Carol.

# FRIENDS SCHOOL KAMUSINGA
## KIMILILI

NAME ......MARKING GUIDE..................................................................

ADM NO.....................INDEX NO. .....................CLASS............... DATE ...........................

# 121/1
# MATHEMATICS PAPER 1
# FORM 4 INTERNAL MOCK TERM 2
# JULY 2026
# TIME: 2 ½ HOURS

**INSTRUCTIONS TO CANDIDATES**

- *Write your name and admission number in the spaces provided at the top of this page.*
- *This paper consists of two sections:* **Section I and Section II.**
- *Answer all questions in* section I and any five questions in Section II.
- *Show all the steps in your calculations, giving your answers at each stage in the spaces below each question.*
- *Marks may be given for correct working even if the answer is wrong.*
- *KNEC Mathematical tables may be used.*
- *This paper contains 15 printed pages.*

**For Examiner's Use Only**

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

| 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

| GRAND TOTAL | |
|---|---|

## SECTION A (50 MARKS)

*Answer all questions in this section.*

1. Without using tables evaluate: (3 marks)

$$\frac{0.1\dot{6}\,(0.\dot{0}\dot{9} + 0.58\dot{3})}{0.11\dot{2}\dot{3}73}$$

$0.1\dot{6} = 0.1666\ldots$

$r = 0.1666\ldots$

$10r = 1.666\ldots$

$100r = 16.666\ldots$

$90r = 15$

$r = \frac{15}{90} = \frac{1}{6}$

$0.58\dot{3} = 0.58333\ldots$

$100r = 58.333\ldots$

$1000r = 583.333\ldots$

$900r = 525$

$r = \frac{525}{900} = \frac{7}{12}$

$0.11\dot{3}37\dot{3} = 0.11237373\ldots$

$10000r = 1123.7373\ldots$

$1000000r = 112373.7373\ldots$

$990000r = 111250$

$r = \frac{111250}{990{,}000} = \frac{89}{792}$

$\therefore \dfrac{\frac{1}{6}+\frac{7}{12}}{\frac{89}{792}} = \frac{9}{12} \div \frac{89}{792} = \frac{9}{12} \times \frac{792}{89}$ (66)

$= \frac{594}{89} = 6.67$

2. A supermarket has 36 apples, 60 oranges and 108 mangoes. The fruits are to be arranged in rows such that each row contains the same number of fruits of each kind. Calculate the total number of fruits in each row for which the number of rows used is maximum. (3 marks)

| | | | |
|---|---|---|---|
| 2 | 36 | 60 | 108 |
| 2 | 18 | 30 | 54 |
| 3 | 9 | 15 | 27 |
| | 3 | 5 | 9 |

GCD = 12.

Apples = $36 \div 12 = 3$ apples

Oranges = $60 \div 12 = 5$ oranges

Mangoes = $108 \div 12 = 9$ mangoes

Total = $3+5+9 = 17$ fruits

3. Two employees Peter and James contributed $\frac{1}{4}$ and $\frac{1}{6}$ of their salaries to start a project. The contribution amounted to Ksh. 32,000. If Peter had contributed $\frac{4}{9}$ and James $\frac{1}{3}$ of their salaries, the total contribution would have been Ksh 30,000. Calculate the salary of each person. (3 marks)

Let Peter − $x$

James − $y$

$(\frac{1}{4}x + \frac{1}{6}y = 32{,}000)\,12$

$(\frac{4}{9}x + \frac{1}{3}y = 30{,}000)\,9$

$(3x + 2y = \overset{384}{\cancel{64}}000)\,3$

$(4x + 3y = 180\,000)\,2$

$9x + 6y = \cancel{384}\,000$

$8x + 6y = 180{,}000$

$x = \cancel{204}\,000$

$x = 204000$

$3x + 2y = \cancel{38}4000$

$3(\overset{204{,}000}{\cancel{72{,}000}}) + 2y = 64000$

$6\cancel{12}{,}000 + 2y = \cancel{38}4000$

~~2y = 28,000~~

~~y = 14000~~

$\frac{2y}{2} = \frac{-228000}{2}$

$y = -114000$

4. The sum of interior angles of a regular polygon is 24 times the size of the exterior angle. Find the number of sides of the polygon and hence name it. (3 marks)

$(n+4)90 = 24\left(\frac{360}{n}\right)$

$90n+360 = \frac{8640}{n}$

$90n^2+360n = 8640$

$n^2+4n=96$

$n^2+4n-96=0$

$(n^2+12n)(-8n-96)=0$

$n(n+12)-8(n+12)=0$

$n-8=0$ or $n+12=0$

$n=8$ $\quad$ $n=-12$

$n=8$.

