

**CSEC Mathematics**  
**January 2022 – Paper 2**  
**Solutions**

## SECTION I

Answer ALL questions.

All working must be clearly shown.

1. (a) Using a calculator, or otherwise, find

(i) the EXACT value of  $\frac{8.9 + 31.6}{0.75 \times 5.4}$  [1]

Using a calculator,

$$\frac{8.9 + 31.6}{0.75 \times 5.4} = 10$$

(ii) the value of  $3.9 \tan(18^\circ)$  correct to 1 decimal place. [1]

Using a calculator,

$$3.9 \tan(18^\circ) = 1.3 \quad (\text{to 1 decimal place})$$

(b) (i) Ria is paid at a rate of \$13.50 per hour. During a certain week she worked 40 hours. How much did she earn that week? [1]

She earned = Number of hours worked  $\times$  Hourly Rate

$$= 40 \times \$13.50$$

$$= \$540$$

- (ii) Ria worked 4 weeks in the month of August and her gross earnings was \$2 463.75. Her regular week comprised 40 hours and overtime was paid at  $1\frac{1}{2}$  times the hourly rate.

Show that Ria worked 15 hours overtime in August. [2]

$$4 \text{ weeks} = 4 \times \$540$$

$$= \$2160$$

$$\text{Overtime wages} = \$2463.75 - \$2160$$

$$= \$303.75$$

$$\text{Overtime rate per hour} = 1.5 \times \$13.50$$

$$= \$20.25$$

$$\text{Number of overtime hours} = \frac{303.75}{20.25}$$

$$= 15 \text{ hours overtime}$$

- (iii) In August, 20% of Ria's gross earnings was deducted as tax. How much money does she have left after the deduction? [2]

$$\text{Percentage left} = (100 - 20)\%$$

$$= 80\%$$

$$\text{Amount of money she had left} = 80\% \text{ of } \$2463.75$$

$$= \$1971$$

- (iv) Ria invested \$219 of her earnings for 3 years at a rate of 4.5% per annum simple interest. How much interest does she receive after 3 years? [2]

$$SI = \frac{P \times R \times T}{100}$$

$$= \frac{219 \times 4.5 \times 3}{100}$$

$$= \$29.57$$

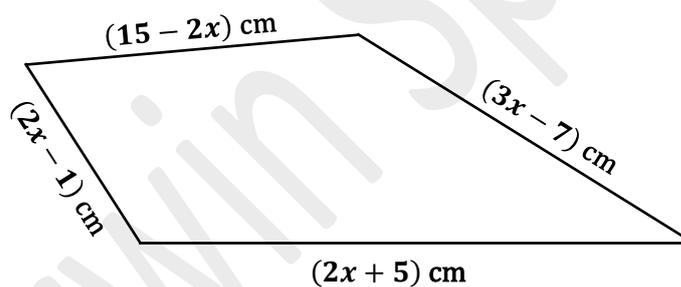
**Total 9 marks**

2. (a) Factorize completely

$$3n^2 + 15np \quad [2]$$

$$3n^2 + 15np = 3n(n + 5p)$$

(b) The diagram below shows a quadrilateral with the length of its sides written in terms of  $x$ .



(i) Write an expression, in terms of  $x$ , for the perimeter of the quadrilateral.

Express your answer in its simplest form. [2]

$$\begin{aligned} \text{Perimeter} &= 15 - 2x + 3x - 7 + 2x - 1 + 2x + 5 \\ &= 5x + 12 \end{aligned}$$

(ii) The perimeter of the quadrilateral is 32 cm.

Find the longest side of the quadrilateral. [2]

$$5x + 12 = 32$$

$$5x = 32 - 12$$

$$5x = 20$$

$$x = \frac{20}{5}$$

$$x = 4 \text{ cm}$$

$$\text{Longest side} = 2x + 5$$

$$= 2(4) + 5$$

$$= 8 + 5$$

$$= 13 \text{ cm}$$

(c) Determine ALL the **integer values** of  $x$  which satisfy the inequality

$$-1 < \frac{2-4x}{3} < 5$$

[3]

$$-1 < \frac{2-4x}{3} < 5$$

$$-3 < 2 - 4x < 15$$

$$-3 - 2 < -4x < 15 - 2$$

$$-5 < -4x < 13$$

$$\frac{-5}{-4} > x > \frac{13}{-4}$$

$$\frac{5}{4} > x > -\frac{13}{4}$$

$$-\frac{13}{4} < x < \frac{5}{4}$$

$$-3.25 < x < 1.25$$

The integer values which satisfy this inequality are  $\{-3, -2, -1, 0, 1\}$ .

Total 9 marks

3. (a) The box below contains the names of 5 quadrilaterals.

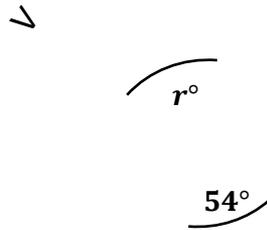
Trapezium	Rhombus	
Kite	Square	Rectangle

Choose the name of **one** quadrilateral from the box that BEST completes **each** statement. [3]

- (i) A ..... **trapezium** ..... has no lines of symmetry and has rotational symmetry of order one.
- (ii) A ..... **rectangle** ..... has EXACTLY **two** lines of symmetry and 4 right angles.
- (iii) A ..... **kite** ..... has one line of symmetry but no rotational symmetry.

- (b) The diagram below shows 4 straight lines, 2 of which are parallel.





- (i) Determine the values of  $q$  and  $r$ .

