

CARIBBEAN SECONDARY EDUCATION CERTIFICATE EXAMINATION (MAY 2015)

MATHEMATICS – Paper 02 General Proficiency.

2 hours and 40 minutes

Section I (Answer ALL questions in this section)

1. (a) Using a calculator, or otherwise, calculate the EXACT value of

(i) $2\frac{2}{5} - 1\frac{1}{3} + 3\frac{1}{2}$ [1 mark]

(ii) $(4.14 \div 5.74) + (1.62)^2$ [2 marks]

(iii) $2 \times 3.142 \times 1.25$ [1 mark]

(iv) $\sqrt{2.89} \times \tan 45^\circ$ [2 marks]

(b) The table below shows a shopping bill prepared for Mrs Rowe. The prices of some items are missing.

| Shopping Bill | | |
|---------------|-----------------|------------------|
| Item | Unit Cost Price | Total Cost Price |
| 3 kg sugar | X | \$10.80 |
| 4 kg rice | Y | Z |
| 2 kg flour | \$1.60 | \$3.20 |

(i) Calculate the value of X, the cost of 1 kg of sugar. [1 mark]

(ii) If the cost price of 1 kg of rice is 80 cents MORE than for 1 kg of flour, calculate the values of Y and Z. [2 marks]

(iii) A tax of 10% of the total cost price of the three items is added to Mrs Rowe's bill. What is Mrs Rowe's TOTAL bill including the tax? [3 marks]

Total 12 marks

2. (a) Given that $a = 4$, $b = 2$ and $c = -1$, find the value of:

(i) $a - b + c$ [1 mark]

(ii) $2a^b$ [1 mark]

(b) A bottle contains 500 ml of orange juice. Write an expression for EACH of the following.

The amount of juice left in the bottle after pouring out

(i) p ml [1 mark]

(ii) q glasses each containing r ml. [1 mark]

(c) Write as a single fraction, as simply as possible

$$\frac{2k}{3} + \frac{2-k}{5} \quad [2 \text{ marks}]$$

(d) Four mangoes and two pears cost \$24.00, while two mangoes and three pears cost \$16.00.

(i) Write a pair of simultaneous equations in x and y to represent the information given above. [2 marks]

(ii) State clearly what x and y represent. [1 mark]

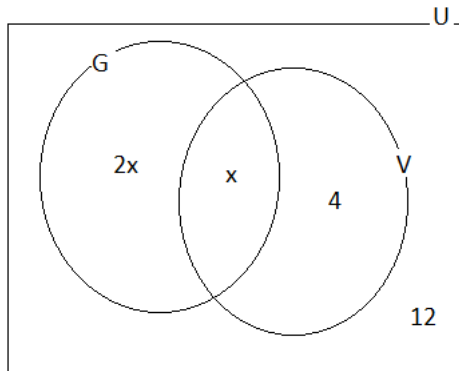
(e) Factorize completely:

(i) $a^3 - 12a$ [1 mark]

(ii) $2x^2 - 5x + 3$ [2 marks]

Total 12 marks

3. (a) The Venn diagram below shows the number of students who play the guitar (G) or te violin (V) in a class of 40 students .



- (i) How many students play neither the guitar nor the violin? [1 mark]
- (ii) Write an expression, in x , which represents the TOTAL number of students in the class. [1 mark]
- (iii) Write an equation which may be used to determine the total number of students in the class. [1 mark]
- (iv) How many students play the guitar? [2 marks]
- (b) Using **a ruler, a pencil and a pair of compasses only**, construct triangle ABC with $AB = 9$ cm, angle $ABC = 90^\circ$ and $BC = 6$ cm.
- Marks will be awarded for construction lines clearly shown. [4 marks]
- (ii) Measure and state the size of angle BAC . [1 mark]
- (iii) On the diagram, show the point D such that $ABCD$ is a parallelogram. [2 marks]

Total 12 marks

4. The table below is designed to show values of x and y for the function $y = x^2 - 2x - 3$, for integer values of x from -2 to 4 .

