SUCCESS PATH JOINT EXAM

2026 MARCH/APRIL EXAMINATION

Kenya Certificate of Secondary Education

MS

121 / 2 - Mathematics Paper 2 (Alt. A)	NAME..
Term 1 March / April, 2026	ADM No..........................
8.00 a.m. - 10.30 a.m.	Signature..

Instructions to candidates

a) *Write your **Index Number** and **sign** in the spaces provided above*

b) *This paper consists of **two** sections. **Section I** and **Section II***

c) *Answer all the questions in **Section I** and only **five** questions from **Section II**.*

d) ***Show all the steps in your calculations, giving your answers at each stage in the spaces provided below each question.***

e) *Marks may be given for correct working even if the answer is wrong*

f) ***Non – programmable** silent electronic calculators and KNEC Mathematical tables may be used, except where stated otherwise.*

g) ***This paper consists of 15 printed pages.***

h) ***Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.***

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

17	18	19	20	21	22	23	24	Total

Grand Total

SECTION I (50 marks)

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

1 Given that $P = 4 + \sqrt{2}$ and $Q = 2 + \sqrt{2}$ and that $\frac{P}{Q} = a + b\sqrt{c}$ where a, b, and c are constants, find the values of a, b and c (3 marks)

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

$\frac{4(2-\sqrt{2})+\sqrt{2}(2-\sqrt{2})}{4-2}$

$\frac{8-4\sqrt{2}+2\sqrt{2}-2}{2}$

$\frac{6-2\sqrt{2}}{2}$

$= 3-\sqrt{2}$

2 Solve the equation $4\sin^2 x + 4\cos x = 5$ for $0^\circ \le x \le 360^\circ$, leaving your answer in degrees. (4 marks)

$4(1-\cos^2 x)+4\cos x=5$

$4-4\cos^2 x+4\cos x=5$

$4y^2-4y=-1$

$4y^2-4y+1=0$

$P=4$
$S=-4$ $\}$ $-2, -2$

$(4y^2-2y)-(2y+1)=0$

$2y(2y-1)-1(2y-1)=0$

$(2y-1)(2y-1)=0$

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

$\cos^{-1}(\frac{1}{2})=30^\circ$

$30^\circ, 300^\circ$

3 Make a the subject of the formula; $R = h\sqrt{y^2 - a^2}$ (3 marks)

$R^2 = h^2(y^2-a^2)$

$R^2 = h^2y^2 - h^2a^2$

$\frac{h^2a^2}{h^2} = \frac{h^2y^2-R^2}{h^2}$

$a^2 = y^2 - \frac{R^2}{h^2}$

$a = \sqrt{y^2 - \frac{R^2}{h^2}}$

Use completing the square method to solve the equation: $4-3x-2x^2=0$ (3 marks)

$$\frac{2x^2}{2}+\frac{3x}{2}=\frac{4}{2}$$
$$x^2+\tfrac{3}{2}x=2$$
$$x^2+\tfrac{3}{2}x+\left(\tfrac{3}{4}\right)^2=2+\left(\tfrac{3}{4}\right)^2$$
$$\left(x+\tfrac{3}{4}\right)^2=2+\tfrac{9}{16}$$
$$\left(x+\tfrac{3}{4}\right)^2=\tfrac{41}{16}$$
$$x+\tfrac{3}{4}=\pm\sqrt{\tfrac{41}{16}}$$
$$x+0.75=\pm 1.6$$
$$x=1.6-0.75 \text{ or } -1.6-0.75.$$
$$=\underline{0.85} \text{ or } -\underline{2.35}$$

5 (a) Expand $(1+2x)^5$ to the fifth term (1 mark)

$$1^5+5(1)^4(2x)+10(1)^3(2x)^2+10(1)^2(2x)^3+(5)(1)^1(2x)^4$$
$$\underline{1+10x+40x^2+80x^3+80x^4.}$$

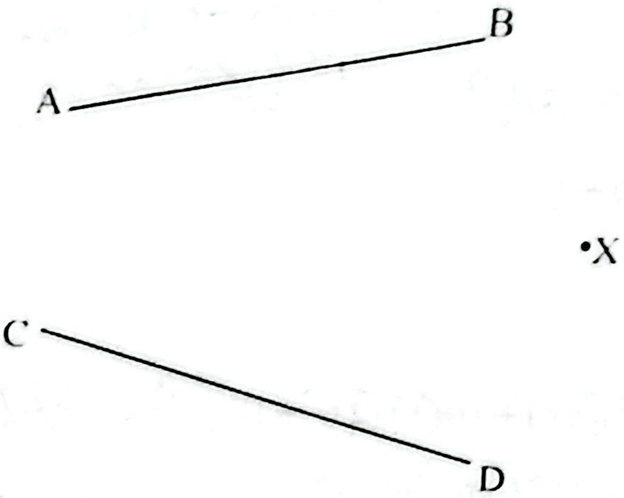
(b) Hence evaluate $(1.02)^5$ correct to 3 decimal places. (2 marks)

$$1+2x=1.02$$
$$2x=0.02$$
$$x=0.01$$
$$1+10(0.01)+40(0.01)^2+80(0.01)^3+80(0.01)^4.$$
$$1+0.1+0.004+0.00008+0.0000008$$
$$=\underline{1.104}$$

