

JANUARY 2011

**EXAMINATION
MATHEMATICS
Paper 02 – General Proficiency**

2 hours 40 minutes

04 JANUARY 2011 (a.m.)

INSTRUCTIONS TO CANDIDATES

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 $S = \frac{\theta}{360} \times 2\pi r$ 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 $A = \frac{\theta}{360} \times \pi r^2$ 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 If $ax^2 + bx + c = 0$,

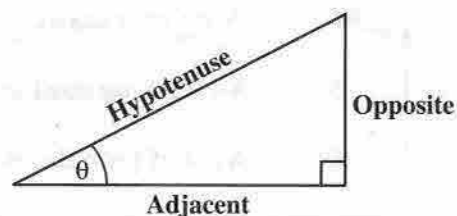
$$\text{then } x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Trigonometric ratios

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

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

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



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

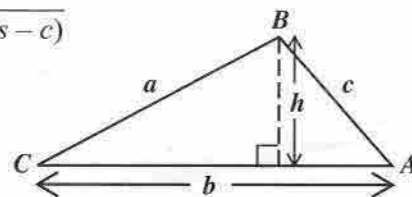
$$\text{Area of } \Delta ABC = \frac{1}{2} ab \sin C$$

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

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

Sine rule

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$



Cosine rule

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

SECTION I

Answer ALL the questions in this section.

All working must be clearly shown.

1. (a) Calculate the exact value of
- (i) $(5.8^2 + 1.02) \times 2.5$ (2 marks)
- (ii) $\frac{2\frac{4}{9}}{4\frac{2}{3}} - \frac{3}{7}$ (3 marks)
- (b) A company pays its employees a basic wage of \$9.50 per hour for a 40-hour week.
- (i) Calculate the basic weekly wage for ONE employee. (1 mark)
- Overtime is paid at a rate of time and a half.
- (ii) Calculate the overtime wage for an employee who works 6 hours overtime in a certain week. (2 marks)
- In a certain week, the company paid its 30 employees a total of \$12 084.00 in basic and overtime wages. Calculate for that week:
- (iii) The TOTAL paid in overtime wages (2 marks)
- (iv) The TOTAL number of overtime hours worked by employees (1 mark)
- Total 11 marks**

2. (a) Simplify
- $$\frac{2x}{5} - \frac{x}{3}$$
- expressing your answer as a single fraction. (2 marks)
- (b) Factorise completely
- $$a^2b + 2ab.$$
- (1 mark)
- (c) Express p as the subject of the formula
- $$q = \frac{p^2 - r}{t}.$$
- (3 marks)

- (d) The students in a class sell donuts to raise money for their school project. The donuts are sold in small and large boxes. The number of donuts in EACH type of box is given in the table below:

Type of Box	Number of Donuts per Box
Small box	x
Large box	$2x + 3$

The students sold 8 small boxes and 5 large boxes in all.

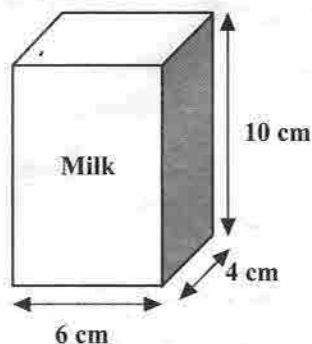
- (i) Write an expression in terms of x to represent the TOTAL number of donuts sold. (2 marks)
- (ii) The total number of donuts sold was 195. Calculate the number of donuts in a
- small box
 - large box. (4 marks)

Total 12 marks

3. (a) Simplify the expression

$$7p^5q^3 \times 2p^2q. \quad (2 \text{ marks})$$

- (b) Fresh Farms Dairy sells milk in cartons in the shape of a cuboid with internal dimensions 6 cm by 4 cm by 10 cm.

