Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
January 2017

Mathematics

Unit T4
(With calculator)
Higher Tier

[GMT41]

MONDAY 9 JANUARY, 9.15am–11.15am

ML

TIME

2 hours, plus your additional time allowance.

INSTRUCTIONS TO CANDIDATES

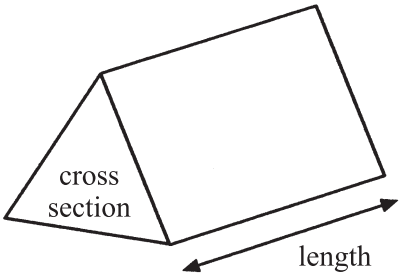
Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page, on blank pages or tracing paper.
Complete in black ink only.
Answer **all twenty-one** questions.
All working 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

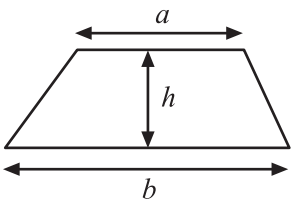
The total mark for this paper is 100.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Functional Elements will be assessed in this paper.
Quality of written communication will be assessed in Question **14**.
You should have a calculator, ruler, compasses and a protractor.
The Formula Sheet is on page 2.

Formula Sheet

Volume of prism = area of cross section × length

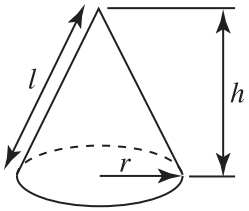


Area of trapezium $= \frac{1}{2}(a+b)h$



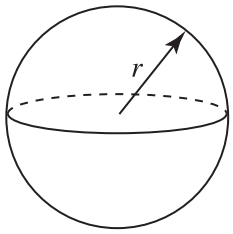
Volume of cone $= \frac{1}{3}\pi r^2 h$

Curved surface area of cone $= \pi r l$

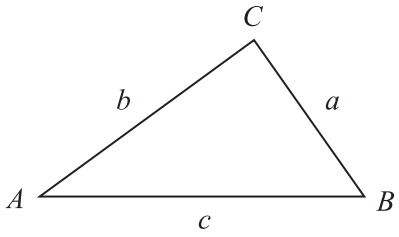


Volume of sphere $= \frac{4}{3}\pi r^3$

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



In any triangle *ABC*



Quadratic Equation

The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$, are given by

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

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 $= \frac{1}{2}ab\sin C$

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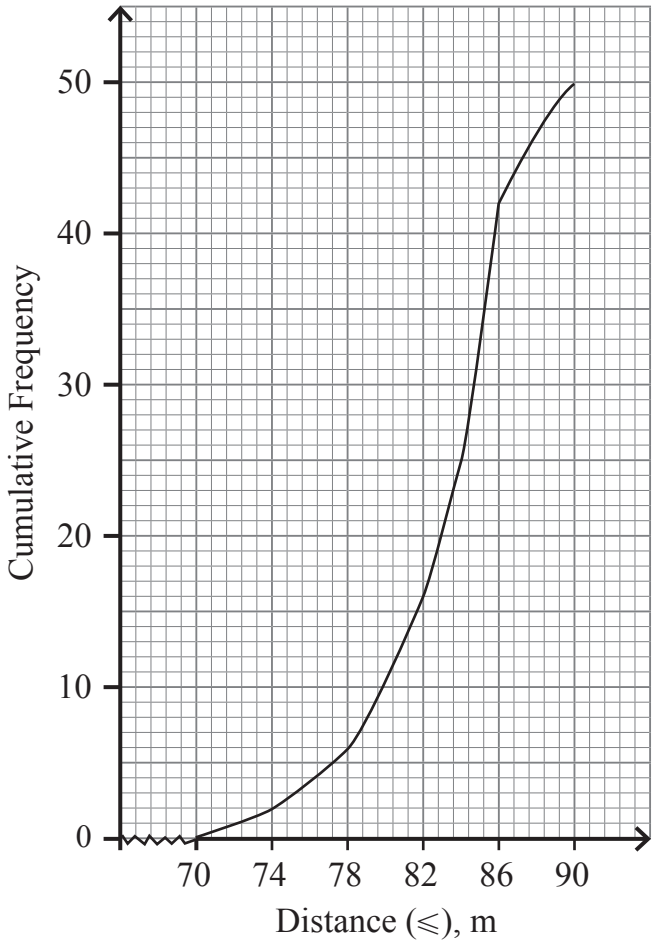
(Questions start overleaf)

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.