$q$  [1]

Angles on a straight line add up to  $180^\circ$ .

$$q = 180^\circ - 54^\circ$$

$$= 126^\circ$$

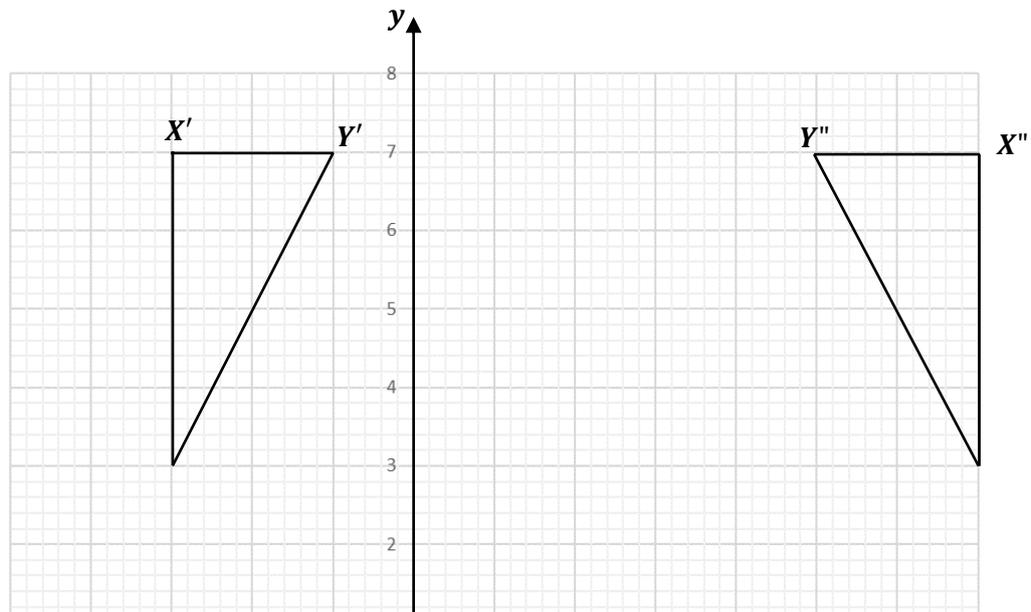
$r$  [1]

Since vertically opposite angles are equal,  $r = 54^\circ$ .

- (ii) Give a geometrical reason why  $\angle p = 71^\circ$ . [1]

Since alternate angles are equal, then  $\angle p = 71^\circ$ .

- (c) The diagram below shows triangles  $X'Y'Z'$  and  $X''Y''Z''$  drawn on a square grid.



$Z'$

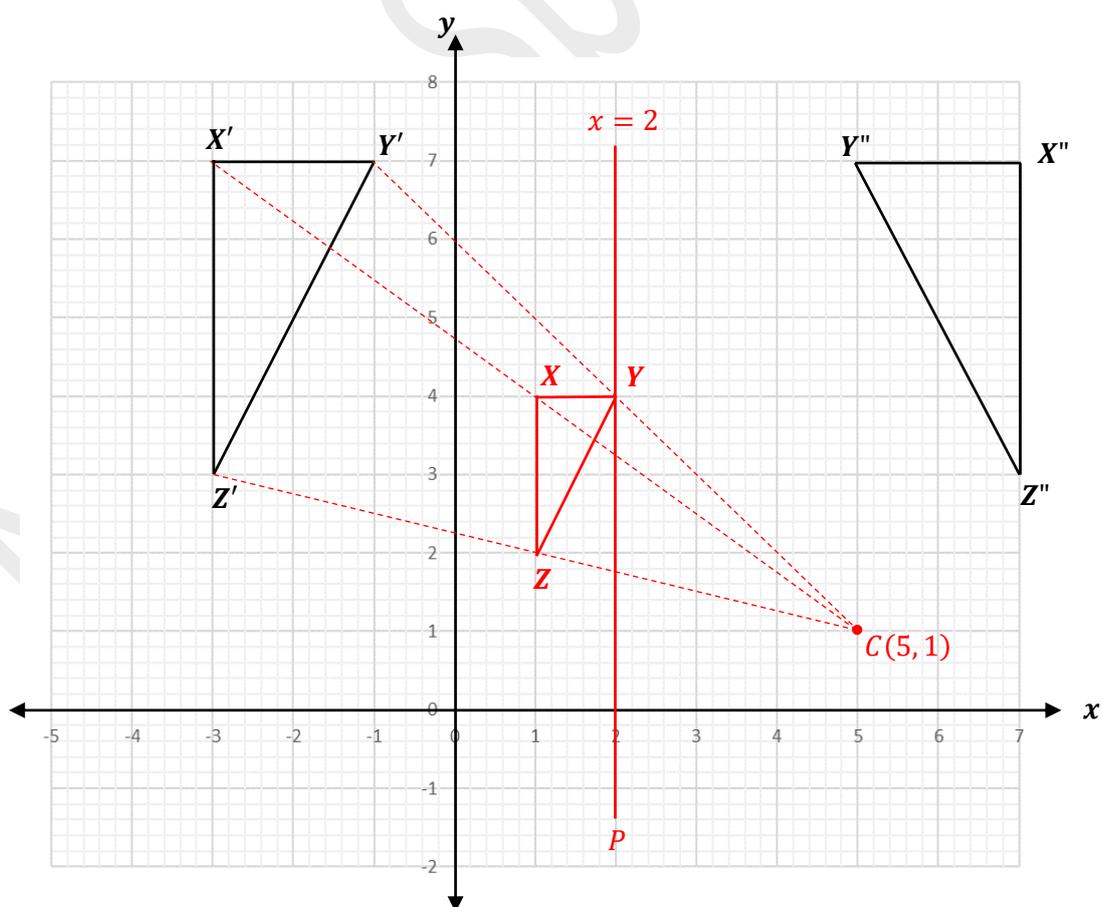
$Z''$



- (i) Triangle  $X'Y'Z'$  is the image of Triangle  $XYZ$  after an enlargement of scale factor 2, with centre  $(5, 1)$ .

Draw triangle  $XYZ$ , the **OBJECT** for Triangle  $X'Y'Z'$ , on the grid above.

