CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

MATHEMATICS

Paper 02 – General Proficiency

2 hours 40 minutes

04 JANUARY 2012 (a.m.)

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of **TWO** sections.
2. There are EIGHT questions in Section I and THREE questions in Section II.
3. Answer **ALL** questions in Section I, and any **TWO** questions from Section II.
4. Write your answers in the booklet provided.
5. All working must be clearly shown.
6. A list of formulae is provided on page 2 of this booklet.

Required Examination Materials

Electronic calculator
Geometry set
Graph paper (provided)

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

LIST OF FORMULAE

Volume of a prism — $V = Ah$ where A is the area of a cross-section and h is the perpendicular length.

Volume of cylinder — $V = \pi r^2 h$ where r is the radius of the base and h is the perpendicular height.

Volume of a right pyramid — $V = \frac{1}{3}Ah$ where A is the area of the base and h is the perpendicular height.

Circumference — $C = 2\pi r$ where r is the radius of the circle.

Arc length — $S = \dfrac{\theta}{360} \times 2\pi r$ where θ is the angle subtended by the arc, measured in degrees.

Area of a circle — $A = \pi r^2$ where r is the radius of the circle.

Area of a sector — $A = \dfrac{\theta}{360} \times \pi r^2$ where θ is the angle of the sector, measured in degrees.

Area of trapezium — $A = \frac{1}{2}(a + b)\,h$ where a and b are the lengths of the parallel sides and h is the perpendicular distance between the parallel sides.

Roots of quadratic equations
v

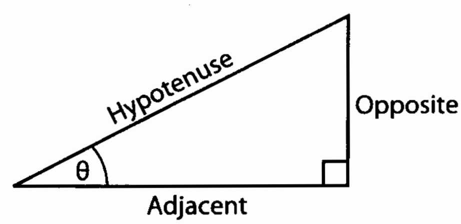
If $ax^2 + bx + c = 0$,

then $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Trigonometric ratios

$\sin\theta = \dfrac{\text{opposite side}}{\text{hypotenuse}}$

$\cos\theta = \dfrac{\text{adjacent side}}{\text{hypotenuse}}$



$\tan\theta = \dfrac{\text{opposite side}}{\text{adjacent side}}$

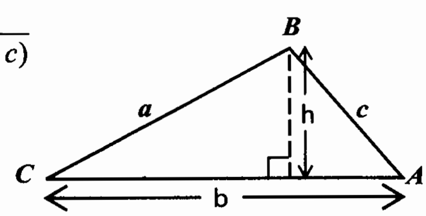
Area of triangle

Area of $\Delta = \frac{1}{2}bh$ where b is the length of the base and h is the perpendicular height.

Area of $\Delta ABC = \frac{1}{2}ab\sin C$

Area of $\Delta ABC = \sqrt{s(s-a)(s-b)(s-c)}$

where $s = \dfrac{a + b + c}{2}$



Sine rule — $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

Cosine rule — $a^2 = b^2 + c^2 - 2bc\cos A$

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SECTION I

Answer ALL the questions in this section.

All working must be clearly shown.

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

(i) $\left(1\frac{3}{4}\right)^2 \div 3\frac{1}{2}$, expressing your answer as a fraction **(3 marks)**

(ii) $\sqrt{0.0529} + 0.216$, expressing your answer in standard form. **(3 marks)**

(b) A typist is paid a basic wage of \$22.50 per hour for a 40-hour week.

(i) Calculate the typist's basic weekly wage. **(1 mark)**

Overtime is paid at one and a half times the basic hourly rate.

(ii) Calculate the overtime wage for ONE hour of overtime work. **(1 mark)**

To earn some extra money, the typist decided to work overtime.

Calculate

(iii) the wage she would earn for overtime if she worked for a TOTAL of 52 hours during a given week. **(2 marks)**

(iv) the number of overtime hours she must work during a given week to earn a TOTAL wage of \$1440. **(2 marks)**

Total 12 marks

2. (a) Solve the pair of simultaneous equations

$$3x + 2y = 13$$
$$x - 2y = -1 .$$

(3 marks)

(b) Factorise completely

(i) $x^2 - 16$ **(1 mark)**

(ii) $2x^2 - 3x + 8x - 12.$ **(2 marks)**

(c) Tickets for a football match are sold at \$30 for EACH adult and \$15 for EACH child. A company bought 28 tickets.

