Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
January 2017

Mathematics

Unit T4
(With calculator)
Higher Tier

MV18

[GMT41]

MONDAY 9 JANUARY, 9.15am–11.15am

Time

2 hours, plus your additional time allowance.

Instructions to Candidates

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Complete in black ink only.
Answer **all twenty-one** questions.
All working should be clearly shown in the spaces provided.
Marks may be awarded for partially correct solutions.
You **may** use a calculator for this paper.

Information for Candidates

The total mark for this paper is 100.
Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.
Functional Elements will be assessed in this paper.
Quality of written communication will be assessed in Question **14.**
You should have a calculator, ruler, compasses and a protractor.
The Formula Sheet is on pages 4 and 5.

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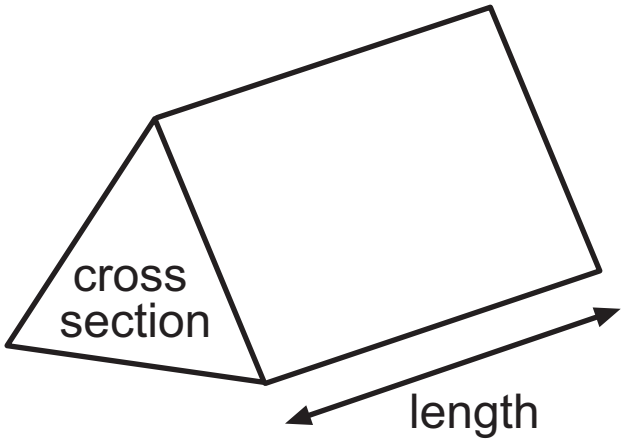
(Questions start on page 6)

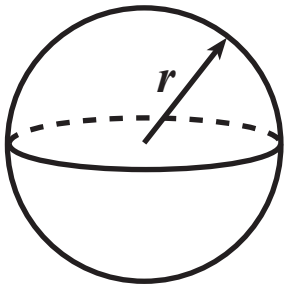
Formula Sheet

Volume of prism = area of cross section × length



Volume of sphere $= \frac{4}{3}\pi r^3$

Surface area of sphere $= 4\pi r^2$



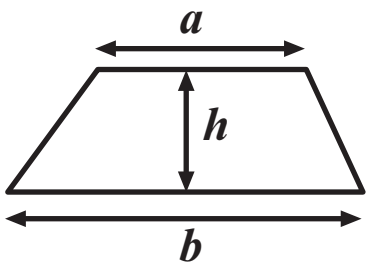
Quadratic Equation

The solutions of $ax^2 + bx + c = 0$

where $a \neq 0$, are given by

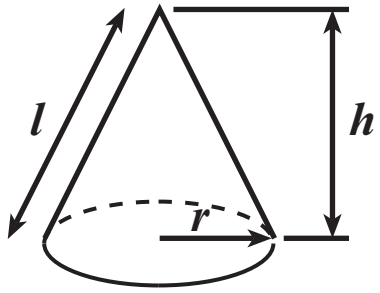
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Area of trapezium $= \frac{1}{2}(a + b)h$