$180(n-\cancel{2})=\cancel{2}$

5. A Kenyan bank buys and sells foreign currency as shown in the table below.

| | Buying | Selling |
|---|---|---|
| 1 US dollar | 128.40 | 128. 87 |
| 1 UK pound | 140.65 | 141.13 |

A tourist arrived in Kenya with 15,000 pounds, which he converted into Ksh at a commission of 5%. He later used 2/3 of the money before changing the balance into dollars at no commission. Calculate to the nearest dollar, the amount he received. (3 marks)

1 pound = 140.65

15,000 = 15000×140.65

= 2,109,750

95% = 2,004,262.50

Spent → $\frac{2}{3}$ × 2004,262.50

= 1,336,175

Balance = 668,087.5

1 dolar = 128.87

668,087.5

$\frac{668087.5\times 1}{128.87} = 5184.197$

≈ 5184 USD.

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

$5^{2x} - 6 \times 5^x + 5 \cancel{\log}\log 10 = \log_2 2 - 1$

$\log_{10} 10 = 1$

$\log_2 2 = 1$

$5^{2x} - 6\times 5^x + 5 = 0$

Let $5^x = y$.

$y^2-6y+5=0$.

$(m,n)=(-5,-1)$

$(y^2-5y)(-y+5)=0$

$y(y-5)-1(y-5)=0$

$(y-1)(y-5)=0$

$y=1$ or $y=5$.

When $y=1$ $\quad$ When $y=5$

$5^x=1=5^0$ $\quad$ $5^x=5^1$

$\therefore x=0$ $\quad$ $x=1$

$\therefore x=0$ or $1$

$\log_2 4$ $\quad$ $2\log_2 2$

10. The ...
of the ...

7. Given that $P = \begin{pmatrix} 1 \\ 1-y \end{pmatrix}$, $Q = \begin{pmatrix} 3 \\ y+2 \end{pmatrix}$ and $|P| = |Q|$. Find the value of y hence find the coordinates of M, the midpoint of PQ. (4 marks)

$|P| = \sqrt{1^2+(1-y)^2}$

$= \sqrt{1+1-2y+y^2}$

$= \sqrt{2+y^2-2y}$

$|Q| = \sqrt{3^2+(y+2)^2}$

$= \sqrt{9+y^2+4y+4}$

$= \sqrt{y^2+4y+13}$

$|P| = |Q|$

$\sqrt{y^2-2y+2} = \sqrt{y^2+4y+13}$

$\cancel{y^2}-2y+2 = \cancel{y^2}+4y+13$

$-6y = 11$

$y = -\frac{11}{6}$

$\therefore P = \begin{pmatrix} 1 \\ 2.8 \end{pmatrix}$ $Q = \begin{pmatrix} 3 \\ 0.2 \end{pmatrix}$

Midpoint

$\left(\frac{1+3}{2}, \frac{2.8+0.2}{2}\right)$

$(2, 1.5)$

8. Under and enlargement centre (2,1), the image of P (1, -1) is $P^1(4,5)$. Determine the scale factor of enlargement. (3 marks)

Centre $(a,b)$

$P(x,y)$

$P^1(x'y')$

$K(x-a) = x'-a$

$K(1-2) = 4$

$-1K = 4$

$K = -4$

9. The masses of two similar rods are 343g and 1331g. If the surface area of the smaller rod is $196cm^2$, calculate the surface area of the larger rod. (3 marks)

$V.s.f = \frac{343}{1331}$

$l.s.f = \left(\frac{343}{1331}\right)^{1/3}$

$= \frac{7}{11}$

$A.s.f = \left(\frac{7}{11}\right)^2 = \frac{49}{121}$

$49 = 196$

$121 = \frac{121 \times 196}{49}$

$= 484cm^2$

10. The area of a rhombus is 60cm². Given that one of its diagonals is 15m long, calculate the perimeter of the rhombus. (3 marks)

$A = \frac{1}{2} \times d_1 \times d_2$

$60 = \frac{1}{2} \times 15 \times d_2$

$60 = 7.5 d_2$

$d_2 = \frac{60}{7.5} = 8cm.$

11. The ratio of the cost of a commodity x to that of commodity y is 2:3 and the ratio of the cost of commodity y to that of Z is 6 : 1. If the total cost of the three commodities is Ksh. 2200, express the cost of commodity Z as a percentage of commodity y. (3 marks)

