THE MATHEMATICS GURUS KCSE PREDICTOR SERIES ONE.

Kenya Certificate Of Secondary Education (K.C.S.E.) 2022.

121/2 — MATHEMATICS — Paper 2

ALT A

FORM FOUR

Oct. 2022–$2\frac{1}{2}$ hours

Name......M|SCHEME...................... Index Number:......SERIES ONE.

Candidate's Signature.......................... Date.......................................

Instructions to candidates

(a) Write your name and admission number in the spaces provided above.
(b) Sign and write the date of examination in the spaces provided.
(c) This paper consists of two sections: Section I and Section II.
(d) Answer all questions in section I and only five questions from section II.
(e) **Show all the steps in your calculations, giving the answer at each stage in the spaces provided below each question.**
(f) Marks may be given for correct working even if the answer is wrong.
(g) **Non-programmable silent electronic calculators and KNEC mathematical tables may be used, except where stated otherwise.**
(h) **This paper consists of 18 printed pages.**
(i) **Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**
(j) **Candidates should answer the questions in English.**

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 in the spaces provided.

1. Find x if $(5x-3)^{\log(5x-3)} = 1.232$ (3 marks)

$\log(5x-3)^{\log(5x-3)} = \log 1.232$ ✓M1

$(\log(5x-3))^2 = \pm\sqrt{\log 1.232}$

$\log(5x-3) = 0.3010$ ✓M1

$5x-3 = $ Antilog of 0.3010

$5x-3 = \pm 2$

$5x-3 = 0.5$

$x = 1$

$x = 0.7$ ✓A1

03

2. Without using tables or a calculator, simplify the expression below in the form $a\sqrt{2}+b\sqrt{6}$; (3 marks)

$$\frac{\cos 225}{\sin 150° + \tan 600°}$$

$\cos 225° = -\cos 45°$

$\sin 150° = \sin 30°$

$\tan 600° = \tan 60°$

$\frac{-\cos 45°}{\sin 30° + \tan 60°}$

$-\frac{1}{\sqrt{2}} \div \left(\frac{1+2\sqrt{3}}{2}\right)$ ✓M1

$\frac{-2}{\sqrt{2}+2\sqrt{6}} \times \frac{(\sqrt{2}-2\sqrt{6})}{(\sqrt{2}-2\sqrt{6})}$ ✓M1

$\frac{-2\sqrt{2}+4\sqrt{6}}{2-24}$

$\frac{\sqrt{2}-2\sqrt{6}}{11} \Rightarrow \frac{1}{11}\sqrt{2} - \frac{2}{11}\sqrt{6}$ ✓A1

03

3. Madam Juliana Cherera expands $(a+b)^2$ incorrectly as a^2+b^2. Find her percentage error if a = 8 and b = 12. (3 marks)

Actual expansion

$(8+12)^2 \Rightarrow 400$

Error made from expansion ✓M1

$8^2 + 12^2 = 208$

$\left(\frac{400-208}{400}\right) \times 100\%$ ✓M1

$= \frac{192}{400} \times 100\%$

$= 48\%$ ✓A1

03

4. Given that the coefficient of second last term of the binomial expansion for $\left(\frac{1}{6}+x\right)^n$ is $\frac{3}{2}$, find the n^{th} term of the expansion. (3 marks)

	2nd last	last
	n	1
	$\left(\frac{1}{6}\right)^1$	$\left(\frac{1}{6}\right)^0$
	x^{n-1}	x^n

$n\cdot\left(\frac{1}{6}\right)^1\left(x^{n-1}\right) = \frac{3}{2}x^{n-1}$ ✓M1

$\frac{n}{6} = \frac{3}{2}$ ✓M1

$n^{th} = 9$ ✓A1

03

5. If one of the root of a quadratic equation is $\frac{3}{2}$, find the value of C hence other root of the equation; (3 marks)

$$6x^2 - 11x + C = 0$$

$6\left(\frac{3}{2}\right)^2 - 11\left(\frac{3}{2}\right) + C = 0$

$\frac{27}{2} - \frac{33}{2} + C = 0$

$-3 + C = 0$

$C = 3$ ✓M1

03

$6x^2 - 11x + 3 = 0$

$6x^2 - 9x - 2x + 3 = 0$ ✓M1

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

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

$x = \frac{1}{3}$ or $x = \frac{3}{2}$

$x = \frac{1}{3}$ ✓A1

Alt

Let the other root be b

$\left(x-\frac{3}{2}\right)(x-b) = 0$

$x^2 + \frac{3}{2}b - xb - \frac{3}{2}x = 0$

$x^2 - xb - \frac{3}{2}x + \frac{3}{2}b = 0$

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

$x^2 - \frac{11}{6}x + \frac{C}{6} =$

$x = \frac{1}{3}, C = 3$

03

6. Make n the subject of the formula; (3 marks)

$$A = \frac{PR(T)^n}{T}$$

$\frac{AT}{PR} = \frac{PR}{PR}T^n$ ✓M1

$T^n = \left(\frac{AT}{PR}\right)$

$n\log T = \log\left(\frac{AT}{PR}\right)$ ✓M1

$n = \frac{\log\left(\frac{AT}{PR}\right)}{\log T}$ ✓ or A1

$n = \log_T\left(\frac{AT}{PR}\right)$

or

$n = \log_T(AT) - (\log_T PR)$

Accept any other relevant expansion.

03

7. A cold water tap can fill a bath in 4 minutes while hot tap can fill in 6 minutes. The drain pipe can empty the bath in $4\frac{1}{5}$ minutes. The two taps and the drain pipe are fully open for 3 minutes after which the drain pipe is closed.