(a) Complete the table of values for the equation $y = x^2 - 2x - 3$.

| | | | | | | | |
|-----|------|------|------|------|------|-----|-----|
| x | -2 | -1 | 0 | 1 | 2 | 3 | 4 |
| y | 5 | | -3 | -4 | -3 | | 5 |

[2 marks]

(b) On graph paper, plot the graph of $y = x^2 - 2x - 3$ using a scale of 2cm to represent 1 unit on the x -axis and 1cm to represent 1 unit on the y -axis. [4 marks]

(c) On your graph, draw a smooth curve passing through the points on your graph.

[1 mark]

(d) Complete the following sentences using information from your graph.

(i) The values of x for which $x^2 - 2x - 3 = 0$ are and [1 mark]

(ii) The minimum value of $x^2 - 2x - 3$ is [1 mark]

(iii) The equation of the line of symmetry of the graph $y = x^2 - 2x - 3$ is

.....

[1 mark]

Total 10 marks

5. (a) A car is travelling at a constant speed of 54 km/h.

(i) Calculate the distance it travels in $2\frac{1}{4}$ hours. [1 mark]

(ii) Calculate the time, in seconds, it takes to travel 315 metres, given that

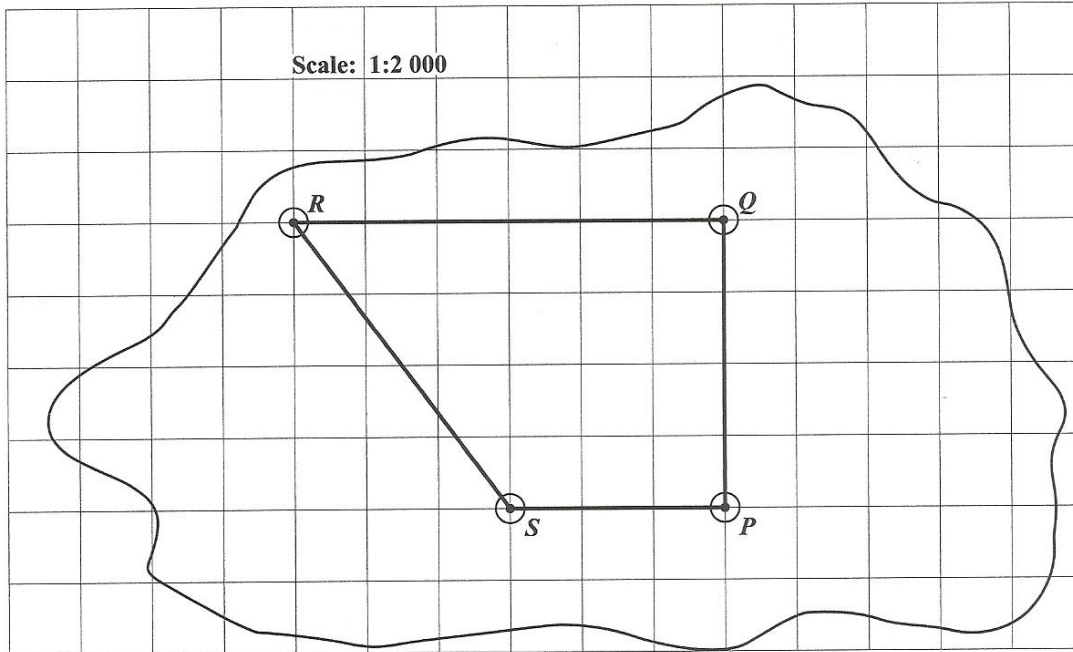
$$1 \text{ km/h} = \frac{5}{18} \text{ m/s} \quad [2 \text{ marks}]$$

(b) Write the following scales in the form 1 : x

(i) 1 millimetre = 1 metre [1 mark]

(ii) 2 cm = 6 m [1 mark]

- (c) The map shown below is drawn on a grid of 1 cm squares. P , Q , R and S are four tracking stations. **The scale of the map is 1:2 000.**