$x : y \quad y : z$

$2 : 3 \quad 6 : 1$

$x : y : z$

$4 : 6 : 1$

$X = \frac{4}{11} \times 2200$

$= 800/-$

$Z = \frac{1}{11} \times 2200$

$= 200/-$

$Y = \frac{6}{11} \times 2200$

$= 1200/-$

~~% → 200~~

$\% = \frac{200}{1200} \times 100$

$= 16.666...$

$= 16.67\%$

12. Simplify the expression (3 marks)

$$\frac{2x^2 - 3xy - 2y^2}{4y^2 - y^2} \div \frac{2x + y}{2x - y}$$

$$\frac{\cancel{(2x+y)}(x-y)}{3y^2} \times \frac{2x-y}{\cancel{(2x+y)}}$$

$$\frac{(x-y)(2x-y)}{3y^2}.$$

10. The area of a rhombus is $60cm^2$. Given that one of its diagonals is 15m long, calculate the perimeter of the rhombus. (3 marks)

$$A = \frac{1}{2} \times d_1 \times d_2$$

$$60 = \frac{1}{2} \times 15 \times d_2$$

$$60 = 7.5 d_2$$

$$d_2 = \frac{60}{7.5} = 8cm.$$

11. The ratio of the cost of a commodity x to that of commodity y is 2:3 and the ratio of the cost of commodity y to that of Z is 6 : 1. If the total cost of the three commodities is Ksh. 2200, express the cost of commodity Z as a percentage of commodity y. (3 marks)

$x : y \quad y : z$

$2 : 3 \quad 6 : 1$

$x : y : z$

$4 : 6 : 1$

$$X = \frac{4}{11} \times 2200 = 800/=$$

$$Z = \frac{1}{11} \times \overset{200}{\cancel{2200}} = 200/=$$

$$Y = \frac{6}{11} \times \overset{200}{\cancel{2200}} = 1200/=$$

$\% \rightarrow \cancel{200}$

$$\% = \frac{200}{1200} \times 100$$

$$= 16.666...$$

$$= 16.67\%$$

12. Simplify the expression (3 marks)

$$\frac{2x^2 - 3xy - 2y^2}{4y^2 - y^2} \div \frac{2x + y}{2x - y}$$

$$\frac{\cancel{(2x+y)}(x-y)}{3y^2} \times \frac{2x-y}{\cancel{(2x+y)}}$$

$$\frac{(x-y)(2x-y)}{3y^2}.$$

13. Solve the following linear inequalities and list the integral values of x. (3 marks)

$3x - 3 \leq ½ (x + 8) < x + 5$

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

$2\frac{1}{2}x \leq 7$

$x \leq 7 \times \frac{2}{5}$

$x \leq \frac{14}{5}$

$x \leq 2\frac{4}{5} \,|\, 2.8$

$\frac{1}{2}x + 4 < x + 5$

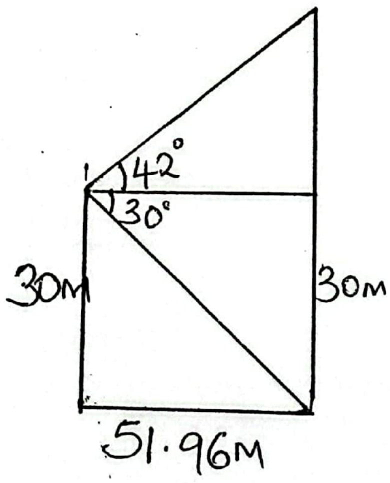
$-\frac{1}{2}x < 1$

$x > -2$

$-2 < x \leq 2.8$

Integral values $-1, 0, 1$ and $2$

14. From a viewing tower 30m above the ground, the angle of depression of an object on the ground is 30 and the angle of elevation of an aircraft vertically above the object is $42^0$ from the tower. Calculate, correct to 2 decimal places, the height of an aircraft above the ground. (3 marks)