(a) What fraction of the bath is filled after the three minutes? (2 marks)

$\left(\frac{1}{4}+\frac{1}{6}\right) - \frac{5}{21} = \frac{5}{28}$ M1

$\frac{5}{28} \times 3 = \frac{15}{28}$ A1

02

(b) How many seconds are required for the bath to be completely filled? (2 marks)

Remaining $\Rightarrow 1 - \frac{15}{28} = \frac{13}{28}$

$1 \text{ min} \Rightarrow \frac{5}{12}$

$? = \frac{13}{28}$

$\frac{13}{28} \times \frac{12}{5} = 1\frac{4}{35} \times 60$ M1

$= 66\,6/7$ A1

$= 67$ seconds

02

04

8. Solve for x in the equation $3\cos^2 x - 1 = 2\sin^2 x + 2\cos x$ for $0° \leq x \leq 360°$ (3 marks)

$3\cos^2 x - 1 = 2(1-\cos^2 x) + 2\cos x$ 1M

$3\cos^2 x - 1 = 2 - 2\cos^2 x + 2\cos x$

$5\cos^2 x - 2\cos x - 3 = 0$

$5\cos^2 x - 5\cos x + 3\cos x - 3 = 0$

$5\cos x(\cos x - 1) + 3(\cos x - 1) = 0$ M

$(5\cos x + 3)(\cos x - 1) = 0$

$\cos x = -3/5, \cos x = 1$

$x = 0, 126.87°$ or $233.13°$ A1

03

9. An object whose area is 10 cm^2 is transformed by the matrix $\begin{bmatrix} 2 & 1 \\ 4 & 5 \end{bmatrix}$ and the image transformed by matrix $\begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$. Find the area of the final image. (3 marks)

$\begin{pmatrix} 3 & 1 \\ -1 & 2 \end{pmatrix}\begin{pmatrix} 2 & 1 \\ 4 & 5 \end{pmatrix} = \begin{pmatrix} 10 & 8 \\ 6 & 6 \end{pmatrix}$ M

$\det = 60 - 48$

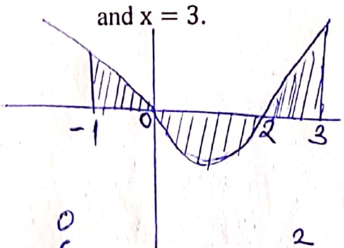
$= 12$ A1

Final image

$12 \times 10 = 120\text{cm}^2$ B1

03

10. Calculate the area bounded by the function $y = x^2 - 2x$, the x – axis and the lines $x = -1$ and x = 3. (3 marks)



$$\int_{-1}^{0}(x^2-2x)\,dx + \int_{0}^{2}(x^2-2x)\,dx + \int_{2}^{3}(x^2-2x)\,dx$$ m1

$$\frac{x^3}{3}-x^2\Big|_{-1}^{0} + \frac{x^3}{3}-x^2\Big|_{0}^{2} + \frac{x^3}{3}-x^2\Big|_{2}^{3}$$

$$\left[0-\left(-\tfrac{1}{3}-1\right)\right]+\left[\tfrac{8}{3}-4\right]+\left[0-\left(\tfrac{8}{3}-4\right)\right]$$ m

$$\left[\frac{4}{3}\right]+\left[-\frac{4}{3}\right]+\left[\frac{4}{3}\right]$$

$$\frac{4}{3}+\frac{4}{3}+\frac{4}{3} = 4 \text{ sq units}$$ A1

03

03

11. New cost of fuel (C) is partly constant and partly varies with the bags of fertilizer (F) after the government subsidy in order to curb future problem on living standard. If the cost of fuel is sh. 5200 when the bags of fertilizer is 15 and if the cost of fuel is sh. 4800 when bags of fertilizer is 10. Find the equation that connecting the relationship between the cost of fuel and the bags of fertilizer. (3 marks)

$C = k + MF$

$5200 = k + 15M$

$4800 = k + 10m$ m1

$400 = 5M$

$M = 80$

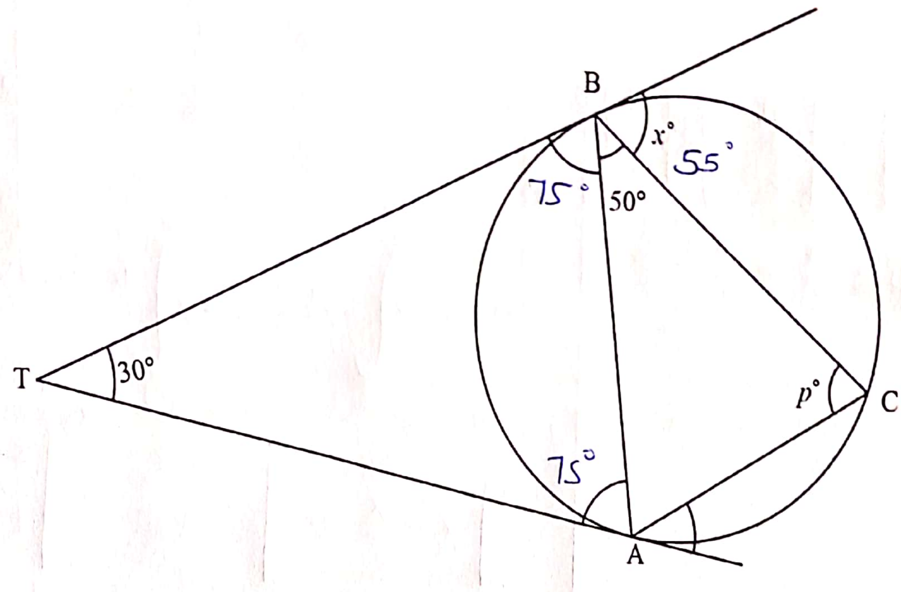
$4800 = k + 80(10)$ A1

$k = 4000$

$C = 4000 + 80F$ B1

03

12. The figure below show a circle, triangle and chords intersecting externally at T.



Find angle x and p. (2 marks)