(i) Determine, in centimetres, the distance from Q to R on the map.
 $QR = \dots\dots\dots$ cm (1 mark)

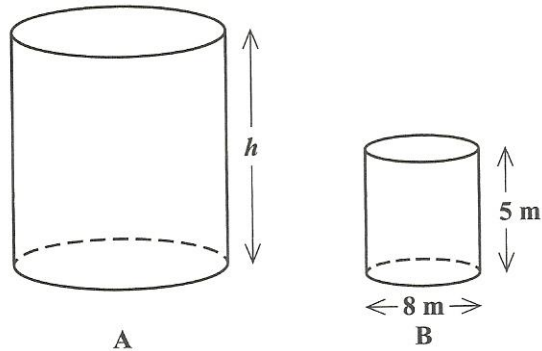
(ii) Determine, by counting, the area in square centimetres of the plane $PQRS$ on the map.
(2 marks)

(iii) Calculate the ACTUAL distance, in kilometres, between Q and R .
[2 marks]

(iv) Calculate the ACTUAL area, in square metres, of the plane $PQRS$.
[2 marks]

Total 12 marks

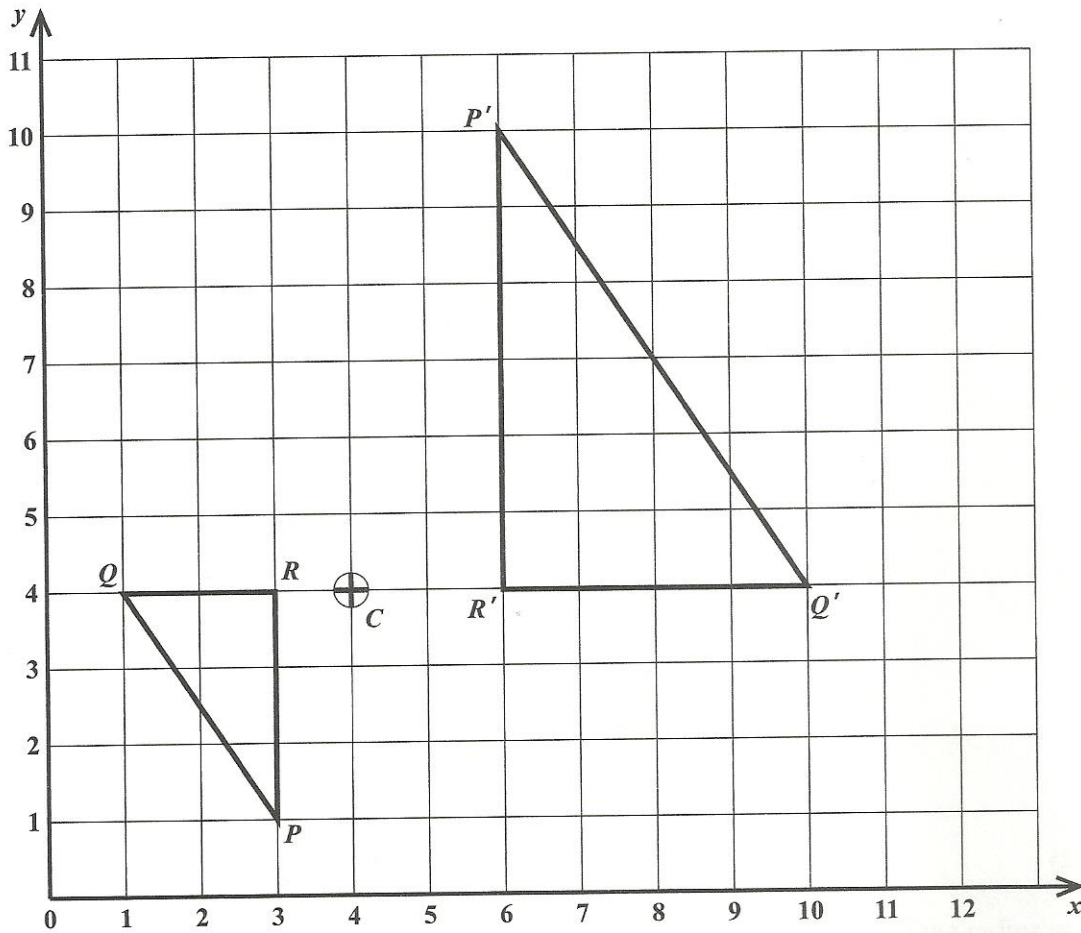
6. (a) The diagram below, not drawn to scale, shows two cylindrical water tanks A and B. Tank B has base diameter 8 m and height 5 m. both tanks are filled with water.



