

JANUARY 2009

**EXAMINATION
MATHEMATICS
Paper 02 – General Proficiency**

2 hours 40 minutes

06 JANUARY 2009 (a.m.)

INSTRUCTIONS TO CANDIDATES

1. Answer ALL questions in Section I, and ANY TWO in Section II.
2. Write your answers in the booklet provided.
3. All working must be shown clearly.
4. A list of formulae is provided on page 2 of this booklet.

Examination Materials

Electronic calculator (non-programmable)

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.

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

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

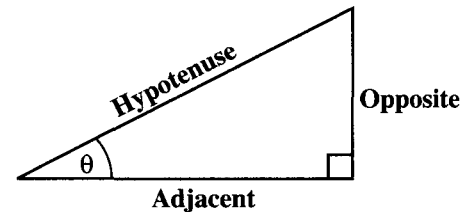
$$\text{then } x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Trigonometric ratios

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

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

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



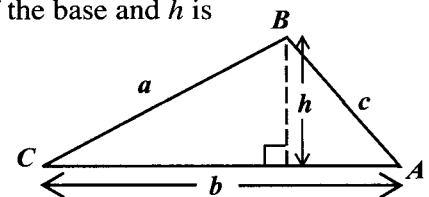
Area of triangle

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

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

NOTHING HAS BEEN OMITTED.

SECTION I

Answer ALL the questions in this section.

All working must be clearly shown.

1. (a) Calculate the EXACT value of

$$\frac{3\frac{3}{4}}{2\frac{1}{3} - \frac{5}{6}}$$

giving your answer as a fraction.

(3 marks)

- (b) BDS\$ means Barbados dollars and EC\$ means Eastern Caribbean dollars.

- (i) Karen exchanged BDS\$2 000.00 and received EC\$2 700.00. Calculate the value of one BDS\$ in EC\$. (2 marks)
- (ii) If Karen exchanged EC\$432.00 for BDS\$, calculate the amount of BDS\$ which Karen would receive. (2 marks)

[Assume that the buying and selling rates are the same.]

- (c) A credit union pays 8% per annum compound interest on all fixed deposits. A customer deposited \$24 000 in an account. Calculate the TOTAL amount of money in the account at the end of two years. (4 marks)

Total 11 marks

2. (a) Simplify, expressing your answer as a single fraction

$$\frac{\frac{2m}{n} - \frac{5m}{3n}}{\quad}$$

(3 marks)

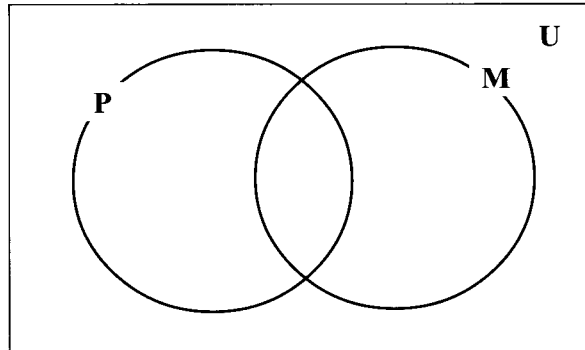
- (b) If $a * b = a^2 - b$, evaluate $5 * 2$. (1 mark)
- (c) Factorize completely $3x - 6y + x^2 - 2xy$. (2 marks)
- (d) A drinking straw of length 21 cm is cut into 3 pieces.
The length of the first piece is x cm.
The second piece is 3 cm shorter than the first piece.
The third piece is twice as long as the first piece.
- (i) State, in terms of x , the length of EACH of the pieces. (2 marks)
- (ii) Write an **expression**, in terms of x , to represent the sum of the lengths of the three pieces of drinking straw. (1 mark)
- (iii) **Hence**, calculate the value of x . (3 marks)

Total 12 marks

3. (a) A school has 90 students in Form 5.
 54 students study Physical Education.
 42 students study Music.
 6 students study neither Physical Education nor Music.
 x students study both Physical Education and Music.

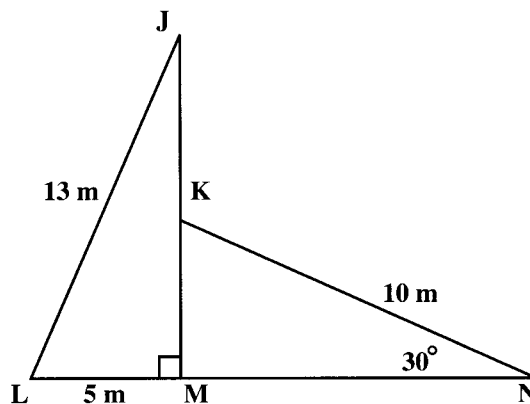
(i) Copy the Venn diagram shown below.