$\tan 30° = \frac{30}{x}$

$x \tan 30° = 30$

$x = \frac{30}{\tan 30°}$

$x = 46.79$

$46.79 + 30$

$= 76.79M$

15. Solve for K in the equation. (3 marks)

$$\left(\frac{20}{12}\right)^{7k-5} = \left(\frac{36}{100}\right)^{k-1}$$

$$\left(\frac{5}{3}\right)^{7K-5} = \left(\frac{6}{10}\right)^{2K-2}$$

$$\left(\frac{5}{3}\right)^{7K-5} = \left(\frac{5}{3}\right)^{-1(2K-2)}$$

$$\left(\frac{5}{3}\right)^{7K-5} = \left(\frac{5}{3}\right)^{-2K+2}$$

$$7K-5 = -2K+2$$

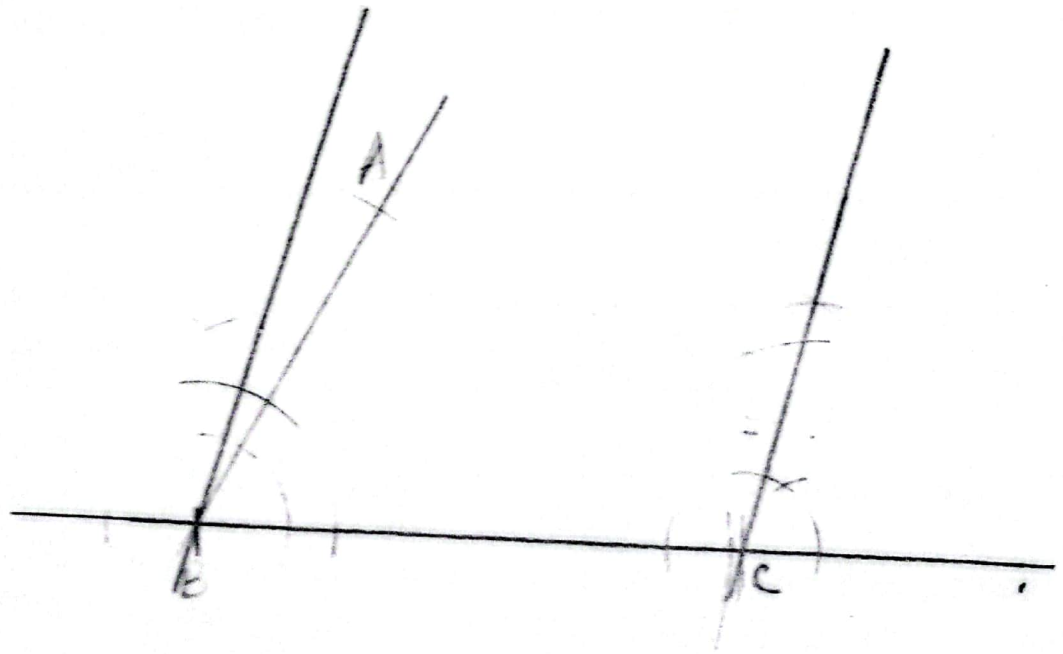
$$9K = 7$$

$$K = \frac{7}{9}$$

AB = 5cm

16. A trapezium ABCD is such that ~~A~~BC = 7.5cm/ABC = ~~75~~ 60° and / BCD = ~~45~~ 105°. Construct ABCD using a ruler and a pair of compass only. (4 marks)

Measure AD



**SECTION II (50 marks)**

*Answer any 5 questions in this section.*

17. A tank has two in let water taps P and Q and another outlet tap R. when empty, the tank can be filled by tap P alone in 5 hours or tap Q in 3 hours. When full, the tank can be emptied in 8 hours by tap R.

(a) The tank is initially empty. Find how long it would take to fill up the tank.

(i) If tap R is closed and taps P and Q are opened at the same time. (2 marks)

Combined rate in 1 hour $= \frac{1}{5} + \frac{1}{3} = \frac{8}{15}$

Time $= \frac{15}{8} = 1\frac{7}{8}$ hrs / 1hrs 52 Min. 30Sec.

(ii) If all the three taps are opened at the same time. Giving your answer to the nearest minute. (2 marks)

Combined rate $= \frac{1}{5} + \frac{1}{3} - \frac{1}{8} = \frac{49}{120}$

In 1hr $= \frac{49}{120}$

Full $= \frac{120}{49} = \cancel{21} = 2\frac{22}{49}$ hrs or 2hrs. 26/7 minutes 54secs.

(b) Assume the tank is initially empty and the three taps are opened as follows:

P at 8:00 am
Q at 9:00 am
R at 9: 30 am

(i) Find the fraction of the tank that would be filled by 10:00am. (3 marks)

At 9am - $1 \times \frac{1}{5} = \frac{1}{5}$ full.

At 9:30 $= 0.5 \times \frac{1}{3} + 1.5 \times \frac{1}{5} = \frac{7}{15}$ full

Remaining $= \frac{8}{45}$ In 30mins $= \frac{1}{2} \times \frac{49}{120} = \frac{49}{240}$

Time, At 10am $= \frac{7}{15} + \frac{49}{240} = \frac{112+49}{240} = \frac{161}{240}$

(ii) Find the time the tank would be fully filled up. Give your answer to the nearest minute. (3 marks)

At ~~10~~ 9:30 $= \frac{7}{15}$ full

Rem. $= \frac{8}{15}$

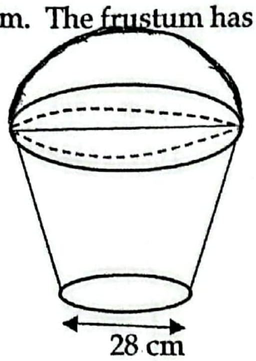
Comb. rate $= \frac{49}{120}$

Time $= \frac{8}{15} \div \frac{49}{120}$

$\frac{8}{15} \times \frac{120}{49} = \frac{64}{49}$ = 1hr 18min. 22 Sec.