6 A man borrowed some money at an interest rate of 20% p.a to start a business. If he paid Kshs 850 000 after one year how much did he borrow? (3 marks)

$$A=P+(P\times r\times t)$$
$$850{,}000=P+0.20P \quad M_1$$
$$850{,}000=1.2P$$
$$P=\frac{850{,}000}{1.2} \quad M_1$$
$$=708{,}333.333.. \quad A_1$$

7 In the diagram below. AB and CD are chords of a circle centre.O. radius r cm passing through
point X.



(a) Construct the circle. Measure its radius, r cm; (3 marks)

(b) Construct the tangent to the circle passing through point X. (1 mark)

8 Solve for x in the equation: $\log\sqrt{x+4} - \log\sqrt{x-4} = \log 12 - \log 4$. (3 marks)

$\log(x+4)^{\frac{1}{2}} - \log(x-4)^{\frac{1}{2}} = \log 12 - \log 4.$

$\log\left(\frac{(x+4)^{\frac{1}{2}}}{(x-4)^{\frac{1}{2}}}\right) = \log\left(\frac{12}{4}\right)$ M1

$\left(\frac{x+4}{x-4}\right)^{\frac{1}{2}} = 3.$

$\cancel{\frac{x+4}{x-4}} = \cancel{\ }$

$\frac{x+4}{x-4} = 9$ M1

$9x - 36 = x + 4.$

$\frac{8x}{8} = \frac{40}{8}$

$x = 5$ A1

If $(x-4)^2 + y^2 = 5$ is the equation of the circle, find the centre and radius of the circle. (2 marks)

$\cancel{x^2-8x+16+y^2=5}$.

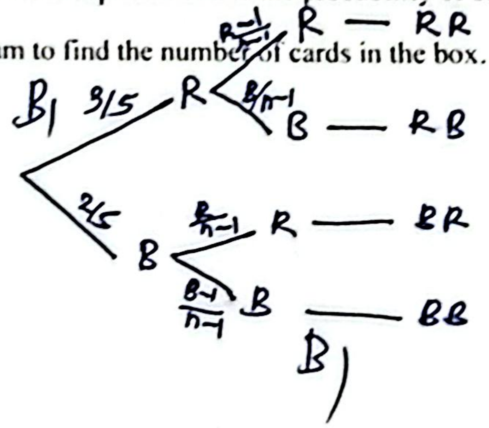
$(x-4)^2 + (y-0)^2 = 5.$

$r = \sqrt{5}$

$= 2.236$ units. B1

Centre $= (4, 0)$ B1

10 A box contains red and blue cards only, in the ratio $3:2$ respectively. Two cards are selected from the box without replacement. If the probability of selecting cards of different colors is $\frac{1}{2}$. Use tree diagram to find the number of cards in the box. (4 marks)



$P(RB) + P(BR) = \frac{1}{2}.$ M1

$\left(\frac{3}{5} \times \frac{2k}{5k-1}\right) + \left(\frac{2}{5} \times \frac{3k}{5k-1}\right) = \frac{1}{2}.$

$\frac{6k}{5(5k-1)} + \frac{6k}{5(5k-1)} = \frac{1}{2}.$

$\frac{12k}{25k-5} = \frac{1}{2}.$

$24k = 25k - 5.$

$5 = 25k - 24k.$

$k = 5$

$\Rightarrow 5 \times 5 = 25$ cards. A1

11 In a transformation, an object with an area $5a^2$ cm^2 is mapped onto an image whose area is $30a^2$ cm^2. Given that the matrix of transformation is $\begin{pmatrix} a & a-1 \\ 2 & 4 \end{pmatrix}$, find the value of a. (3 marks)

$4a - 2(a-1) = \frac{30a^2}{5a^2}.$ B1

$4a - 2a + 2 = 6$ M1

$\frac{2a}{2} = \frac{4}{2}.$

$a = 2$ A1

12 The data below shows numbers written by pupils during CBC training are 2, 6, y, 3, 5 and the mean 3. Calculate the value of y hence find the semi-interquartile range of the data. (4 ma