(1 mark)



- (ii) Show on your Venn diagram the information relating to the students in Form 5.
 (2 marks)
- (iii) Calculate the number of students who study BOTH Physical Education and Music.
 (3 marks)

- (b) The diagram below, **not drawn to scale**, shows two straight wires, LJ and NK , supporting a vertical pole, MJ . LMN is a straight line on the horizontal plane. Angle $JML = 90^\circ$, angle $KNM = 30^\circ$, $LJ = 13$ m, $LM = 5$ m and $KN = 10$ m.

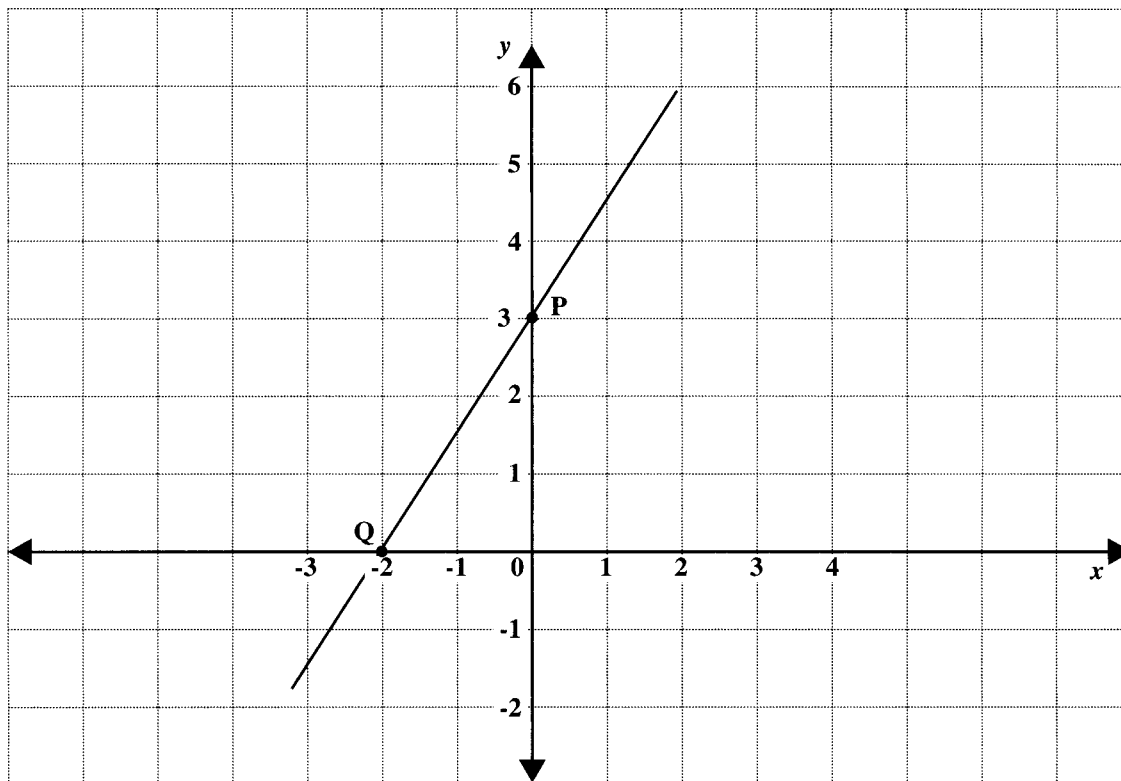


Calculate, in metres, the length of

- (i) MK (3 marks)
- (ii) JK . (3 marks)

Total 12 marks

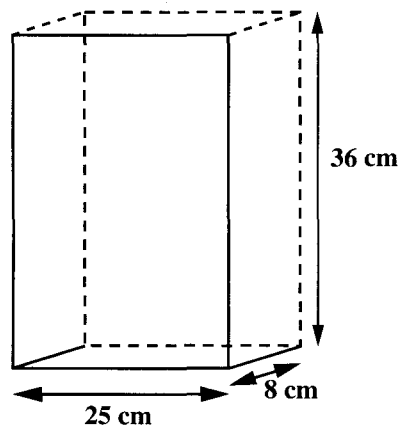
4. The diagram below represents the graph of a straight line which passes through the points P and Q .



- (a) State the coordinates of P and Q . (2 marks)
- (b) Determine
- the gradient of the line segment PQ (2 marks)
 - the equation of the line segment PQ . (2 marks)
- (c) The point $(-8, t)$ lies on the line segment PQ . Determine the value of t . (2 marks)
- The line segment, AB , is perpendicular to PQ , and passes through $(6, 2)$.
- (d) Determine the equation of AB in the form $y = mx + c$. (3 marks)

Total 11 marks

5. A company makes cereal boxes in the shape of a right prism.

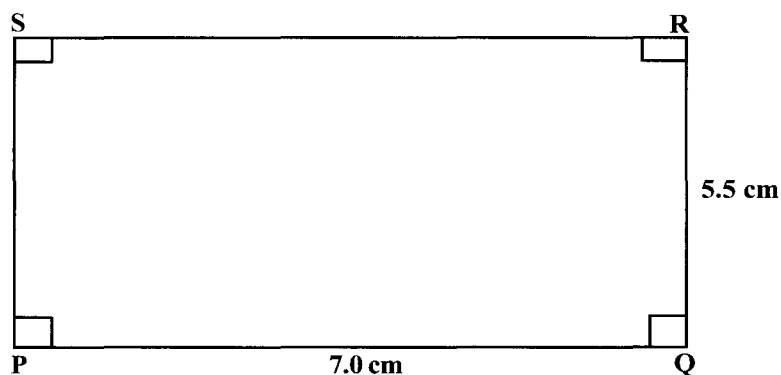


EACH large box has dimensions 25 cm by 8 cm by 36 cm.