$x = 55°$ B1

$p = 75°$ B1

02

13. The table below shows the income tax for a certain year.

Monthly taxable income(Ksh.)	Tax rate %
1 – 9820	10
9821 – 18940	15
18941 – 28060	20
28061 – 37180	25
Over 37180	30

In that year, Mr. Kilukumi paid a net tax of Ksh. 5820 per month. His total monthly taxable benefits amounted to Ksh. 17220 and was also entitled to a monthly personal relief of Ksh. 1050. Calculate Kilukumi's his monthly salary. (4 marks)

Gross tax

$\Rightarrow 5820 + 1050$

Ksh 6870 ✓M1

Slabs

$9820 \times \frac{10}{100} = 982$

$9120 \times \frac{15}{100} = 1368$

$9120 \times \frac{20}{100} = 1824$

$9120 \times \frac{25}{100} = 2280$ ✓M1

Gross tax sh 6454

$x \cdot \frac{30}{100} = 416$

$x = 1386.67$ ✓A1

Taxable income

Ksh 38566.70

Salary

$38566.70 - 17220$

Ksh 21,346.70 B1

04

14. Given that a circle $x^2 + y^2 - 6x + 3y + C = 0$ passes through the point $R(8,1)$ and that P is another point such that RP is the diameter of the circle, find the coordinates of P.(4 marks)

$(8)^2 + (1)^2 - 6(8) + 3(1) + C = 0$

$64 + 1 - 48 + 3 + C = 0$

$20 + C = 0$ M1

$C = -20$

$x^2 + y^2 - 6x + 3y = 20$

$(x-3)^2 + (y+3/2)^2 = 20 + (3)^2 + (3/2)^2$

$x = 3,\ y = -1.5$

Centre $C(3, -1.5)$ A1

$R(8,1)$ — $C(3,-1.5)$ — $P(x,y)$ M1

$\frac{8+x}{2} = 3,\ x = -2,\ \frac{1+y}{2} = -1.5,\ y = -4$

$P(-2,-4)$ A1

04

15. Coffee at sh. 80 per kg is mixed with coffee at sh. 120 per kg. In the ratio 2: 3 respectively. In what ratio should this mixture be mixed with coffee at $sh.$ 128 per kg to produce a blend worth sh. 108 per kg. (3 marks)

$\frac{2 \times 80 + 3 \times 120}{5} = 104$ Per kg M1

104   128

108

20   4 M1

5 : 1 or 1 : 5 A1

Alto

$\frac{104x + 128y}{x+y} = 108$ $x : y = 5 : 1$

03

16. The set of data below shows the height of the maize seedlings in a certain seed bed and recorded as follows;

9, 4, 5, 6, 8, 10, 2, 7

Calculate the standard deviation of the height of the maize seedlings. (3 marks)

$\frac{\Sigma X^2}{NO} = \frac{9^2 + 4^2 + 5^2 + 6^2 + 8^2 + 10^2 + 2^2 + 7^2}{8}$ M1

$\frac{375}{8} = 46.875$

$\Sigma \bar{X}^2 = \frac{9+4+5+6+8+10+2+7}{8}$ M1

$= \left(\frac{51}{8}\right)^2 = 40.640625$

Std deviation $= \pm\sqrt{46.875 - 40.640625}$

$= \pm 2.49687$

hence

$\Rightarrow 2.49687$ A1

03

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SECTION II (50 marks)

Answer only five questions from this section in the spaces provided.

17. (a) A sequence is forms by adding corresponding terms of Geometric progression and Arithmetic progression. The first, second and the third terms of the sequence formed are 28, 68 and 156 respectively. Given that the common ratio of the GP is 3, find the first term of GP and AP and the common different of the AP. (5 marks)

	first	second	Third term
GP	a_1	$a_1 r$	$a_1 r^2$
AP	a_2	$a_2 + d$	$a_2 + 2d$
	28	68	156

$a_1 + a_2 = 28$

$a_1 r + a_2 + d = 68$

$a_1 r^2 + a_2 + 2d = 156$ ✓B1

$a_2 = 28 - a_1$

$a_1 r + 28 - a_1 + d = 68$ ✓m1

$a_1 r - a_1 + d = 40$

$d = 40 + a_1 - a_1 r$

$a_1 r^2 + 28 - a_1 + 80 + 2a_1 - 2a_1 r = 156$ ✓m1

$a_1 r^2 - a_1 + 2a_1 - 2a_1 r = 48$

$a_1 r^2 + a_1 - 2a_1 r = 48$

$9a_1 + a_1 - 6a_1 = 48$ ✓m1

$4a_1 = 48$

$a_1 = 12,\ a_2 = 16$

$d = 40 + 12 - 36$

$d = 16$

first term of GP is 12

first Term of AP is 16 ✓A1

Common difference of AP is 16

05

(b) The second and third terms of a geometric progression (GP) are 48 and 24(P + 1) respectively. Find the value of P and hence the first term given that the sum of the first three terms of the geometric progression (GP) is 152. (5 marks)