[2]



- (ii) Triangle  $X'Y'Z'$  is mapped onto Triangle  $X''Y''Z''$  by a reflection in the line  $P$ . State the equation of the mirror line,  $P$ . [1]

The equation of the mirror line,  $P$ , is  $x = 2$ .

**Total 9 marks**

4. Three functions  $f$ ,  $g$  and  $h$  are defined as

$$f(x) = 2x - 1 ; g(x) = 3x + 2 \text{ and } h(x) = 5^x.$$

- (a) Find the value of

(i)  $f\left(\frac{1}{2}\right)$  [1]

$$f(x) = 2x - 1$$

$$f\left(\frac{1}{2}\right) = 2\left(\frac{1}{2}\right) - 1$$

$$= 1 - 1$$

$$= 0$$

(ii)  $h(0)$  [1]

$$h(x) = 5^x$$

$$h(0) = 5^0$$

$$= 1$$

(iii)  $g^2(-3)$

$$g(x) = 3x + 2$$

$$g(-3) = 3(-3) + 2$$

$$= -9 + 2$$

$$= -7$$

Now,

$$g^2(-3) = g[g(-3)]$$

$$= g(-7)$$

$$= 3(-7) + 2$$

$$= -21 + 2$$

$$= -19$$

(b) Find  $gf(x)$ , giving your answer in its simplest form.

[2]

$$gf(x) = g[f(x)]$$

$$= g(2x - 1)$$

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

$$= 6x - 3 + 2$$

$$= 6x - 1$$

(c) (i) Find  $g^{-1}(x)$ .

[2]

Let  $y = g(x)$ .

$$y = 3x + 2$$

Interchanging variables  $x$  and  $y$ .

$$x = 3y + 2$$

Making  $y$  the subject of the formula.

$$x - 2 = 3y$$

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

$$\therefore g^{-1}(x) = \frac{x-2}{3}$$

(ii) Hence, or otherwise, determine the value of  $x$  when  $g^{-1}(x) = 4$ . [1]

$$g^{-1}(x) = \frac{x-2}{3}$$

Hence,

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

$$12 = x - 2$$

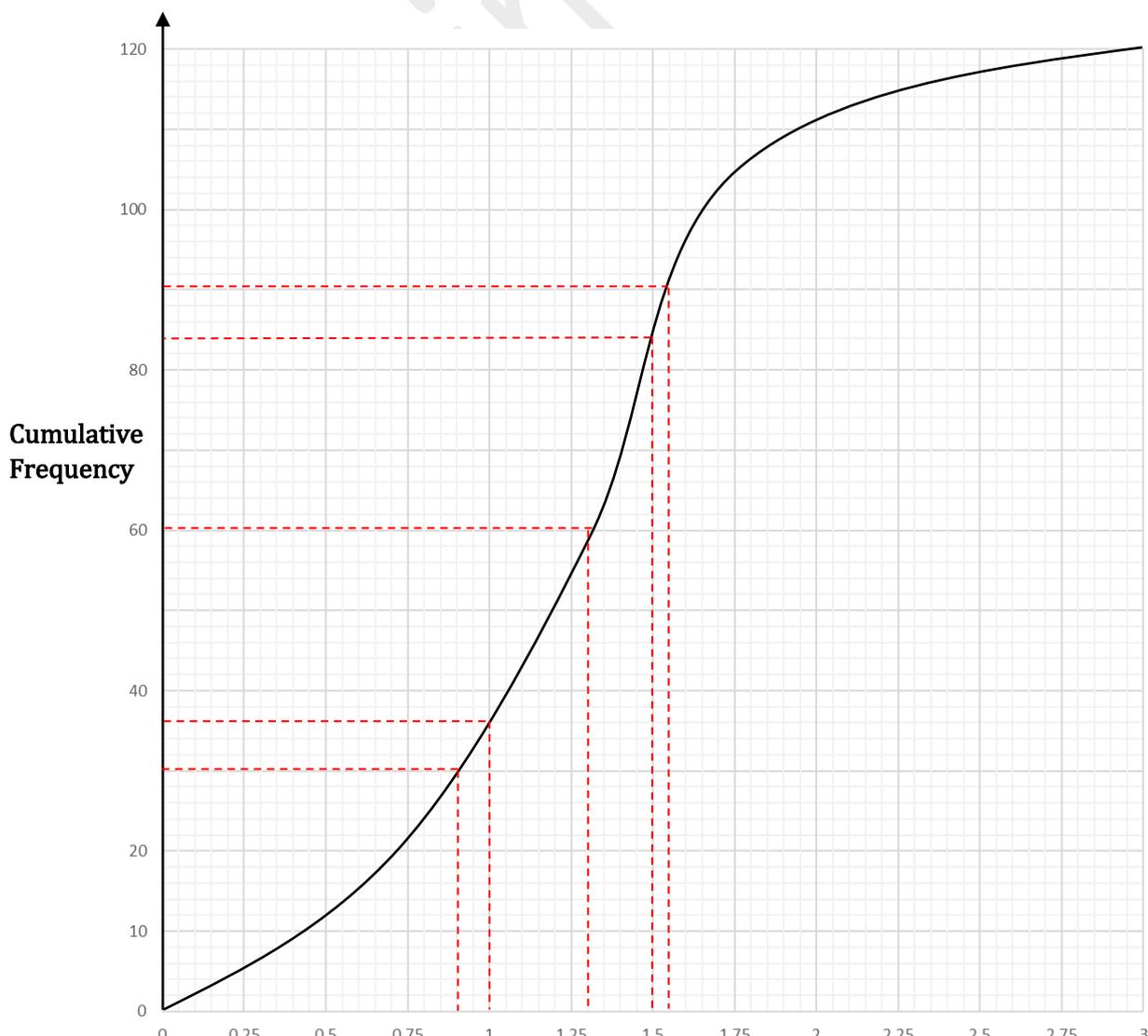
$$12 + 2 = x$$

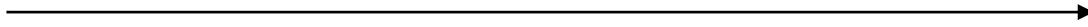
$$14 = x$$

$\therefore$  The value of  $x$  when  $g^{-1}(x) = 4$  is  $x = 14$ .

