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Rewarding Learning

Centre Number

71

Candidate Number

General Certificate of Secondary Education
January 2014

Mathematics

Unit T4

(With calculator)
Higher Tier

MV18

[GMT41]

FRIDAY 10 JANUARY, 9.15 am–11.15 am

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 blue or black ink only.
Answer **all twenty** questions.
Any working should be clearly shown in the spaces provided since marks may be awarded for partially correct solutions.
You **may** use a calculator for this paper.

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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 **questions 3(b) and 10**.
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)

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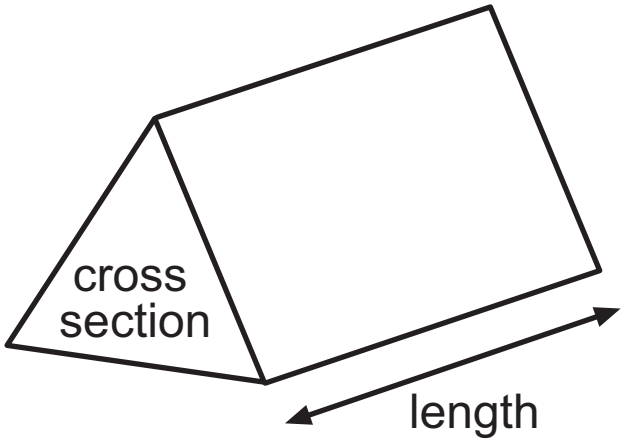
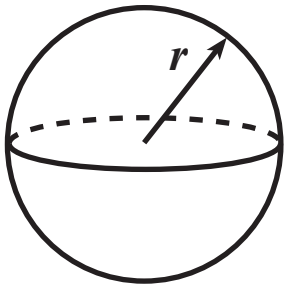
Formula Sheet

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

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

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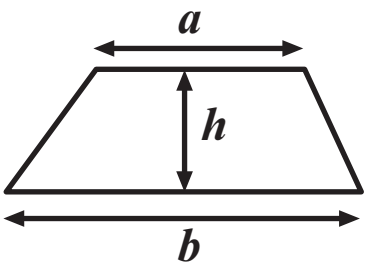
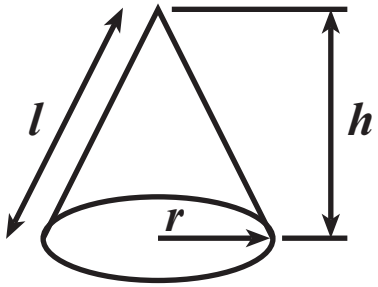
Area of trapezium $= \frac{1}{2}(a + b)h$

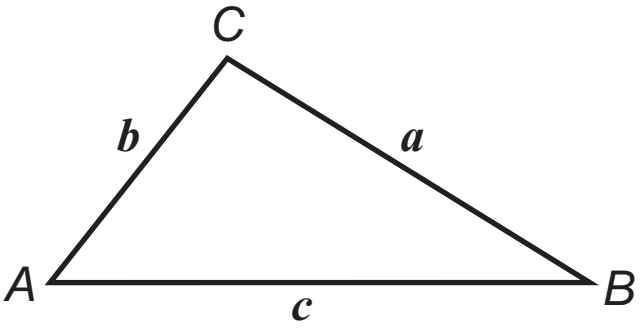


Volume of cone $= \frac{1}{3}\pi r^2 h$

Curved surface area of cone $= \pi rl$



In any triangle *ABC*



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

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

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

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1 On every swing, a pendulum reaches 60% of the previous distance.

The pendulum swings 1.8 metres on its first swing.

After how many swings will the distance first fall below 20 cm? [2 marks]

Answer _____ swings

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2 During a very cold winter a glacier increased its volume by 32%.

At the end of the winter its volume was found to be 6864 km^3.

What was its original volume at the start of that winter?
[3 marks]

Answer _____ km^3

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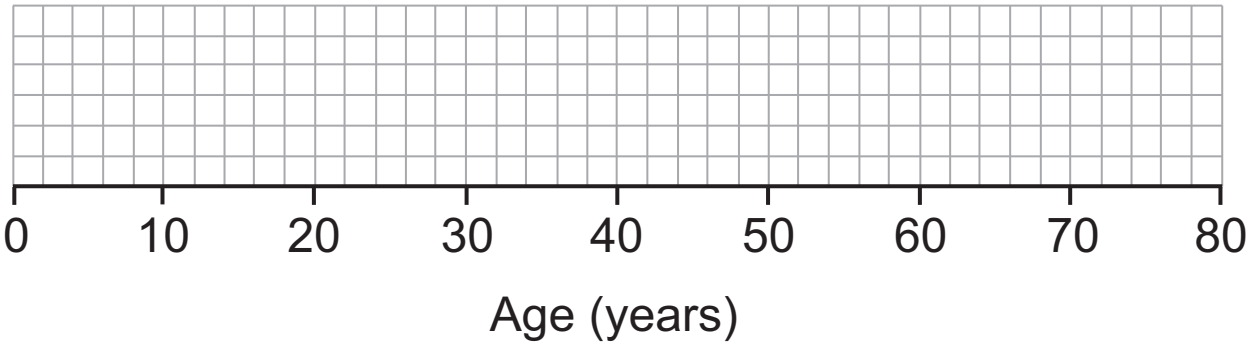
Quality of written communication will be assessed in part (b) of this question.