1st term	2nd term	3rd term
$\left(\frac{96}{P+1}\right)$	48	$24(P+1)$

$ar = 48$

$r = \frac{24(P+1)}{48}$ ✓m1

$r = \left(\frac{P+1}{2}\right)$

$\left(\frac{96}{P+1}\right) + 48 + 24(P+1) = 152$ ✓m1

$\frac{12}{P+1} + 3(P+1) = 13$

$12 + 3P^2 + 6P + 3 = 13P + 13$

$3P^2 - 7P + 2 = 0$ ✓m1

$P = \frac{1}{3}$ or $P = 2$ ✓A1

First term $\Rightarrow \frac{96}{3} = 32$ or $\frac{96}{4/3} = 72$ ✓B1

05

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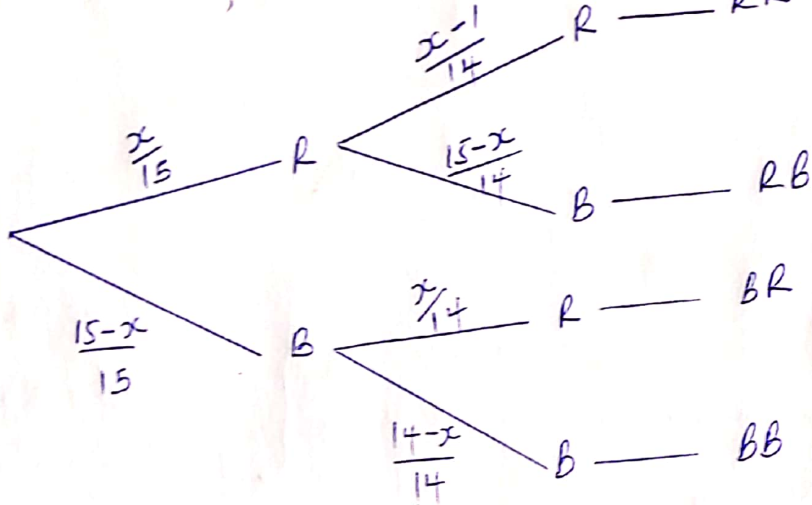
18. A bag contains 15 balls, some are Red while others are blue. A ball is taken at random without replacement and the colors recorded. This is done twice. If the probability that the two balls are of blue colors is $\frac{3}{7}$.

(a) How many balls are red. (4 marks)

Let $R \to x$, $B \Rightarrow 15-x$



$\frac{x}{15} \cdot \frac{x-1}{14} = \frac{3}{7}$ M1

$\frac{x^2-x}{210} = 3/7$ M1

$x^2 - x - 90 = 0$

$x(x-10) + 9(x-10) = 0$ M1

$(x+9)(x-10) = 0$

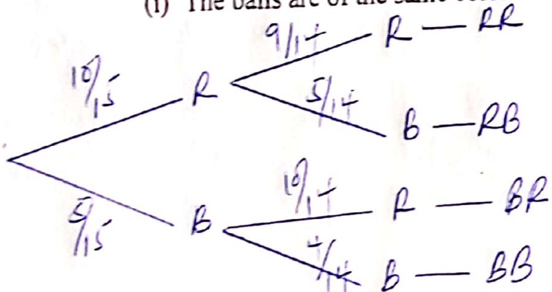
$x = -9,\ x = 10$

Red balls are 10 A1

04

(b) Calculate the probability that;

(i) The balls are of the same color. (2 marks)



P[RR] or P[BB]

$\left(\frac{10}{15} \times \frac{9}{14}\right) + \left(\frac{5}{15} \times \frac{4}{14}\right)$ M1

$\frac{3}{7} + \frac{2}{21} = \frac{11}{21}$ A1

02

(ii) The balls are of different colors. (2 marks)

P[RB] + P[BR]

$\left(\frac{10}{15} \times \frac{5}{14}\right) + \left(\frac{5}{15} \times \frac{10}{14}\right)$ M1

$\frac{5}{21} + \frac{5}{21} = \frac{10}{21}$ B1

02

(c) Find the probability of obtaining at least red ball. (2 marks)

$1 - P[BB]$

$1 - \left[\frac{5}{15} \times \frac{4}{14}\right]$ M1

$1 - \frac{2}{21}$

$\Rightarrow \frac{19}{21}$ B1

02

10

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19. The following distribution shows the masses to the nearest kg of 50 animals in a certain farm.

Mass(kg)	$25 \leq x \leq 35$	$35 \leq x \leq 45$	$45 \leq x \leq 55$	$55 \leq x \leq 65$	$65 \leq x \leq 75$	$75 \leq x \leq 85$
Frequency	3	11	18	12	5	x
C.f	3	14	32	44	49	50