(i) If x of these tickets were for adults, write in terms of x,

a) the number of tickets for children **(1 mark)**

b) the amount spent on tickets for adults **(1 mark)**

c) the amount spent on tickets for children. **(1 mark)**

(ii) Show that the TOTAL amount spent on the 28 tickets is $\$(15x + 420)$. **(1 mark)**

(iii) Given that the cost of the 28 tickets was \$660, calculate the number of adult tickets bought by the company. **(2 marks)**

Total 12 marks

3. (a) A universal set, U, is defined as:

$U = \{ 51, 52, 53, 54, 55, 56, 57, 58, 59 \}$

A and B are subsets of U, such that:

$A = \{$ odd numbers $\}$

$B = \{$ prime numbers $\}$

(i) List the members of the set A. **(1 mark)**

(ii) List the members of the set B. **(1 mark)**

(iii) Draw a Venn diagram to represent the sets A, B and U. **(3 marks)**

(b) (i) **Using a pair of compasses, a ruler and a pencil**

a) construct a triangle CDE in which $DE = 10$ cm, $DC = 8$ cm and $\angle CDE = 45°$. **(4 marks)**

b) construct a line, CF, perpendicular to DE such that F lies on DE. **(2 marks)**

(ii) Using a protractor, measure and state the size of $\angle DCE$. **(1 mark)**

Total 12 marks

4. (a) The following is an extract from a bus schedule. The bus begins its journey at Belleview, travels to Chagville and ends its journey at St. Andrews.

Town	Arrive	Depart
Belleview	—	6:40 a.m.
Chagville	7:35 a.m.	7:45 a.m.
St. Andrews	8:00 a.m.	—

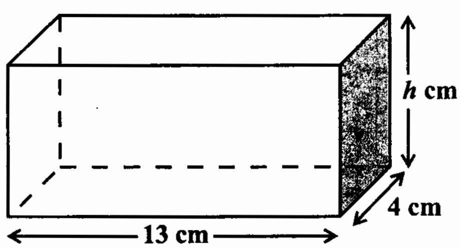
(i) How long did the bus spend at Chagville? **(1 mark)**

(ii) How long did the bus take to travel from Belleview to Chagville? **(1 mark)**

(iii) The bus travelled at an average speed of 54 km/hour from Belleview to Chagville. Calculate, in kilometres, the distance from Belleview to Chagville. **(2 marks)**

(b) Water is poured into a cylindrical bucket with a base area of 300 cm^2. If 4.8 litres of water was poured into the bucket, what is the height of the water in the bucket? **(3 marks)**

(c) The diagram below, **not drawn to scale**, shows a cuboid with length 13 cm, width 4 cm and height h cm.



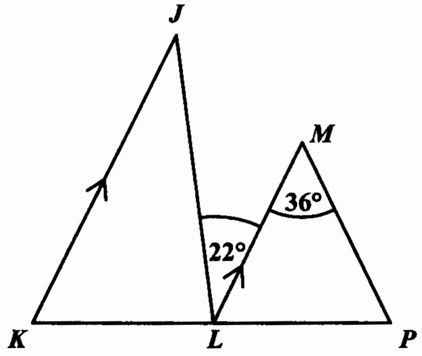
(i) State, in terms of h, the area of the shaded face of the cuboid. **(1 mark)**

(ii) Write an expression, in terms of h, for the volume of the cuboid. **(1 mark)**

(iii) If the volume of the cuboid is 286 cm^3 calculate the height, h, of the cuboid. **(2 marks)**

Total 11 marks

5. (a) The diagram below, **not drawn to scale**, shows TWO triangles, JKL and MLP, with JK parallel to ML. $LM = MP$, KLP is a straight line, angle $JLM = 22°$ and angle $LMP = 36°$.