Take $\pi = 3.14$.

- (i) Calculate the volume of water in Tank B. [2 marks]
- (ii) If the area of the base of A is 314 m^2 , calculate the length of the radius of Tank A. [1 mark]
- (iii) Tank A holds 8 times as much water as tank B. Calculate the height, h , of Tank A. [2 marks]

- (b) The diagram below shows triangle PQR and its image, triangle $P'Q'R'$, after an enlargement centred at the point C on the diagram.



Use the information from the diagram to complete the statements below.

(i) The size of the scale factor is (1 mark)

(ii) The scale factor is negative because

.....

..... (1 mark)

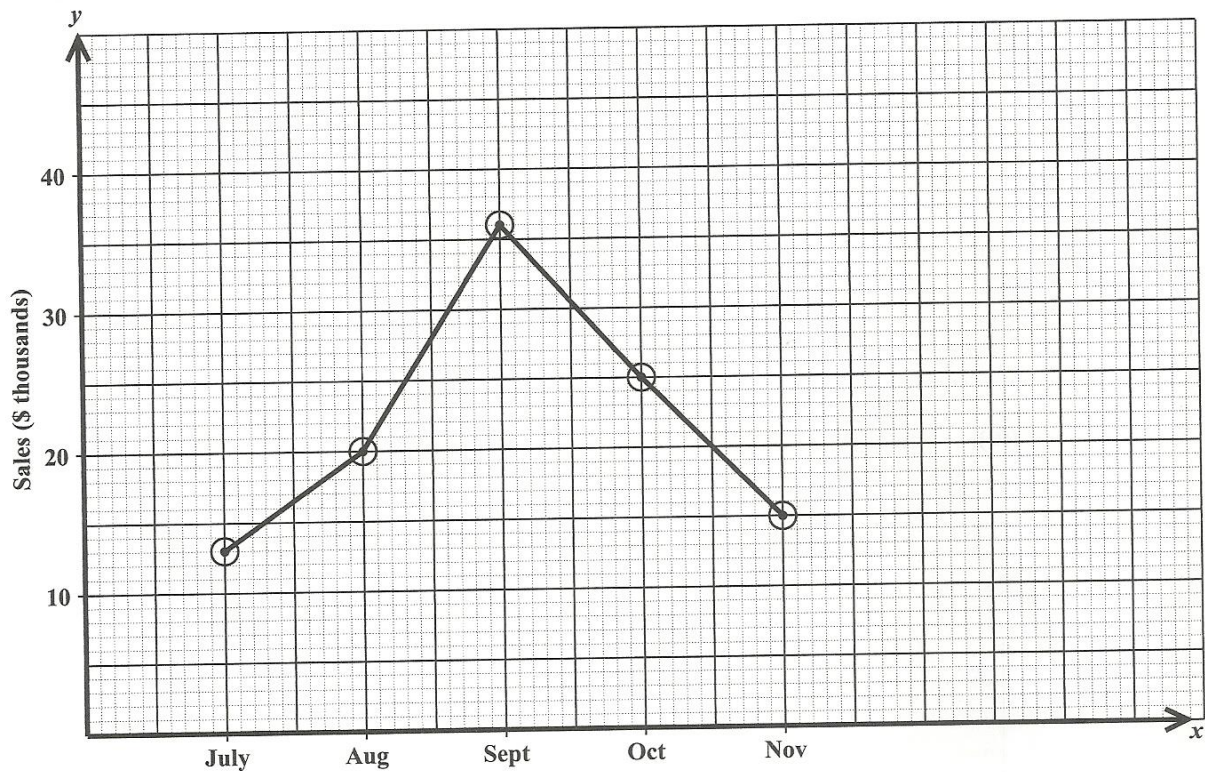
(iii) The length of PQ is $\sqrt{13}$ units, therefore the length of $P'Q'$ is units.