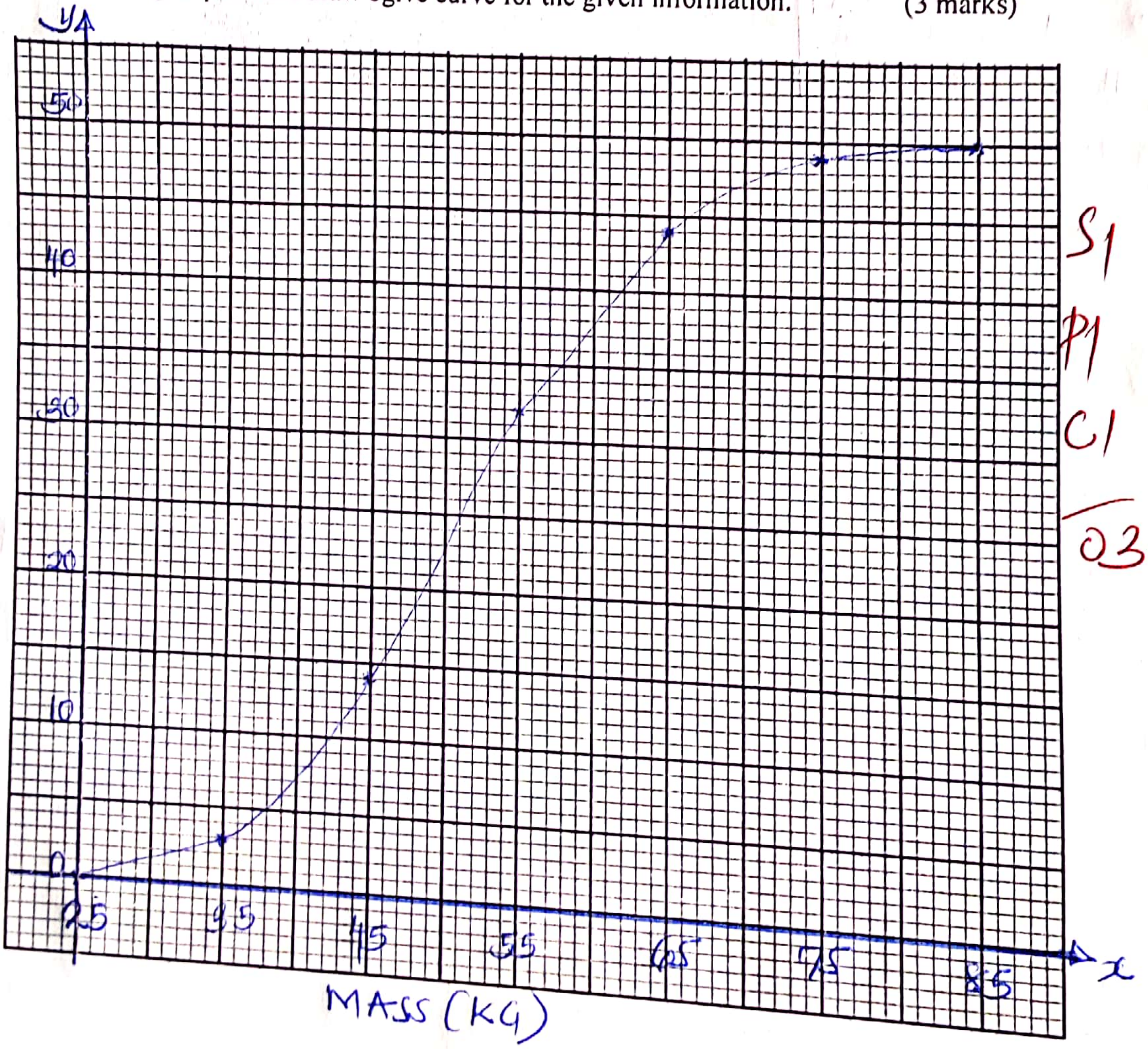
(a) Find the value of x. (1 mark)

$49 + x = 50$

$x = 1$ ✓ B1

01

(b) On the grid provided draw ogive curve for the given information. (3 marks)



S1
P1
C1
03

03

(c) Use the graph to find;

(i) Median mass. (1 mark)

$\frac{1}{2} \times 50 = 25^{th}$

$\Rightarrow \underline{\underline{51.5 \pm 0.5}}$ ✓ B1

01

01

(ii) Quartile deviation. (3 marks)

$Q_1 \Rightarrow \frac{1}{4} \times 50 = 12.5^{th}$

$= \underline{\underline{44 \pm 0.5}}$ ✓ M1

$Q_3 \Rightarrow 3/4 \times 50 = 37.5^{th}$

$= \underline{\underline{59.5 \pm 0.5}}$

$\frac{59.5 - 44}{2}$ ✓ M1

$\underline{\underline{7.75\,kg}}$ ✓ A1

03

(iii)Percentage of animals whose mass is at least 50 kg. (2 marks)