$\frac{2+6+y+3+5}{5} = 3$ B

$\frac{16+y}{5} = 3$

$16+y = 15$

$y = -1$ B1

~~-1, 3, 5,~~

$-1, 2, 3, 5, 6$ B1

$Q_1 = \frac{2+-1}{2}$

$= 0.5$

$Q_3 = \frac{5+6}{2}$

$= 5.5$

Q_1, Q_3 B1

$\frac{Q_3 - Q_1}{2}$

$= \frac{5.5 - 0.5}{2}$

$= \frac{5}{2}$

$= 2.5$ A1

13 The cost per kg of Sony sugar is Shs.230 and the cost per kg of Sukaris from Riat is Shs. Y. The two brands of sugar are mixed in the ratio $2:1$ and sold at Shs.240 per kg, determine the value of Y? (3 marks)

~~Sony sugar~~ =

$\frac{2 \times 230 + y}{2+1} = 240$ M1

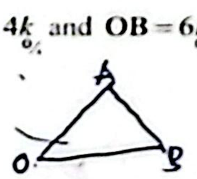
$\frac{460+y}{3} = 240$

$460 + y = 720$ M1

$y = 720 - 460$

$y = \underline{\underline{260}}$ A1

14 Given that O is the origin, $\mathbf{OA} = 8\underset{\sim}{i} + 9\underset{\sim}{j} - 4\underset{\sim}{k}$ and $\mathbf{OB} = 6\underset{\sim}{i} + 11\underset{\sim}{j} + 2\underset{\sim}{k}$. If R divides AB externally in the ratio 3:1, find $|\mathbf{OR}|$. (3 marks)



$\vec{r} = \frac{m\vec{b} - n\vec{a}}{m-n}$

$= \frac{3(6i+11j+2k) - 1(8i+9j-4k)}{3-1}$ M1

$\frac{18i+33j+6k-8i-9j+4k}{2}$

$\frac{10i+24j+10k}{2}$ M1

$\vec{OR} = 5i+12j+5k$ M1

$|OR| = \sqrt{5^2+12^2+5^2}$

$= \sqrt{194}$

$= 13.928$ units A1

In a geometric progression , the sum of the first and the fourth terms is −1575 while the sum of the third and the sixth terms is −25200, find the possible value of the common difference. (3 marks)

$a + ar^3 = -1575$

$a(1+r^3) = -1575$

$ar^2 + ar^5 = -25200$ M1

$ar^2(1+r^3) = -25200$

$\frac{ar^2(1+r^3)}{a(1+r^3)} = \frac{-25200}{-1575}$

$r^2 = 16$. M1

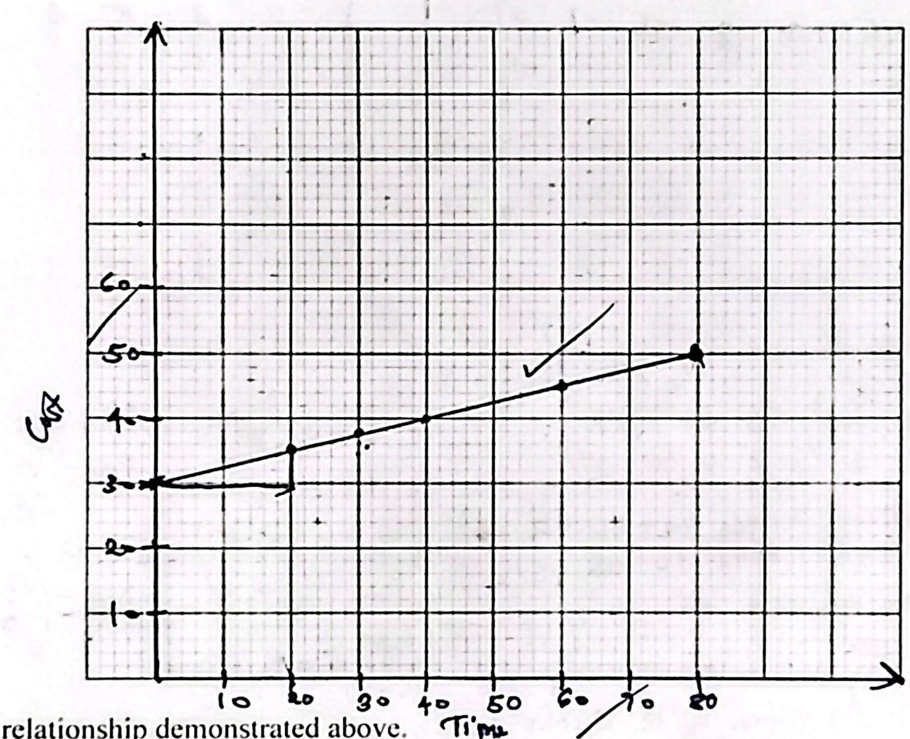
$r = \sqrt{16}$

$r = \pm 4$ A1

16 The table below shows the cost of call rates per time(minutes)

Cost (Kshs)	30	35	38	40	45	50
Time (Mins)	0	20	30	40	60	80

(a) On the grid below, 1cm to represent 10 units on both axes, plot the graph of cost of call rates against time(mins); (2 marks)