**Total 9 marks**

5. The cumulative frequency diagram below shows information about the distance,  $d$  km, that each of 120 students walks to school on a particular day.





Distance,  $d$  (km)

- (a) How many students walked AT MOST 1 km to school on that day? [1]

The number of students who walked at most 1 km to school on that day is 36 students.

- (b) Using the cumulative frequency diagram, determine an estimate of

- (i) the median [1]

The median occurs at  $\frac{120}{2} = 60^{\text{th}}$  value.

From the graph, the median = 1.3 km

- (ii) the lower quartile [1]

The lower quartile occurs at  $\frac{120}{4} = 30^{\text{th}}$  value.

From the graph, the lower quartile = 0.9 km

- (iii) the interquartile range [1]

The upper quartile occurs at  $\frac{3(120)}{4} = 90^{\text{th}}$  value.

From the graph, the upper quartile = 1.55 km

$$\begin{aligned} \text{Interquartile range} &= \text{Upper quartile} - \text{Lower quartile} \\ &= 1.55 - 0.9 \\ &= 0.65 \text{ km} \end{aligned}$$

(c) A student is chosen at random. What is the probability that the student walked for **more than** 1.5 km to school that day? [2]

Number of students who walked less than 1.5 km = 84 (from graph)

$$\begin{aligned} \text{Number of students who walked more than 1.5 km} &= 120 - 84 \\ &= 36 \end{aligned}$$

$$\begin{aligned} \therefore P(\text{student walked more than 1.5 km}) &= \frac{\text{Number of students who walked more than 1.5 km}}{\text{Total number of students}} \\ &= \frac{36}{120} \\ &= \frac{3}{10} \end{aligned}$$

(d) Complete the table below and use the information to calculate an estimate of the mean distance walked by the students on that day. [3]

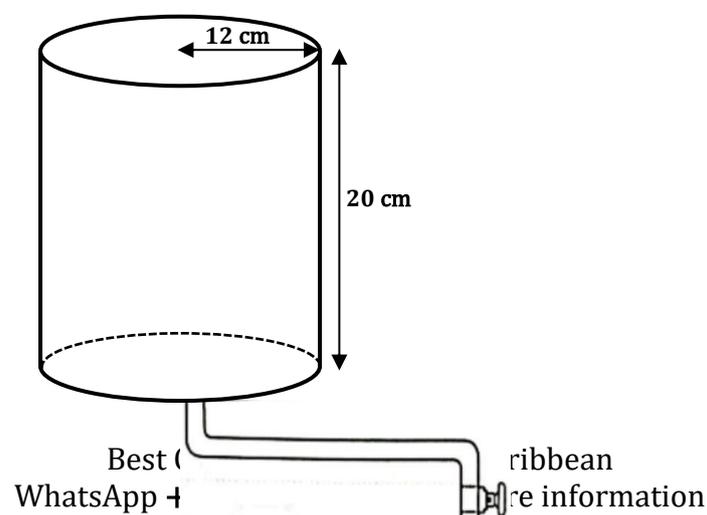
Distance, $d$ (km)	Midpoint ( $x$ )	Cumulative Frequency	Number of students ( $f$ )	$f \times x$

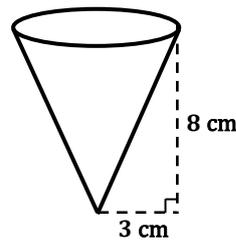
$0 < d \leq 0.5$	0.25	12	12	3.0
$0.5 < d \leq 1.0$	0.75	36	24	18
$1.0 < d \leq 1.5$	1.25	82	46	57.5
$1.5 < d \leq 2.0$	<u>1.75</u>	112	<u>30</u>	<u>52.5</u>
$2.0 < d \leq 2.5$	2.25	118	<u>6</u>	<u>13.5</u>
$2.5 < d \leq 3.0$	2.75	120	2	5.5

$$\begin{aligned} \text{Mean} &= \frac{\sum fx}{\sum f} \\ &= \frac{150}{120} \\ &= 1.25 \text{ km} \end{aligned}$$

**Total 9 marks**

6. At a track meet, a cylindrical container, fitted with a pipe as shown in the diagram below, is used to serve water to athletes. The cylindrical container of radius 12 cm and height 20 cm is **completely** filled with water and the pipe fitted at the bottom dispenses water into cone-shaped cups. The cone-shaped cups have a radius of 3 cm and a height of 8 cm.





- (a) Calculate the volume of water in the cylindrical container, **in litres**. Write your answer correct to 2 decimal places. [ $1\ 000\ \text{cm}^3 = 1\ \text{litre}$ ] [3]

$$\begin{aligned} \text{Volume} &= \pi r^2 h \\ &= \pi (12)^2 (20) \\ &= 9047.79\ \text{cm}^3 \end{aligned}$$

[ $\pi$  was used from calculator where  $\pi = 3.141592654$ ]

Now,

$$1\ 000\ \text{cm}^3 = 1\ \text{litre}$$

$$1\ \text{cm}^3 = \frac{1}{1000}\ \text{litre}$$

$$9047.79\ \text{cm}^3 = \frac{1}{1000} \times 9047.79$$

$$9.05\ \text{litres} \quad (\text{to 2 decimal places})$$

- (b) Water flows from the cylindrical container along the pipe into the cone-shaped cups at a rate of  $7.8\ \text{ml}$  per second.

Calculate the time taken to fill ONE of the empty cone-shaped cups. Give your answer correct to the nearest second.