$50 - 21$

$= 29$ animals ✓ M1

$\frac{29}{50} \times 100\%$

$= \underline{\underline{58\%}}$ ✓ A1

02

10

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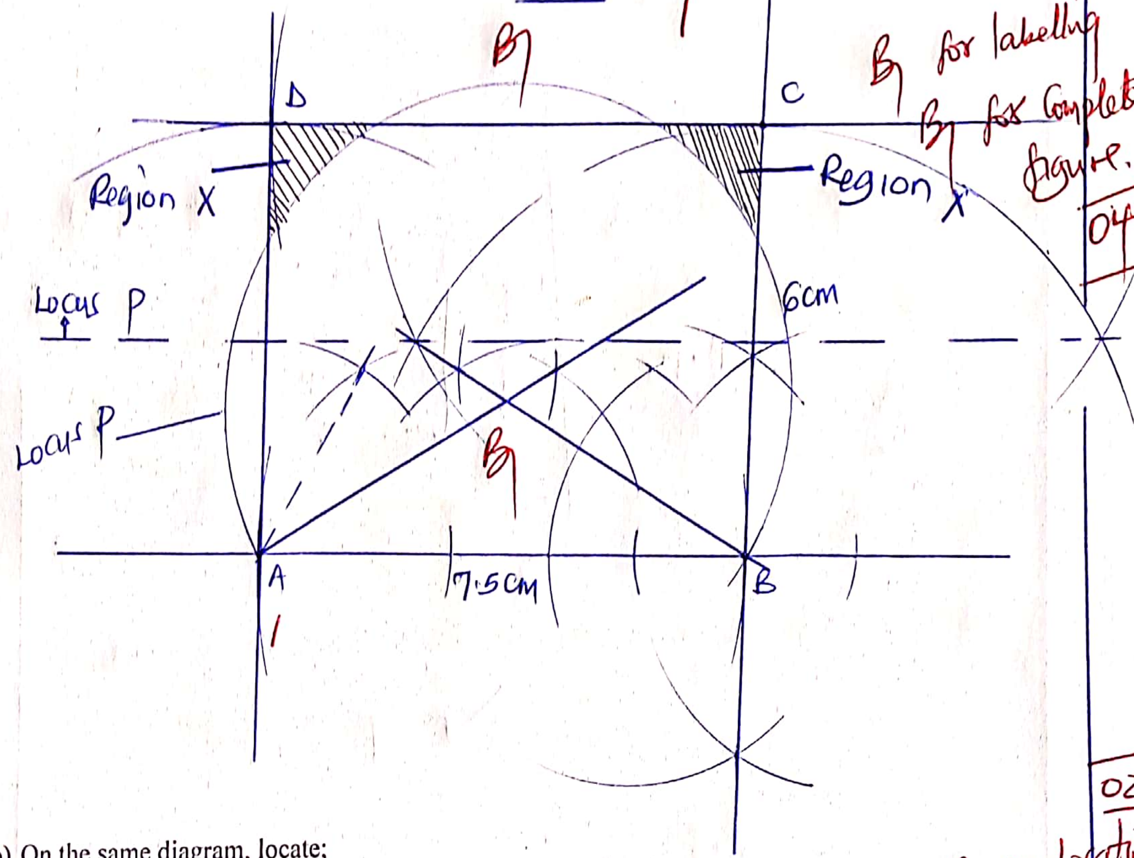
20. Using a ruler and a pair of compass only;

(a) Construct a rectangle ABCD in which AB = 75 m and BC = 60 m. Use a scale of 1 cm representing 10 m. Measure length AC. (4 marks)

$AC = 9.6cm \times 10$

$= \underline{\underline{96m}}$ B1

B1 for construction
B1 for labelling
B1 for complete figure.
04



02

(b) On the same diagram, locate;

(i) Locus P such that angle APB = 60° (2 marks) B1 for locating Centre
B1 for locus P.

(ii) Locus Q which is nearer to line CD than line AB. (2 marks)

B1 for construction of line.
B1 for imaginary line - 02

02

(c) Shade the region inside a rectangle in which variable X lies such that angle APB ≤ 60° and AB > CD. (2 marks)

B1 for one region
B1 for another region.

10

21. The position of two points, A and C are A(30°S, 21°W) and C(35°N, 40°E) respectively. Port B is north of A and west of C.

(a) State the position of B. (1 mark)

B (35°N, 21°W) B1

01

(b) Find the distance in nautical miles between;

(i) Ports A and B. (2 marks)

$\alpha = 35° + 30°$ M1

$\alpha = 65°$

$65° \times 60 = \underline{\underline{3900\,nm}}$ B1

02

(ii) Ports B and C to the nearest nautical miles. (2 marks)

$\theta = 21° + 40° = \underline{\underline{61°}}$

$\theta \times 60 \cos\alpha$ M1

$61 \times 60 \cos 35$

$\Rightarrow 2998.096482\,nm$

$\Rightarrow \underline{\underline{2998\,nm}}$ B1

02

(c) A ship left port C for port B on Thursday 1540 hours at an average speed of 575 km/hr. Given that 1 nm = 1.853 km, calculate;

(i) The local time at port B when the ship left port C. (2 marks)

B (35°N, 21°W) ⟶ C (35°N, 40°E)

↓ 1540hrs

15° → 1h

61° → ?

$\frac{61}{15}$ = 4hrs 04mins M1

15:40
4:04
11:36am B1

$\underline{\underline{\text{Thursday 11:36am}}}$

02

(ii) The day and the time the ship arrived at port B. (3 marks)

Distance = 2998 × 1.853

$\Rightarrow \underline{\underline{5555.294\,km}}$ M1

$T.T = \frac{5555.294}{575}$

$\Rightarrow \underline{\underline{9\text{hrs } 40\text{mins}}}$ A1

11:36
9:40

21:16 hours or B1

9:16 pm on Thursday (same day)

03

10

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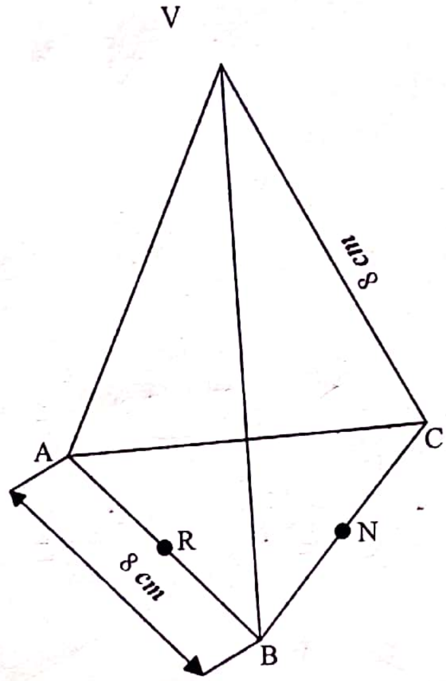
22. The figure below shows a regular tetrahedron VABC of sides 8 cm. R and Z are the mid points of AB and BC respectively.