(b) Find the relationship demonstrated above. (2 marks)

$M = \frac{35-30}{20-0}$

$= \frac{5}{20}$

$= 0.25$

$c = mt + c$

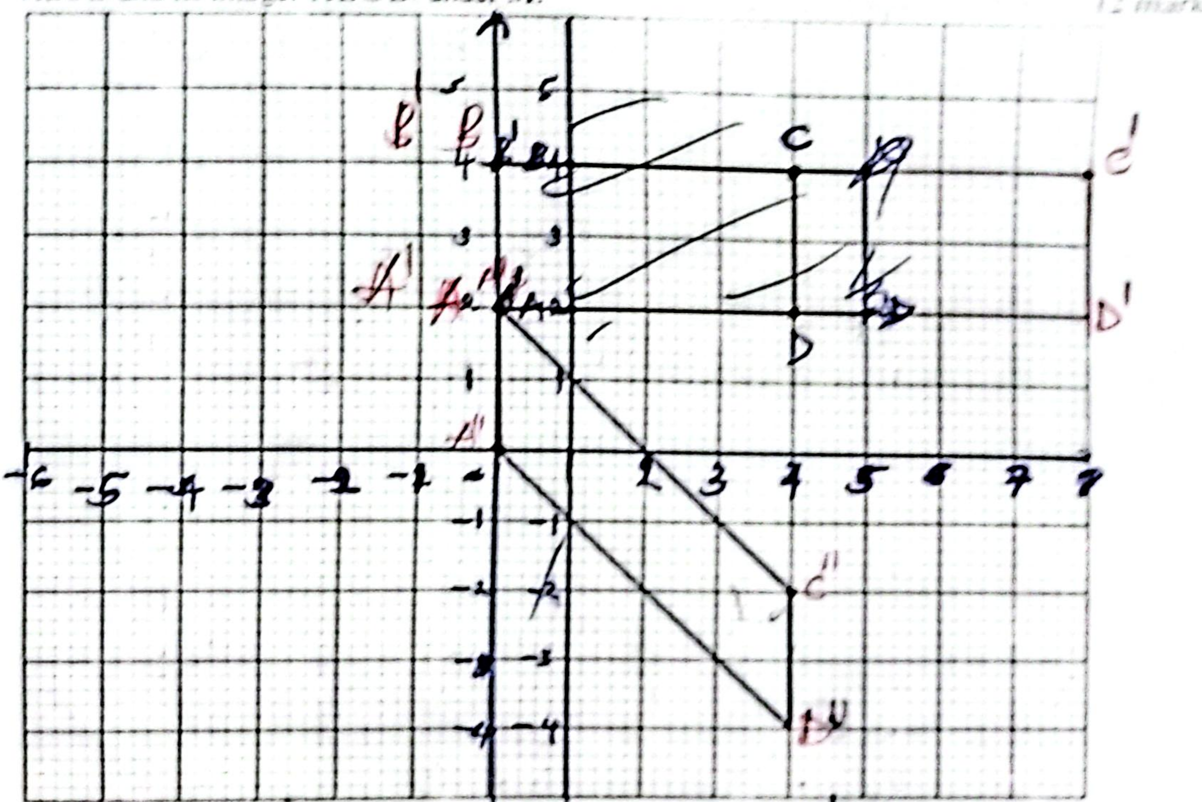
$c = 0.25t + 30$

SECTION II (50 Marks)

Answer any five questions from this section in the spaces provided

17 The vertices of a rectangle ABCD are $A(0,2)$, $B(0,4)$, $C(4,4)$ and $D(4,2)$. The vertices of its image under a transformation **M** ar $A'(0,2)$, $B'(0,4)$, $C'(8,4)$ and $D'(8,2)$.