- (a) Calculate the volume in cubic centimetres, of ONE large cereal box. (2 marks)
- (b) Calculate the total surface area of ONE large cereal box. (4 marks)
- (c) The cereal from ONE large box can exactly fill six small boxes, each of equal volume.
- (i) Calculate the volume of ONE small cereal box. (2 marks)
- (ii) If the height of a small box is 20 cm, list TWO different pairs of values which the company can use for the length and width of a small box. (2 marks)

Total 10 marks

6. (a) The diagram below, **not drawn to scale**, shows rectangle PQRS with $PQ = 7.0$ cm and $QR = 5.5$ cm.



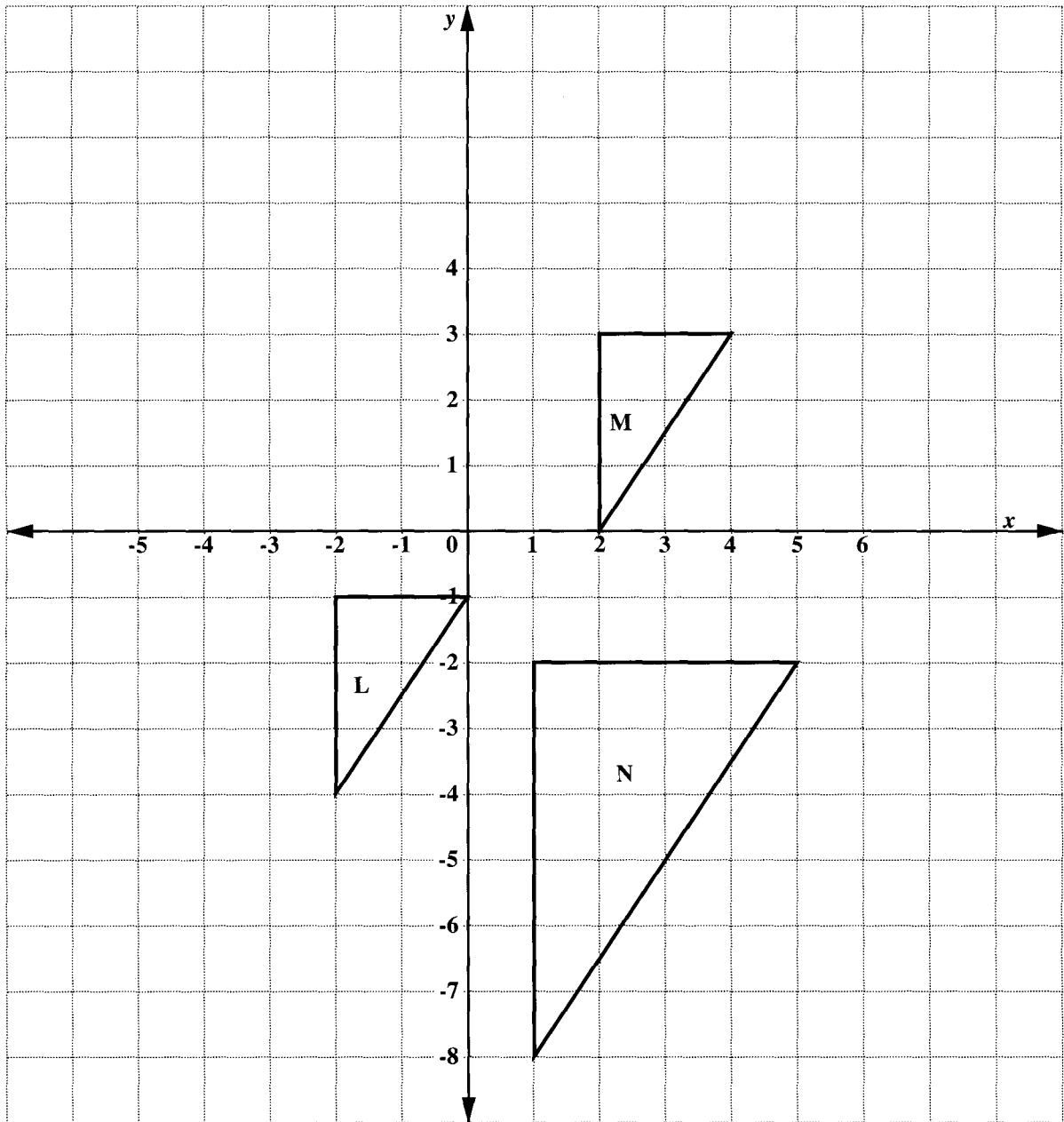
Using a ruler, a pencil and a pair of compasses only, construct the rectangle.