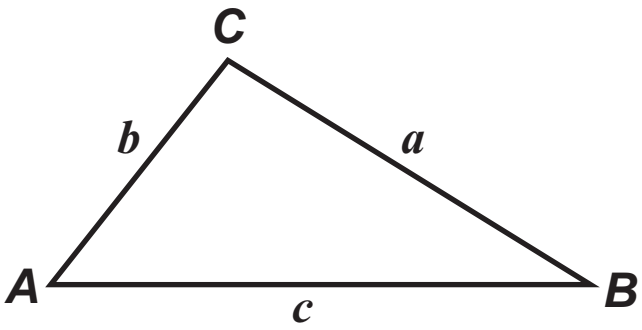


Volume of cone $= \frac{1}{3}\pi r^2 h$

Curved surface area of cone $= \pi rl$



In any triangle *ABC*

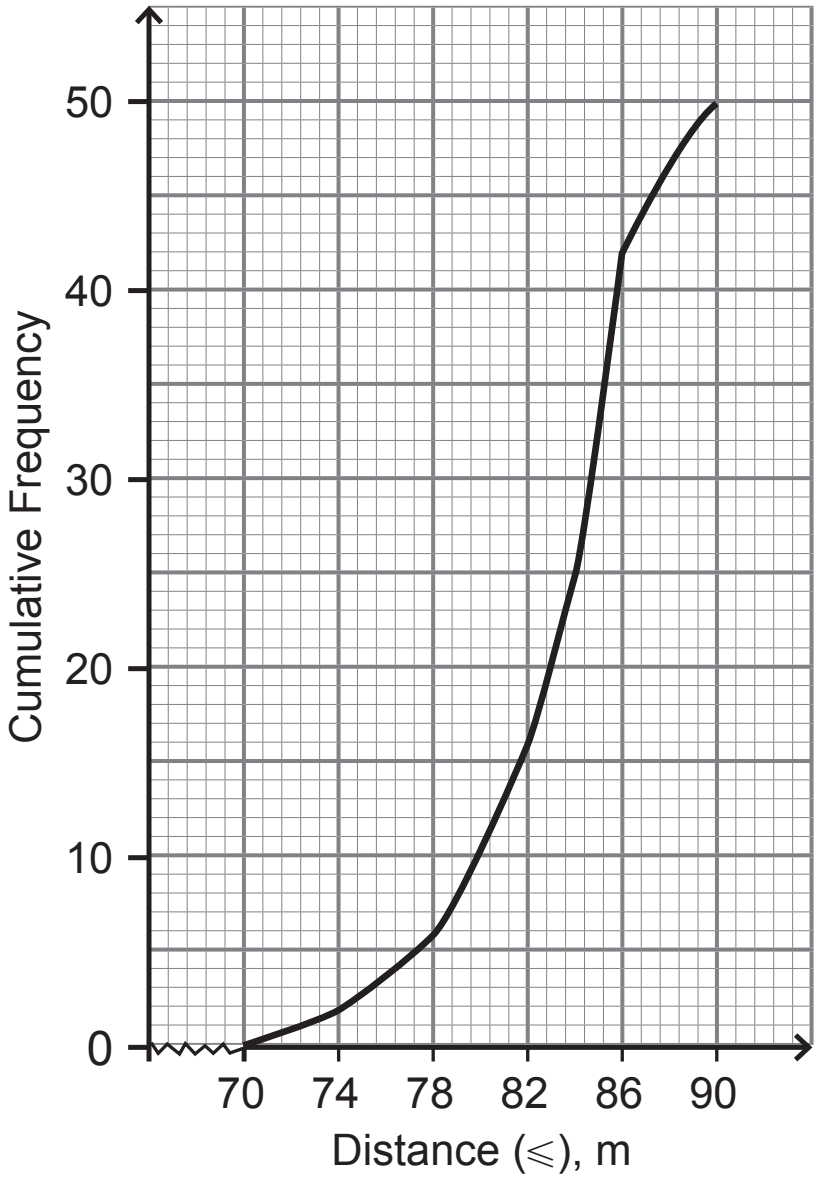


Sine Rule: $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

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

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

1 The cumulative frequency graph shows the distances thrown by 50 competitors in a javelin competition.



(a) Use the graph to estimate the median distance thrown. [1 mark]

Answer _____ m

(b) Use the graph to estimate the interquartile range. [2 marks]

Answer _____ m

(c) Use the graph to complete the two tables below.
[1 mark for **(i)**, 2 marks for **(ii)**]

(i)

Distance (less than or equal to), m	Cumulative Frequency
70	0
74	2
78	6
82	
86	
90	

(ii)

Distance d (m)	Frequency
$66 < d \leqslant 70$	0
$70 < d \leqslant 74$	2
$74 < d \leqslant 78$	4
$78 < d \leqslant 82$	
$82 < d \leqslant 86$	
$86 < d \leqslant 90$	

2 **(a)** Complete the missing power

$5^6 \div 5^2 = 5^{\square}$ [1 mark]

(b) Show, **without the use of a calculator**, that

$\frac{8^4}{16^2} = 16$ [3 marks]