9:30
+ 1:18:22
10:48:22 AM

18. The diagram below shows a model of a solid structure in the shape of frustrum of a cone with a hemisphere top. The diameter of the hemispherical part is 70cm and is equal to the diameter of the top of the frustrum. The frustum has a base diameter of 28cm and slant height of 60cm.




Taking $\pi = 3.142$ calculate

(a) The slant height of the cone from which the frustrum was cut off. (2 marks)

$\frac{70}{28} = \frac{60+l}{l}$

$70l = 1680 + 28l$

$42l = 1680.$

$l = 40$

$L = 40 + 60$

$= 100cm$

(b) The surface area of the model. (4 marks)

$= 2 \times 3.142 \times 35^2 + 3.142 \times 14^2 + [(3.142 \times 35 \times 100) - (3.142 \times 14 \times 40)]$

$= 7697.9 + 615.832 + (10997 - 1759.52)$

$= 17551.212 \, cm^2$

(c) The volume of the model. (4 marks)

Smaller cone volume $= \frac{1}{3} \times 3.142 \times 4^2 \times \sqrt{40^2 - 14^2}$

$= 7691.739215cm^3$

Bigger cone vol. $= \frac{125}{8} \times 7691.7392$

$= 120{,}183.4252cm^3$

Total vol $= (120{,}183.452 - 7691.739215) + \frac{2}{3} \times 3.142 \times 35^3$

$= 112491.684 + 89808.8333$

$= 202{,}300.593cm^2$

19. Find the equation of the perpendicular line from the point T(-2, 6) to the line joining **A (-2, 1)** and **B (-8,-2)** (3 marks)

gradient of AB $\frac{1+2}{-2+8} = \frac{3}{6} = \frac{1}{2}$

Gradient of lar Line $\frac{1}{2} M_2 = -2$

$M = -1$

$\frac{y-6}{x+2} = -1$

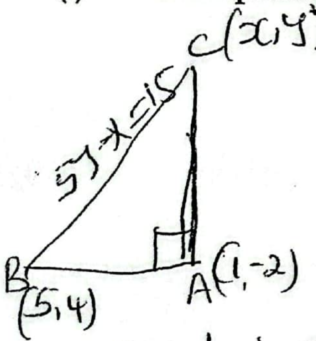
$y - 6 = -x - 2$

$y = -x + 4$

(a) A triangle ABC is right angled of point A. The vertices of the triangle are **A(1,-2)**, **B (5,4)**, **C(x,y)**. The equation of line BC is $5y - x = 15$.

Determine

(i) The equation for line AC in the form $ax + by + c = 0$. Where a, b and c are integers. (4 marks)




Gradient of AB $= \frac{4+2}{5-1}$

$\frac{6}{4} = \frac{3}{2}$

Gradient of lar Line $\frac{3}{2} M_2 = -1$

$M_2 = -\frac{2}{3}$

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

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

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

$3y = -2x - 4$

$2x + 3y + 4 = 0$

(ii) The coordinates of point c. (2 marks)

BC $y = \frac{x}{5} + 3$

AC $y = -\frac{2}{3}x + \frac{4}{3}$

$\frac{x}{5} + 3 = -\frac{2}{3}x - \frac{4}{3}$

$15 \times \frac{13}{15}x = -\frac{13}{3} \times \frac{15}{13}$

$x = -5$

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

$C(-5, 2)$

(b) (i) Line passes through point A and parallel to line BC. Determine the x – intercept and y – intercept of the line. (2 marks)

parallel Line $M_1 = M_2$

$G = \frac{1}{5}$

$\frac{y+2}{x-1} = \frac{1}{5}$

$y + 2 = \frac{1}{5}x + \frac{6}{5}$

$y = \frac{1}{5}x - \frac{4}{5}$

X-intercept $y = 0$

$0 = \frac{1}{5}x - \frac{4}{5}$

$\frac{4}{5} = \frac{1}{5}x \times \frac{5}{1}$

$x = (4, 0)$

y intercept $x = 0$

$y = -\frac{4}{5}$ $(0, -\frac{4}{5})$

(ii) Determine the angle the line makes with the x – axis. (2 marks)

$y = \frac{1}{5}x - \frac{4}{5}$

Gradient $= \frac{1}{5}$

$\tan^{-1}\frac{1}{5} = 11.31^\circ$

20. A number of workers working in Friends School Kamusinga decided to raise sh 144, 000 to buy a plot of land. Each person was to contribute the same amount. Before the contributions were collected five of the workers retired. This meant that the remaining contributors had to pay more to meet the target.

(a) If there were n workers originally, find the expression of the increase in contribution per person. (2 marks)

Originally $= \frac{144{,}000}{n}$.

New $= \frac{144{,}000}{n-5}$

Increase $= \frac{144{,}000}{n-5} - \frac{144{,}000}{n} = \frac{720{,}000}{n^2-5n}$.