[The volume,  $V$ , of a cone with radius  $r$  and height  $h$  is  $V = \frac{1}{3}\pi r^2 h$ .] [3]

$$1 \text{ ml} = 1 \text{ cm}^3$$

$$\begin{aligned} 7.8 \text{ ml} &= 7.8 \times 1 \\ &= 7.8 \text{ cm}^3 \end{aligned}$$

$$\begin{aligned} V &= \frac{1}{3}\pi r^2 h \\ &= \frac{1}{3}\pi(3)^2(8) \\ &= 24\pi \text{ cm}^3 \end{aligned}$$

$$\begin{aligned} \text{Number of seconds} &= \frac{\text{Volume of cone}}{7.8} \\ &= \frac{24\pi}{7.8} \\ &= 10 \text{ seconds} \quad (\text{to the nearest second}) \end{aligned}$$

(c) Determine the number of empty cone-shaped cups in (b) that can be **completely** filled from the cylindrical container. [3]

$$\begin{aligned} \text{Number of cups} &= \frac{2880\pi}{24\pi} \\ &= 120 \text{ cups} \end{aligned}$$

**Total 9 marks**

7. A sequence of figures is made from lines of unit length and dots. The lines form a series of octagons and squares. The dots are placed at each vertex.

The first 3 figures in the sequence are shown below.

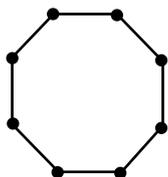


Figure 1

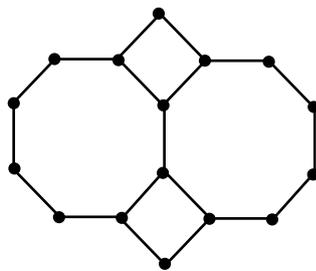


Figure 2

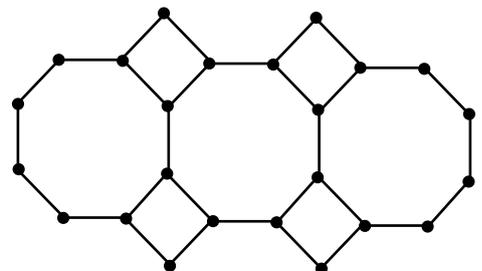
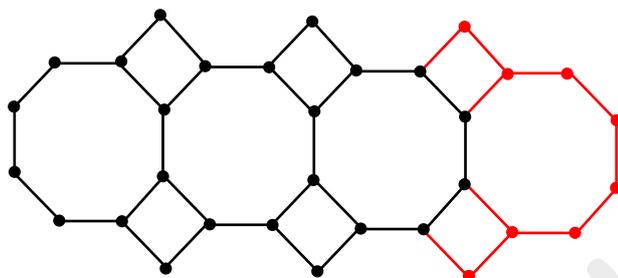


Figure 3

- (a) Figure 3 of the sequence is shown by itself below. Add more lines of unit length and dots to Figure 3 to correctly represent Figure 4. [2]



- (b) The number of dots,  $D$ , and the number of unit lines that form the perimeter of the shape,  $P$ , form a pattern. The values for  $D$  and  $P$  for the first 3 figures are written in the table below.

Complete the rows numbered (i), (ii) and (iii).

Figure Number	Number of Dots ( $D$ )	Perimeter of Figure ( $P$ )
1	8	8
2	16	14
3	24	20
(i) 4	<u>32</u>	<u>26</u>
⋮	⋮	⋮
(ii) <u>14</u>	<u>112</u>	86
⋮	⋮	⋮
(iii)		

$n$	<u>          <math>8n</math>          </u>	<u>          <math>6n+2</math>          </u>
-----	--------------------------------------------	----------------------------------------------

[2]

(c) For any figure,  $n > 1$ , the number of dots,  $D$ , is greater than its perimeter,  $P$ .

Determine the value of  $n$  for a figure in which the difference between  $D$  and  $P$  is

36.

[2]

$$D - P = 36$$

$$8n - (6n + 2) = 36$$

$$8n - 6n - 2 = 36$$

$$2n - 2 = 36$$

$$2n = 36 + 2$$

$$2n = 38$$

$$n = \frac{38}{2}$$

$$n = 19$$

Total 10 marks

## SECTION II

Answer ALL questions.

### ALGEBRA, RELATIONS, FUNCTIONS AND GRAPHS

8. The function  $f: x \rightarrow 3 + 5x - x^2$ .

(a) (i) Complete the table of values for  $f(x) = 3 + 5x - x^2$ .

[2]

$x$	-1	0	1	2	3	4	5	6
$f(x)$	-3	3	7	9	9	7	3	-3

Let  $y = 3 + 5x - x^2$ .

When  $x = 0$ ,

$$\begin{aligned} y &= 3 + 5(0) - (0)^2 \\ &= 3 + 0 - 0 \\ &= 3 \end{aligned}$$

When  $x = 1$ ,

$$\begin{aligned} y &= 3 + 5(1) - (1)^2 \\ &= 3 + 5 - 1 \\ &= 7 \end{aligned}$$

When  $x = 4$ ,

$$\begin{aligned} y &= 3 + 5(4) - (4)^2 \\ &= 3 + 20 - 16 \\ &= 7 \end{aligned}$$

