Name: ......M/ scheme........ ....Adm No: .... Class:...............

Index No...................

School:..........................

121/1
MATHEMATICS ALT A
Paper 1

SEPTEMBER 2021
2½ hours
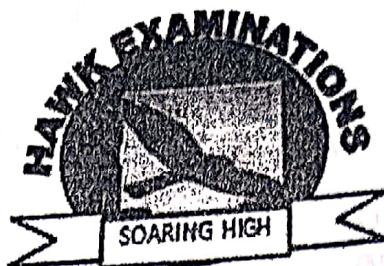
HAWK1 CLUSTER EXAMINATIONS 2021
Kenya Certificate of Secondary Education (KCSE)
MATHEMATICS
PAPER 1
TIME: 2½ HOURS

INSTRUCTIONS TO CANDIDATES

a) Write your Name, School and Index Number in the spaces provided at the top of this page.
b) This paper contains TWO sections: section I and section II
c) Answer all the questions in Section I and strictly any FIVE questions in section II.
d) All answers and working must be written on the question paper in the spaces provided below each question.
e) 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 electronic calculators and KNEC mathematical tables may be used except where stated otherwise.

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   **GRAND TOTAL**

17	18		19	20	21	22	23	24	TOTAL

This paper consists of 15 printed pages. Candidates should check the question paper to ensure that all pages are printed as indicated and no questions are missing

1

Answer ALL the Questions in this section in the spaces provided.

(3mks)

1. Without using a calculator, find x if:

$$\frac{1}{x} = \frac{8 \times -2 \div 4 + -3}{-6 \div 2 \times 5 - 3 + 4}$$

$(8 \times -2) \div 4 + -3$

$2 \times (-2) - 3 = -7$ - - - - - - - B_1

Denim

$-6 \div 2 \times 5 - 3 + 4$

$-15 + 1 = -14$ - - - - - M_1

$\frac{-7}{-14} = \frac{1}{2}$ - - - - - A_2

$x = 2$ - - - - - - A_1

2. The exterior angle of a regular polygon is equal to one third of the interior angle. Calculate the number of sides of the polygon. (3 mks)

$Ext = \frac{x}{3}$

$Int = x$

$\frac{x}{3} + x = 180$ - - - - M_1

$\frac{4}{3}x = 180$

$x = 135$ - - - - m_1

$n = \frac{360}{45} = 8 \text{ sides}$ - - A_1

3. Solve for x in the equation (3 mks)

$$9^{x+1} + 3^{2x+1} = 36$$

$9(3^{2x}) + 3(3^{2x}) = 36$

let $3^{2x} = y$ - - - - - M_1

$9y + 2y = 36$ - - - - - m_1

$12y = 36$

$y - 3$

$3^{2x} = 3^1$

$2x = 1$

$x = \frac{1}{2}$ - - - 2 A_1

4. Find all the integral values of x which satisfy the inequality (3 mks)
$$3(1+x) < 5x - 14 < x + 46$$

$3 + 3x < 5x - 14$

$2x > 17$

$x > 8.5$ — — — — — M,

$5x - 14 < x + 46$

$4x < 60$

$x < 15$ — — — — — — M,

$8.5 < x < 15$

Integral values

$9, 10, 11, 12, 13, 14$ — — — — A,

5. Simplify: $\dfrac{8x^2 + 6x - 9}{16x^2 - 9}$ (3mks)

$\dfrac{(4x-3)(2x+3)}{(4x-3)(4x+3)}$ — — — M,

— — — M,

$\dfrac{2x+3}{4x+3}$ — — — A,

6. A rectangular floor of a room measures 5.4m long by 4.2m wide. The room is to be covered with square tiles. Calculate the minimum number of tiles that can be used to cover the floor (4 mks)

2	540 cm	420 cm
3	270	210
2	90	70
5	45	35
	9	7

B,

$GCD = 2 \times 3 \times 2 \times 5$

12×5

60 — — B,

No of tiles $= \dfrac{540 \times 420}{60 \times 60}$ — M

$= 9 \times 7 = 63$ tiles. A,

3

7. Use the exchange rates below to answer this question.

	Buying (Ksh)	Selling (Ksh)
1 US dollar	105.00	105.40
1 UK Sterling pound (£)	145.20	145.75