Calculate, giving reasons for your answers, the measure of EACH of the following:

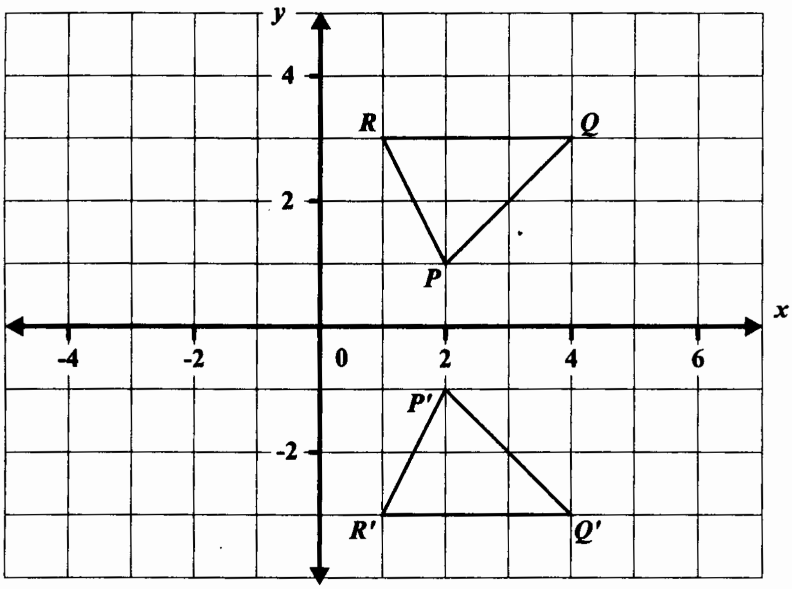
(i) $\angle MLP$

(ii) $\angle LJK$

(iii) $\angle JKL$

(iv) $\angle KLJ$ **(4 marks)**

(b) The diagram below shows a triangle, PQR, and its image, $P'Q'R'$.



(i) State the coordinates of P and Q. **(2 marks)**

(ii) Describe fully the transformation that maps triangle PQR onto triangle $P'Q'R'$. **(2 marks)**

(iii) Write down the coordinates of the images of P and Q under the translation $\begin{pmatrix} 3 \\ -6 \end{pmatrix}$. **(2 marks)**

Total 10 marks

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6. The table below shows corresponding values of x and y for the function $y = x^2 - 2x - 3$, for integer values of x from -2 to 4.

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

(a) Copy and complete the table. **(2 marks)**

(b) **Using a scale of 2 cm to represent 1 unit on the x-axis, and 1 cm to represent 1 unit on the y-axis**, plot the points whose x and y values are recorded in your table, and draw a smooth curve through your points. **(4 marks)**

(c) Using your graph, estimate the value of y when $x = 3.5$. Show on your graph how the value was obtained. **(2 marks)**

(d) Without further calculations,

(i) write the equation of the axis of symmetry of the graph **(1 mark)**

(ii) estimate the minimum value of the function y **(1 mark)**

(iii) state the values of the solutions of the equation: $x^2 - 2x - 3 = 0$. **(1 mark)**

