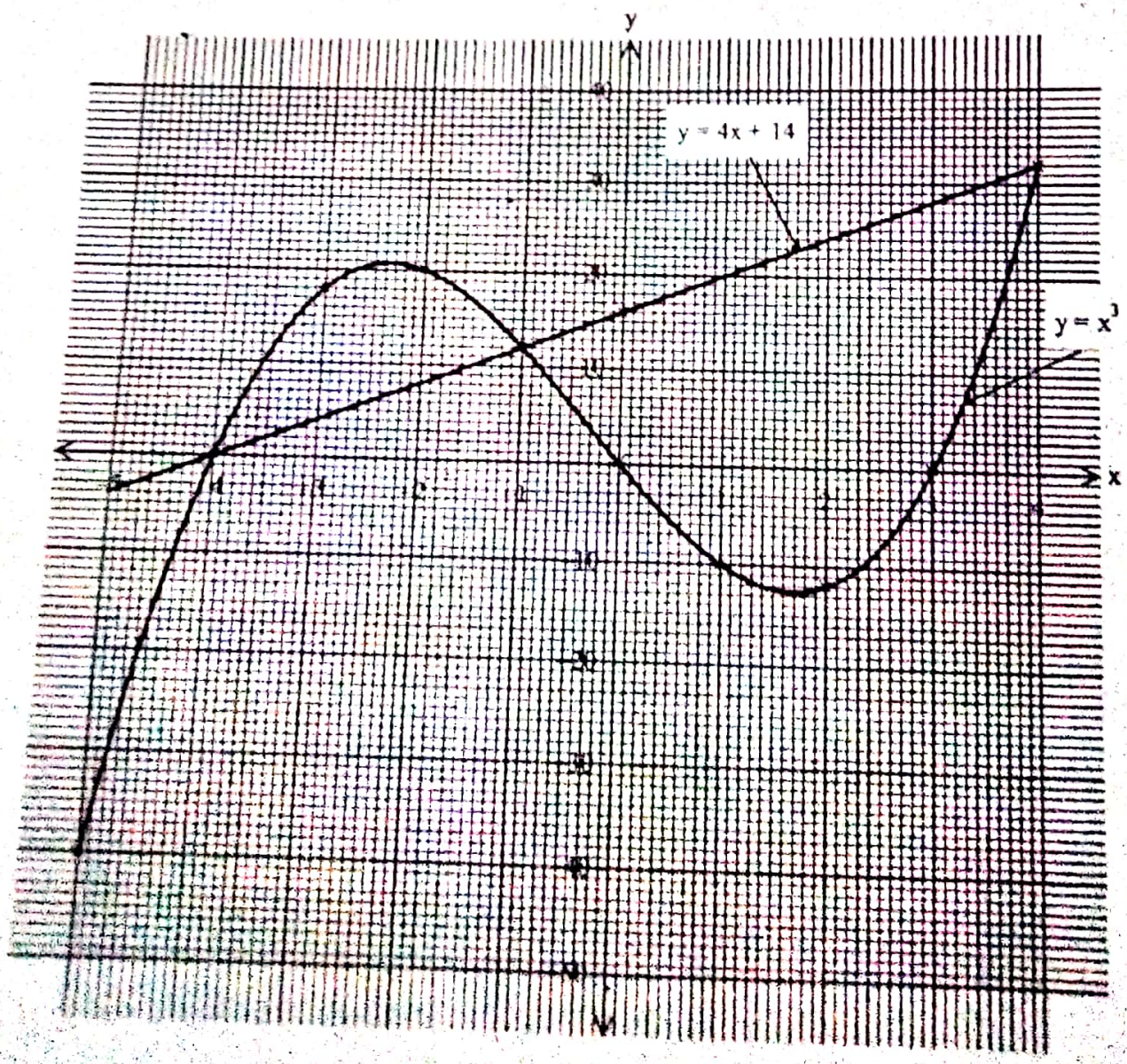
$$= 1 - (0.048)\checkmark \quad M1$$

$$= 0.952\checkmark \quad A1$$

22. a) Complete the table below for the equation $y = x^3 + x^2 - 12x$ for $-5 \leq x \leq 4$. (2 marks)

x	−5	−4	−3	−2	−1	0	1	2	3	4
y	−40	0	18	20	12	0	−10	−12	0	32

(b) Draw the graph of $y = x^3 + x^2 - 12x$. Use a scale of: 1cm rep 1 unit (x − axis) and 1cm rep. 10 units (y − axis) (3 marks)



S1
P1
C1
L1

(c) Using your graph, solve the equations:

(i) $x^3 + x^2 - 12x = 0$ (1 mark)

$$\begin{array}{r} x^3 + x^2 - 12x = y \\ \underline{x^3 + x^2 - 12x = 0} \\ 0 = y \end{array} \quad -$$

Checking where the curve cuts $y = 0$, we have;

$x = -4$ or $x = 0$ or $x = 3$✓ B1

(ii) $2x^3 + 2x^2 - 32x - 32 = 0$ (2 marks)

Dividing through by 2, we have;

$$x^3 + x^2 - 16x - 16 = 0$$

Solving by eliminations, we have;

$$\begin{array}{r} x^3 + x^2 - 12x + 0 = y \\ \underline{x^3 + x^2 - 16x - 16 = 0} \\ 4x + 16 = y \end{array} \quad -$$

x	0	−4
y	16	0

$x = -4$ or $x = 1$ or $x = 4$.✓ B1

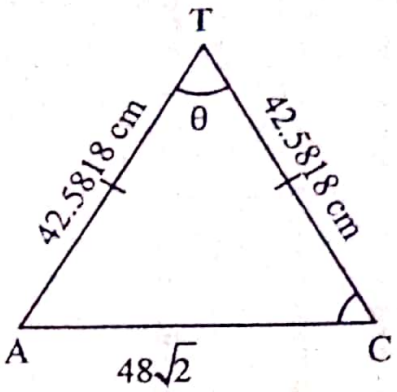
(iii) State the maximum and minimum turning points of the curve (2 marks)

Maximum turning point is;

$(-2.4, 20.8)$✓ B1

Minimum turing point is;

$(1.7, -12.6)$✓ B1



$$(48\sqrt{2})^2 = (42.5818)^2 + (42.5818)^2 - 2(42.5818 \times 42.5818)\cos T \checkmark \text{ M1}$$

$$981.58 = -2(42.5818)^2 \cos T$$

$$\cos T = -0.270674 \checkmark \text{ M1}$$

$< ATC$ is obtuse therefore it is in 2^{nd} quard.

$$< T = \cos^{-1}(-0.270674)$$

$$= 105.704$$

$$= 106°. \checkmark \text{ A1}$$

24. A famine relief food agent has to transport 900 bags of maize and beans from the city to one of the distributing centres. He intends to use trucks which can carry 150 bags at a time and vans which can carry 60 bags at a time. The cost of running a truck for the journey is sh 5000 while that of running a van is sh 4000. The agent has a maximum of sh 44000 to spend. Let x represents the number of trucks and y represents the number of vans used.

(a) Write down all the inequalities to represent the above information. (3 marks)

$60x + 150y \geq 900$ ✓ B1

$4000x + 5000y \leq 44000$ ✓ B1

$x \geq 0$ ✓ B1

(b) Represent the inequalities in (a) graphically. (4 marks)

$60x + 150y \geq 900$

$-2x + 5y \geq 60$

x	3	10
y	6	2

$4000x + 5000y \leq 44000$

$4x + 5y \leq 44$

x	6	8.5
y	4	2