A tourist arrived in Kenya from Britain with 7800 UK (£). He converted the whole amount of money to Kenyan shillings. While in Kenya, he spent 70% of this money and changed the rest to US dollars. Calculate the amount of money to the nearest dollar he received. (4 mks)

$$7800 \times 145.20 = Sh. 1132560 - - - - B_1$$

$$\frac{30}{100} \times 1132560 = Ksh. 339768 - - - B_1$$

$$\frac{339768}{105.40} = 3223.605 - - - B_1$$

$$3224 \text{ us dollars} - - - B_1$$

8. The point A (3, 2) is mapped onto A^I(8, 4) under a translation U. Find the coordinates of the image of B (7, 2) under the same translation. (3 mks)

$$T = \binom{8}{4} - \binom{3}{2} = \binom{5}{2} - - - - M_1$$

$$B^I = \binom{5}{2} + \binom{7}{2} = \binom{12}{4} - - - - M_1$$

$$B^I (12, 4) - - - - A_1$$

9. Five men working for 8 hours a day take 2 days to cultivate an acre of land. How many days would four men working 10 hours a day at a double rate take to cultivate 3 acres of land? (3 mks)

M	T	W	RD
5	8	1	2
4	10	3	2?

B_1

$$days = \frac{5}{4} \times \frac{8}{10} \times \frac{3}{1} \times \frac{1}{2} \times 2 - - - M_1$$

$$= 3 \text{ days} - - - A_1$$

4

10. Given that $\sin(2x-30)^\circ - \cos(3x-50)^\circ = 0$, find the value of x (3 mks)

$$2x - 30 + 3x - 50 = 90 \qquad M_1$$
$$5x - 80 = 90$$
$$5x = 170 \qquad M_1$$
$$x = 34^\circ \qquad A_1$$

11. The masses of two similar solid spheres are 1200g and 32400g respectively. If the surface area of the smaller sphere is 575 cm^2, find the surface area of the larger sphere.   (3 mks)

$$V.S.F = \frac{32400}{1200} = \frac{27}{1} \qquad M_1$$

$$L.S.F = \frac{3}{1}$$
$$A S F = \frac{9}{1} \qquad M_1$$

$$\text{Area of larger} = \left(\frac{9}{1} \times 575\right)$$
$$5175 \ cm^2 \qquad A_1$$

12. Work out the following using tables of reciprocals and squares leaving your answer to the nearest 4 significant figures   (3 mks)

$$\frac{13}{0.947^2} + \frac{4}{23.6}$$

$$\frac{13}{9.47^2 \times 10^{-3}} + \frac{4}{23.6} \qquad M_1$$

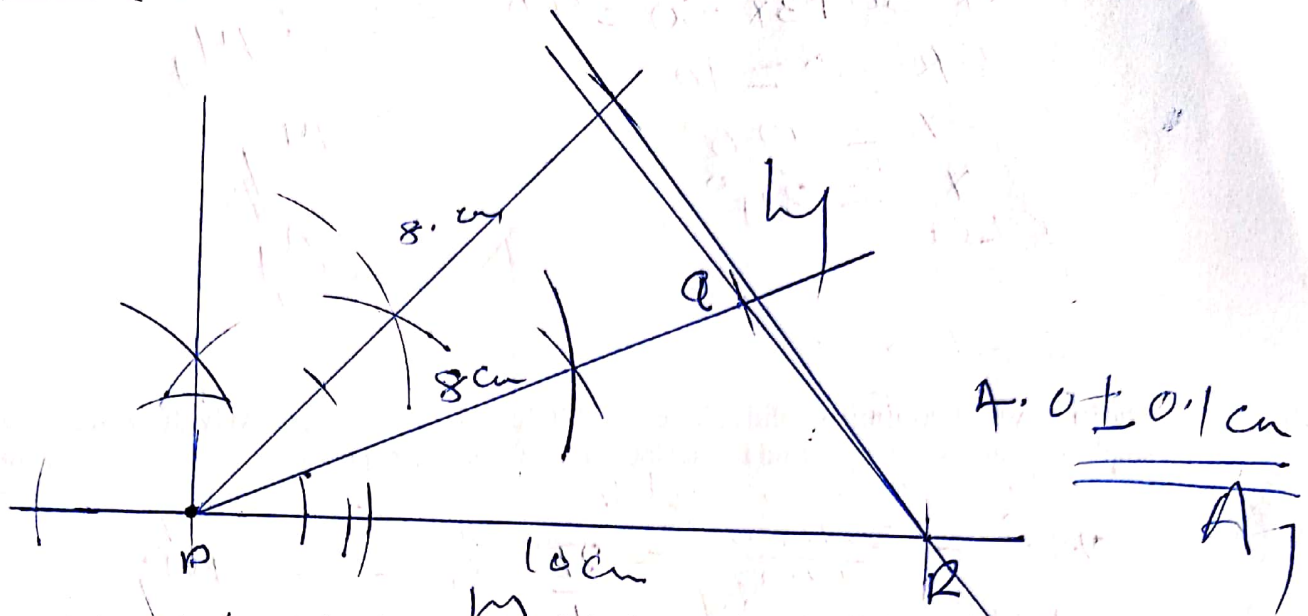$$\frac{1300(8.968^{-1})}{10} + \frac{4(2.36^{-1})}{10.} \qquad M_1$$

$$\frac{144.95}{10} + \frac{1.6948}{10}$$

$$14.495 + 0.16948$$

$$= 14.66948 \qquad A_1$$

$$= 14.66$$

13. Using a ruler and a pair of compasses only, construct a triangle PQR in which <RPQ = 22.5°, PR = 10cm and PQ = 8 cm. Measure QR (3 mks)