(a) On the grid provided, using a scale of 1 cm to represent 1 unit on both axes, draw the rectangle ABCD and its image, A'B'C'D' under **M**. (2 marks)



(b) Determine the matrix of transformation, **M** (3 marks)

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix}\begin{pmatrix} 0 & 0 & 4 & 4 \\ 2 & 4 & 4 & 2 \end{pmatrix} = \begin{pmatrix} 0 & 0 & 8 & 8 \\ 2 & 4 & 4 & 2 \end{pmatrix}$$

$$\begin{pmatrix} 0+2b & 0+4b & 4a+4b & 4a+2b \\ 0+2d & 0+4d & 4c+4d & 4c+2d \end{pmatrix} = \begin{pmatrix} 0 & 0 & 8 & 8 \\ 2 & 4 & 4 & 2 \end{pmatrix}$$

$0+2b=0$
$2b=0$ | $b=0$ | $4a+0=8$, $a=2$ | $0+2d=2$, $d=1$

$4c+4=4$
$4c=0$
$c=0$

$M=\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$

(c) Describe fully the transformation **M**. (2 marks)

A stretch, with scale factor 2 and invariant line y-axis.

(d) On the same grid as in (a) above, draw the image of rectangle ABCD under a shear with line $x=-2$ invariant and $A(0,2)$ is mapped onto $A''(0,0)$. (3 marks)

$y''=y-1(x+2)$ and $x''=x$.

$B(0,4) \rightarrow B''(0,2)$

$C(4,4) \rightarrow C''(4,-2)$

$D(4,2) \rightarrow D''(4,-4)$

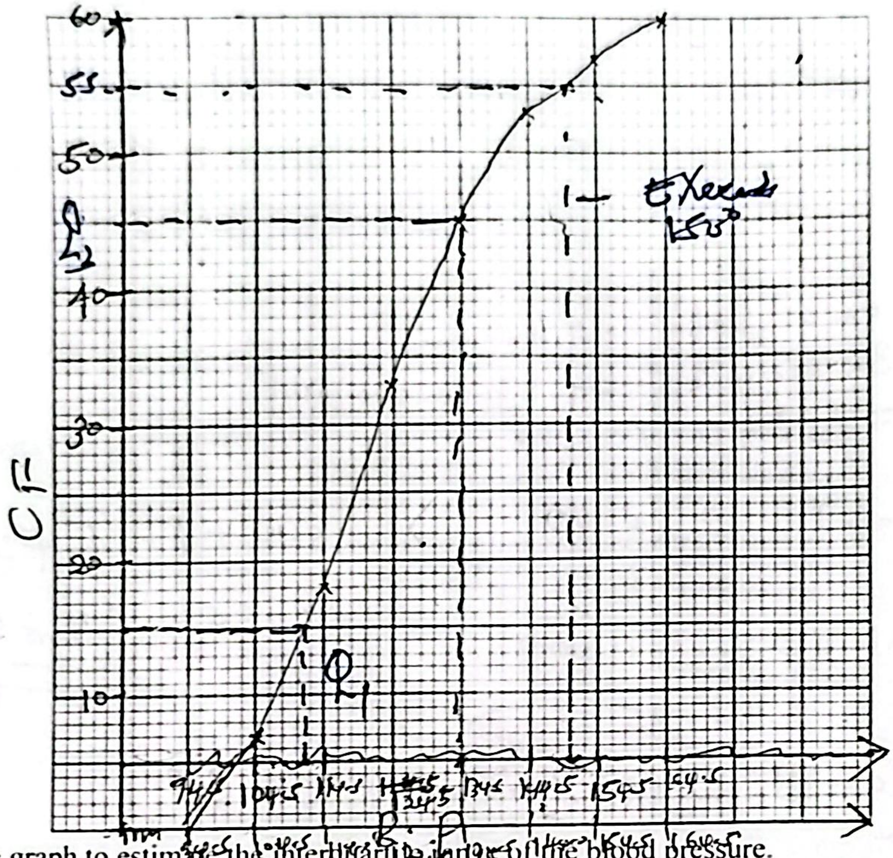
$A(0,2) \rightarrow A''(0,0)$

0.5×20

The systolic blood pressure of 60 patients attending a clinic was recorded as follows.

Blood pressure	95 – 104	105 – 114	115 – 124	125 – 134	135 – 144	145 – 154	155 – 164
Number of patients	7	11	15	12	8	4	3
CF	7	18	33	45	53	57	60

(a) On the grid provided, draw an ogive that represents the above information. (4 marks)



$0.5 \times 20 = 10$

0.2×5

(b) Use the graph to estimate the interquartile range of the blood pressure. (3 marks)

$Q_1 = \frac{1}{4}N$

$= \frac{1}{4} \times 60$

$= 15^{th}$

$Q_3 = \frac{3}{4} \times 60$

$= 45^{th}$

$= 134.5 - 111.50$

$= \underline{23.0 \pm 0.5}$

(c) Determine the percentage of patients whose blood pressure exceeds 150. (3 marks)

$60 - 55$

$= 5$ patients

$\frac{5}{60} \times 100$

$= 8.33\%$

0.5 X 20

The systolic blood pressure of 60 patients attending a clinic was recorded as follows:

