



# NAIROBI SCHOOL

Kenya Certificate of Secondary Education

**121/1 - MATHEMATICS - Paper 1**  
**(ALT A)**  
**2 ½ hours**

## THE NAIROBI SCHOOL MOCK EXAMINATIONS

### July/August, 2023

Name \_\_\_\_\_ Adm. No \_\_\_\_\_ Class \_\_\_\_\_

Candidate's Signature \_\_\_\_\_ Date \_\_\_\_\_

#### Instructions to candidates

- (i) Write your name, admission number and class in the space provided above.
- (ii) Sign and write the date of examination in the spaces provided above.
- (iii) This paper consists of two sections: **Section I** and **Section II**.
- (iv) Answer **all** the questions in **Section I** and **only five** questions from **Section II**.
- (v) Show all the steps in your calculations, giving your answer at each stage in the spaces provided below each question.
- (vi) Marks may be awarded for correct working even if the answer is wrong.
- (vii) Non-programmable silent electronic calculators and KNEC Mathematical Tables may be used, except where stated otherwise.
- (viii) This paper consists of 14 printed pages. 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 in the spaces provided.

1. Evaluate:  $\frac{\frac{1}{2} \text{ of } 3\frac{1}{2} + (2\frac{1}{2} \frac{1}{3})}{\frac{3}{4} \text{ of } 2\frac{1}{2} + \frac{1}{2}}$

$$\frac{7}{4} + \frac{15-2}{6}$$

$$\frac{\frac{3}{4} \times 5\frac{1}{2} \times \frac{8}{7}}{\frac{21+26}{12} \times \frac{4}{15}}$$

$$\frac{47}{12} \times \frac{41}{15} = \frac{47}{45} \checkmark = \frac{2}{45} \checkmark$$

(3 marks)

M<sub>1</sub>M<sub>1</sub>A<sub>1</sub>

2. Determine the value of p if  $r = 0.4827$  and  $q = 2.034$

$$\frac{1}{r} = \frac{1}{p^2} + \frac{1}{q}$$

$$\frac{1}{p^2} = \frac{1}{r} - \frac{1}{q} = \frac{q-r}{rq}$$

$$p^2 = \frac{rq}{q-r}$$

$$p = \sqrt{\frac{rq}{q-r}} = \sqrt{\frac{0.4827 \times 2.034}{2.034 - 0.4827}} \checkmark$$

$$= \sqrt{\quad} = \underline{0.7955} \checkmark$$

(3 marks)

M<sub>1</sub> making p the subjectM<sub>1</sub> ✓ substituteA<sub>1</sub>

3. Factorize and simplify the expression completely.

$$\frac{(x+y)(2x-5y)-(x+y)^2}{12y-2x}$$

$$\frac{(x+y)(2x-5y-x-y)}{2(by-x)}$$

$$\frac{(x+y)(x-by)}{2(by-x)}$$

$$-\frac{1}{2}(x+y) \checkmark \checkmark$$

(3 marks)

A<sub>1</sub> ✓ factorizeM<sub>1</sub> ✓ divisionA<sub>1</sub>

4. A trader bought 360 trays of eggs at Ksh. 450 per tray. He later discovered that 15% were spoiled and she could not sell them. How much must she sell the good eggs per dozen in order to make a profit of 40%? (3 marks)

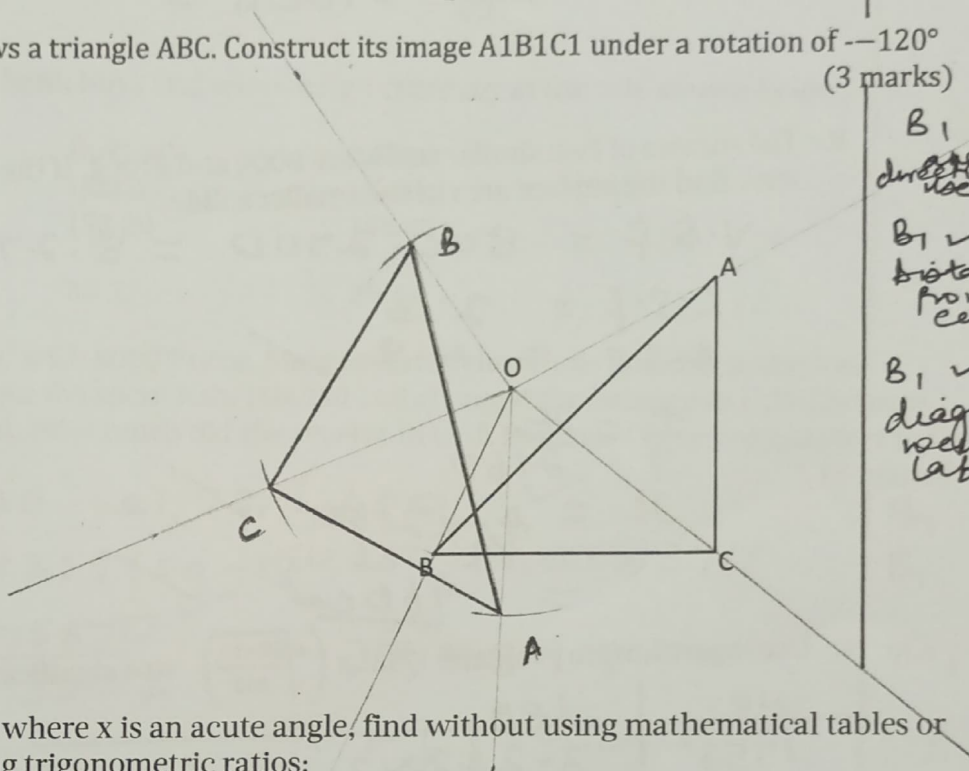
Total ~~sets~~ <sup>cost</sup> =  $360 \times 450 = 162,000$  ✓