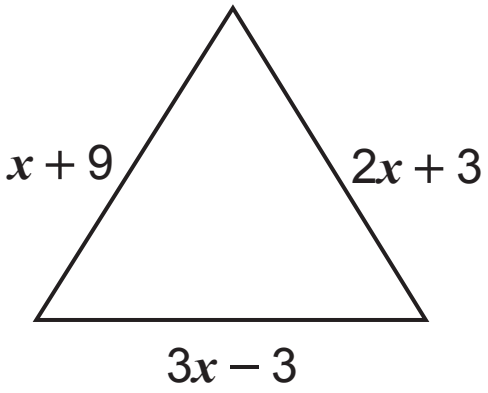
3 **(a)** Expand and simplify $3(4x + 3)(2x - 1)$ [3 marks]

Answer _____

(b) Factorise $t^2 - 49$ [1 mark]

Answer _____

4



The diagram shows an equilateral triangle.

Form and solve an equation to calculate the **perimeter** of the triangle. [1 mark for equation, 3 marks for perimeter]

Equation _____

Answer perimeter = _____

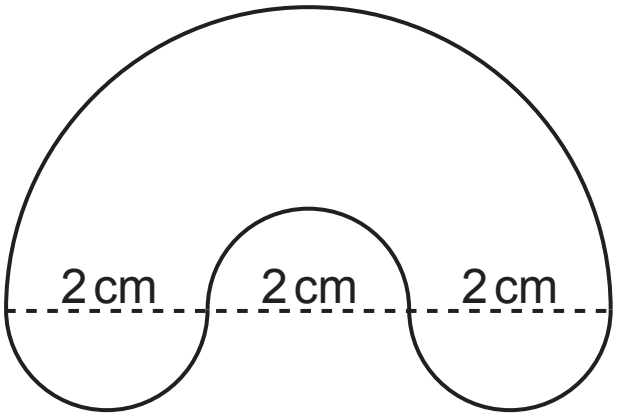
5 Solve the equation $\frac{3(x-2)}{4} - 3 = \frac{x+4}{3}$ [4 marks]

Show all your working clearly.

A solution by trial and improvement will not be accepted.

Answer $x =$ _____

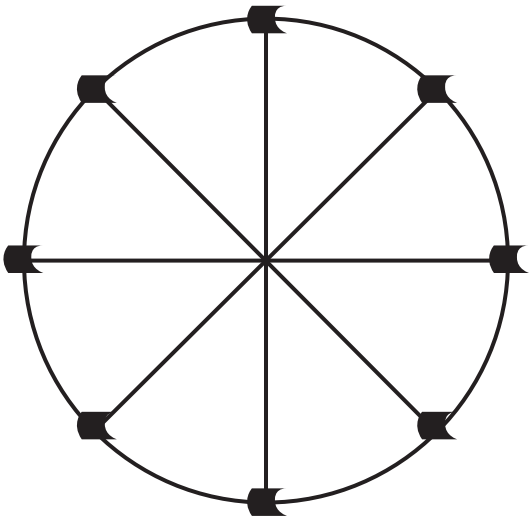
6 A shape with four semicircular edges is shown.



Calculate the perimeter of the shape. [4 marks]

Answer _____ cm

7 The diagram shows a big wheel at a fairground. The radius of the wheel is 26 m.

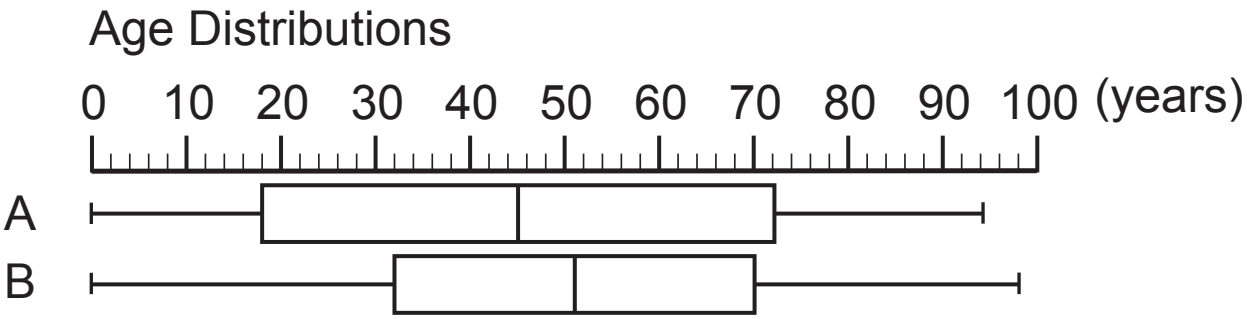


When the wheel starts to turn, Jill is in the bottom carriage on the ground.