[1 mark]

(iv) The area of triangle PQR is square units. [1 mark]

(v) The area of $P'Q'R'$ is Times the area of riangle PQR which is square units. [2 marks]

7. The line graph below shows the monthly sales, in thousands of dollars, at a car dealership for the period July to November 2014.



(a) Complete the table below to show the sales for EACH month.

| Month | July | August | September | October | November |
|-----------------------|------|--------|-----------|---------|----------|
| Sales in \$ Thousands | 13 | | 36 | | |

(2 marks)

- (b) (i) Between which TWO consecutive months was there the GREATEST increase in sales? [1 mark]
- (ii) Between which TWO consecutive months was there the SMALLEST increase in sales? [1 mark]
- (iii) What feature of the line graph enables you to infer that the increase in sales between two consecutive months was the greatest or the smallest? [2 marks]
- (c) Calculate the mean monthly sales for the period July to November 2014. [2 marks]
- (d) The TOTAL sales for the period July to December was \$130 000.
- (i) Calculate the sales, in dollars, for the month of December. [1 mark]
- (ii) Complete the line graph to show the sales for December. [2 marks]

Total 11 marks

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8. A sequence of figures is made up of equilateral triangles, called unit triangles with unit sides. The first three figures in the sequence are shown below.



Figure 1

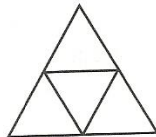


Figure 2

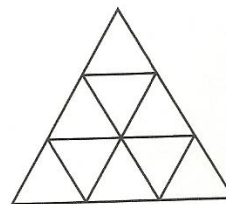


Figure 3

- (a) Draw Figure 4 of the sequence.

- (b) Study the patterns of numbers in each row of the table below. Each row relates to one of the figures in the sequence of figures. Some rows have not been included in the table.

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

| | Figure | Number of Unit Triangles | Number of Unit Sides | |
|-------|--------|--------------------------|--------------------------------------|-----------|
| | 1 | 1 | $\frac{(3 \times 1)(1 + 1)}{2} = 3$ | |
| | 2 | 4 | $\frac{(3 \times 2)(2 + 1)}{2} = 9$ | |
| | 3 | 9 | $\frac{(3 \times 3)(3 + 1)}{2} = 18$ | |
| (i) | 4 | | | (2 marks) |
| (ii) | | 144 | | (2 marks) |
| (iii) | 25 | | | (2 marks) |
| (iv) | n | | | (2 marks) |

Total 10 marks

SECTION II

Answer TWO questions in this section.

ALGEBRA AND RELATIONS, FUNCTIONS AND GRAPHS

9. (a) A teacher marks an examination out of a maximum of 120 marks. The marks are then converted to percentages.

- (i) Calculate the percentage for a student who scores

60 marks

120 marks

[2 marks]

- (ii) On graph sheet provided, plot a graph to show the information in (i).

[2 marks]

- (iii) A candidate is awarded 95 marks on the examination. Use the graph drawn at (ii) to determine the candidate's percentage.

Draw line on your graph to show how the percentage was obtained. [1mark]

- (iv) A candidate is awarded a Grade A if her percentage is 85% or more. Use the graph drawn at (ii) to determine the minimum mark the candidate needs to be awarded a Grade A. [2 marks]

- (b) The functions $f(x)$ and $g(x)$ are defined as

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

- (i) Evaluate $g(5)$.

[2 marks]

- (ii) Write an expression in terms of x for $f^{-1}(x)$.