No of <sup>dozens</sup> eggs sold =  $\frac{360 \times 85}{100} \times \frac{30}{12} = 765$

cost per dozen =  $\frac{162,000 \times 1.4}{765}$  ✓  
 $= \underline{\underline{296.47}}$  ✓

B ✓  
 cost ✓  
 M ✓  
 A ✓

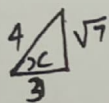
5. The diagram below shows a triangle ABC. Construct its image A<sub>1</sub>B<sub>1</sub>C<sub>1</sub> under a rotation of -120° about centre O. (3 marks)



B<sub>1</sub> ✓  
~~directly used~~  
 B<sub>1</sub> ✓  
 rotation from cent ✓  
 B<sub>1</sub> ✓  
 diagram well label ✓

6. Given that  $\cos x = 0.75$ , where  $x$  is an acute angle, find without using mathematical tables or calculators the following trigonometric ratios:

i.  $\sin x$



$\frac{\sqrt{7}}{4}$  ✓

(1 mark)

B<sub>1</sub>

ii.  $\tan^2(90 - x)$

$\left(\frac{3}{\sqrt{7}}\right)^2$  ✓

$= \frac{9}{7}$  ✓  
 $= 1\frac{2}{7}$  ✓

(2 marks)

M<sub>1</sub>  
 A<sub>1</sub>



7. A farmer has 200m of fencing with which three sides of a rectangular enclosure, the fourth side being existing wall of the yard. Find in metres the dimension of the largest possible field that can be enclosed. (3 marks)

let width be  $x$

$$A = x(200 - 2x)$$

$$= 200x - 2x^2$$

$$\frac{dA}{dx} = 200 - 4x = 0 \quad \checkmark$$

$$200 = 4x$$

$$50 = x \quad \checkmark$$

$$\text{width} = 50\text{m}$$

$$\text{length} = 100\text{m} \quad \checkmark$$

M<sub>1</sub>M<sub>1</sub>A<sub>1</sub>

for bot

8. The masses of two similar solids are 800g and 2700g. If the surface area of the larger one is 2160 cm<sup>2</sup>, find the surface area of the smaller solid. (3 marks)

$$V.S.F = 800:2700 = 8:27$$

$$L.S.F = 2:3$$

$$A.S.F = 4:9 \quad \checkmark$$

$$\frac{A}{9} = \frac{x}{2160}$$

$$x = \frac{4}{9} \times 2160 \quad \checkmark$$

$$= 960\text{cm}^2 \quad \checkmark$$

B<sub>1</sub>

V.A.S.

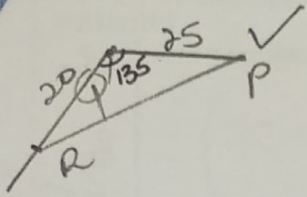
M<sub>1</sub>A<sub>1</sub>

9. Use logarithms to evaluate:  $1753^2 \times \left(\sqrt[3]{\frac{0.00513}{458}}\right)$  to 4 significant figures (3marks)

NO.	Log
1753 <sup>2</sup>	3.2438 × 2 = 6.4876
0.00513	3.7101
458	2.6609
	5.0492 ÷ 3 = 2.3497
	<u>4.8373</u>