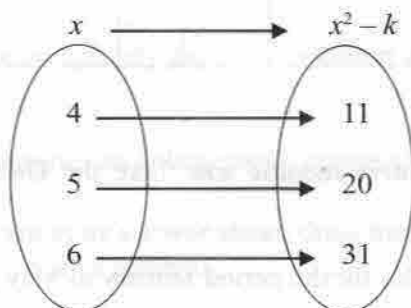


- (i) Calculate, in cm^3 , the volume of milk in EACH carton. (2 marks)
- (ii) A recipe for making ice-cream requires 3 litres of milk. How many cartons of milk should be bought to make the ice-cream? (3 marks)
- (iii) One carton of milk is poured into a cylindrical cup of internal diameter 5 cm. What is the height of milk in the cup? Give your answer to 3 significant figures. [Use $\pi = 3.14$] (4 marks)

Total 11 marks

4. (a) The Universal set, U , is given as
 $U = \{ \text{Whole numbers from 1 to 12} \}$
- H is a subset of U , such that $H = \{ \text{Odd numbers between 4 and 12} \}$.
- (i) List the members of the set H (1 mark)
- J is a subset of U , such that $J = \{ \text{Prime numbers} \}$.
- (ii) List the members of the set J . (1 mark)
- (iii) Draw a Venn diagram to represent the sets U, H and J , showing ALL the elements in the subsets. (3 marks)
- (b) (i) Using a pencil, ruler and a pair of compasses only, construct a triangle LMN with angle $LMN = 60^\circ$, $MN = 9$ cm and $LM = 7$ cm.
ALL construction lines MUST be clearly shown. (4 marks)
- (ii) Measure and state the size of $\angle MNL$. (1 mark)
- (iii) On the diagram, show the point, K , such that $KLMN$ is a parallelogram. (2 marks)
- Total 12 marks**

5. (a) The equation of a straight line is given by:
- $$3y = 2x - 6$$
- Determine
- (i) the gradient of the line (2 marks)
- (ii) the equation of the line which is perpendicular to $3y = 2x - 6$, and passes through the point $(4, 7)$. (3 marks)
- (b) The arrow diagram shown below represents the relation $f: x \rightarrow x^2 - k$, where $x \in \{3, 4, 5, 6, 7, 8, 9, 10\}$