Blood pressure	95 – 104	105 – 114	115 – 124	125 – 134	135 – 144	145 – 154	155 – 164
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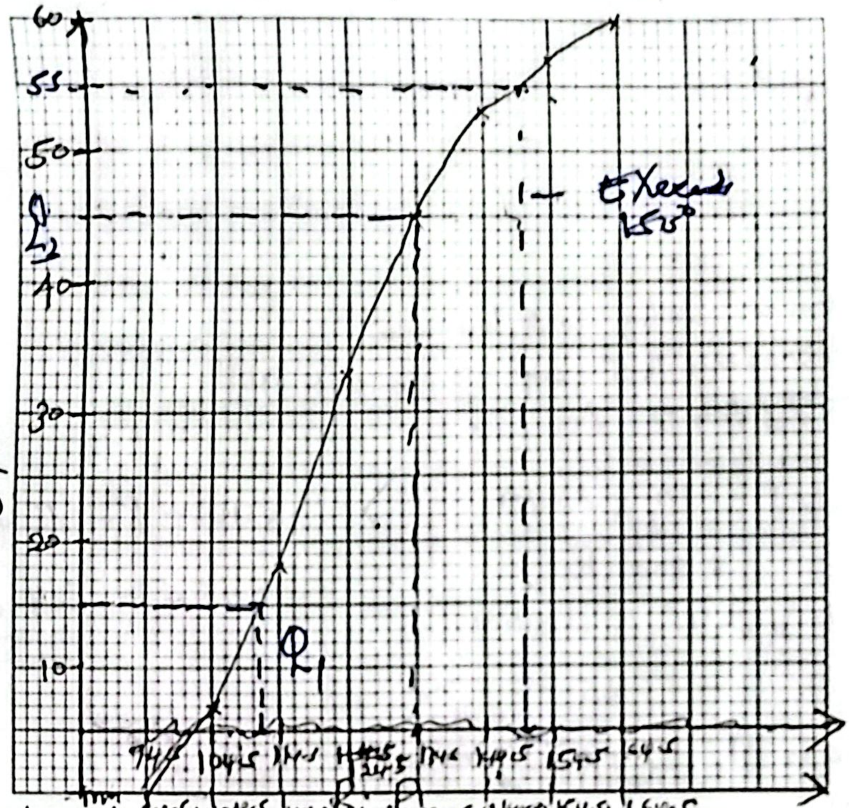


0.5 X 20 = 10

0.2 X 5

(b) Use the graph to estimate the interquartile range of the blood pressure. (3 marks)

$Q_1 = \frac{1}{4}N$
$= \frac{1}{4} \times 60$
$= 15^{th}$

$Q_3 = \frac{3}{4} \times 60$
$= 45^{th}$
$= 134.5 - 111.5$
$= 23.0 \pm 0.5$

(c) Determine the percentage of patients whose blood pressure exceeds 150. (3 marks)

$60 - 55$
$= 5$ patients

$\frac{5}{60} \times 100$
$= 8.33\%$

19 The table below shows the income tax rates for a certain financial year.

Monthly income (in Ksh)	Tax rate in each shilling
10001 – 18000	10%
18001 – 29500	15%
29501 – 39500	20%
39501 – 49600	25%
Above 49600	30%

A civil servant earns a monthly salary of Kshs.32 000. She gets a medical allowance of Kshs.2 540, non – taxable allowance of Kshs.4 550 and a house allowance equal to 40% of her basic salary.

(a) Determine:

(i) Her monthly taxable pay. (2 marks)

Basic Salary + Allowances

$= 32{,}000 + 2540 + \frac{40}{100} \times 32000$ M1

$= 47340$ A1

(ii) Her monthly total tax. (4 marks)

Slab I $= \frac{10}{100} \times 8000$

$= 800$ B1

Slab II $= \frac{15}{100} \times 11500$

$= 1725$

Slab III: $\frac{20}{100} \times 10{,}000$ M1

$= 2000$

Slab (IV) $= \frac{25}{100} \times 7840$

$= 1960$ M1

$800 + 1725 + 2000 + 1960$

$=$ Ksh. $\underline{\underline{6485}}$ A1

(b) Every month, the employee is entitled to:

- A personal relief of Kshs.1,200
- Insurance relief equal to 15% of her monthly insurance premium.