[2 marks]

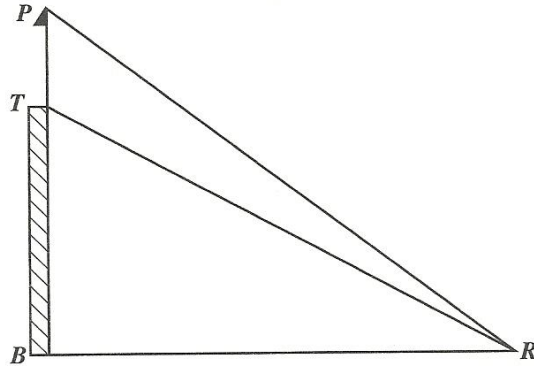
- (iii) Write an expression for $gf(x)$, in the form $(x + a)(x + b)$, where a and $b \in R$

[4 marks]

Total 15 marks

MEASUREMENT, GEOMETRY AND TRIGONOMETRY

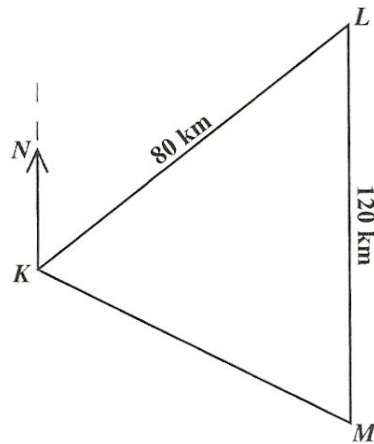
10. (a) The diagram below, **not drawn to scale**, shows a vertical tower, BT , with a flagpole, TP , mounted on it. A point R is on the same horizontal ground as B , such that $RB = 60$ m, and the angles of elevation of T and P from R are 35° and 42° , respectively.



- (i) Label the diagram to show
- the distance 60 m
 - the angles of 35° and 42°
 - any right angle(s). (3 marks)
- (ii) Calculate the length of the flagpole, giving your answer to the nearest metre.

[4 marks]

- (b) The diagram below, **not drawn to scale**, shows the relative positions of three fishing boats, K , L and M . L is on a bearing of 040° from K and M is due south of L . $LM = 120$ km and $KL = 80$ km.



- (i) On the diagram show the bearing of 040° . (1 mark)
- (ii) Calculate the measure of $\angle KLM$. [1 mark]
- (iii) Calculate the length, to the nearest kilometre, of KM . [3 marks]
- (iv) Calculate the measure of angle LKM to the nearest degree. [2 marks]
- (v) Calculate the bearing of M from K . [1 mark]

Total 15 marks

VECTORS AND MATRICES

11. (a) (i) Calculate the matrix product \mathbf{AB} where $A = \begin{bmatrix} 1 & 1 \\ 2 & 3 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$ [2 marks]
- (ii) Show that the matrix product of \mathbf{A} and \mathbf{B} is NOT commutative, that is $AB \neq BA$ [2 marks]
- (iii) Find A^{-1} , the inverse of A . [2 marks]
- (iv) Given that $M = \begin{bmatrix} 2x & 2 \\ 9 & 3 \end{bmatrix}$ calculate the value(s) of x for which $|M| = 0$. [2 marks]
- (b) The position vectors of the points R, S and T , relative to an origin, O , are $\begin{pmatrix} -3 \\ 4 \end{pmatrix}$, $\begin{pmatrix} 1 \\ 1 \end{pmatrix}$ and $\begin{pmatrix} 5 \\ -2 \end{pmatrix}$ respectively.
- (i) Calculate the value of $|\overrightarrow{OR}|$. [1 mark]
- (ii) Express in the form $\begin{pmatrix} x \\ y \end{pmatrix}$, the vectors \overrightarrow{RS} and \overrightarrow{ST} . [2 marks]
- (iii) Using the results of combining the vectors in (b) (ii), justify that RS is parallel to ST and that RST is a straight line. [2 marks]

Total 15 marks