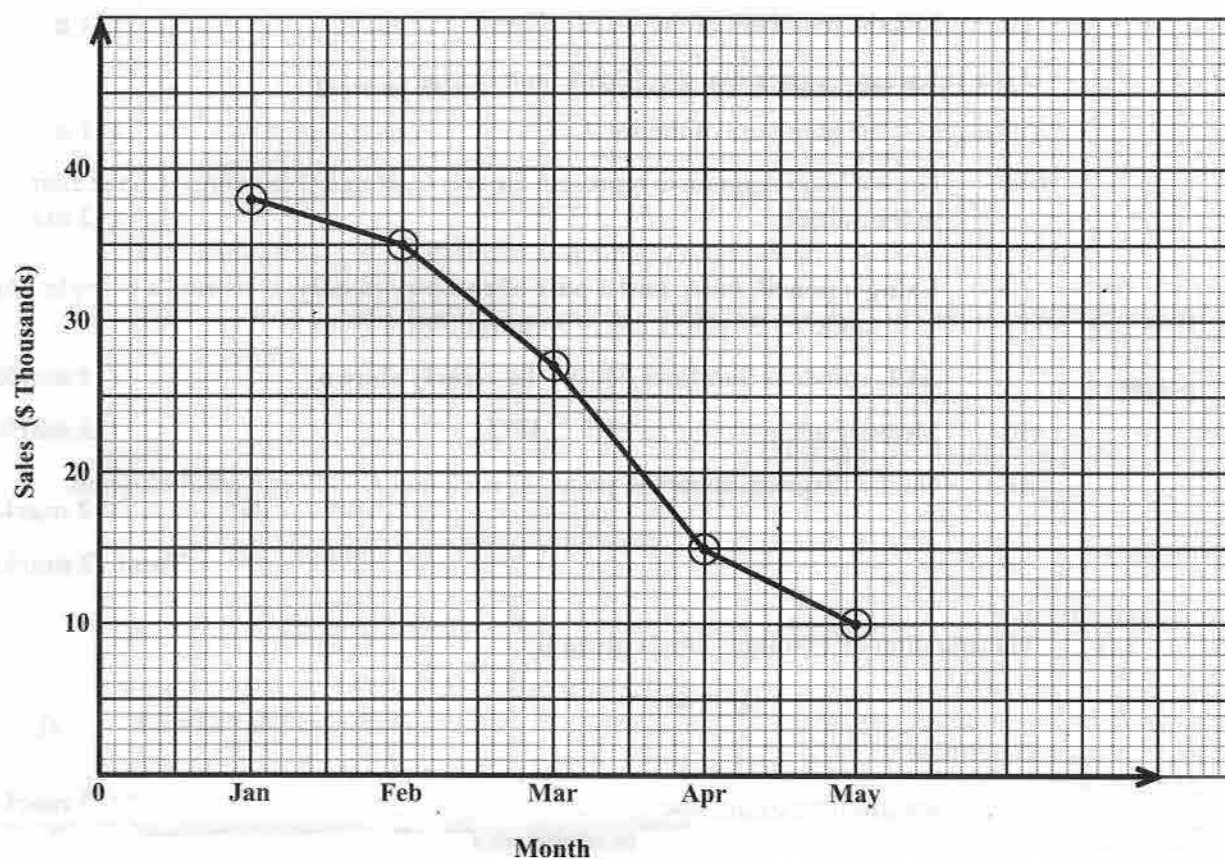


Calculate the value of

- (i) k (2 marks)
- (ii) $f(3)$ (2 marks)
- (iii) x when $f(x) = 95$. (2 marks)

Total 11 marks

6. The line graph below shows the monthly sales, in thousands of dollars, at a school cafeteria for the period January to May 2010.



- (i) Copy and complete the table below to show the sales for EACH month.

Month	Jan	Feb	Mar	Apr	May
Sales in \$Thousands	38		27		

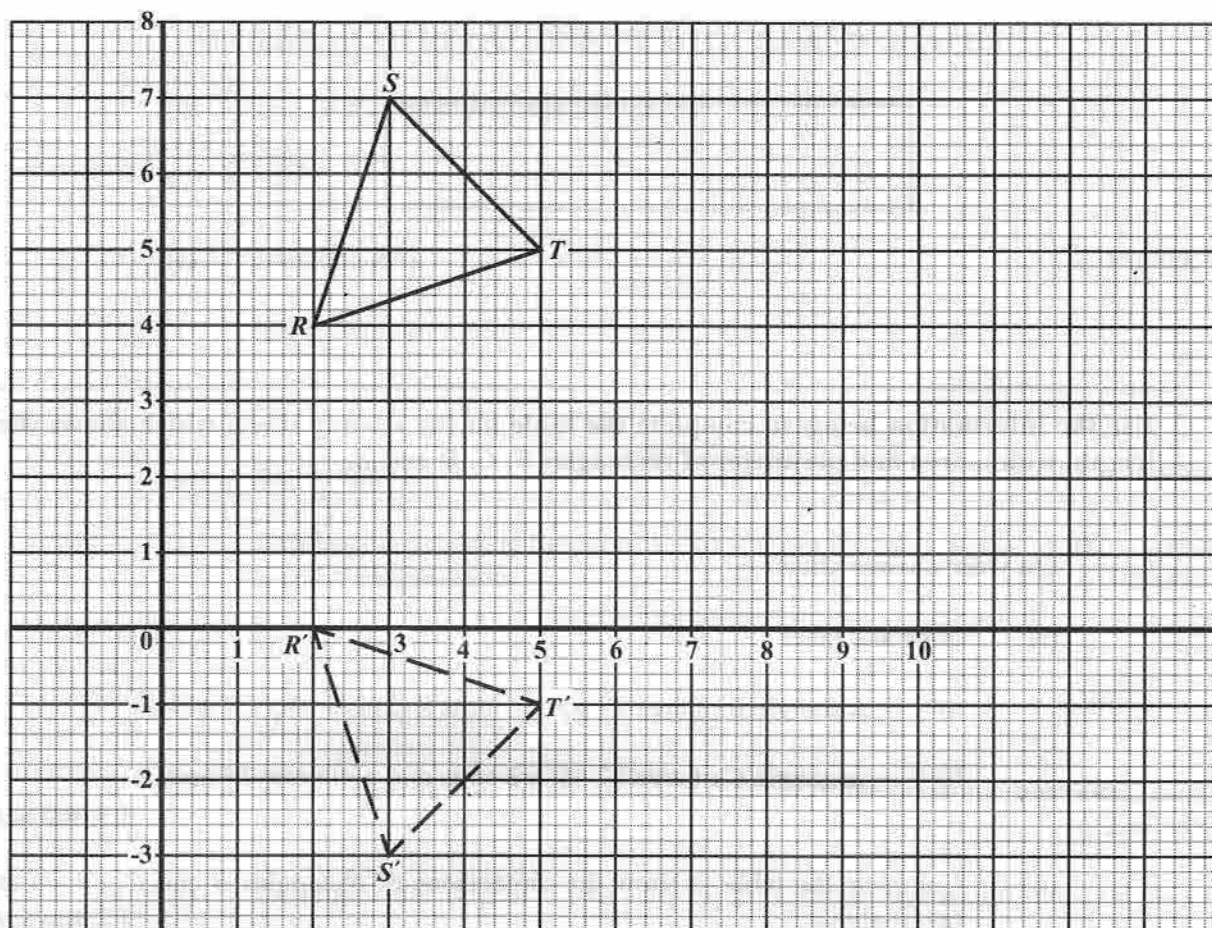
(3 marks)