68754<sup>3</sup>68750.B<sub>1</sub> ✓  
logsB<sub>1</sub> ✓  
ad

10. Village P is 25 km due east of village Q. Another village R is 20 km from Q on a bearing of S45°W. Calculate how far village R is from village P. (3 marks)



$$r^2 = 20^2 + 25^2 - 2 \times 20 \times 25 \cos 135$$

$$= 1025 + 707.107$$

$$= 1732.107$$

$$r = \underline{41.62 \text{ km}}$$

11. A Kenyan commercial bank buys and sells foreign currency at the rate shown below:

Currency	Buying (Kshs.)	Selling (Kshs.)
1 Euro	153.20	153.45
1 UAE Dirham	38.27	38.42

A French tourist arrived with 8000 Euros. She converted the whole amount to the local currency. While in Kenya she spent Ksh. 150,230 and changed the balance to UAE Dirhams before leaving for Dubai. How much did she receive in UAE Dirhams? Give your answer to the nearest Dirham.

$$8000 \times 153.20 = 1,225,600$$

$$\text{Remaining} = 1,225,600 - 150,230 = 1,075,370$$

$$\frac{1,075,370}{38.42} = 27,989.8$$

$$\approx 27,990$$

12. A number P is formed by adding all negative integers greater than -10 while a number Q is formed by adding all positive square numbers less than 10. Find:

Find:

a) P + Q

$$P = -9 + -8 + -7 + -6 + -5 + -4 + -3 + -2 + -1 = -45$$

$$Q = 1 + 4 + 9 = 14$$

$$P + Q = 14 - 45 = -31$$

b) Another number R = 15. Determine the difference between P and R.

$$\begin{array}{r} 45 \\ -15 \\ \hline 60 \end{array}$$

(4 marks)

B<sub>1</sub>

B<sub>1</sub>

M<sub>1</sub>

A<sub>1</sub>

(2 marks)

B<sub>1</sub> value of q add

B<sub>1</sub>

(1 mark)

B<sub>1</sub>



13. A metal sheet measuring 1.2m long, 50cm wide and 2.5mm thick is melted down and recast into a new sheet with a square base. If the new sheet is eight times as thick as the original sheet, find to the nearest centimetre, the length of the base of the new sheet. (3 marks)

$$\text{Volume} = 120 \times 50 \times 0.25 = 1500 \text{ cm}^3 \quad \checkmark$$

$$\begin{aligned} \text{New thickness} &= 0.25 \times 8 = 2 \text{ cm} \\ \text{New width} &= \frac{4}{3} \times 50 = 66\frac{2}{3} \end{aligned} \quad \checkmark$$

$$66\frac{2}{3} \times 2$$

$$= 11.25$$

$$\approx 11 \text{ cm} \quad \checkmark$$

14. Four angles of a polygon are  $145^\circ$ ,  $140^\circ$ ,  $173^\circ$ , and  $172^\circ$ . The remaining angles are each  $135^\circ$ . Calculate the sum of the interior angles of the polygon. (3 marks)

$$360 - (25 + 40 + 7 + 8) = 2$$

$$\therefore \text{No of sides} = 2 + 4 = 6 \quad \checkmark$$

$$\text{Sum} = 180(b-2) = 720 \quad \checkmark$$

15. A curve whose equation is  $y = mx^3 - 3x^2$  passes through a point  $(-1, 2)$ . Determine the value of  $m$ . Hence, determine the equation of the normal to the curve at this point in the form  $y = mx + c$ . (4 marks)

$$2 = -m - 3$$

$$m = -5 \quad \checkmark$$

$$y = -5x^3 - 3x^2$$

$$\frac{dy}{dx} = -15x^2 - 6x$$

$$\text{Gr of tangent} = -15(-1)^2 - 6(-1) = -9$$

$$\text{Gr of normal} = \frac{1}{9} \quad \checkmark$$

$$\frac{y-2}{x+1} = \frac{1}{9} \quad \checkmark \quad \therefore y-2 = \frac{1}{9}x + \frac{1}{9} \quad \therefore y = \frac{1}{9}x + \frac{19}{9} \quad \checkmark$$

16. Solve the simultaneous inequalities  $\frac{2y+1}{-2} > \frac{y-1}{3} \geq \frac{3+y}{-1}$  and hence state all the integral values of  $y$ . (3 marks)

$$\frac{2y+1}{-2} > \frac{y-1}{3}$$

$$6y+3 < -2y+2$$

$$8y < -1$$

$$y < -0.125$$

$$\frac{y-1}{3} \geq \frac{3+y}{-1}$$

$$-y+1 \leq 9+3y$$

$$-10 \leq 4y$$

$$-2.5 \leq y$$

$$-2.5 \leq y < -0.125$$

$$-2, -1$$

SECTION II (50 MARKS)