Total 11 marks

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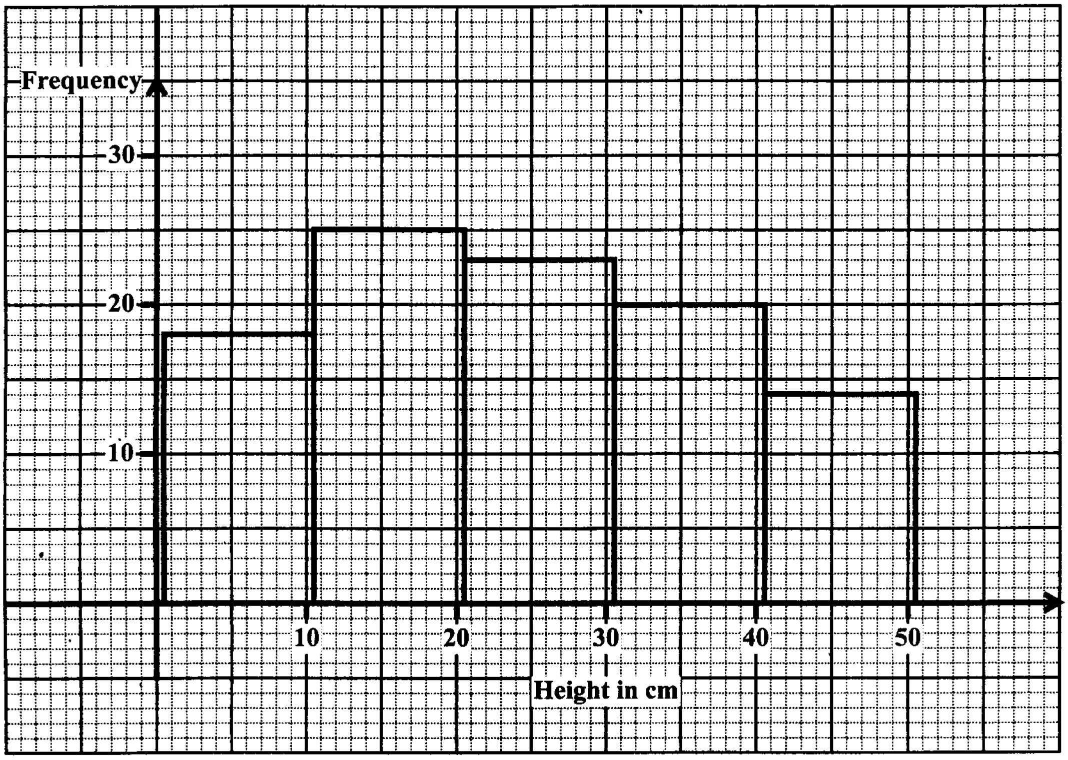
7. The histogram below shows the distribution of heights of seedlings in a sample.



(a) Copy and complete the frequency table for the data in the sample.

Height in cm	Mid-point	Frequency
1 - 10	5.5	18
11 - 20	15.5	25
21 - 30		
31 - 40		
41 - 50		

(3 marks)

(b) Determine

(i) the modal class interval **(1 mark)**

(ii) the number of seedlings in the sample **(2 marks)**

(iii) the mean height of the seedlings **(4 marks)**

(iv) the probability that a seedling chosen at random has a height that is GREATER than 30 cm. **(2 marks)**

Total 12 marks

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8. **An answer sheet is provided for this question.**

Sarah is making a pattern of squares using straws. She uses four straws for the sides and two longer straws for the diagonals. The first three figures in her sequence of shapes are shown below:

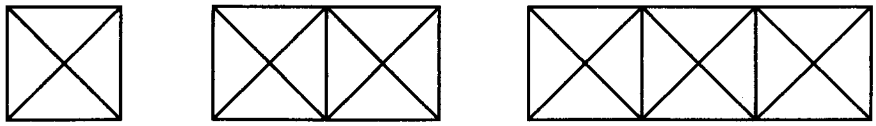

Figure 1 **Figure 2** **Figure 3**

(a) **On your answer sheet,** draw Figure 4, the FOURTH shape in the pattern.

(2 marks)

(b) **On your answer sheet,** complete the TWO rows in the table for

(i) Figure 4

(ii) Figure 10.

		Total Number of Straws	
	Figure	**Formula**	**Number**
	1	$1(6) - 0$	6
	2	$2(6) - 1$	11
	3	$3(6) - 2$	16
(i)	4		
(ii)	10		

(4 marks)

(c) Which figure in the sequence uses 106 straws? **(2 marks)**

(d) Obtain an expression in n, for the total number of straws used in the n^{th} pattern.

(2 marks)

Total 10 marks

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SECTION II

Answer TWO questions in this section.

ALGEBRA AND RELATIONS, FUNCTIONS AND GRAPHS

9. (a) (i) Make x the subject of the formula

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

(2 marks)