- (ii) Between which TWO consecutive months was there the GREATEST decrease in sales? (1 mark)
- (iii) Calculate the mean monthly sales for the period January to May 2010. (3 marks)
- (iv) The TOTAL sales for the period January to June was \$150 000. Calculate the sales, in dollars, for the month of June. (2 marks)
- (v) Comment on how the sales in June compared with the sales in the previous five months. (2 marks)

Total 11 marks

7. An answer sheet is provided for this question.

The diagram below shows triangle RST and its image $R'S'T'$ after a transformation.



(i) Write down the coordinates of R and R' . (2 marks)

(ii) Describe completely the transformation which maps triangle RST onto triangle $R'S'T'$. (3 marks)

(iii) RST undergoes an enlargement, centre, $(0,4)$, scale factor, 3.

a) On your answer sheet, draw triangle $R''S''T''$, the image of triangle RST under the enlargement.

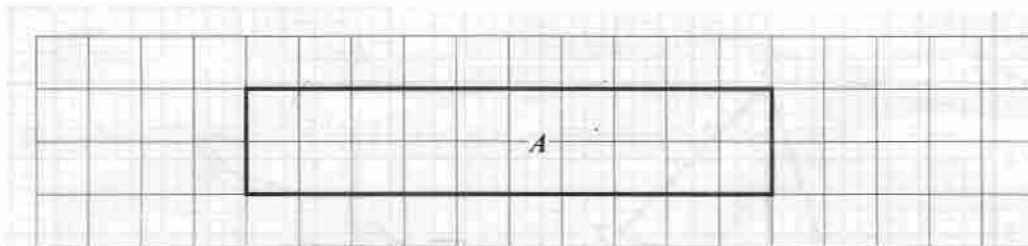
b) Given that the area of triangle RST is 4 square units, calculate the area of triangle $R''S''T''$.

c) State TWO geometrical relationships between triangles RST and $R''S''T''$. (7 marks)

Total 12 marks

8. An answer sheet is provided for this question.

The answer sheet shows a rectangle, A , of area 20 square units and perimeter 24 units.



Use the information below to complete the table on the answer sheet, which shows the length, width, area and perimeter of rectangles B , C , D and E .

(a) On your answer sheet,

(i) draw and label

a) rectangle B of area 27 square units and perimeter 24 units

b) rectangle C of area 32 square units and perimeter 24 units.

(4 marks)

(ii) Complete the table to show the dimensions of rectangles B and C , drawn at (a) (i) above. (2 marks)

(b) Rectangle D has a perimeter of 24 cm, with length, l , and width, w . If the area of the rectangle D is to be as large as possible, determine the values of l and w . In the table, write the values of l , w and the area of rectangle D . (2 marks)

(c) Rectangle E has a perimeter of 36 cm, length, l , and width, w . If the area of the rectangle E is to be as large as possible, determine the values of l and w . In the table, write the values of l , w and the area of the rectangle E . (2 marks)

Total 10 marks

SECTION II

Answer TWO questions in this section.