Answer only five questions from this section

17. a) Find the quadratic equation whose roots are  $-\frac{3}{4}$  and  $\frac{2}{3}$  write it in the form  $ax^2 + bx + c = 0$  where a, b and c are integers. (3 marks)

$$\left(x + \frac{3}{4}\right) \left(x - \frac{2}{3}\right) = 0$$

$$x^2 - \frac{2}{3}x + \frac{3}{4}x - \frac{6}{12} = 0$$

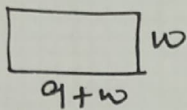
$$12x^2 - 8x + 9x - 6 = 0$$

$$12x^2 + x - 6 = 0$$

- c) The length of a floor of a rectangular hall is 9m more than its width. The area of the floor is  $136m^2$ .

i) Calculate the perimeter of the floor

(4 marks)



$$w(9+w) = 136$$

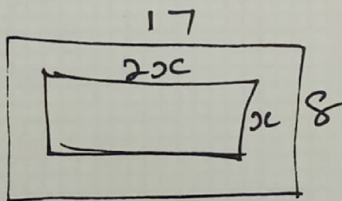
$$w^2 + 9w - 136 = 0$$

$$\frac{-9 \pm \sqrt{9^2 - 4 \times 1 \times -136}}{2 \times 1}$$

$$= \frac{-9 \pm 25}{2} = \frac{16}{2} = 8 \text{ or } -17$$

$$L = 17, P = \frac{(17+8) \times 2}{2} = 50m.$$

- ii) A rectangular carpet is placed on floor of the hall leaving an area of  $64cm^2$ . If the length of the carpet is twice its width, determine the width of the carpet (3 marks)



$$136 - 2x^2 = 64$$

$$2x^2 - 72 = 0$$

$$x^2 - 36 = 0$$

$$(x+6)(x-6) = 0$$

$$x = 6m \text{ or } -6m.$$

$$\text{width} = 6m.$$

$$136 - 2x^2 = 64$$

$$2x^2$$

18) The table below shows the age distribution in years of 72 residence of a village in Keiyo county.

Age (years)	1- 5	6-10	11-20	21-30	31-50	51-55	56-65
Frequency	4	8	8	6	40	3	3

FD. 0.80 1.6 0.8 0.6 2 0.6 0.3

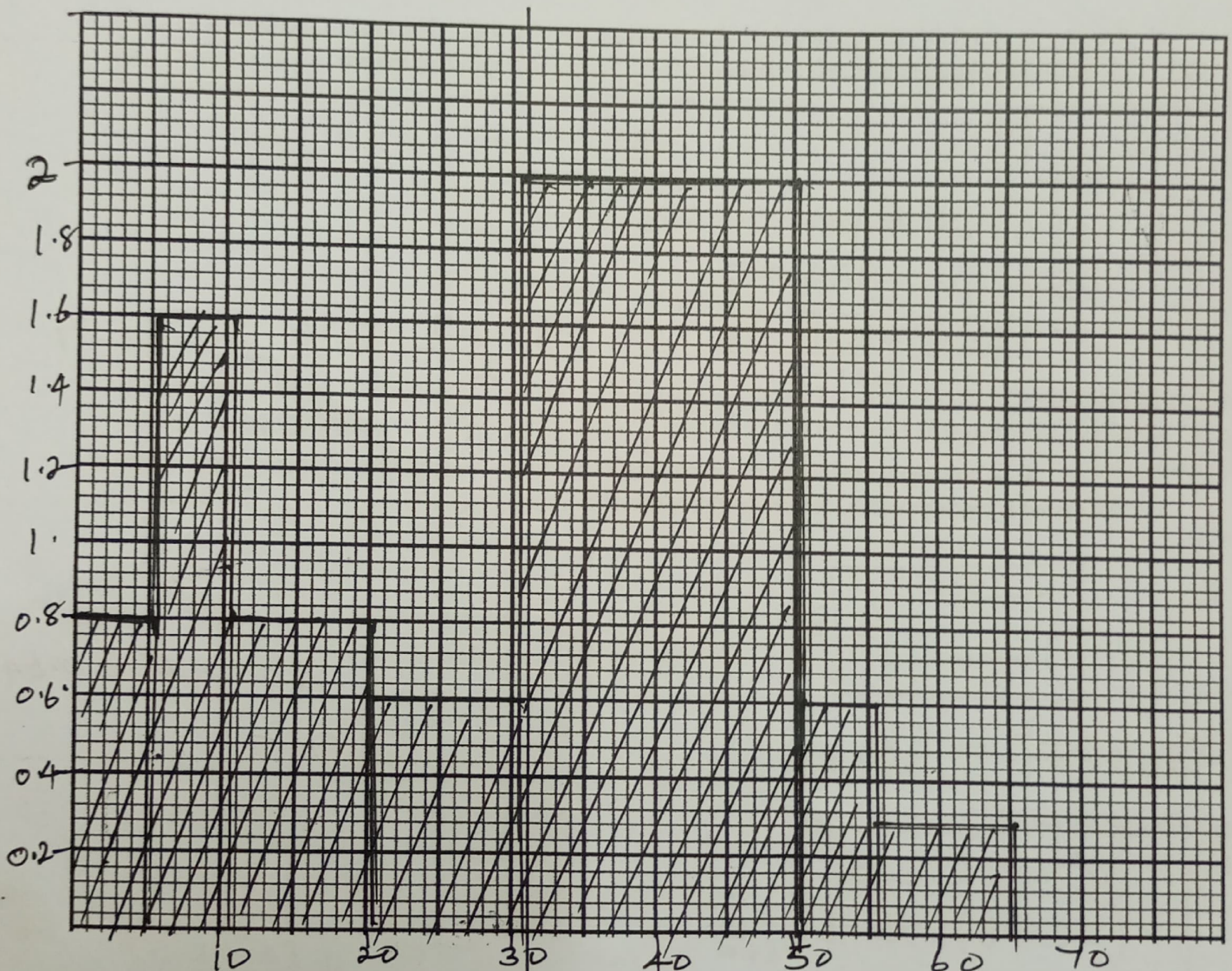
a) Determine the mean age of the villagers. (3 marks)