Her monthly insurance premium is Kshs2,500. Calculate;

(i) Her net tax per month. (2 marks)

= Gross tax – (Personal relief + insurance)

$= 6485 - (1200 + \frac{15}{100} \times 2500)$ M1

$6485 - 1575$

$= 4910$ A1

(ii) Her net pay per month. (2 marks)

$47340 + 4550$

$=$ Ksh. 51890

$= 51890 - 7410$ B1

$= 44{,}480$ A1

(a) Miss Claure started working as an accountant in a large law firm in the year 2001. He starting salary was Shs. 40 000 and her contract promised that she will be receiving a pay rise of 5% every year thereafter. Miss Claure plans to retire in 2030. Find to the nearest shillings:

(i) Her salary in the year 2022 and 2030: (4 marks)

$a = 40,000$

$r = 1 + 0.05$

$= 1.05$

For 2022 $T_n = ar^{n-1}$ M1

$T_{22} = 40,000(1.05)^{21}$

$= 40,000(2.78596)$

$= 111,438$ A1

For 230: $n = 30$ M1

$T_{30} = 40,000(1.05)^{29}$

$= 40,000(4.1161)$

$= 164,644$ A1

(ii) Her total earnings in employment for the year 2001 to 2030, inclusive. (3 marks)

$S_n = \frac{a(r^n - 1)}{r-1}$

$S_{30} = \frac{40000(1.05^{30} - 1)}{1.05 - 1}$ M1

$= \frac{40000(3.3219)}{0.05}$ M1

$= 2,657520$ A1

(b) The first four even numbers less than ten are such that the 1st, 2nd and the 4th forming the first three consecutive terms of a geometric sequence. Determine the n^{th} term of the sequence. (3 marks)

$2, 4, 6, 8$ M1

$a = 2$

2^{nd} term $= 4$

3^{rd} term $= 8$

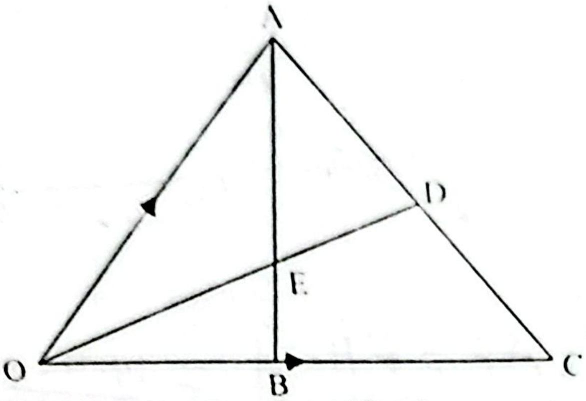
$r = \frac{4}{2} = 2$ or $8/4 = 2$ M1

$T_n = ar^{n-1}$

$T_n = 2(2)^{n-1}$

$= 2^n$ A1

In the figure below, **OA** = **a** and **OB** = **b** $\mathbf{OB} = \frac{2}{5}\mathbf{OC}$. D is the midpoint of **AC** and **AB** intersect **OD** at E.



(a) Express the following vectors in terms of a and b only;

(i) AB (1 mark)

$\vec{AB} = \vec{AO} + \vec{OB}$

$= -a + b$

$= b - a$ B1

(ii) OD (2 marks)

$= \frac{1}{2}(\vec{OA} + \vec{OC})$

$= \frac{1}{2}(a + \frac{5}{2}b)$ M1

$= \frac{1}{2}a + \frac{5}{4}b$ A1

(b) Given further that AE= *k*AB and OE = *h*OD where *k* and *h* are parameters, express OE in two different ways, hence find the values of *k* and *h*; (5 marks)

$\vec{OE} = h(\frac{1}{2}a + \frac{5}{4}b)$

$= \frac{h}{2}a + \frac{5h}{4}b$ --- (i) M1

$\vec{OE} = a + k(b - a)$

$= (1-k)a + kb$ M1 --- (ii)

$1 - k = \frac{h}{2}$

$h = 2 - 2k$ M1

B:

$k = \frac{5h}{4}$

$h = \frac{4k}{5}$.

$2 - 2k = \frac{4k}{5}$.

$10 - 10k = 4k$

$k = 5/7$ A1

$h = 4/5(5/7)$

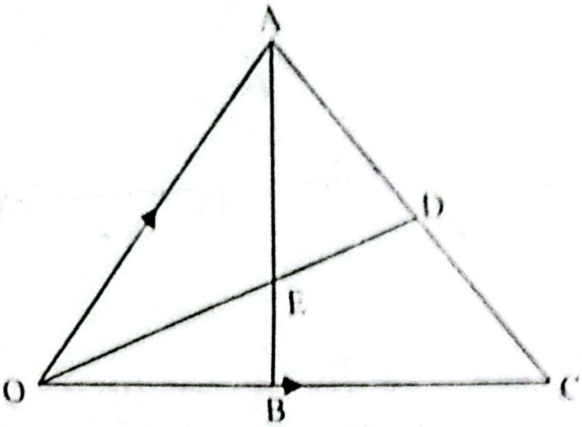
$h = \frac{4}{7}$. A1

(c) State the ratio in which E divides:

(i) AB; (1 mark)

(ii) OD. (1 mark)

In the figure below, $OA = a$ and $OB = b$ $OB = \frac{2}{5}OC$. D is the midpoint of AC and AB intersect OD at E..