ALGEBRA AND RELATIONS, FUNCTIONS AND GRAPHS

9. (a) The functions $f(x)$ and $g(x)$ are defined as:

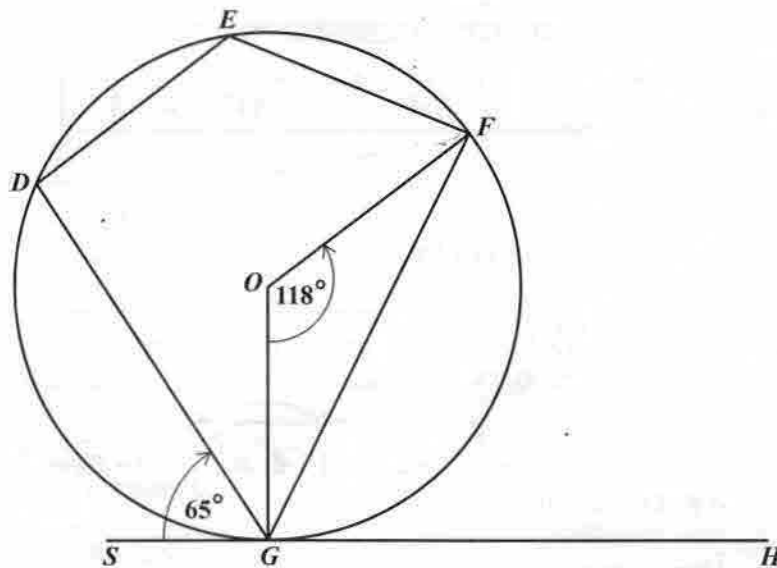
$$f(x) = \frac{2x-7}{x} \quad \text{and} \quad g(x) = \sqrt{x+3}$$

- (i) Evaluate $f(5)$. (1 mark)
- (ii) Write expressions in x for
- a) $f^{-1}(x)$
- b) $gf(x)$. (6 marks)
- (b) (i) Express the quadratic function $1 - 6x - x^2$, in the form $k - a(x + h)^2$, where a , h and k are constants. (3 marks)
- (ii) Hence state
- a) the maximum value of $1 - 6x - x^2$
- b) the equation of the axis of symmetry of the quadratic function. (2 marks)
- (iii) Determine the roots of $1 - 6x - x^2 = 0$, giving your answers to 2 decimal places. (3 marks)

Total 15 marks

MEASUREMENT AND GEOMETRY AND TRIGONOMETRY

10. (a) The diagram, below, **not drawn to scale**, shows a circle, centre, O . SGH is a tangent to the circle, $\angle FOG = 118^\circ$ and $\angle DGS = 65^\circ$.



Calculate, **giving reasons for EACH step of your answer**, the measure of:

- (i) $\angle OGF$ (2 marks)
- (ii) $\angle DEF$ (3 marks)
- (b) J , K and L are three sea ports. A ship began its journey at J , sailed to K , then to L and returned to J .

The bearing of K from J is 054° and L is due east of K .

$JK = 122$ km and $KL = 60$ km.

- (i) Draw a clearly labelled diagram to represent the above information. Show on the diagram
- the north/south direction
 - the bearing 054°
 - the distances 122 km and 60 km. (3 marks)
- (ii) Calculate
- the measure of angle JKL
 - the distance JL
 - the bearing of J from L . (7 marks)

Total 15 marks

VECTORS AND MATRICES

11. (a) Under a matrix transformation, $M = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, the points, V and W are mapped onto V' and W' such that:

$$\begin{aligned} V(3,5) &\rightarrow V'(5,-3) \\ W(7,2) &\rightarrow W'(2,-7) \end{aligned}$$

- (i) Determine the values of a , b , c and d . (3 marks)
- (ii) State the coordinates of Z such that $Z(x, y) \rightarrow Z'(5,1)$ under the transformation, M . (2 marks)
- (iii) Describe FULLY the geometric transformation, M . (2 marks)
- (b) \vec{OP} and \vec{OR} are position vectors with respect to the origin, O .