Calculate;

(a) The length VR. (2 marks)

$8^2 - 4^2 = \sqrt{48}$ ✓ M1

$\Rightarrow 6.928cm$ ✓ A1

02

(b) The angle between the planes VAB and the plane ABC. (3 marks)

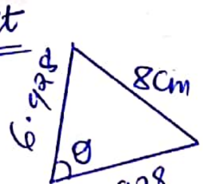
$\frac{1}{3} \times 6.928cm = 2.3094cm$ ✓ M1

$\cos\theta = \frac{2.3094}{6.928}$ ✓ M1

$\theta = \cos^{-1}\left(\frac{2.3094}{6.928}\right)$

$\theta = 70.53°$ ✓ A1

Alt



$8^2 = 6.928^2 + 6.928^2 - 2(6.928)(6.928)\cos R$

$\Rightarrow 70.53°$

03

(c) The perpendicular height of the tetrahedron. (2 marks)

$\sin 70.53 = \frac{h}{6.928}$ ✓m1

$h = 6.928 \sin 70.53^\circ$

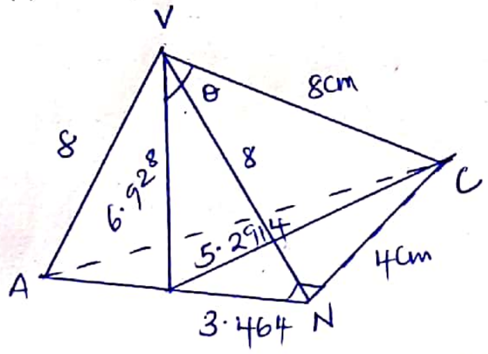
$h = 6.532cm$

$6.928^2 - 2.3094^2$

$h = 6.532cm$ ✓A1

02

(d) The angle between the line VC and the plane VAN. (3 marks)



$5.2914^2 = 8^2 + 6.928^2 - 2(8)(6.928)\cos\theta$ ✓m1

$27.9993 = 64 + 47.997184 - 110.848\cos\theta$

$110.848\cos\theta = 83.9979$

$\cos\theta = 0.757775368$ ✓M1

$\theta = \cos^{-1}(0.757775368)$

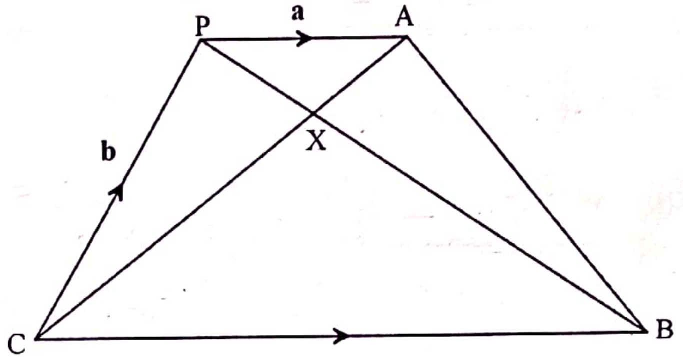
$\theta = 40.732^\circ$ ✓A1

03

03

10

23. In the figure below, PABC is a trapezium. $\overrightarrow{PA}$ parallel to $\overrightarrow{CB}$. Diagonals $\overrightarrow{PB}$ and CA intersect at X and $\overrightarrow{CB} = 2\overrightarrow{PA}$, $\overrightarrow{PA} = \mathbf{a}$ and $\overrightarrow{CP} = \mathbf{b}$.



(a) Find in terms of **a** and **b**, the vectors;

(i) $\overrightarrow{AB}$. (1 mark)

$-\underset{\sim}{a} - \underset{\sim}{b} + 2\underset{\sim}{a}$ | $\underset{\sim}{a} - \underset{\sim}{b}$ B1

(ii) $\overrightarrow{PB}$ (1 marks)

$-\underset{\sim}{b} + 2\underset{\sim}{a}$ | $2\underset{\sim}{a} - \underset{\sim}{b}$ B1

(iii) $\overrightarrow{CA}$ (1 mark)

$\underset{\sim}{b} + \underset{\sim}{a}$ | $\underset{\sim}{a} + \underset{\sim}{b}$ B1

B1 03

(b) Given further $\overrightarrow{PX} = k\overrightarrow{PB}$ and $\overrightarrow{CX} = h\overrightarrow{CA}$, where k and h are constants;

(i) Express PX in two different ways, hence find the value of k and h. (4 marks)

$\overrightarrow{PX} = k(2\underset{\sim}{a} - \underset{\sim}{b})$

$2\underset{\sim}{a}k - \underset{\sim}{b}k \to (I)$ M1

$\overrightarrow{PX} = \overrightarrow{PC} + h\overrightarrow{CA}$

$-\underset{\sim}{b} + h(\underset{\sim}{b} + \underset{\sim}{a})$

$-\underset{\sim}{b} + \underset{\sim}{b}h + \underset{\sim}{a}h$

$\underset{\sim}{b}(h-1) + \underset{\sim}{a}h \to (II)$ M1

$2\underset{\sim}{a}k = \underset{\sim}{a}h$

$2k = h \to (III)$

$\underset{\sim}{b}(h-1) = -\underset{\sim}{b}k$

$h - 1 = -k \to (IV)$

$h = 1 - k$

$2k = 1 - k$ M1

$3k = 1$

$k = \frac{1}{3}$

$h = 1 - \frac{1}{3}$ A1

$h = \frac{2}{3}$

04

(ii) Show that P, X and B are collinear. (3 marks)

$\overrightarrow{PX} = k\overrightarrow{PB}$

$\overrightarrow{PX} = \frac{1}{3}(2\underset{\sim}{a} - \underset{\sim}{b})$

$\overrightarrow{PB} = (2\underset{\sim}{a} - \underset{\sim}{b})$ M1

$k = \dfrac{\frac{1}{3}(2\underset{\sim}{a} - \underset{\sim}{b})}{(2\underset{\sim}{a} - \underset{\sim}{b})}$ M1

$k = \frac{1}{3}$

$3\overrightarrow{PX} = \overrightarrow{PB}$

$\overrightarrow{PX} \parallel \overrightarrow{PB}$ B1

Share P as a common point hence P, X and B are collinear.