8. cm

8cm

4

Q

10cm

P

R

4. 0 ± 0.1 cm

A

14. A two digit number is such that the sum of its digits is 13. When the digits are interchanged, the original number is increased by 9. Find the original number. (3 mks)

Number = x y

$x + y = 13$

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

$10y + x - 10x - y = 9$

$9y - 9x = 9$

$9x + y = 13$

$9y + 9x = 117$

$9y - 9x = 9$

$\dfrac{18y}{18} = \dfrac{126}{18}$

$y = 7$

$x + 7 = 13$

$x = 13 - 7$

$x = 6$

Number = 67

15. By expressing numbers in terms of their prime factors, solve the following without using mathematical tables (3mks)

$$\dfrac{\sqrt[3]{675 \times 135}}{\sqrt{2025}}$$

$675 = 5^2 \times 3^3$

$135 = 5 \times 3^3$

$2025 = 3^4 \times 5^2$

$$\dfrac{\sqrt[3]{5^3 \times 3^5}}{\sqrt{3^4 \times 5^2}} = \dfrac{5 \times 3^2}{3^2 \times 5}$$

$$= 1$$

B

A

16. The densities of water and alcohol are **1 g/cm³** and **0.8 g/cm³** respectively. If 3 litres of water is added to 7 litres of alcohol. Calculate the density of the mixture   (3 mks)

Volume of water = $3000 cm^3$

Vol of alcohol = $7000 cm^3$

mass of water = $3000 \times 1 = 3000g$

mass of alcohol = $7000 \times 0.8 = 5600g$

mass of mixture = $8600g$

Vol of mixture = $10,000 cm^3$

density of mixture = $\dfrac{8600g}{10,000 cm^3}$

$= 0.86g/cm^3$

17. Triangle ABC with vertices A(3,4), B(1,3) and C(2,1).
   a) On the grid provided draw the triangle ABC and its image $A^IB^IC^I$ under a rotation of $+90^0$ about (0,0). (3 mks)
   b) Draw triangle $A^{II}B^{II}C^{II}$, the image of triangle $A^IB^IC^I$ under a reflection in the line $y = x$. (3 mks)
   c) Draw triangle $A^{III}B^{III}C^{III}$, the image of triangle $A^{II}B^{II}C^{II}$ under a rotation of -90^0 about (0,0). (2 mks)
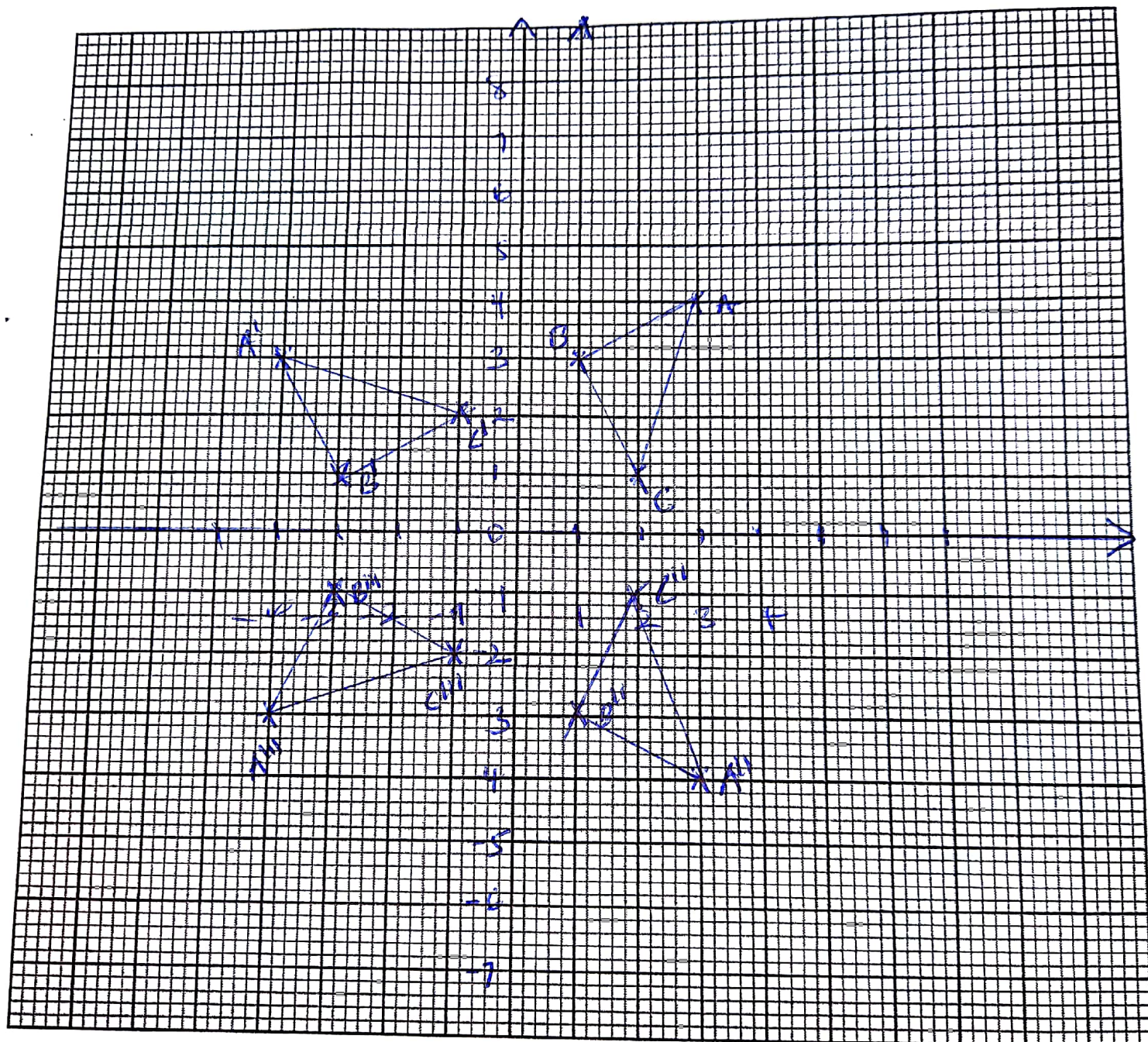
d) Describe a single transformation that maps triangle ABC onto triangle $A^{III}B^{III}C^{III}$ (2 mks)