P is the point $(2,7)$ and $\vec{PR} = \begin{pmatrix} 4 \\ -3 \end{pmatrix}$.

- (i) Write in the form $\begin{pmatrix} a \\ b \end{pmatrix}$ the vectors:
- a) \vec{OP}
- b) \vec{OR} (3 marks)
- (ii) A point S has coordinates $(14,-2)$.
- a) Find \vec{RS} .
- b) Show that P , R and S are collinear. (5 marks)

Total 15 marks

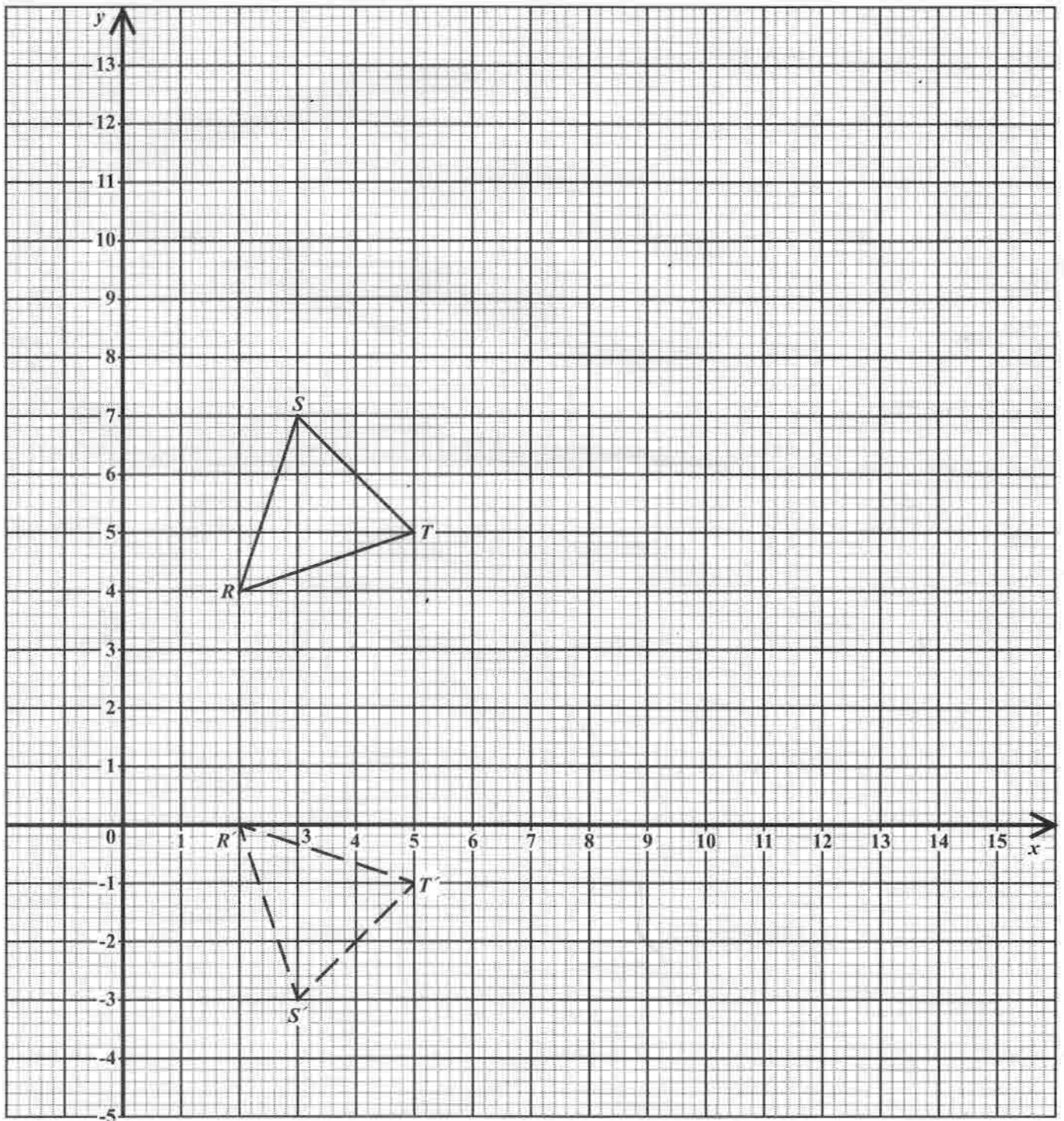
END OF TEST

EXAMINATION
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Answer Sheet for Question 7