(a) Express the following vectors in terms of a and b only:

(i) AB (1 mark)

$\vec{AB} = \vec{AO} + \vec{OB}$

$= -a + b$

$= b - a$ B1

(ii) OD (2 marks)

$= \frac{1}{2}(\vec{OA} + \vec{OC})$

$= \frac{1}{2}(a + \frac{5}{2}b)$ M1

$= \frac{1}{2}a + \frac{5}{4}b$ A1

(b) Given further that $AE = k AB$ and $OE = h OD$ where k and h are parameters, express OE in two different ways, hence find the values of k and h; (5 marks)

$\vec{OE} = h(\frac{1}{2}a + \frac{5}{4}b)$

$= \frac{h}{2}a + \frac{5h}{4}b$ --- (i) M1

$\vec{OE} = a + k(b - a)$

$= (1-k)a + kb$ M1 - (ii)

$1 - k = \frac{h}{2}$

$h = 2 - 2k$ M1

B:

$k = \frac{5h}{4}$

$h = \frac{4k}{5}$.

$2 - 2k = \frac{4k}{5}$.

$10 - 10k = 4k$

$k = 5/7$ A1

$h = 4/5(5/7)$

$h = \frac{4}{7}$. A1

(c) State the ratio in which E divides:

(i) AB; (1 mark)

AE : EB

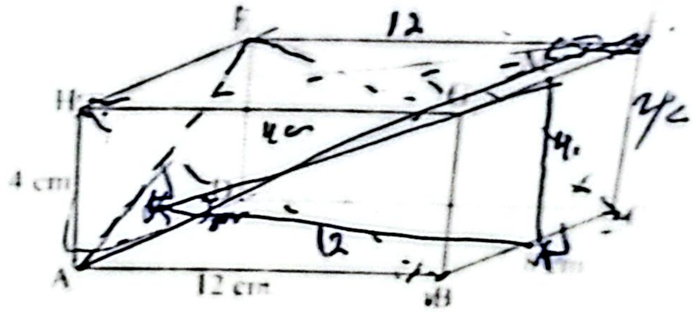
5 : 2

(ii) OD. (1 mark)

$\frac{4}{7}\vec{OE} = \frac{4}{7}\vec{OD}$

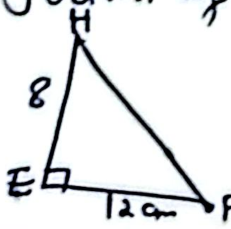
4 : 3 .

23 The figure below shows a cuboid ABCDEFGH. Given that AB = 12cm, BC = 8cm and AH = 4



(a) State and calculate the projection of AF on the plane EFGH. *(3 marks)*

Projection of AF = FH



$= \sqrt{8^2+12^2}$

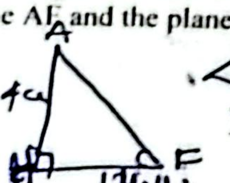
$= \sqrt{64+144}$

$= \sqrt{208}$

$= \underline{\underline{14.42 \text{ cm}}}$

(b) Determine the angle between the:

(i) line AF and the plane EFGH. *(2 marks)*



$\angle AFH$

$\tan\theta = \frac{4}{14.2} = 0.277$

$\tan^{-1}(0.277) = \underline{\underline{15.5°}}$

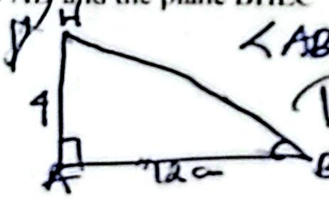
~~= 0.333~~

~~$\tan^{-1}(0.333)$~~

~~= 18.43°~~

$\frac{8 \times 6}{48}$

(ii) line AD and the plane BHEC *(2 marks)*



$\angle ABH$

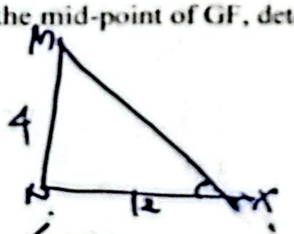
$\tan\theta = \frac{4}{12}$

$= 0.333$

$\tan^{-1}(0.333) = \underline{\underline{18.43°}}$

$\frac{64}{90}$

(c) Given that M is the mid-point of GF, determine the angle between the planes AMD and ABCD. *(3 marks)*



$\angle NXM$

$\tan\theta = \frac{4}{12}$

$= 0.333$

$\tan^{-1}(0.333) = \underline{\underline{18.43°}}$