Reflection on the line $y+x=0$

18. A straight line L_1 has its x-intercept and y-intercept as -6 and 4 respectively.

a) Write down the equation of line L_1 in the form ax+by+c=0, where a, b and c are constants. (3 mks)

$(-6, 0)$ $(0, 4)$

$m = \dfrac{4-0}{0--6}$

$= \dfrac{4}{6}$

$= \dfrac{2}{3}$ ✓

$\dfrac{y-4}{x-0} = \dfrac{2}{3}$ ✓

$3(y-4) = 2x$

$3y - 12 = 2x$

$-2x + 3y - 12 = 0$ ✓

M_1

m_1

A_1

b) Another line L_2 which is perpendicular to L_1 passes through P (2, 3K) and Q (-K, 8). Find the value of K. (2 mks)

$m_1 m_2 = -1$

$\dfrac{2}{3} m_2 = -1$

$m_2 = -\dfrac{3}{2}$

$\dfrac{8 - 3K}{-K - 2} = \dfrac{-3}{2}$

$2(8 - 3K) = 2(-K - 2)$

$16 - 12K = -2K - 4$

$20 = 10K$

$K = 2$

c) Find the equation of line L_2 hence find the point of intersection of lines L_1 and L_2. (3 mks)

$(-2, 8)$ $m = -\dfrac{3}{2}$

$\dfrac{y-8}{x+2} = \dfrac{-3}{2}$

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

$2y - 16 = -3x - 6$

$2y + 3x = 10$ or $y = -\dfrac{3}{2}x + 5$ ✓

$2y + 3x = 10$ ③
$3y - 2x = 12$ ②

$6y + 9x = 30$
$6y - 4x = 24$

$13x = 6$

$x = \dfrac{6}{13}$

$2y + 3\left(\dfrac{6}{13}\right) = 10$

$2y + \dfrac{18}{13} = 10$

$2y = 10 - \dfrac{18}{13}$

$y = 4.3$

$(0.46, 4.3)$

d) Calculate the angle which line L_1 makes with the x-axis (2 mks)

$Tan^{-1} \dfrac{2}{3}$

$33.69°$

19. A port B is on a bearing of 080^0 from a port A and at a distance of 95 km. A submarine is stationed at the port D which is on a bearing of 200^0 from A, and a distance of 124 km from B. A ship leaves B and moves directly southwards to an island C, which is on a bearing of 140^0 from A. the submarine at D on realizing that the ship was heading for the island, decided to head straight for the island to intercept the ship.