How high will Jill's carriage be above the ground when the wheel has turned 115°? [4 marks]

Answer _____ m

8 The box plots show the distribution of ages of the people living in two cities, A and B.



(a) In which city is the interquartile range greater? How can you tell this from the diagram? [1 mark]

Answer city _____ because _____

_____

(b) In which city are people generally older? Explain your answer. [1 mark]

Answer city _____ because _____

_____

(c) Complete the sentence [1 mark]

75% of the people in city A are aged over _____

9 The line L has equation $y = -3x - 6$

This line crosses the y axis at the point A and the x axis at the point B.

(a) Write down the co-ordinates of A. [1 mark]

Answer (_____ , _____)

(b) Find the equation of the line perpendicular to L which passes through the point B. [4 marks]

Answer _____

10 The temperature in a desert fell to 10ºC during a twelve hour period.

This represented an 80**%** decrease.

Calculate the temperature at the beginning of the twelve hour period. [3 marks]

Answer _____ ºC

11 A scientist collected the following data from an experiment.

d	4	6
W	9	4

The scientist was unsure as to the correct formula linking the variables d and W.

He tried these three possible formulae:

A $W = kd^2$

B $W = \frac{k}{d^2}$

C $W = \frac{k}{d}$

(a) Explain clearly why formula A could not be correct.
[1 mark]

(b) Show clearly which is the correct formula and find the value of k for that formula. [3 marks]

Formula _____ and k = _____

(c) Hence find the value of

(i) W when d = 12 [1 mark]

Answer _____

(ii) d when W = 0.04 [1 mark]

Answer _____

12 Solve $5t^2 - 8t - 11 = 0$ [3 marks]

No marks will be awarded for using trial and improvement.

Give your answers correct to two decimal places.

Answer _____

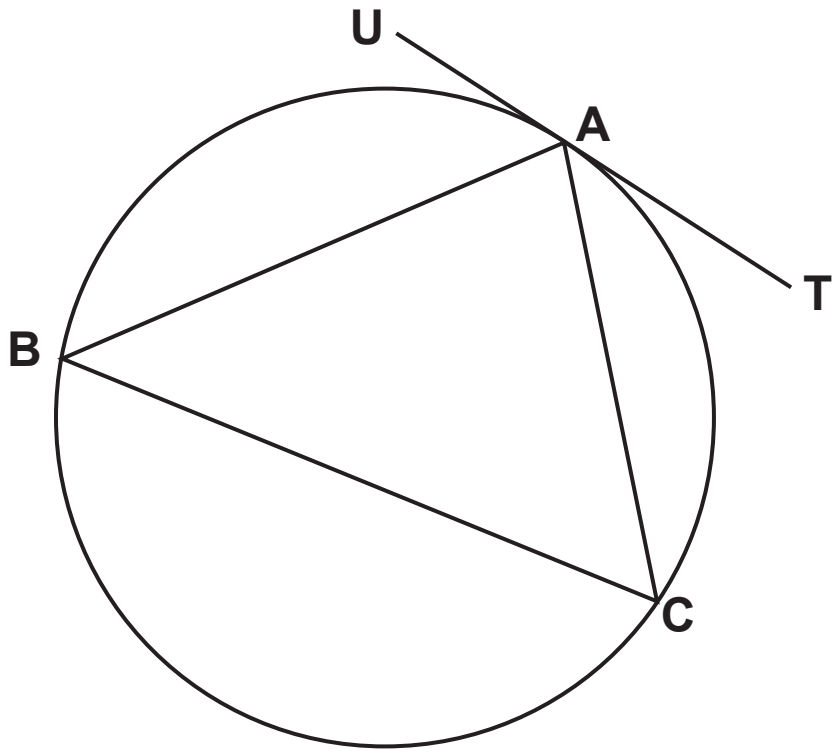
13 **Without using a calculator** evaluate $225^{-\frac{1}{2}} \times (2\frac{1}{3})^{-3}$
[2 marks]

Answer _____

Quality of written communication will be assessed in this question.