(6 marks)

GO ON TO THE NEXT PAGE

An answer sheet is provided for this question.

- (b) The diagram below shows three triangles labelled L , M and N .



L is mapped onto M by a translation.

- (i) State, in the form $\begin{pmatrix} x \\ y \end{pmatrix}$, the vector which represents the translation.

(2 marks)

(ii) L is mapped onto N by an enlargement:

- a) Find and label **on your answer sheet** the point G , the centre of the enlargement. **Show your method clearly.**
- b) State the coordinates of G .
- c) State the scale factor of the enlargement.

(4 marks)

Total 12 marks

7. The table below shows the distribution of marks on a test for a group of 70 students.

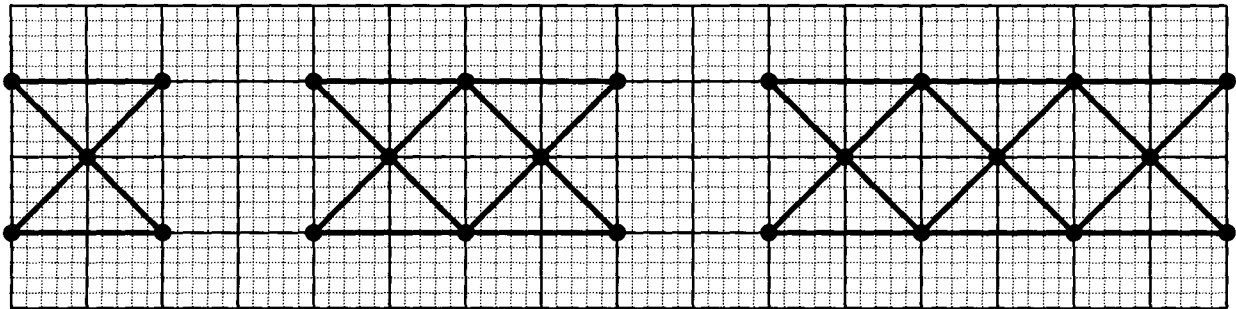
Mark	Frequency	Cumulative Frequency
1 – 10	2	2
11 – 20	5	7
21 – 30	9	16
31 – 40	14	
41 – 50	16	
51 – 60	12	
61 – 70	8	
71 – 80	4	70

- (a) Copy and complete the table to show the cumulative frequency for the distribution. (2 marks)
- (b) (i) Using a scale of 1 cm to represent 5 marks on the horizontal axis and 1 cm to represent 5 students on the vertical axis, draw the cumulative frequency curve for the scores. (5 marks)
- (ii) What assumption have you made in drawing your curve through the point (0,0)? (1 mark)
- (c) The pass mark for the test is 47. Use your graph to determine the number of students who passed the test. (2 marks)
- (d) What is the probability that a student chosen at random had a mark less than or equal to 30? (2 marks)

Total 12 marks

8. An answer sheet is provided for this question.

The figure below shows the first three diagrams in a sequence. Each diagram is made up of dots connected by line segments. In each diagram, there are d dots and l line segments.



On the answer sheet provided:

- (a) Draw the fourth diagram in the sequence. (2 marks)
- (b) Complete the table by inserting the missing values at the rows marked (i) and (ii).

No. of dots d	Pattern connecting l and d	No. of line segments l
5	$2 \times 5 - 4$	6
8	$2 \times 8 - 4$	12
11	$2 \times 11 - 4$	18
(i) 62	()	()
(ii) ()	()	180

- (c) (i) How many dots are in the sixth diagram of the sequence? (1 mark)
- (ii) How many line segments are in the seventh diagram of the sequence? (1 mark)
- (iii) Write the rule which shows how l is related to d . (2 marks)

Total 10 marks

SECTION II

Answer TWO questions in this section.

ALGEBRA AND RELATIONS, FUNCTIONS AND GRAPHS

9. (a) Make t the subject of the formula

$$\frac{p}{2} = \sqrt{\frac{t+r}{g}}. \quad (3 \text{ marks})$$

- (b) (i) Express the function $f(x) = 2x^2 - 4x - 13$ in the form $f(x) = a(x+h)^2 + k$.
(3 marks)

Hence, or otherwise, determine

- (ii) the values of x at which the graph cuts the x -axis (4 marks)
- (iii) the interval for which $f(x) \leq 0$ (2 marks)
- (iv) the minimum value of $f(x)$ (1 mark)
- (v) the value of x at which $f(x)$ is a minimum. (2 marks)