03

10

24. Jose Camargo, a Venezuelan man makes two types of vote identification; A and B. He take 3 hours to make one pair of type A and 4 hours to make one pair of B. He works for a maximum of 120 hours to make x pairs of type A and y pairs of type B. It costs him sh. 400 to make a pair of type A and sh. 150 to make a pair of type B. His total cost does not exceed sh. 9000. He must make 8 pairs of type A and more than 12 pairs of type B.

(a) Write down four inequalities representing the information above. (4 marks)

$3x + 4y \leq 120$ B1 $\qquad$ $400x + 150y \leq 9000$

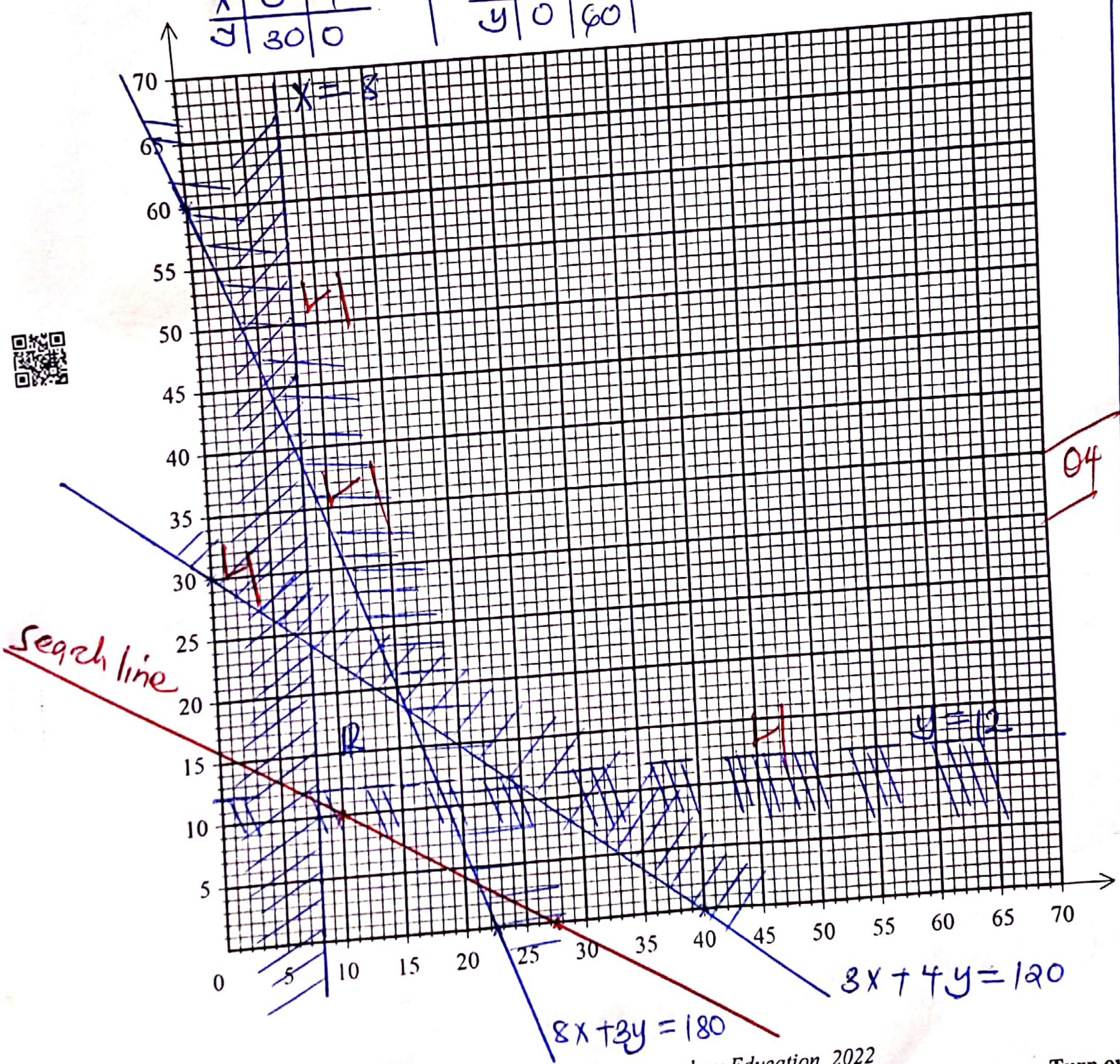
$x \geq 8$ B1, $y > 12$ B1 $\qquad$ $8x + 3y \leq 180$ B1 $\quad$ 04

04

(b) On the grid below, draw the inequalities represented above. (4 marks)

x	0	40
y	30	0

x	22.5	0
y	0	60



04

(c) Jose Carmago makes a profit of sh.40 on each pair of type A and sh.70 on each pair of type b. Use the graph in part (b) above to determine the maximum possible profit he makes. (2 marks)

Objective function

$40x + 70y = k$

$(10, 10)$

$40(10) + 70(10) = k$

$400 + 700 = k$

$k = 1100$

Re-write the objective function

$4x + 7y = 110$

x	10	27.5
y	10	0

$(8, 23)$

Type A is 8

Type B is 23

Total profit $\Rightarrow 40(8) + 70(23)$

$= \text{ksh } 1930$

02

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