14 Use the circle given to prove the Alternate Segment Theorem. [4 marks]

Each step of the proof must have a correct geometrical reason to explain it.



15 The table shows information about 250 workers in a factory.

Work Area	Number of Women	Number of Men
Dispatch	4	28
Office	26	14
Design	15	12
Canteen	34	20
Production	29	68

The manager decides to carry out a survey about the workers' views on a new logo for the company.

He decides to take a sample of 60 workers.

(a) One option is to go to the canteen at lunchtime and select 60 workers.

Give two reasons why this may not produce a representative sample. [2 marks]

1. _____

_____

2. _____

_____

The manager decides to use a stratified sample of 60 workers instead.

(b) Work out the number of women that should be in the sample. [2 marks]

Answer _____

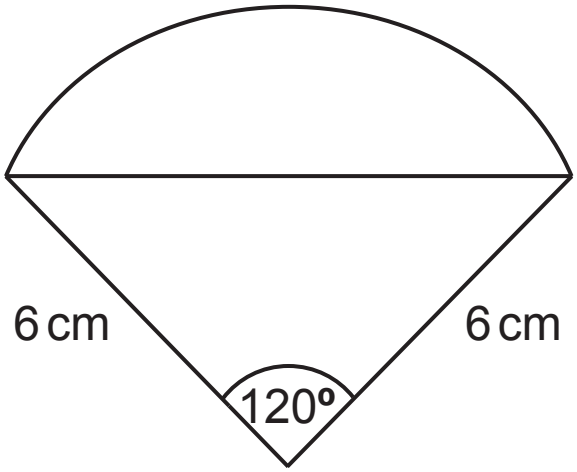
(c) How many office workers should be in the sample? [2 marks]

Answer _____

(d) Suggest one way the manager could achieve an even more reliable sample. [1 mark]

Answer _____

16 The diagram shown is a sector of a circle of radius 6 cm with an angle of 120°



Calculate the area of the segment. [4 marks]

Answer _____ cm^2

17 (a) Factorise fully $30ax^2 + 5axy - 60ay^2$ [3 marks]

Answer _____

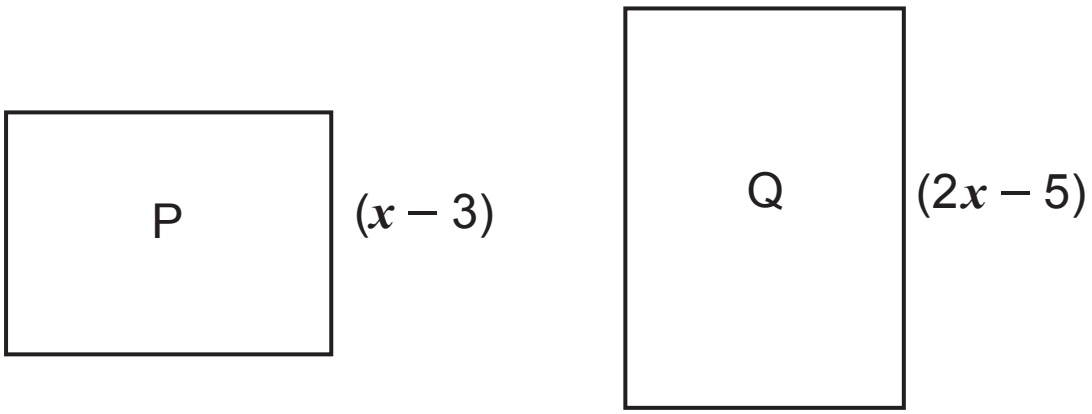
(b) Using your answer from above and given that $a \neq 0$ solve

$30ax^2 + 5axy - 60ay^2 = 0$

to find two answers for x in terms of y. [2 marks]