Total 15 marks

10. (a) Two functions are defined as follows:

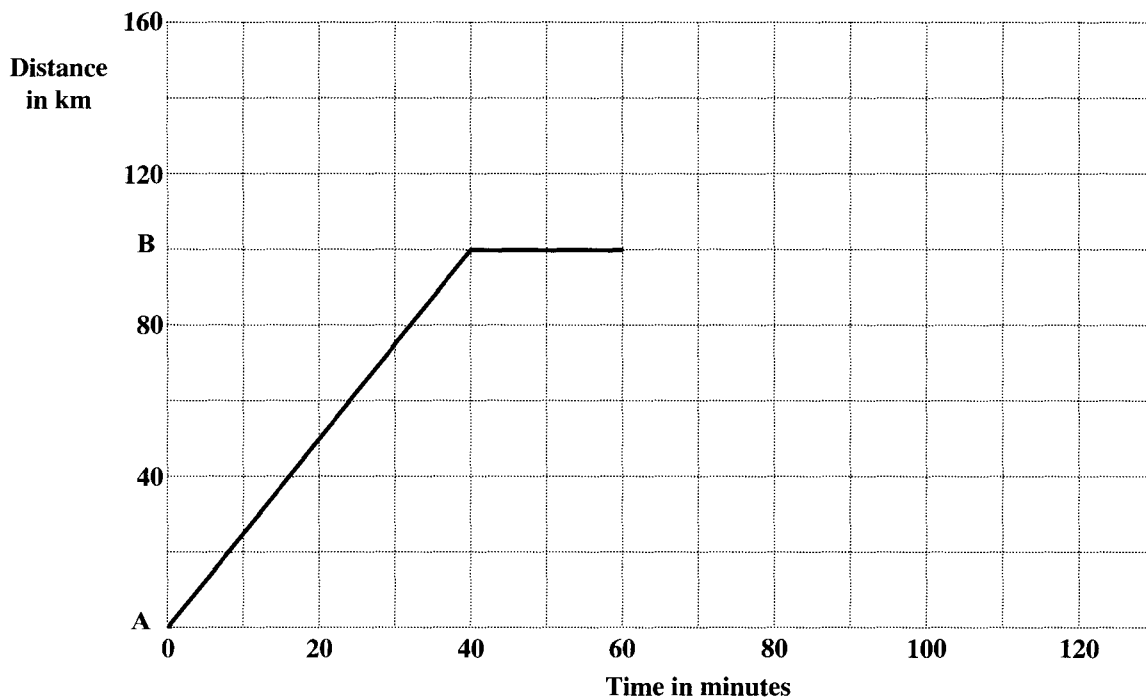
$$f: x \rightarrow x - 3$$

$$g: x \rightarrow x^2 - 1$$

- (i) Calculate $f(6)$. (1 mark)
- (ii) Find $f^{-1}(x)$. (1 mark)
- (iii) Show that $f g (2) = f g (-2) = 0$. (3 marks)

- (b) **An answer sheet is provided for this question.**

The distance-time graph below describes the journey of a train between two train stations, A and B. Answer the questions below **on the answer sheet**.



- (i) For how many minutes was the train at rest at B? (1 mark)
- (ii) Determine the average speed of the train, in km/h, on its journey from A to B. (3 marks)

The train continued its journey away from stations A and B to another station C, which is 50 km from B. The average speed on this journey was 60 km/h.

- (iii) Calculate the time, in minutes, taken for the train to travel from B to C. (3 marks)
- (iv) **On your answer sheet**, draw the line segment which describes the journey of the train from B to C. (3 marks)

Total 15 marks

GEOMETRY AND TRIGONOMETRY

11. (a) (i) Copy and complete the table for the graph of

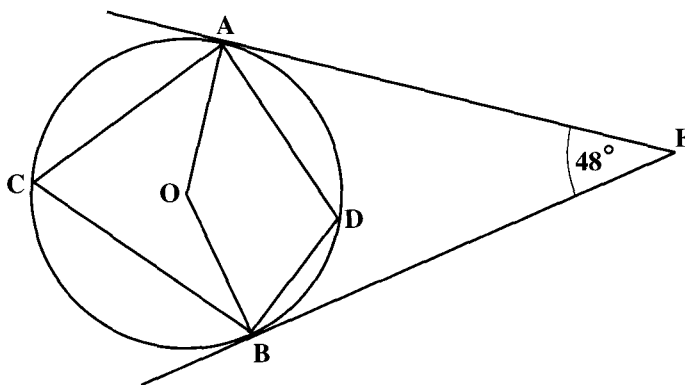
$$y = \frac{1}{2} \tan x, \text{ for } 10^\circ \leq x \leq 60^\circ.$$

x	10°	20°	30°	40°	50°	60°
y	0.13		0.29		0.60	0.87

(1 mark)

- (ii) Using a scale of 2 cm to represent 10° (10 degrees) on the horizontal axis and 10 cm to represent 1 unit on the vertical axis, plot the values from the table and draw a smooth curve through your points. (4 marks)
- (iii) Use your graph to estimate the value of x when $y = 0.7$. (1 mark)

- (b) The diagram below, **not drawn to scale**, shows a circle with centre, O . EA and EB are tangents to the circle, and angle $AEB = 48^\circ$.