$$3 \times 4 + 8 \times 8 + 15.5 \times 8 + 25.5 \times 6 + 40.5 \times 40 + 53 \times 3 + 60.5 \times 3$$

$$12 + 64 + 124 + 153 + 1620 + 159 + 181.5 = 2313.5$$

$$\text{mean} = \frac{2313.5}{72} = 32 \frac{1319}{99676} \approx \underline{\underline{32.13}}$$

b) On the grid provided draw a histogram to represent the data. (4 marks)



c) Use the graph and by drawing a vertical line find to the median age. (3 marks)

$$0.8 \times 5 +$$

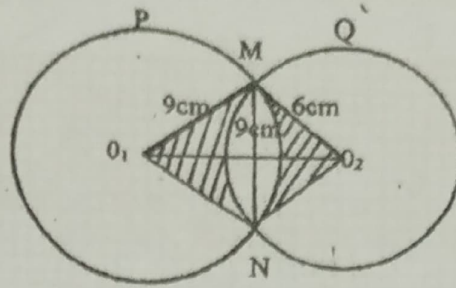
$$A + 8 + 8 + 6 + 20 \times x = \frac{72}{2}$$

$$x = 0.5$$

$$\text{median} = 30.5 + 0.5 = \underline{\underline{31}}$$



19. The following figure shows two circles P and Q with centre  $O_1$  and  $O_2$  respectively and their radii are 9 cm and 6 cm respectively. The common chord MN is 9 cm long. (Not drawn in scale).



a)

Find the value of

- i. Angle  $MO_1N$ .

$$2 \sin^{-1}\left(\frac{4.5}{9}\right) = 60^\circ$$

(2 marks)

- ii. Angle  $MO_2N$

$$2 \sin^{-1}\left(\frac{4.5}{6}\right) = 97.18^\circ$$

(2 marks)

b) Find the area of:

- i) Triangle  $MO_1N$

$$\frac{1}{2} \times 9 \times 9 \sin 60 = 35.07$$

(2 marks)

- ii) Triangle  $MO_2N$

$$\frac{1}{2} \times 6 \times 6 \sin 97.18 = \underline{\underline{17.86}}$$

(1 marks)

c) Find the area of the shaded region.