Answer _____ m [1]

(b) Use the graph to estimate the interquartile range.

Answer _____ m [2]

(c) Use the graph to complete the two tables below.

(i)

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

[1]

(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]

[Turn over

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

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

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

$$\frac{8^4}{16^2} = 16$$

[3]

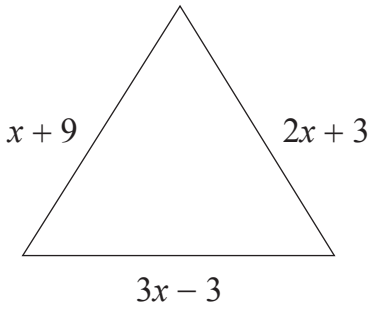
3 **(a)** Expand and simplify $3(4x + 3)(2x - 1)$

Answer _____ [3]

(b) Factorise $t^2 - 49$

Answer _____ [1]

4



The diagram shows an equilateral triangle.

Form and solve an equation to calculate the **perimeter** of the triangle.

Equation _____ [1]

Answer perimeter = _____ [3]

[Turn over

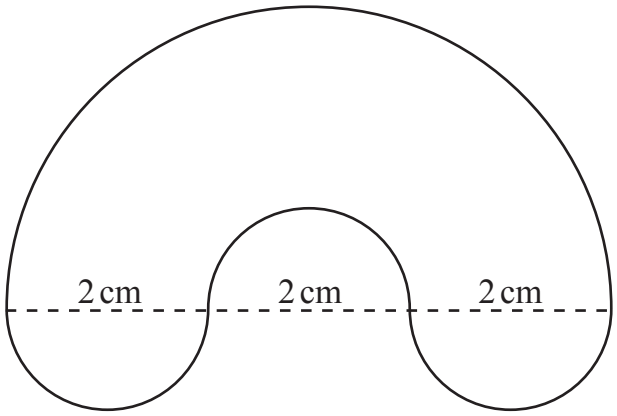
5 Solve the equation $\frac{3(x-2)}{4} - 3 = \frac{x+4}{3}$

Show all your working clearly.

A solution by trial and improvement will not be accepted.

Answer $x =$ _____ [4]

6 A shape with four semicircular edges is shown.

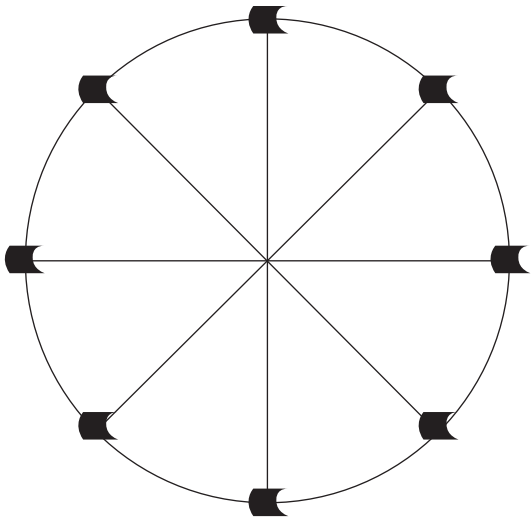


Calculate the perimeter of the shape.

Answer _____ cm [4]

[Turn over

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

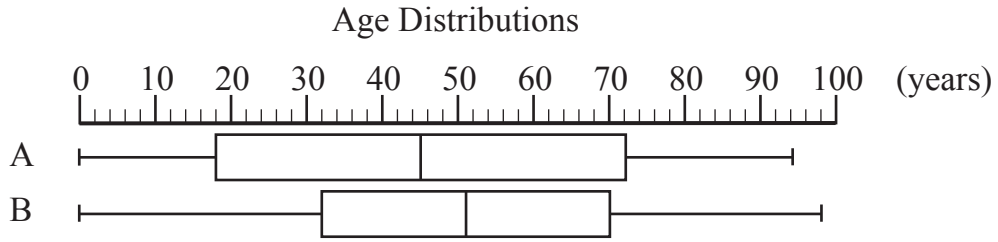


When the wheel starts to turn, Jill is in the bottom carriage on the ground.