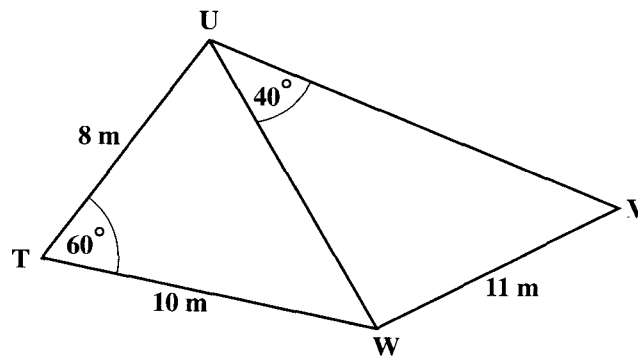


Calculate, **giving reasons for your answer**, the size of EACH of the following angles:

- (i) $\angle OAE$ (2 marks)
- (ii) $\angle AOB$ (3 marks)
- (iii) $\angle ACB$ (2 marks)
- (iv) $\angle ADB$ (2 marks)

Total 15 marks

12. (a) On the diagram below, **not drawn to scale**, $TU = 8$ m, $TW = 10$ m, $VW = 11$ m, angle $UTW = 60^\circ$ and angle $WUV = 40^\circ$.



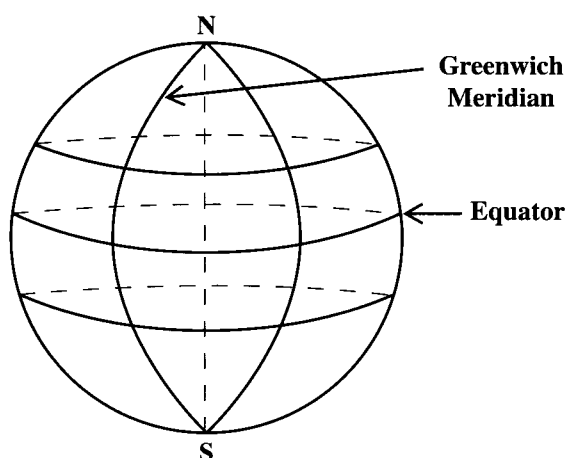
Calculate

- (i) the length of UW (2 marks)
- (ii) the size of the angle UVW (2 marks)
- (iii) the area of triangle TUW . (2 marks)

In this question use $\pi = \frac{22}{7}$, and assume that the earth is a sphere of radius 6 370 km.

- (b) The diagram below, **not drawn to scale**, represents the surface of the earth. The points N and S represent the North and South Poles respectively. The Equator and Greenwich Meridian are labelled. The following are also shown on the diagram but they are not labelled:

- circles of latitude 30°N and 20°S
- circle of longitude 40° E .



- (i) Copy the diagram and label it to show
- a) circles of latitude 30°N and 20°S
 - b) circle of longitude 40° E
 - c) the point P (30°N , 40°E). (5 marks)

- (ii) The position of the point Q is 20° S and 40° E .

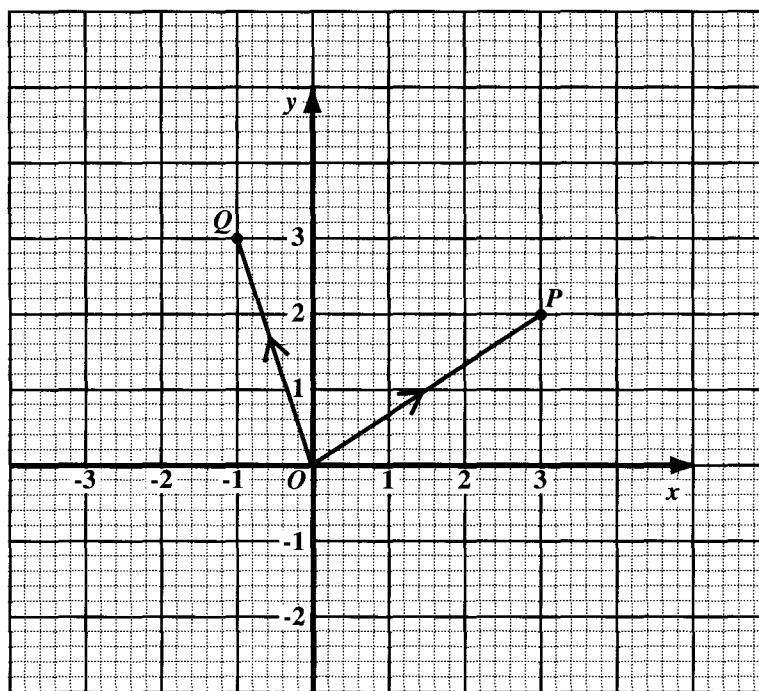
Calculate, **correct to 3 significant figures**,