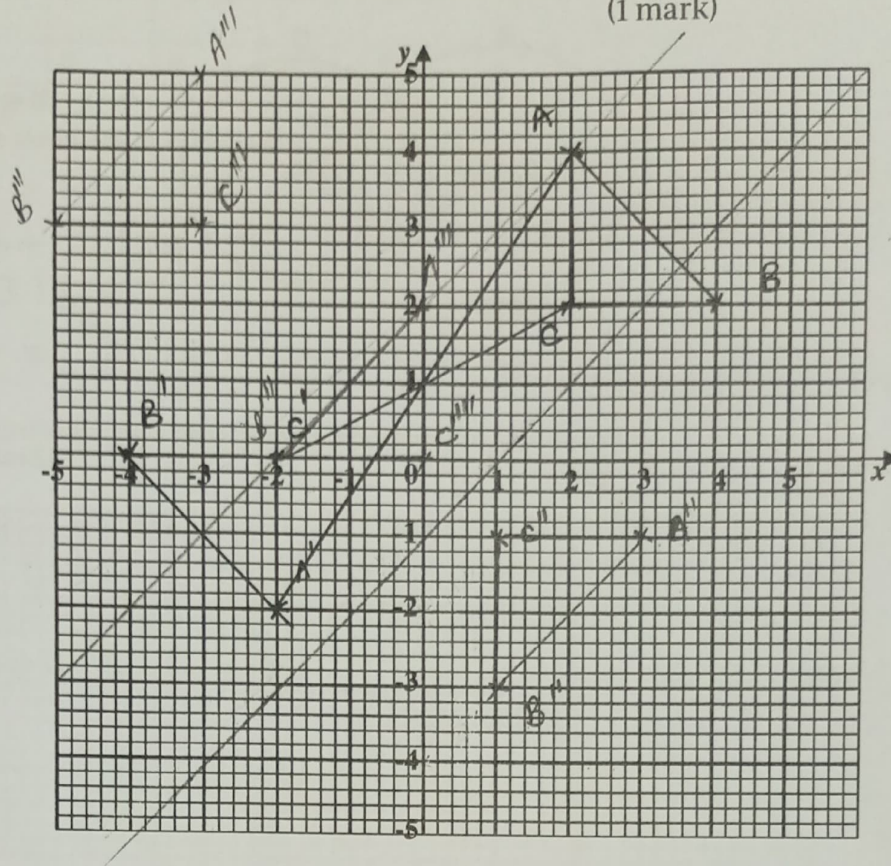
(4 marks)

$$\frac{60}{360} \times \frac{22}{7} \times 9^2 - 35.07 = 42.43 - 35.07 = 7.359$$

$$\frac{97.18}{360} \times \frac{22}{7} \times 6^2 - 17.86 = 30.54 - 17.86 = \frac{12.68}{20.039}$$

$$\begin{aligned} \text{Area} &= (35.07 + 17.86) - (20.039) \\ &= \underline{\underline{32.891}} \end{aligned}$$

20. (a) Triangle ABC has vertices A(2,4), B(4,2) and C(2,2). On the grid provided draw triangle A'B'C' (1 mark)



B<sub>1</sub> ✓

(b) Triangle A'B'C' with coordinates A'(-2, -2), B'(-4,0) and C'(-2,0) is the image of ABC under an enlargement. Draw triangle A'B'C' and hence determine the centre of enlargement and the enlargement scale factor. (3 marks)

centre (0,1)  
S.f. = -1

B<sub>1</sub> ✓  
B<sub>1</sub> ✓  
C ✓  
B<sub>1</sub> ✓

(c) Triangle A'B'C' is mapped onto A''B''C'' by a rotation of -90° about (0,1). Draw triangle A''B''C'' and state its coordinates. (3 marks)

(d) Draw triangle A'''B'''C''' the image of triangle A''B''C'' after a reflection in the line  $y = x - 1$ , and state its coordinates. (3 marks)



21. A line passes through the points (3, 4) and (1.5, 6).

(a) Find the equation of the line in the form  $y = mx + c$ , where  $m$  and  $c$  are constants.

$$\begin{aligned} 4 &= 3m + c \quad \checkmark \\ 6 &= 1.5m + c \\ \hline -2 &= 1.5m \quad \checkmark \\ m &= -\frac{4}{3} \end{aligned}$$

$$c = 3 \cdot 4 - 3\left(-\frac{4}{3}\right) = 8 \quad \checkmark$$

(3 marks)

 $m_1$  $m_1$  $A_1$  $(6 \text{ or } 6.0)$ 

(b) State the coordinates of the point M at which the line in (a) above cuts the y-axis.

$$M(0, 8) \quad \checkmark$$

(1 mark)

(c) Another line which is perpendicular to the line in (a) above and passing through M cuts the x-axis at N.

Determine the coordinates of point N.

(4 marks)

$$\frac{y-8}{x-0} = \frac{3}{4} \quad \checkmark$$

$$y-8 = \frac{3}{4}x$$

$$0-8 = \frac{3}{4}x \quad \checkmark$$

$$-\frac{16}{3} = x \quad \checkmark$$

$$N\left(-5\frac{1}{3}, 0\right) \quad \checkmark$$

(d) Calculate the length of  $\overline{MN}$ .