How high will Jill's carriage be above the ground when the wheel has turned 115º?

Answer _____ m [4]

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?

Answer city _____ because _____

_____ [1]

(b) In which city are people generally older? Explain your answer.

Answer city _____ because _____

_____ [1]

(c) Complete the sentence

75% of the people in city A are aged over _____ [1]

[Turn 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.

Answer (_____ , _____) [1]

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

Answer _____ [4]

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

This was an 80% decrease.

Calculate the temperature at the beginning of the twelve hour period.

Answer _____ºC [3]

[Turn over

11 A scientist collected the following data from an experiment.

d	4	6
W	9	4

The scientist was not sure of 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]

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

Formula _____ and k = _____ [3]

(c) **(i)** Find the value of W when $d = 12$

Answer _____ [1]

(ii) Find the value of d when W = 0.04

Answer _____ [1]

[Turn over

12 Solve $5t^2 - 8t - 11 = 0$

No marks will be awarded for using trial and improvement.

Give your answers correct to two decimal places.

Answer _____ [3]

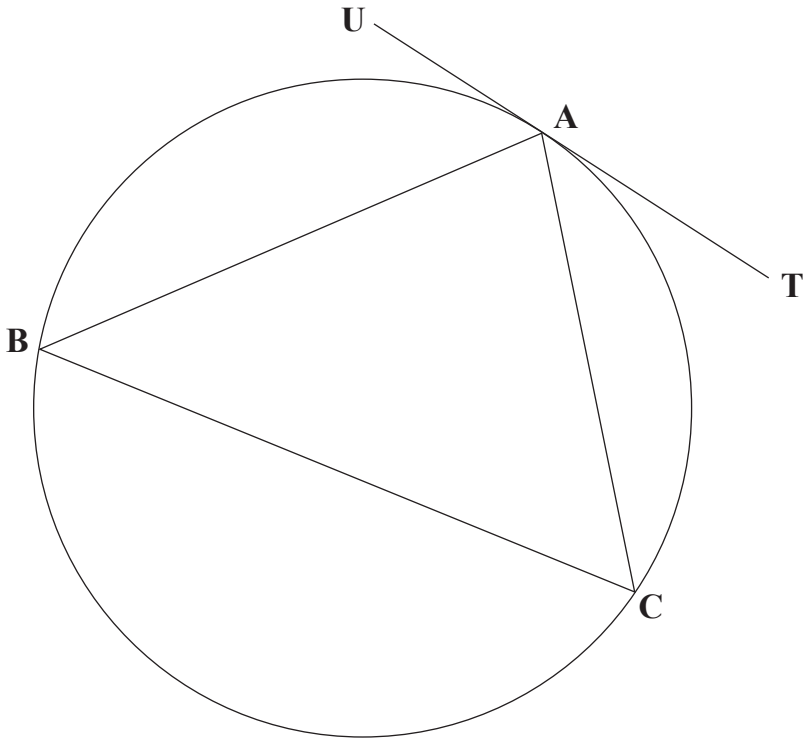
13 **Without using a calculator** evaluate $225^{-\frac{1}{2}} \times (2^{\frac{1}{3}})^{-3}$

Answer _____ [2]

Quality of written communication will be assessed in this question.

14 Use the circle given to prove the Alternate Segment Theorem.

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



[4]

[Turn over

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 do a survey about the workers' opinions 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.

Write down two reasons why this may not produce a representative sample.

1. _____

_____

2. _____

_____ [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.

Answer _____ [2]

(c) How many office workers should be in the sample?

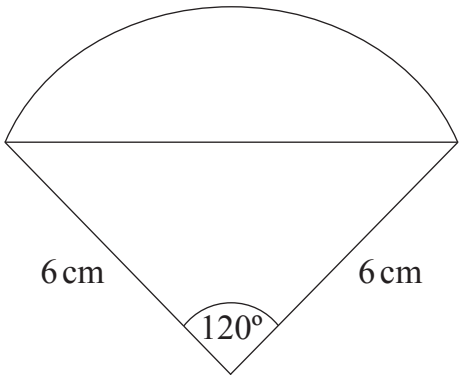
Answer _____ [2]

(d) Suggest one way the manager could achieve a more reliable sample.