- a) the **SHORTEST** distance from P to Q measured along the common circle of longitude (2 marks)
- b) the radius of the circle of latitude on which Q lies. (2 marks)

Total 15 marks

VECTORS AND MATRICES

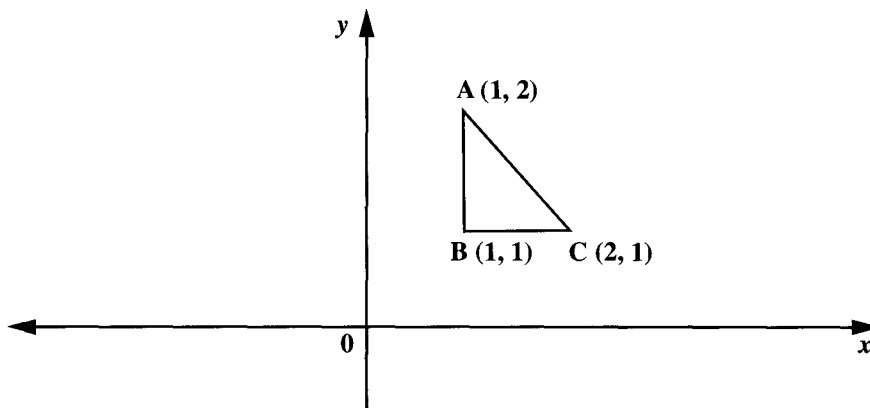
13. The diagram below shows position vectors \vec{OP} and \vec{OQ} .



- (a) Write as a column vector, in the form $\begin{pmatrix} x \\ y \end{pmatrix}$
- (i) \vec{OP} (1 mark)
- (ii) \vec{OQ} (1 mark)
- (b) The point R has coordinates $(8, 9)$.
- (i) Express \vec{QR} as a vector in the form $\begin{pmatrix} x \\ y \end{pmatrix}$. (2 marks)
- (ii) Using a vector method, show that \vec{OP} is parallel to \vec{QR} . (1 mark)
- (iii) Determine the magnitude of the vector \vec{PR} . (2 marks)
- (c) The point S has coordinates (a, b) .
- (i) Write \vec{QS} as a column vector, in terms of a and b . (2 marks)
- (ii) Given that $\vec{QS} = \vec{OP}$, calculate the value of a and the value of b . (3 marks)
- (iii) Using a vector method, show that $OPSQ$ is a parallelogram. (3 marks)

Total 15 marks

14. (a) Calculate the matrix product $3AB$, where $A = \begin{pmatrix} 1 & 2 \\ 2 & 1 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & 3 \\ 2 & 5 \end{pmatrix}$.
(3 marks)
- (b) The diagram below, **not drawn to scale**, shows a triangle, ABC whose coordinates are stated.



Triangle ABC undergoes two successive transformations, V followed by W , where

$$V = \begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix} \text{ and } W = \begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}.$$

- (i) State the effect of V on triangle ABC . (2 marks)
- (ii) Determine the 2×2 matrix that represents the combined transformation of V followed by W . (3 marks)
- (iii) Using your matrix in (b) (ii), determine the coordinates of the image of triangle ABC under this combined transformation. (3 marks)
- (c) (i) Write the following simultaneous equations in the form $AX = B$ where A , X and B are matrices:

$$\begin{aligned} 11x + 6y &= 6 \\ 9x + 5y &= 7 \end{aligned}$$
(2 marks)
- (ii) **Hence**, write the solution for x and y as a product of two matrices. (2 marks)