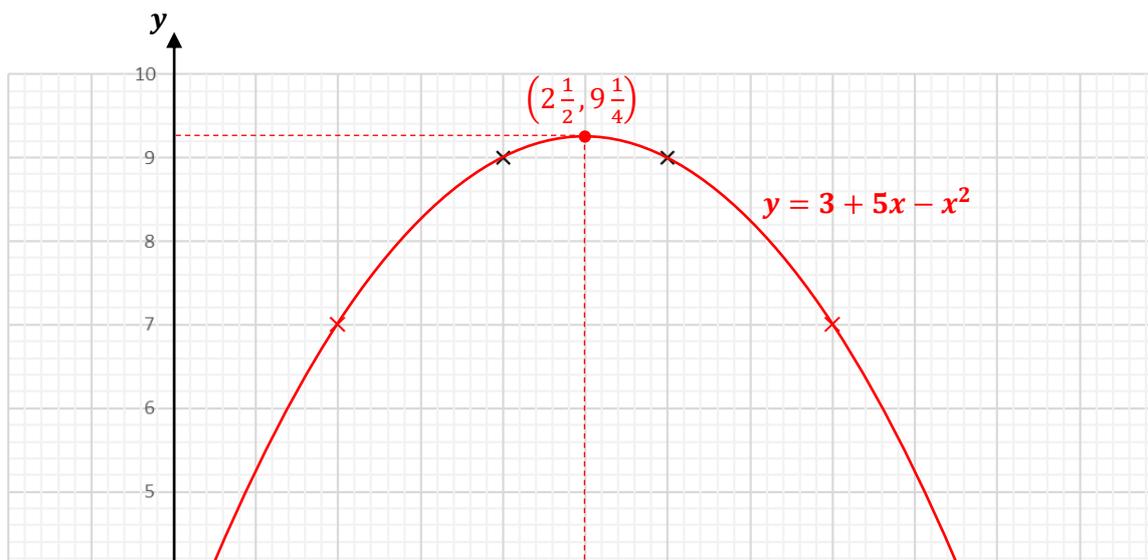
When  $x = 6$ ,

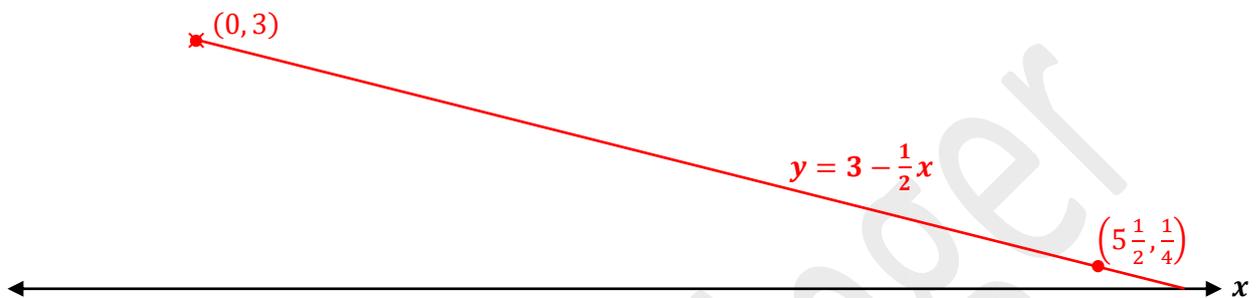
$$\begin{aligned} y &= 3 + 5(6) - (6)^2 \\ &= 3 + 30 - 36 \\ &= -3 \end{aligned}$$

(ii) On the grid below, complete the graph of  $f(x) = 3 + 5x - x^2$  for

$$-1 \leq x \leq 6.$$

[3]





(b) (i) Write down the equation of the axis of symmetry of the graph of

$$f(x) = 3 + 5x - x^2.$$

[1]

From the graph, the axis of symmetry is  $x = 2\frac{1}{2}$ .

(ii) State the maximum value of the function.

[1]

The maximum value of  $f(x) = 9\frac{1}{4}$ .

(c) Write down the co-ordinates of the point where the line  $y = 3 - \frac{1}{2}x$

(i) crosses the  $x$ -axis [1]

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

When  $y = 0$ ,

$$0 = 3 - \frac{1}{2}x$$

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

$$x = 3 \times 2$$

$$x = 6$$

$\therefore$  The line crosses the  $x$ -axis at the point  $(6, 0)$ .

(ii) crosses the  $y$ -axis [1]

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

When  $x = 0$ ,

$$y = 3 - \frac{1}{2}(0)$$

$$= 3 - 0$$

$$= 3$$

$\therefore$  The line crosses the  $y$ -axis at the point  $(0, 3)$ .

- (d) On the grid on page 22, draw the line  $y = 3 - \frac{1}{2}x$ . [1]

See graph above.

- (e) Using your graph, determine the solution to the equations

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

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

The solution of the equations will be at the points of intersections of both graphs.

Points of intersection are  $(0, 3)$  and  $(5\frac{1}{2}, \frac{1}{4})$ .

$$\therefore x = 0 \text{ and } y = 3 \quad \text{or} \quad x = 5\frac{1}{2} \text{ and } y = \frac{1}{4}$$

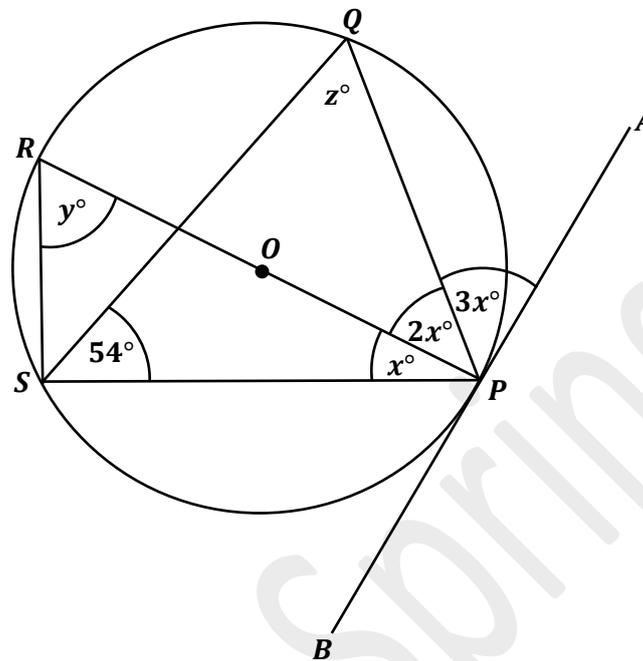
Total 12 marks

### GEOMETRY AND TRIGONOMETRY

9. (a) The diagram below shows a circle, with the points  $P$ ,  $Q$ ,  $R$  and  $S$  lying on its circumference and its centre marked  $O$ .  $RP$  is a diameter of the circle and  $AB$  is a

tangent to the circle at  $P$ . Angle  $APQ = 3x^\circ$ , angle  $QPR = 2x^\circ$ , angle  $RPS = x^\circ$

and angle  $QSP = 54^\circ$ .