Answer _____ [1]

[Turn over

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



Calculate the area of the segment.

Answer _____ cm^2 [4]

17 **(a)** Factorise fully $30ax^2 + 5axy - 60ay^2$

Answer _____ [3]

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

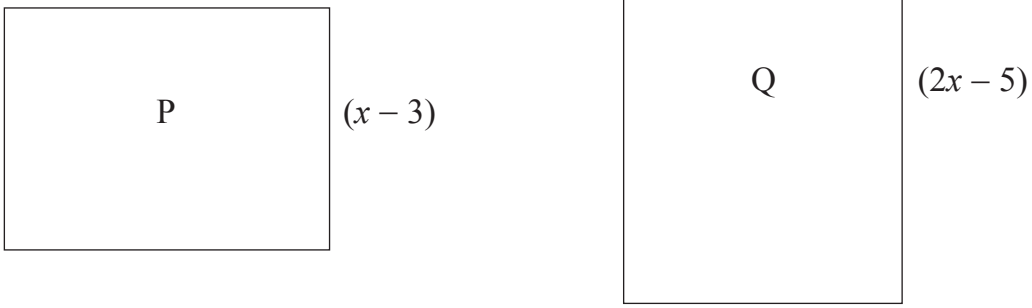
$$30ax^2 + 5axy - 60ay^2 = 0$$

to find two answers for x in terms of y.

Answers $x =$ _____ , $x =$ _____ [2]

[Turn over

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.

Length of rectangle P _____ cm Length of rectangle Q _____ cm [7]

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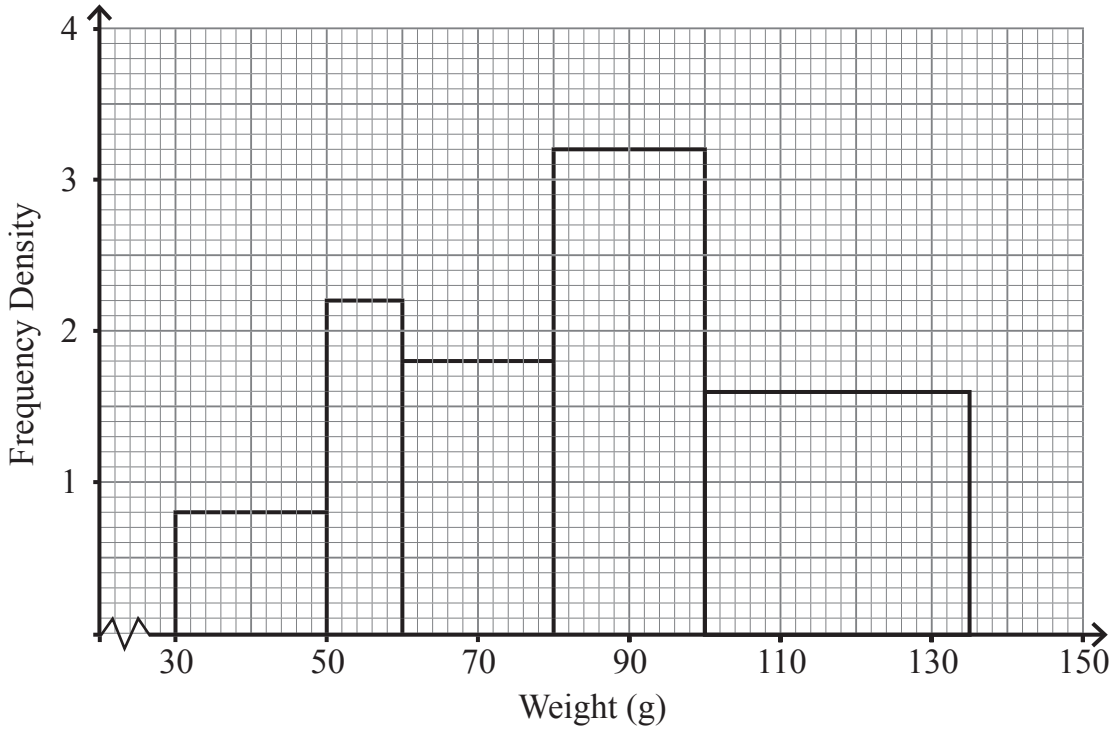
(Questions continue overleaf)

[Turn over

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.