(b) If the increase in the contribution per person was sh 2, 400, find the number of workers originally in the school. (4 marks)

$\frac{720{,}000}{n^2-5n} = \frac{2{,}400}{1}$

$24\cancel{00}n^2 - 120\cancel{00}n = 720{,}0\cancel{0}\cancel{0}$

$n^2 - 5n - 300 = 0$.

$(n^2 - 20n)(+15n - 300) = 0$

$n(n-20) + 15(n-20) = 0$

$(n+15)(n-20) = 0$

$n+15=0$ $\quad$ $n-20=0$

$n=-15$ $\quad$ $n=20$

(c) How much would each person have contributed to the nearest shilling if the 5 workers did not retire. (2 marks)

$\frac{144{,}000}{20} = 7200/=$

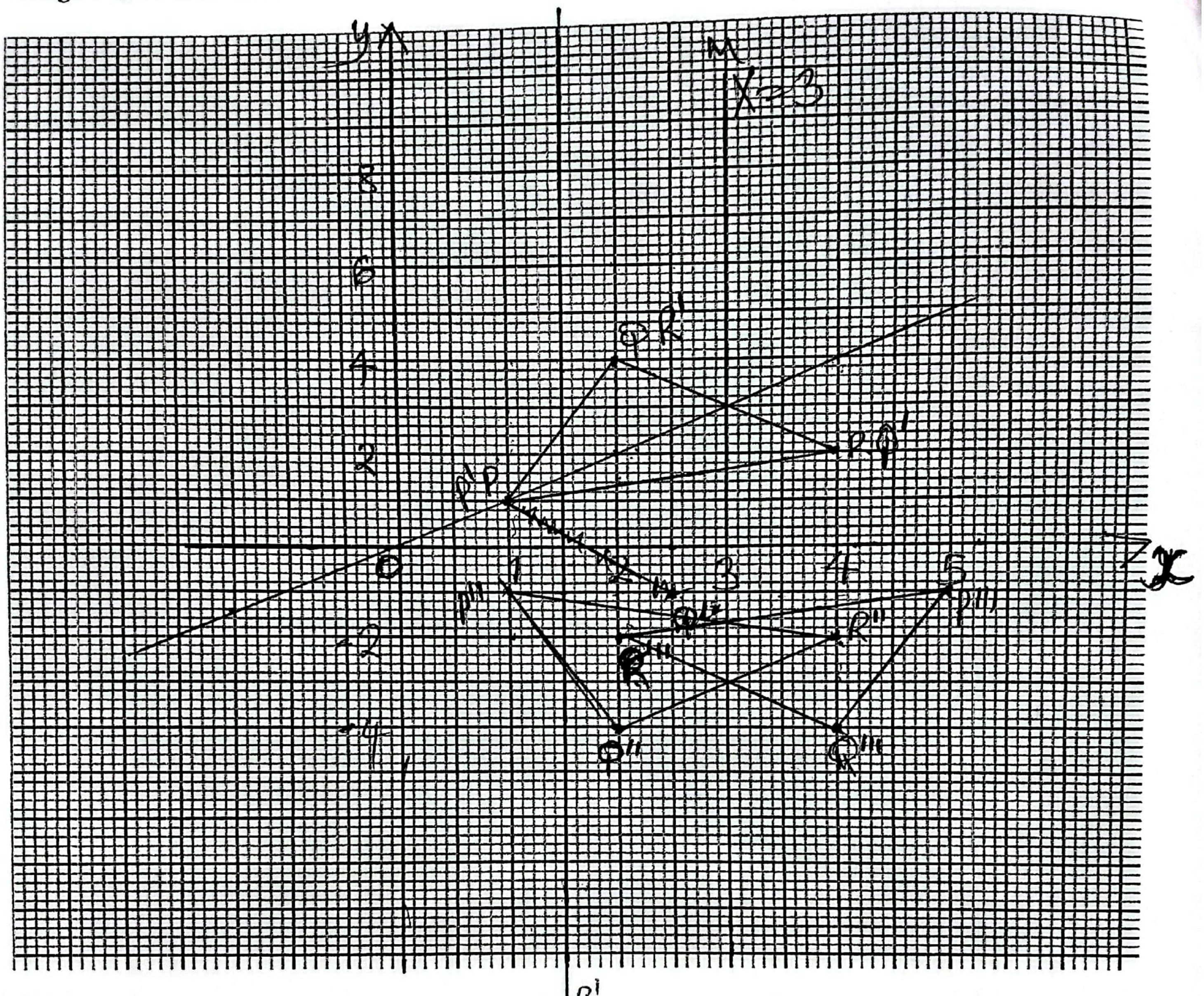
(d) Calculate the percentage increase in the contribution per person because of the retirement. (2 marks)

New Cont, $= \frac{144{,}000}{15} = 9600/=$

Increase $= 9600 - 7200 = 2400$

$\% \ \frac{2400}{7200} \times 100 = \underline{33.33\%}$

21. A triangle PQR has vertices at P(1,1), Q (2,4) and R(4,2). Draw on the same axes triangle PQR and its image P′Q′R′ after a reflection in the lien y – x = 0. (3 marks)




(b)On the same axes draw P″Q″R″ the image of P′Q′ after – 90⁰ turns about the origin and state the coordinates of ΔP″Q″R″. (2 marks)

(c)Describe the transformation that maps ΔP″Q″R″ onto ΔPQR. (2 marks)

Reflection in the line y=0.