Answers $x =$ _____ , $x =$ _____

18 Two rectangles P and Q are shown.

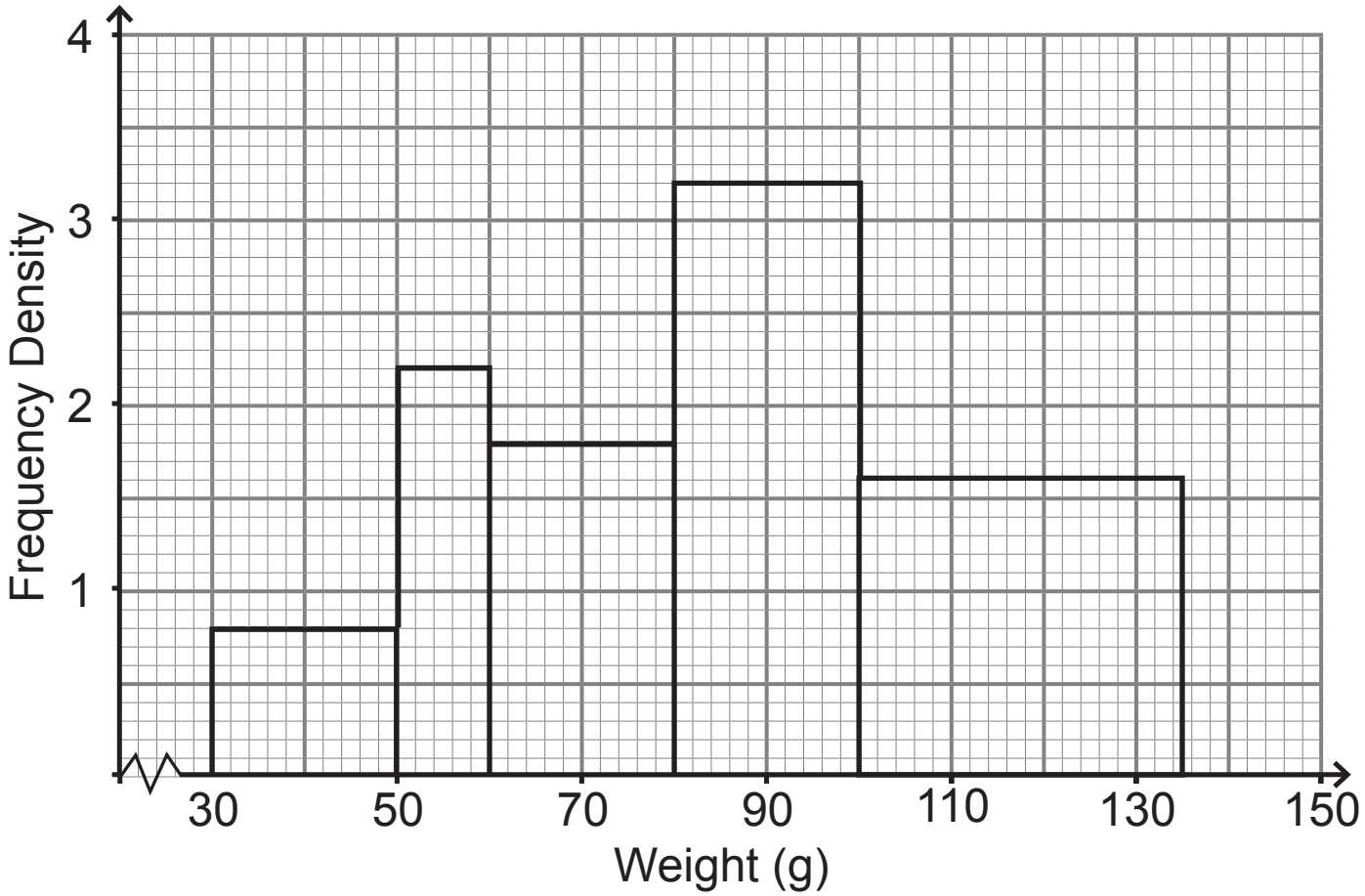


The **width** of rectangle P is $(x - 3)$ cm and the **width** of Q is $(2x - 5)$ cm.
The area of rectangle P is 2 cm^2 and the area of rectangle Q is 3 cm^2.
The sum of the lengths of the two rectangles is 3 cm.