a) Using a scale of 1 cm rep 10 km, make a scale drawing showing the relative positions of A, B, C and D. (4 mks)
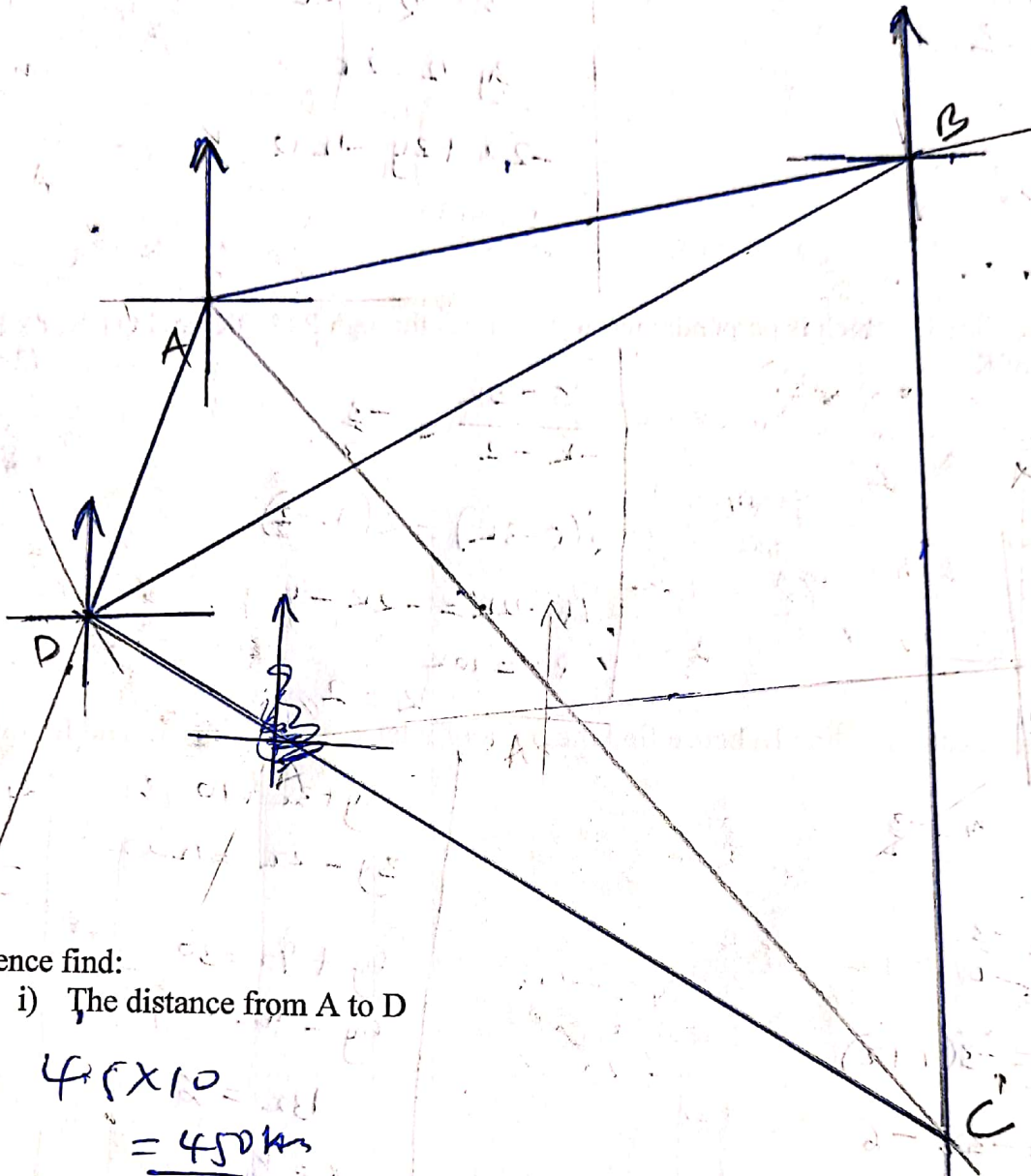
b) Hence find:

i) The distance from A to D (2 mks)

4.5×10

$= 450 \text{ km}$

ii) The bearing of the submarine from the ship when the ship was setting off from B. (1 mk)

060^0

iii) The bearing of the island C from D (1 mk)

122^0

iv) The distance the submarine had to cover to reach the island C (2 mks)

12.7×10

$127 \text{ km} \pm 0.10$

20. Three siblings Sheila, Ledisa and David wanted to build their parent house worth Ksh. 600,000. They agreed to contribute half of the money equally and the remainder in the ratio 3: 5: 2 respectively.

a) Calculate the amount of money contributed by each sibling (3 mks)