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

[2]

(b) Calculate an estimate of the median weight of the letters.

Answer _____ g [2]

(c) Calculate an estimate for the weight of the lightest of the heaviest 50 letters.

Answer _____ g [3]

20 Solve $y = 1 - x$ and $x^2 + y^2 + x = 16$

Answer _____ [5]

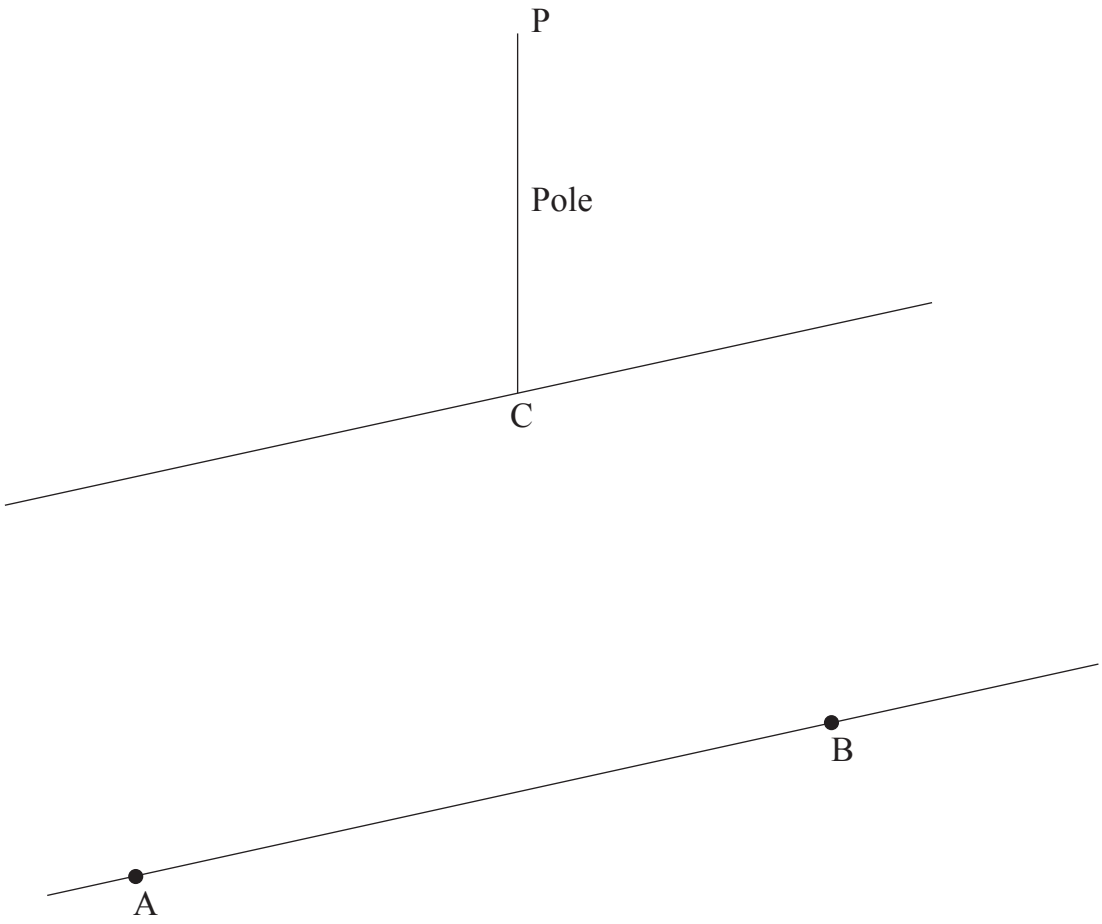
[Turn over

21 The diagram shows a canal with parallel edges.

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 edge 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]

(b) Find the width of the canal.

Answer _____ m [8]

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