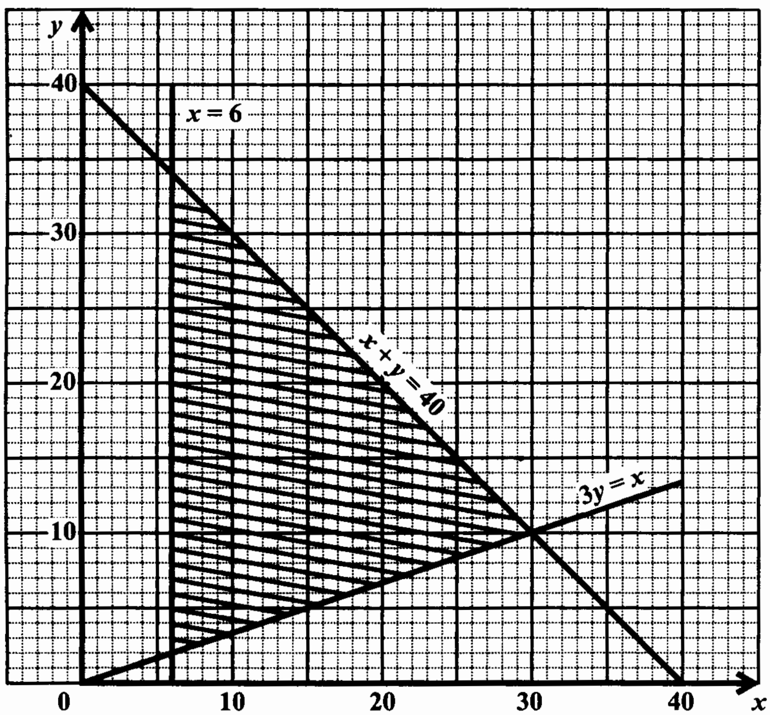
(ii) Hence, determine the inverse of $f(x) = \frac{2x+3}{x-4}$, where $x \neq 4$.

(2 marks)

(iii) Find the value of x for which $f(x) = 0$. **(2 marks)**

(b) The diagram below shows the graphs of three lines and a shaded region defined by three inequalities associated with these lines.

The inequality associated with the line $3y = x$ is $3y \geq x$.



(i) State the other TWO inequalities which define the shaded region.

(2 marks)

The function $p = 4x + 3y$ satisfies the solution set represented by the closed triangular region.

(ii) Identify the three pairs of (x, y) values for which p has a maximum or a minimum value. **(3 marks)**

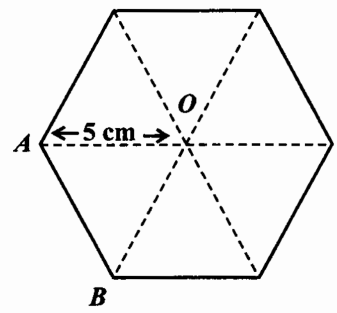
(iii) Which pair of (x, y) values makes p a maximum? **Justify your answer.**

(4 marks)

Total 15 marks

MEASUREMENT, GEOMETRY AND TRIGONOMETRY

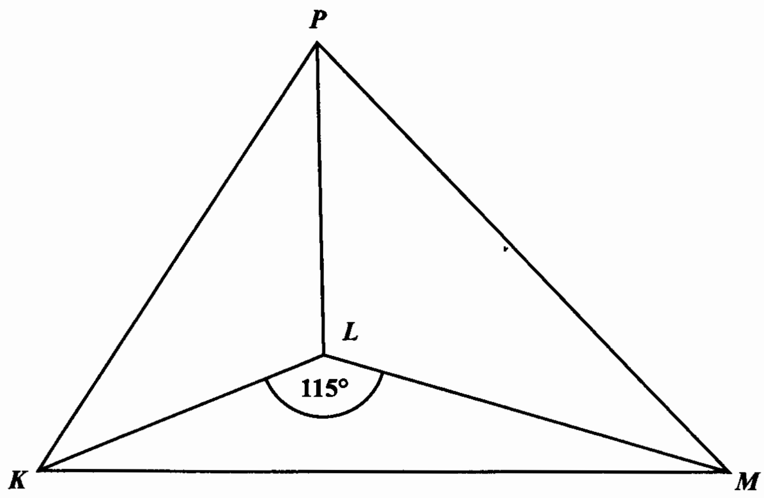
10. (a) The diagram below, **not drawn to scale**, shows a regular hexagon with centre, O, and $AO = 5$ cm.