(2 marks)

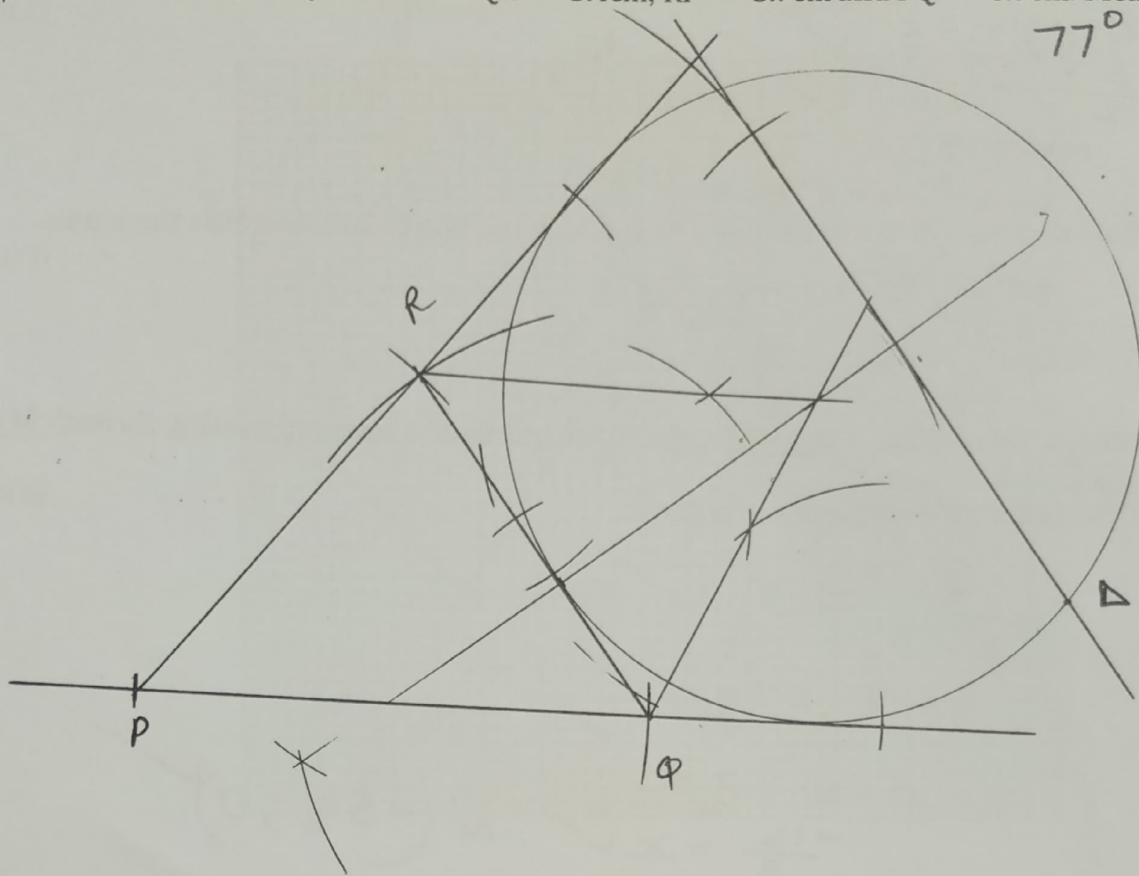
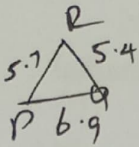
$$\sqrt{8^2 + \left(\frac{16}{3}\right)^2} \quad \checkmark$$

$$= \underline{\underline{9.615}} \text{ units}$$



22. Using a ruler and a pair of compasses only construct:

(a) Triangle PQR such that QR = 5.4cm, RP = 5.7cm and PQ = 6.9cm. Measure angle PRQ (2marks)



77°

B<sub>1</sub> ✓  
B<sub>1</sub> ✓

(b) A circle that touches QR and PR and PQ extended. Measure the radius of the circle. (4 marks)

radius = 4.2 cm.