Total 15 marks

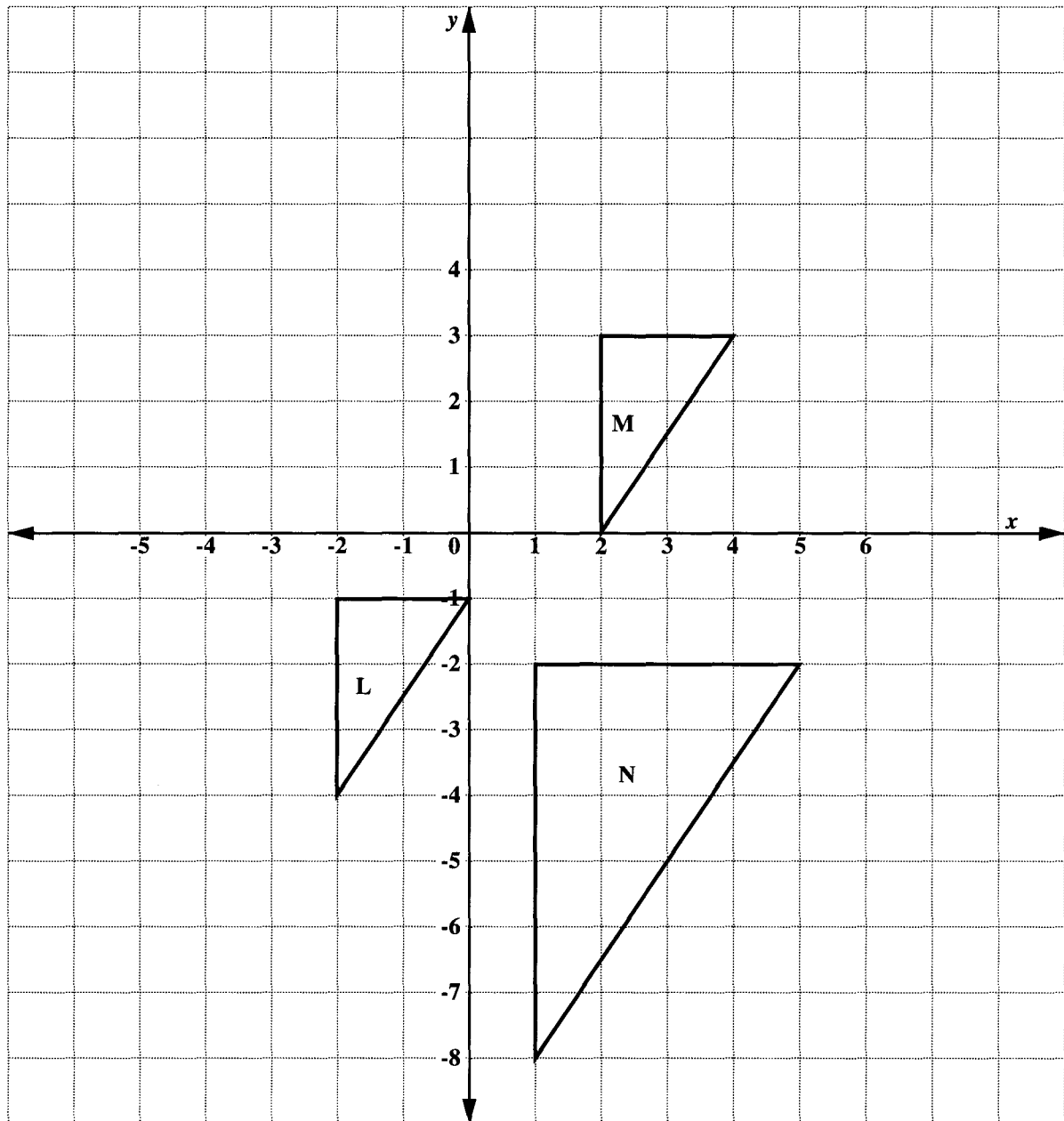
END OF TEST

**EXAMINATION
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Answer Sheet for Question 6 (b)

Candidate Number

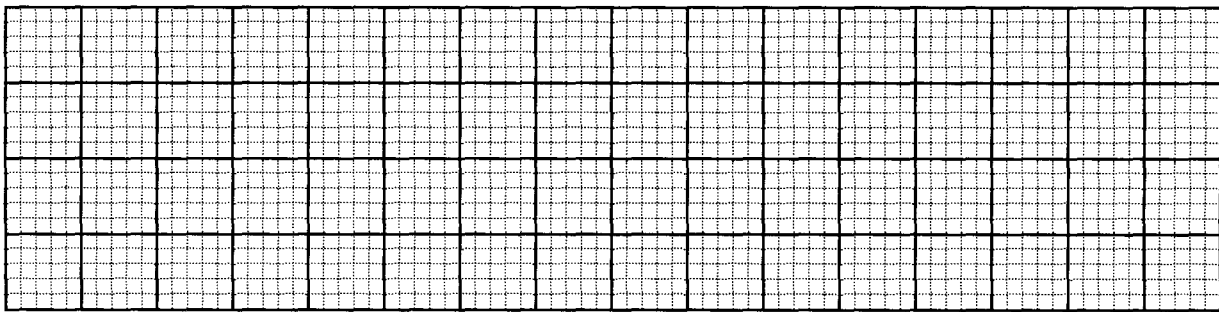


**EXAMINATION
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Paper 02 – General Proficiency**

Answer Sheet for Question 8

Candidate Number

(a)



(b)

	No. of dots <i>d</i>	Pattern connecting <i>l</i> and <i>d</i>	No. of line segments <i>l</i>
	5	$2 \times 5 - 4$	6
	8	$2 \times 8 - 4$	12
	11	$2 \times 11 - 4$	18
(i)	62	()	()
(ii)	()	()	180

- (c) (i) _____
- (ii) _____
- (iii) _____

**EXAMINATION
MATHEMATICS
Paper 02 – General Proficiency**

Answer Sheet for Question 10 (b)

Candidate Number

(i) _____

(ii) _____

(iii) _____

(iv)