Determine the value of EACH of the following angles. Show detailed working where possible and give a **reason** for your answer.

(i)  $x$

[2]

Angle made by a tangent ( $PA$ ) and a radius ( $OP$ ) at the point of contact ( $P$ ) is  $90^\circ$ .

$$\begin{aligned} \widehat{OPA} &= 2x^\circ + 3x^\circ \\ &= 5x^\circ \end{aligned}$$

Hence,

$$5x^\circ = 90^\circ$$

$$x = \frac{90^\circ}{5}$$

(ii)  $y$

[2]

The angle formed in a semi-circle is a right angle.

$$R\hat{S}P = 90^\circ$$

Consider  $\Delta RSP$ .

Angles in a triangle add up to  $180^\circ$ .

$$y + 90^\circ + 18^\circ = 180^\circ$$

$$y = 180^\circ - 90^\circ - 18^\circ$$

$$y = 72^\circ$$

(iii)  $z$

[2]

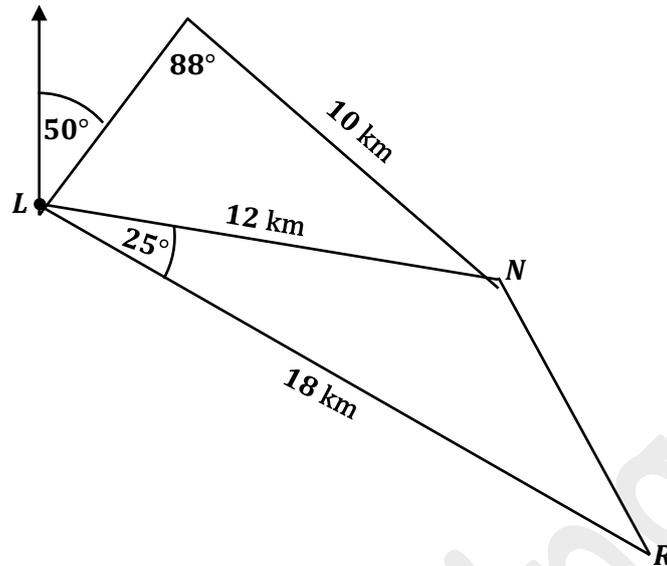
Angles subtended by a chord,  $SP$ , at the circumference of a circle and standing on the same arc ( $S\hat{R}P$  and  $S\hat{Q}P$ ) are equal.

$$\therefore z = 72^\circ$$

(b) The diagram below shows straight roads connecting the towns  $L$ ,  $M$ ,  $N$  and  $R$ .

$LR = 18$  km,  $LN = 12$  km and  $MN = 10$  km. Angle  $RLN = 25^\circ$  and angle  $LMN = 88^\circ$ .





- (i) Calculate angle  $MLN$ .

[3]

Consider  $\triangle MLN$ .

Using the sine rule,

$$\frac{MN}{\sin \hat{MLN}} = \frac{LN}{\sin \hat{LMN}}$$

$$\frac{10}{\sin \hat{MLN}} = \frac{12}{\sin 88^\circ}$$

$$\sin \hat{MLN} = \frac{10 \times \sin 88^\circ}{12}$$

$$\sin \hat{MLN} = 0.8328$$

$$\hat{MLN} = \sin^{-1}(0.8328)$$

$$\hat{MLN} = 56.4^\circ \quad (\text{to 1 decimal place})$$

- (ii) Calculate the distance  $NR$ .

[2]

Consider the  $\triangle NLR$ .

Using the cosine rule,

$$(NR)^2 = (LN)^2 + (LR)^2 - 2(LN)(LR) \cos N\hat{L}R$$

$$= (12)^2 + (18)^2 - 2(12)(18) \cos 25^\circ$$

$$= 76.475036$$

$$NR = \sqrt{76.475036}$$

$$= 8.75 \text{ km} \quad (\text{to 2 decimal places})$$

- (iii) Determine the bearing of Town  $R$  from Town  $L$ . [1]

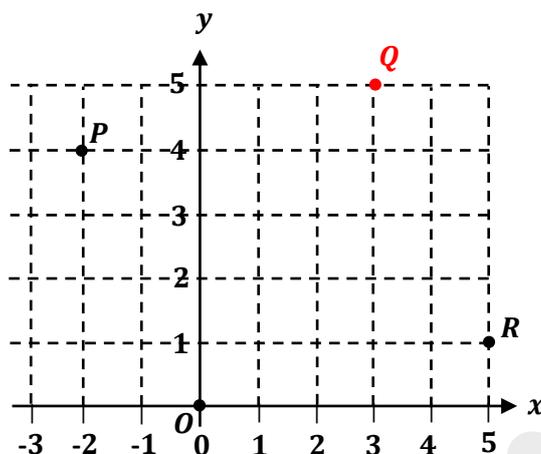
$$\text{Bearing of Town } R \text{ from Town } L = 50^\circ + 56.4^\circ + 25^\circ$$

$$= 131.4^\circ$$

**Total 12 marks**

## VECTORS AND MATRICES

10. (a) Three points,  $O$ ,  $P$  and  $R$ , are shown on the grid below.  $O$  is the origin.



- (i) Write the position vector of  $R$ ,  $\overrightarrow{OR}$ , in the form  $\begin{pmatrix} a \\ b \end{pmatrix}$ . [1]

$$R = (5, 1)$$

$$\therefore \overrightarrow{OR} = \begin{pmatrix} 5 \\ 1 \end{pmatrix} \text{ which is of the form } \begin{pmatrix} a \\ b \end{pmatrix}, \text{ where } a = 5 \text{ and } b = 1.$$

- (ii) Another point,  $Q$ , is located in such a way that  $\overrightarrow{QR} = \begin{pmatrix} 2 \\ -4 \end{pmatrix}$ .