B<sub>1</sub> ✓  
B<sub>1</sub> ✓  
B<sub>1</sub> ✓

(c) Point D is on this circle such angle DQR is obtuse and the area of triangle DQR is equals to the area of triangle PQR. Locate point D. (4 marks)

$$\sqrt{9(3.6)(3.3)(2.1)} = \frac{1}{2} \times 5.4 \times h$$

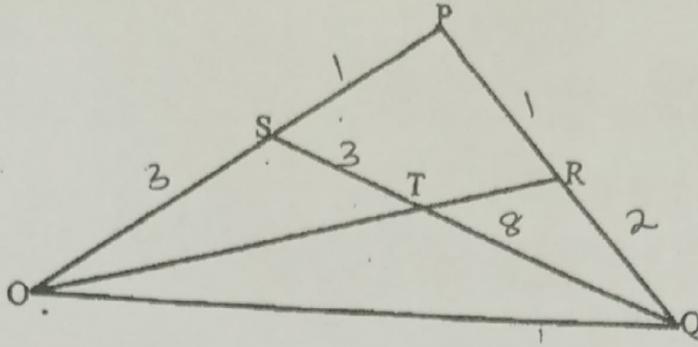
$$\frac{14.98 \times 2}{5.4} = h =$$

$$h = 5.55 \checkmark$$

M<sub>1</sub>  
A<sub>1</sub>  
B<sub>1</sub> ✓  
V<sub>11</sub> ✓  
B<sub>1</sub> ✓



23. In the figure below, OPQ is a triangle in which  $OS = \frac{3}{4} OP$  and  $QR:RP = 2:1$ . Line OR and SQ meet at T.



- (a) Given that  $OP = p$  and  $OQ = q$ , express the following vectors in terms of  $p$  and  $q$ .

- i.  $PQ$  (1 mark)

$$\underline{q} - \underline{p}$$

- ii.  $OR$  (2 marks)

$$\frac{2}{3}\underline{p} + \frac{1}{3}\underline{q}$$

- iii.  $SQ$  (1 mark)

$$\underline{q} - \frac{3}{4}\underline{p}$$

- (b) You are further given that  $ST = mSQ$  and  $OT = nOR$ . By expressing  $OT$  in two ways, determine the values of scalars  $m$  and  $n$ . (5 marks)

$$\underline{OT} = m(\underline{q} - \frac{3}{4}\underline{p}) + \frac{3}{4}\underline{p} = m\underline{q} - \frac{3}{4}m\underline{p} + \frac{3}{4}\underline{p}$$

$$\underline{OT} = n(\frac{2}{3}\underline{p} + \frac{1}{3}\underline{q}) = m\underline{q} + (\frac{3}{4} - \frac{3}{4}m)\underline{p}$$

$$= \frac{2}{3}n\underline{p} + \frac{1}{3}n\underline{q}$$

$$\frac{2}{3}n\underline{p} + \frac{1}{3}n\underline{q} = (\frac{3}{4} - \frac{3}{4}m)\underline{p} + m\underline{q}$$

$$\frac{m}{\frac{3}{4} - \frac{3}{4}m} = \frac{1/3 n}{2/3 n}$$

$$\therefore \frac{3/4 - 3/4(1/3 n)}{3/4} = \frac{2/3 n}{1/3 n}$$

$$\frac{3/4 - 1/4 n}{3/4} = \frac{2}{1} = \frac{8 + 3n}{12} = \frac{11n}{12}$$

$$n = \frac{3 \times 12}{4 \times 11} = \frac{9}{11}$$

$$m = \frac{1/3 (\frac{9}{11})}{2/3 (\frac{9}{11})} = \frac{3}{11}$$

- (c) Find the ratio in which Q divides ST

$$SQ:QT = \underline{11:8}$$

(1 mark)

24. A particle moves in a straight line such that the displacement,  $S = 2t^3 - 5t^2 + 4t + 3$ , where  $t$  is time in seconds and  $s$  is displacement in metres.

Find:

- (a) The displacement of the particle in the 2<sup>nd</sup> second. (2 marks)

$$\left[ 2t^3 - 5t^2 + 4t + 3 \right]_1^2$$

$$\left( 2(2^3) - 5(2^2) + 4(2) + 3 \right) - \left( 2(1)^3 - 5(1)^2 + 4(1) + 3 \right)$$

$$7 - 4 = 3$$

- (b) The velocity of the particle when  $t = 2$ . (3 marks)

$$\frac{ds}{dt} = 6t^2 - 10t + 4$$

when  $t = 2$

$$6(2)^2 - 10(2) + 4$$

$$8 \text{ m/s}$$

- (c) The values of  $t$  when the particle is momentarily at rest. (3 marks)

$v = 0$  when at rest.

$$6t^2 - 10t + 4 = 0$$

$$6t^2 - 6t - 4t + 4 = 0$$

$$6t(t-1) - 4(t-1) = 0$$

$$(6t-4)(t-1) = 0$$

$$t = \frac{2}{3} \text{ and } t = 1$$

- (d) The acceleration of the particle when  $t = 1$ . (2 marks)

$$\frac{d^2s}{dt^2} = 12t - 10$$

when  $t = 1$

$$12(1) - 10$$

$$2 \text{ m/s}^2$$