Sheila : Letisha : David = 3:5:2

Total amount = sh600,000

sheila = $\frac{3}{10}$ × 600,000 = 180,000 ✓

Letisa = $\frac{5}{10}$ × 600,000 = 300,000 ✓

David = $\frac{2}{10}$ × 600,000 = 120,000 ✓

b) Due to inflation, the cost of the house increased by Ksh. 120,000 before they could purchase the construction materials. If the siblings decided to contribute the additional cost in the ratio of their contribution, determine the additional amount contributed by each sibling (4 mks)

New price = 600,000 + 120,000

= 720,000 ✓

shula = $\frac{3}{10}$ × 720,000 = 216,000

216,000 - 180,000 = 36,000 ✓

Letisca = $\frac{5}{10}$ × 720,000 = 360,000

360,000 - 300,000

= 60,000

David = $\frac{2}{10}$ × 720,000

= 144,000 ✓

144,000 - 120,000

= 24,000 ✓

c) Water and milk are mixed in the ratio 2: 5 to form 350 ml of the mixture. If 30 cm³ of water is added to the mixture, calculate the new ratio of water to milk (3 mks)

Water = $\frac{2}{7}$ × 350

= 100ml ✓

New water = 100+30

= 130ml ✓

11

New ratio of w:m = 130:250

13 : 25 ✓

21. Students who sat for a Mathematics test were grouped by marks as shown in the table below

Marks	$0 \leq x < 5$	$5 \leq x < 15$	$15 \leq x < 25$	$25 \leq x < 45$	$45 \leq x < 75$
No. of students	9	43	62	74	12

a) Estimate the mean marks (4 mks)

Marks	x	f	fx	f·d
0-4	2	9	18	1·8
5-14	9·5	43	408·5	4·3
15-24	19·5	62	1209	6·2
25-44	34·5	74	2553	3·7
45-74	59·5	12	714	0·4
		$\Sigma f = 200$	Σfx 4902·5	

$$\bar{X} = \frac{\Sigma fx}{\Sigma f}$$

$$= \frac{4902·5}{200}$$

$$= 24·5125$$

b) i) On the grid provided, draw a histogram of frequency density versus class boundaries of the data above.

Use scale of : 1 cm represents 5 units on the horizontal axis and
2 cm represents 5 units on the vertical axis (4 mks)

Constant → k

Frequency Density

Marks.
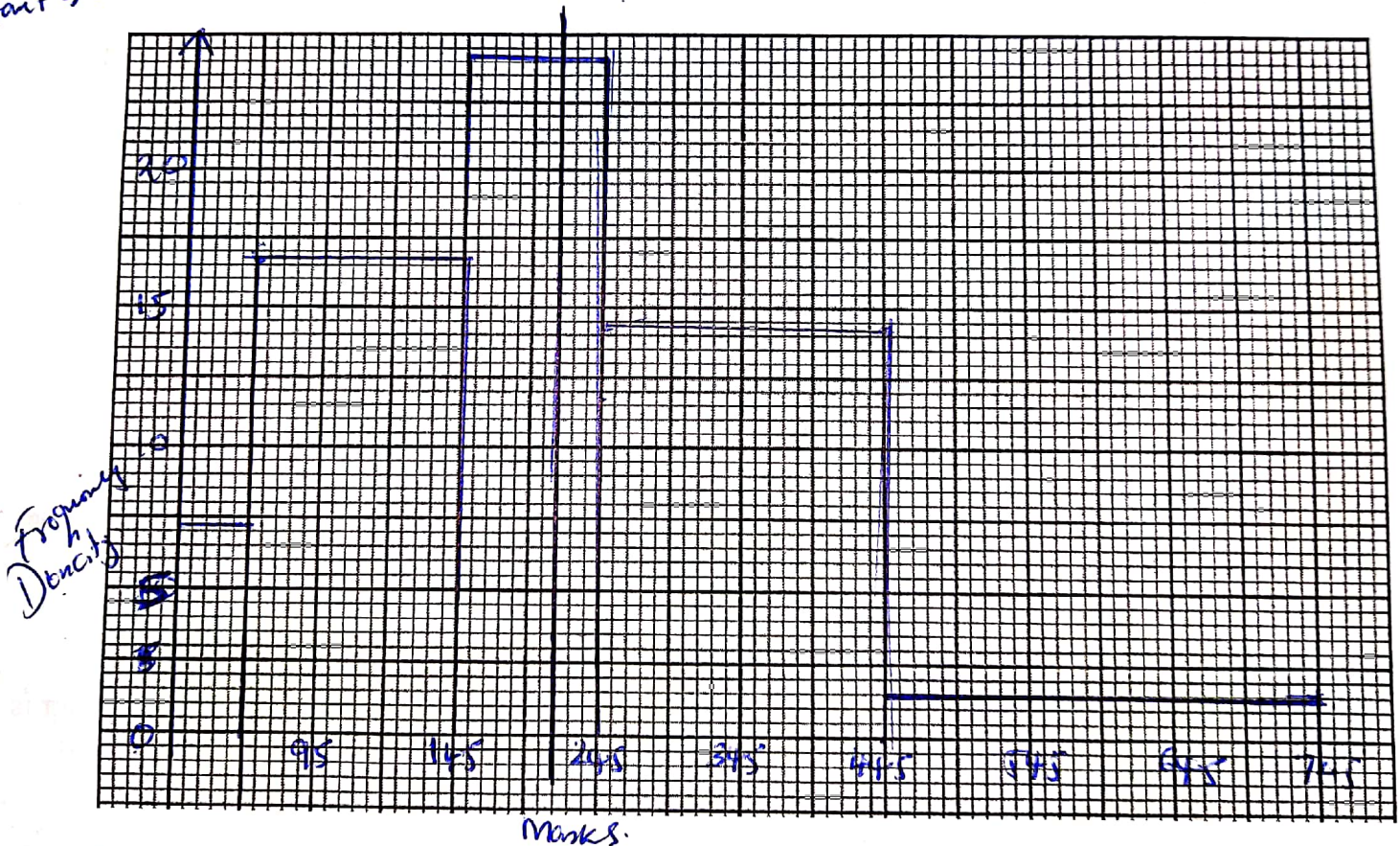
ii) Using the area under graph, draw a vertical line representing the median mark hence state the median mark from the graph (2 mks)