By forming and solving an equation find the lengths of both rectangles. [7 marks]

Length of rectangle P _____ cm
Length of rectangle Q _____ cm

19 The histogram shows the weights (g) of letters passing through a post office sorting machine in a day.



(a) Use the graph to complete the frequency table for this data. [2 marks]

Weight W (g)	
$30 \leqslant W < 50$	

(b) Calculate an estimate of the median weight of the letters. [2 marks]

Answer _____ g

(c) Calculate an estimate for the weight of the lightest of the heaviest 50 letters. [3 marks]

Answer _____ g

20 Solve $y = 1 - x$ and $x^2 + y^2 + x = 16$ [5 marks]

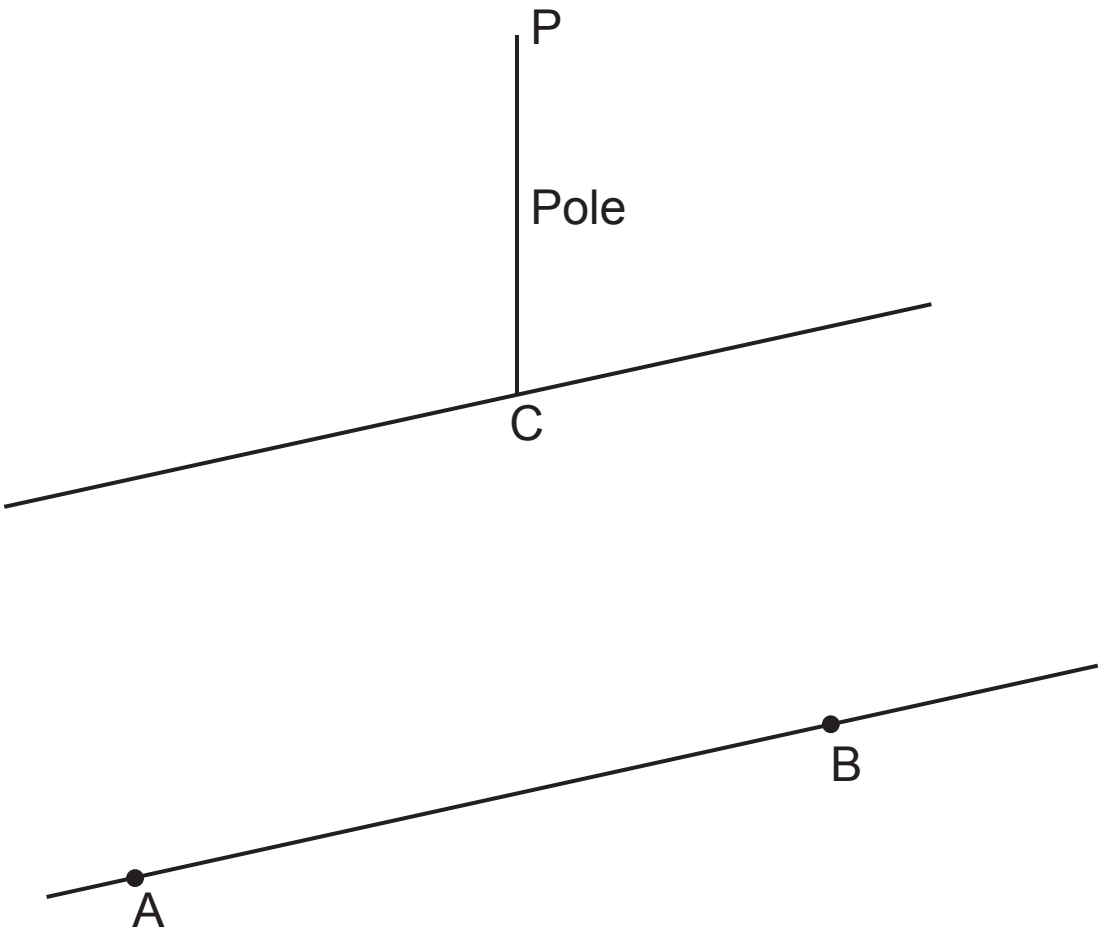
Answer _____

21 The diagram shows a canal with parallel banks.

On the edge of one side of the canal is a vertical pole 8 m high.

A and B are two points on the opposite bank and they are 14 m apart.

The angle of elevation of the top of the pole from A is 32° and from B the angle of elevation is 44°



(a) Show clearly the angles of elevation from A and B.
[1 mark]

(b) Find the width of the canal. [8 marks]

Answer _____ m

THIS IS THE END OF THE QUESTION PAPER

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For Examiner's use only	
Question Number	**Marks**
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