Using this information, plot the point  $Q$  on the graph. [1]

$$\text{Let } Q = (x, y)$$

$$\text{So, } \overrightarrow{OQ} = \begin{pmatrix} x \\ y \end{pmatrix}$$

Now,

$$\overrightarrow{QR} = \overrightarrow{OR} - \overrightarrow{OQ}$$

$$\begin{pmatrix} 2 \\ -4 \end{pmatrix} = \begin{pmatrix} 5 \\ 1 \end{pmatrix} - \begin{pmatrix} x \\ y \end{pmatrix}$$

$$\begin{pmatrix} 2 \\ -4 \end{pmatrix} = \begin{pmatrix} 5 - x \\ 1 - y \end{pmatrix}$$

Comparing and equating corresponding entries gives:

$$2 = 5 - x \qquad \text{and} \qquad -4 = 1 - y$$

$$x = 5 - 2 \qquad \qquad \qquad y = 1 + 4$$

$$x = 3 \qquad \qquad \qquad y = 5$$

Hence,  $\overrightarrow{OQ} = \begin{pmatrix} 3 \\ 5 \end{pmatrix}$  and  $Q = (3, 5)$

See grid above.

- (iii) Determine  $|\overrightarrow{QR}|$ , the magnitude of  $\overrightarrow{QR}$ . [2]

$$\overrightarrow{QR} = \begin{pmatrix} 2 \\ -4 \end{pmatrix}$$

$$|\overrightarrow{QR}| = \sqrt{(2)^2 + (-4)^2}$$

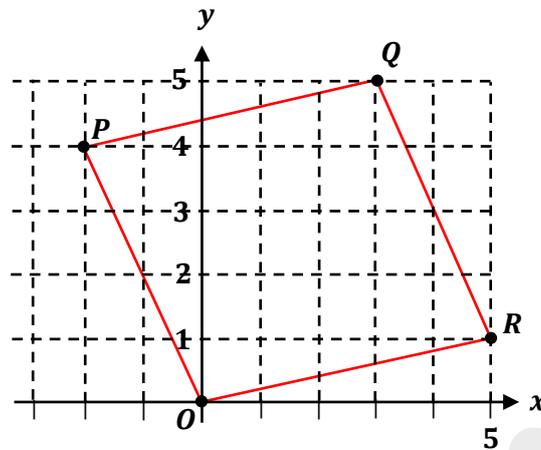
$$= \sqrt{4 + 16}$$

$$= \sqrt{20}$$

$$= 2\sqrt{5} \text{ units}$$

$\therefore$  The magnitude of  $\overrightarrow{QR}$  is  $|\overrightarrow{QR}| = 2\sqrt{5}$  units.

- (iv) Show, by calculation, that  $OPQR$  is a parallelogram.



The coordinates of  $P = (-2, 4)$ .

$$\text{So, } \vec{OP} = \begin{pmatrix} -2 \\ 4 \end{pmatrix}.$$

$$\vec{PO} = -\vec{OP}$$

$$= -\begin{pmatrix} -2 \\ 4 \end{pmatrix}$$

$$= \begin{pmatrix} 2 \\ -4 \end{pmatrix}$$

$$\text{And } \vec{QR} = \begin{pmatrix} 2 \\ -4 \end{pmatrix}.$$

Hence,  $|\vec{QR}| = |\vec{PO}|$  and  $\vec{QR}$  is parallel to  $\vec{PO}$ .

If one pair of opposite sides of a quadrilateral is both parallel and equal, then the quadrilateral is a parallelogram.

Q.E.D.

(b) Calculate the value of  $x$  and the value of  $y$  in the matrix equation below.

$$\begin{pmatrix} 1 & 5 \\ 2 & y \end{pmatrix} \begin{pmatrix} -4 & 1 \\ 2 & 9 \end{pmatrix} = \begin{pmatrix} x & 46 \\ 6 & 65 \end{pmatrix} \quad [3]$$

$$\begin{pmatrix} 1 & 5 \\ 2 & y \end{pmatrix} \begin{pmatrix} -4 & 1 \\ 2 & 9 \end{pmatrix} = \begin{pmatrix} x & 46 \\ 6 & 65 \end{pmatrix}$$

$$\begin{pmatrix} (1 \times -4) + (5 \times 2) & (1 \times 1) + (5 \times 9) \\ (2 \times -4) + (y \times 2) & (2 \times 1) + (y \times 9) \end{pmatrix} = \begin{pmatrix} x & 46 \\ 6 & 65 \end{pmatrix}$$

$$\begin{pmatrix} -4 + 10 & 1 + 45 \\ -8 + 2y & 2 + 9y \end{pmatrix} = \begin{pmatrix} x & 46 \\ 6 & 65 \end{pmatrix}$$

$$\begin{pmatrix} 6 & 46 \\ -8 + 2y & 2 + 9y \end{pmatrix} = \begin{pmatrix} x & 46 \\ 6 & 65 \end{pmatrix}$$

Comparing and equating corresponding entries gives:

$$6 = x$$

and

$$2 + 9y = 65$$

$$9y = 65 - 2$$

$$9y = 63$$

$$y = \frac{63}{9}$$

$$y = 7$$

$$\therefore x = 6 \text{ and } y = 7$$

(c) A transformation,  $T$ , is represented by the matrix  $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ , maps  $S(2, 5)$  onto

$S'(5, 2)$ . Describe fully the **single** transformation  $T$ . [2]

$$T = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$

$T$  maps  $S(2, 5)$  onto  $S'(5, 2)$ .

Therefore,  $T$  represents a reflection in the line  $y = x$ .

**Total 12 marks**

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**END OF TEST**

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**IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.**

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