(d)Draw ΔP‴Q‴R‴ the image of ΔP″Q″R″ under reflection in the line x = 3. State the coordinates of ΔP‴Q‴R‴. (3 marks)

P'''(5,1) Q'''(4,-4) R'''(2,-2)

PQR an

22. The displacement S metres of a moving particle after t seconds in given by $s = 2t^3 - 5t^2 + 4t + 2$.
Determine:

(2 marks)

(i) The velocity of the particle when $t = 2$.

$$\frac{ds}{dt} = 6t^2 - 10t + 4$$
$$= 6(2)^2 - 10(2) + 4$$
$$= 8 m/s$$

(2 marks)

(ii) The value of t when the particle is momentarily at rest.

At rest $V = 0$

$$6t^2 - 10t + 4 = 0$$
$$6t^2 - 6t - 4t + 4 = 0$$
$$6t(t-1) - 4(t-1) = 0$$
$$(6t-4)(t-1) = 0$$
$t = 2/3$ or $t = 1$

(2 marks)

(iii) The displacement when the particle is momentarily at rest.

$$S = 2t^3 - 5t^2 + 4t + 2$$
$$= 2(1)^3 - 5(1)^2 + 4(1) + 2$$
$$= 3m$$

(2 marks)

(iv) The acceleration of the particle when $t = 5$.

$$\frac{dv}{dt} = 12t - 10$$
$$= 12(5) - 10$$
$$= 60 - 10 = 50 m/s^2$$

(2 marks)

(v) The maximum velocity attained.

At max Velocity $a = 0$

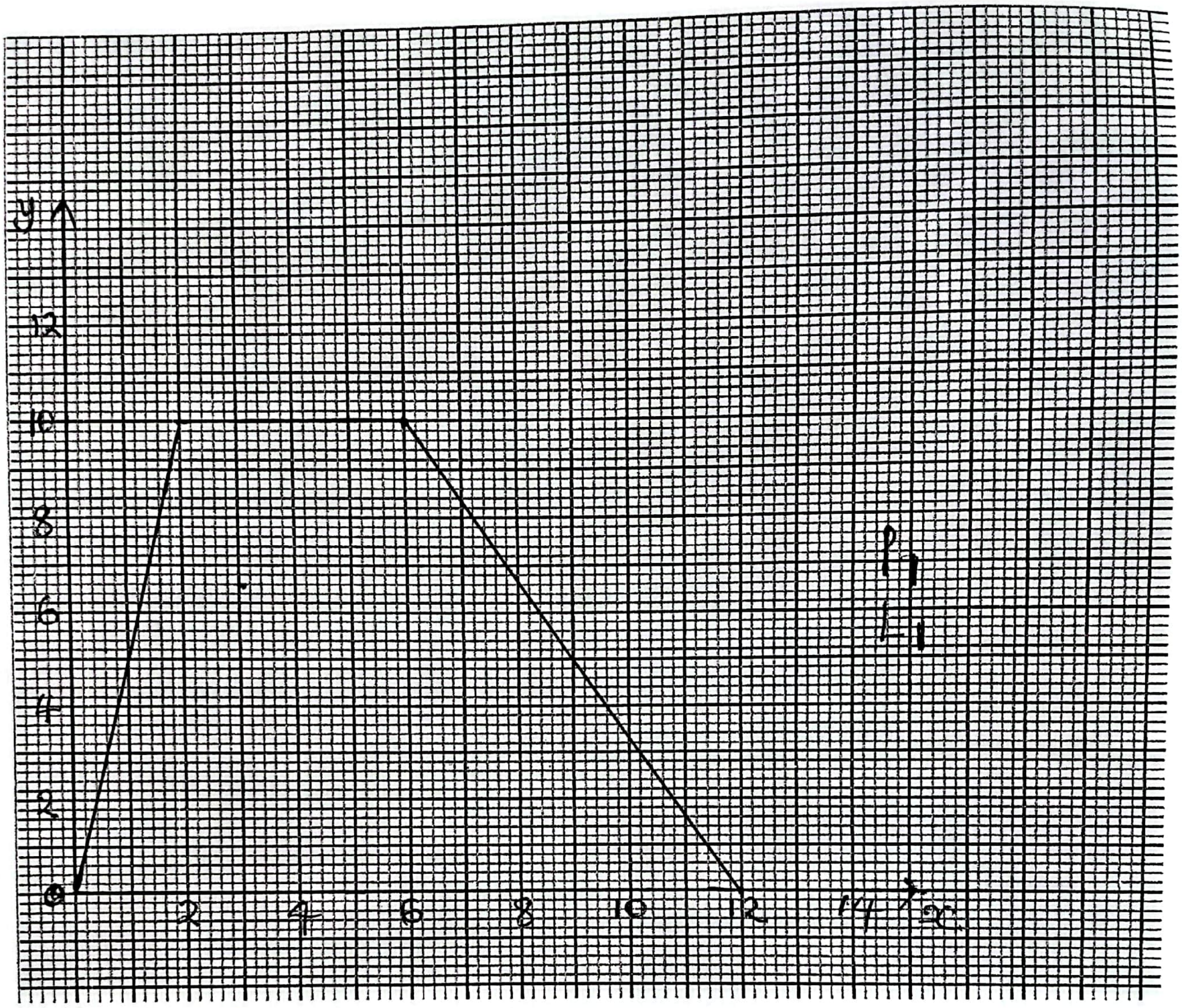
$$12t - 10 = 0$$
$$12t = 10$$
$$t = \frac{10}{12} = 5/6$$