(i) Determine the size of angle AOB. **(2 marks)**

(ii) Calculate, to the nearest whole number, the area of the hexagon. **(3 marks)**

(b) The diagram below, **not drawn to scale**, shows a vertical pole, PL, standing on a horizontal plane, KLM. The angle of elevation of P from K is 28°, KL = 15 m, LM = 19 m and $\angle KLM$ = 115°.



(i) Copy the diagram. Show the angle of elevation, 28° and ONE right angle. **(2 marks)**

(ii) Calculate, giving your answer to 2 significant figures, the measure of

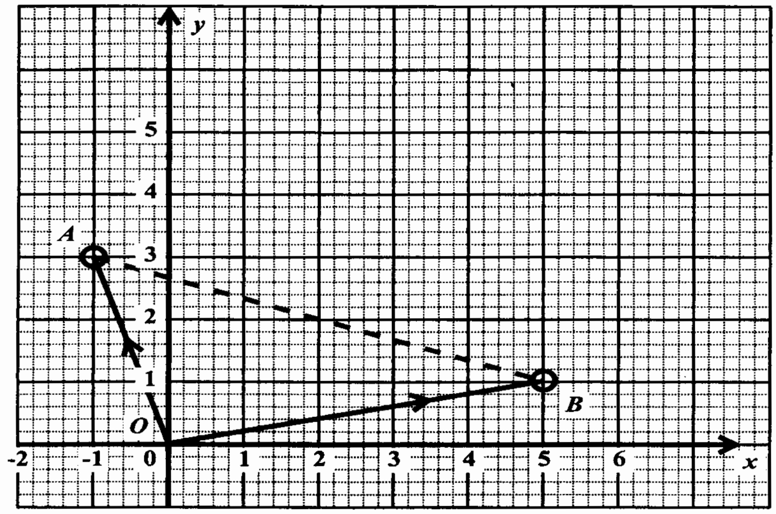
a) PL **(2 marks)**

b) KM **(3 marks)**

c) the angle of elevation of P from M. **(3 marks)**

Total 15 marks

11. (a) The diagram below shows two position vectors $\overrightarrow{OA}$ and $\overrightarrow{OB}$.



(i) Write as a column vector, in the form $\begin{pmatrix} x \\ y \end{pmatrix}$:

a) $\overrightarrow{OA}$ **(1 mark)**

b) $\overrightarrow{OB}$ **(1 mark)**

c) $\overrightarrow{BA}$ **(2 marks)**

(ii) Given that G is the mid-point of the line AB, write as a column vector in the form $\begin{pmatrix} x \\ y \end{pmatrix}$:

a) $\overrightarrow{BG}$ **(1 mark)**

b) $\overrightarrow{OG}$ **(1 mark)**

(b) L and M are two matrices where

$$L = \begin{pmatrix} 3 & 2 \\ 1 & 4 \end{pmatrix} \text{ and } M = \begin{pmatrix} -1 & 3 \\ 0 & 2 \end{pmatrix}.$$

Evaluate

(i) $L + 2M$ **(2 marks)**

(ii) LM **(2 marks)**

(c) The matrix, Q, is such that $Q = \begin{pmatrix} 4 & 2 \\ 1 & 1 \end{pmatrix}$.

(i) Find Q^{-1}. **(2 marks)**

(ii) Using a matrix method, find the values of x and y in the equation

$$\begin{pmatrix} 4 & 2 \\ 1 & 1 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 8 \\ 3 \end{pmatrix}.$$ **(3 marks)**

Total 15 marks

END OF TEST

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

TEST CODE **01234020**

FORM TP 2012017

JANUARY 2012

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

MATHEMATICS

Paper 02 – General Proficiency

Answer Sheet for Question 8 **Candidate Number** ....

(a) Draw the FOURTH shape in the pattern:

(b) Complete the table for Figure 4 and Figure 10.

		Total Number of Straws	
	Figure	**Formula**	**Number**
	1	$1(6) - 0$	6
	2	$2(6) - 1$	11
	3	$3(6) - 2$	16
(i)	4		
(ii)	10		

(c) Which figure in the sequence uses 106 straws?

(d) Obtain an expression in n, for the total number of straws used in the n^{th} pattern.

ATTACH THIS ANSWER SHEET TO YOUR ANSWER BOOKLET