Median = 21·3.

12

22. A solid consists of a cone and hemisphere. The common diameter of the cone and the hemisphere is **12 cm** and the slanting height of the cone is **10 cm**.

a) Calculate correct to two decimal places:
   i) the surface area of the solid   (3 mks)

$$S \cdot A = \hat{\Pi} R L + 2 \hat{\Pi} R^2$$

$$= \frac{22}{7} \times 6 \times 10 + \frac{22}{7} \times 2 \times 6^2 \quad \checkmark \; m_1$$

$$188 \cdot 57 + 226 \cdot 29 \quad \checkmark \quad m_1$$

$$414 \cdot 86 cm^2 \quad \checkmark \quad A_1$$

   ii) the volume of the solid   (4 mks)

$$Volume = \frac{1}{3} \hat{\Pi} r^2 h + \frac{2}{3} \hat{\Pi} r^3$$

$$h = \sqrt{10^2 - 6^2}$$

$$\sqrt{100 - 36} = 8 cm \quad \checkmark \quad h_1$$

$$\frac{1}{3} \times \frac{22}{7} \times 6^2 \times 8 + \frac{2}{3} \times \frac{22}{7} \times 6^3 \quad \checkmark \quad m_1$$

$$301 \cdot 71 + 452 \cdot 57 \quad \checkmark \quad m_1$$

$$754 \cdot 28 \; cm^3 \quad \checkmark \quad A_1$$

b) If the density of the material used to make the solid is **1.3 g/cm³**, calculate its mass in kilograms   (3 mks)

$$density = 1 \cdot 3 g/cm^3$$

$$1300 \; kg/m^3 \quad \checkmark \quad m_1$$

$$mass = density \times volume \quad \checkmark \quad m_1$$

$$\frac{1300 \times 754 \cdot 28}{1000\,000}$$

$$= 0 \cdot 980564 \; kg \quad \checkmark \quad A_1$$
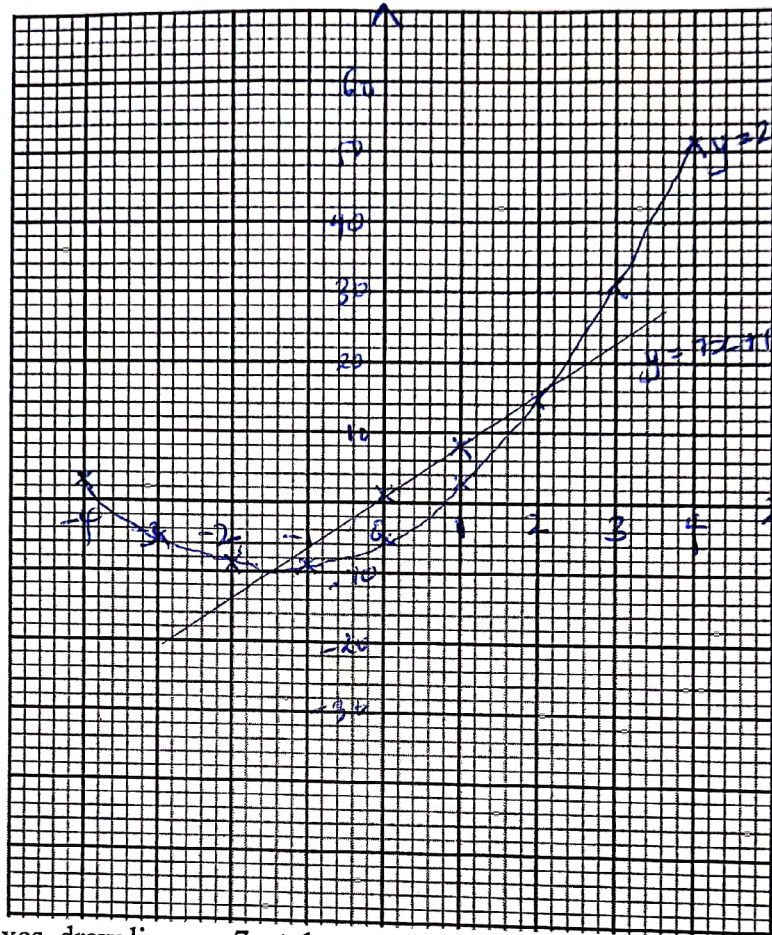
13