Max Velocity

$$= 6\left(\frac{10}{12}\right)^2 - 10\left(\frac{10}{12}\right) + 4$$
$$= \frac{600}{144} - \frac{100}{12} + 4 = -\frac{1}{6} m/s$$

23. A particle moves from rest and attains a velocity of 10m/s after 2 seconds. It then moves with this velocity for four seconds then decelerates uniformly to rest after another six seconds.

(a) On the grid provided below, draw a velocity – time graph for the motion of this particle. (2 marks)




(b) From the graph:

(i) The acceleration of the particle during the first two seconds. (1 mark)

$a = \frac{10-0}{2} = 5 m/s^2$

(ii) The deceleration of the particle during the last six seconds. (1 mark)

$a = \frac{0-10}{6} = -1\frac{2}{3} m/s^2$ Deceleration $1\frac{2}{3} m/s^2$

(iii) The total distance covered by the particle. (2 marks)

Total distance $= \left(\frac{4+12}{2}\right)10 = 80m$.

(c) Calculate the time taken by the particle to cover half the distance. (4 marks)

$\frac{1}{2} \times 80 = 40m$

Time taken to cover first 2 seconds

$= \frac{1}{2} \times 2 \times 10 = 10m$

$40 - 10 = 30m$

$10t = 30$

$t = 3$ seconds.

Time $= 3 + 2$

$= 5$ seconds

24. The position vectors of A, B and C are 3i – 2j, - 6i + 4j and -9i – 3j respectively.

(a) State the column vectors.

(i) AB (2 marks)

$$AB = B - A$$

$$= \begin{pmatrix} -6 \\ 4 \end{pmatrix} - \begin{pmatrix} 3 \\ -2 \end{pmatrix} = \begin{pmatrix} -9 \\ 6 \end{pmatrix}$$

(ii) CB (2 marks)

$$CB = B - C$$

$$= \begin{pmatrix} -6 \\ 4 \end{pmatrix} - \begin{pmatrix} -9 \\ -3 \end{pmatrix} = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$$

(b) Find the distance from A to C. (2 marks)

$$AC = C - A$$

$$= \begin{pmatrix} -9 \\ -3 \end{pmatrix} - \begin{pmatrix} 3 \\ -2 \end{pmatrix} = \begin{pmatrix} -12 \\ -1 \end{pmatrix}$$

$$|AC| = \sqrt{(-12)^2 + (-1)^2} = \sqrt{145} = 12.04 \text{ units}$$

(c) Find the coordinates of the midpoint of AC. (2 marks)

$$\left( \frac{3i + 9i}{2}, \frac{2j + -3j}{2} \right)$$

$$\left( \frac{-6i}{2}, \frac{-5j}{2} \right) = 3i, -2.5j \quad \text{point } (-3, -2.5)$$

(d) If point C′ is the image of C under translation vector $\begin{pmatrix} 1 \\ -3 \end{pmatrix}$. Find the coordinate of C′

$$C + \begin{pmatrix} 1 \\ -3 \end{pmatrix} = C'$$

$$\begin{pmatrix} -9 \\ -3 \end{pmatrix} + \begin{pmatrix} 1 \\ -3 \end{pmatrix} = \begin{pmatrix} -8 \\ -6 \end{pmatrix}$$

$$C' = (-8, -6) \text{ or } -8i - 6j$$