Candidate Number



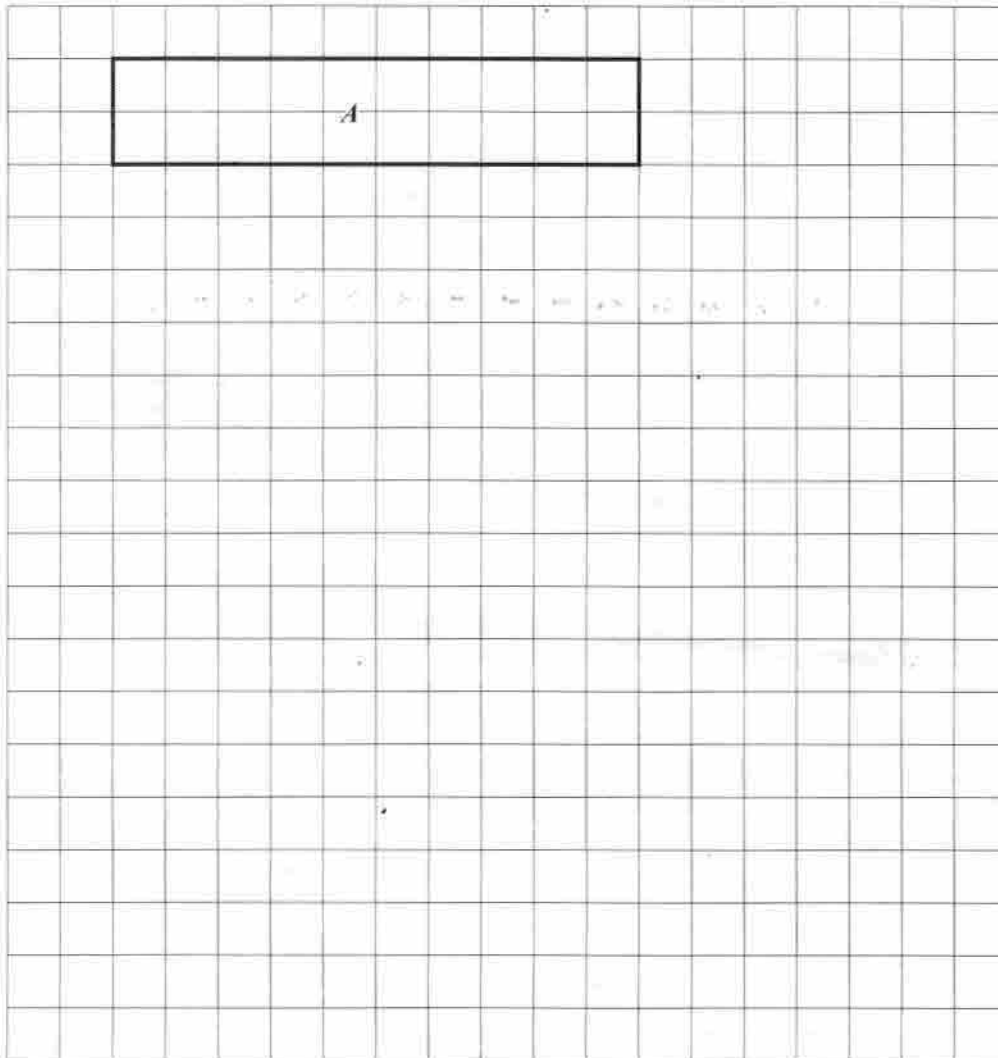
ATTACH THIS ANSWER SHEET TO YOUR ANSWER BOOKLET

**EXAMINATION
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Answer Sheet for Question 8

Candidate Number



Rectangle	Length	Width	Area (square units)	Perimeter (units)
A	10	2	20	24
B	_____	_____	27	24
C	_____	_____	32	24
D	_____	_____	_____	24
E	_____	_____	_____	36