$$\frac{}{10}$$

23. a) Fill the table below for the function $y = 2x^2 + 6x - 5$ for the domain $-4 \le x \le 3$ (2 mks)

x	-4	-3	-2	-1	0	1	2	3
y	3	-5	-9	-9	-5	3	15	31	32

b) (i) Draw the graph of $y = 2x^2 + 6x - 5$ on the grid given

Use the scale: Horizontal axis 1 cm for 1 unit and Vertical axis 1 cm for 5 units.   (3 mks)

(ii) On the same axes, draw line $y = 7x + 1$ (1 mk)

x	0	1
y	1	8

(iii) Determine the values of x at the points of intersection of the curve and the line $y = 7x + 1$ (2 mks)

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

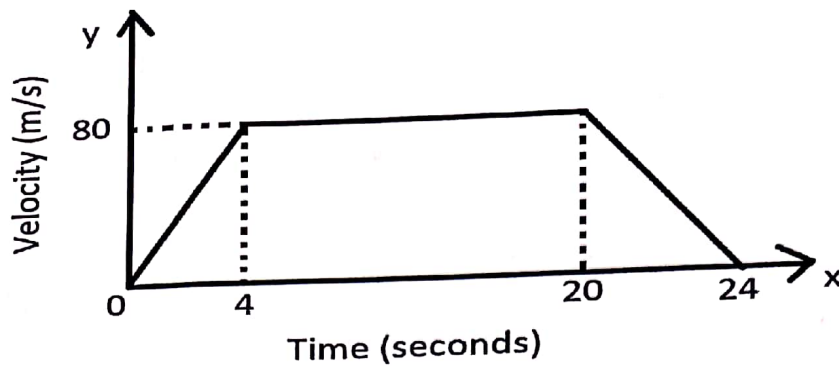c) Use your graph to estimate the value of $2x^2 + 6x - 5 = 0$ (2 mks)

$y = 0$

$x = -3.7$ or $x = 0.72$

14

24. a) The figure below is a velocity time graph

Calculate: (2 mks)
i) the deceleration of the car

$$a = \frac{V-u}{t} = \frac{-80}{4}$$

$$= \frac{0-80}{4} \checkmark \quad -20m/s^2$$

$$\text{deceleration} \rightarrow 20 \, m/s^2 \, \checkmark$$

ii) the total distance travelled by the car (2 mks)

$$D = \text{Area under graph} \quad \bigg| \quad \frac{1}{2} \times 40s \times 80$$

$$\frac{1}{2}(a+b)h \qquad = 160m \checkmark$$

$$\frac{1}{2}(24+16) \, 80 \, \checkmark$$

b) A car left Nairobi towards Eldoret at 7.12 am at an average speed of 90 km/hr. at 8.22 am, a bus left Eldoret for Nairobi at an average speed of 72 km/hr. The distance between the two towns is 348 km.

Calculate:
i) the time of the day when the two vehicles met (4 mks)

$$R.s = 90 + 72 \qquad \bigg| \quad 348 - 105$$

$$= 162 \, km/hr \checkmark \qquad = 243km$$

$$D = 90 \times 1\frac{1}{6} \qquad \bigg| \quad Time = \frac{243}{162} \checkmark$$

$$= 90 \times \frac{7}{6} \qquad \qquad = \frac{3}{2} \, hrs$$

$$= 105km$$

$$8:22 + \frac{3}{2} hrs \checkmark$$

$$9:52 \, am \checkmark$$

ii) the distance from Nairobi to the meeting place (2 mks)

$$D = S \times T$$

$$90 \times \frac{3}{2}$$

$$= 135 \, km \checkmark$$

From Nairobi $= 135 + 105$

$$= 240km \cdot \checkmark$$

15

10