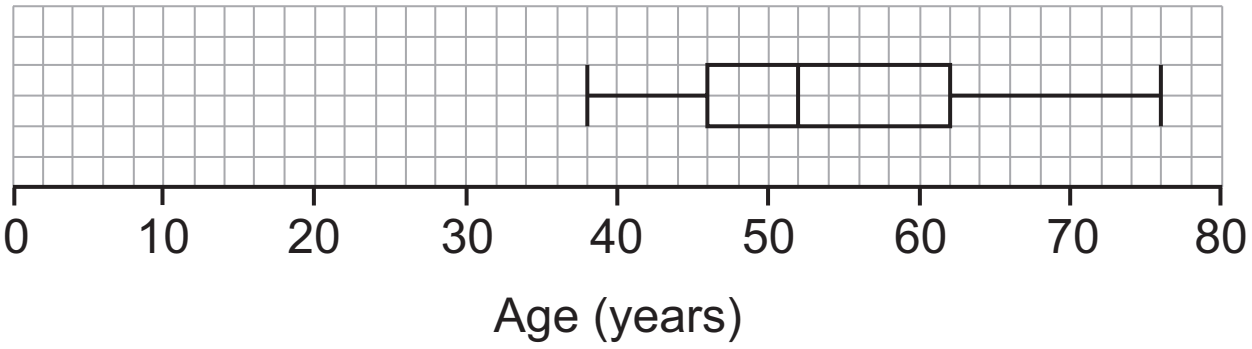
3 The information given below relates to the ages (in years) of members of a badminton club.

Lower Quartile = 28
Median = 32
Upper Quartile = 54
Youngest = 12
Range = 58

(a) Draw a box plot to show this information. [3 marks]



(b) The box plot below shows the age distribution of members of a bowls club.



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Compare the age distributions of the members of the badminton club and the bowls club. [2 marks]

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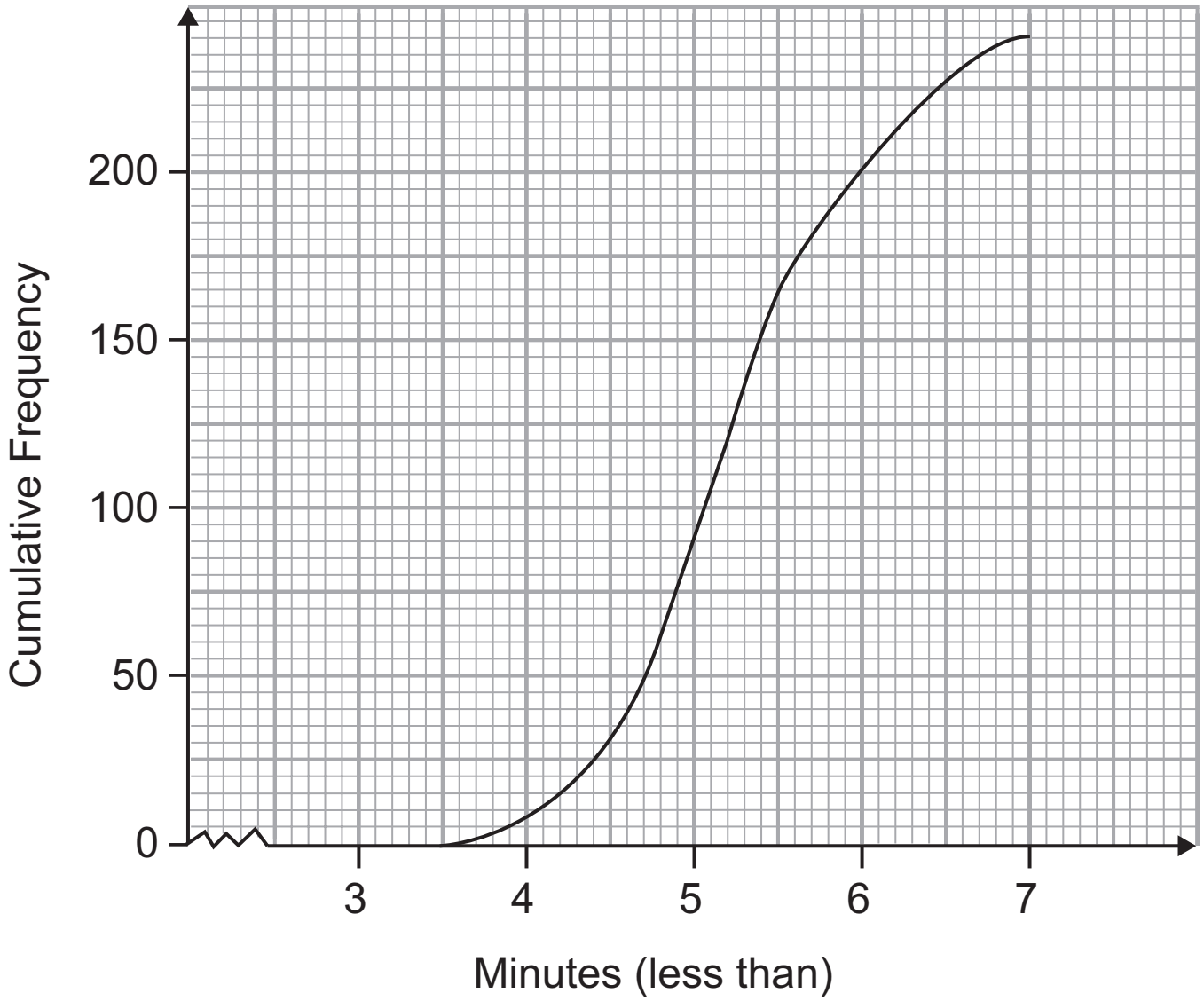
4 The cumulative frequency curve represents the times taken to run 1500 m by each of the members of a running club.



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

Answer _____ minutes

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(b) Any member taking more than $5\frac{1}{2}$ minutes has to do extra training.
Use the graph to estimate the percentage of runners who have to undertake extra training. [2 marks]

Answer _____ **%**

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5 PQRS represents a rectangular gate.
PS = 200 cm and SR = 300 cm.

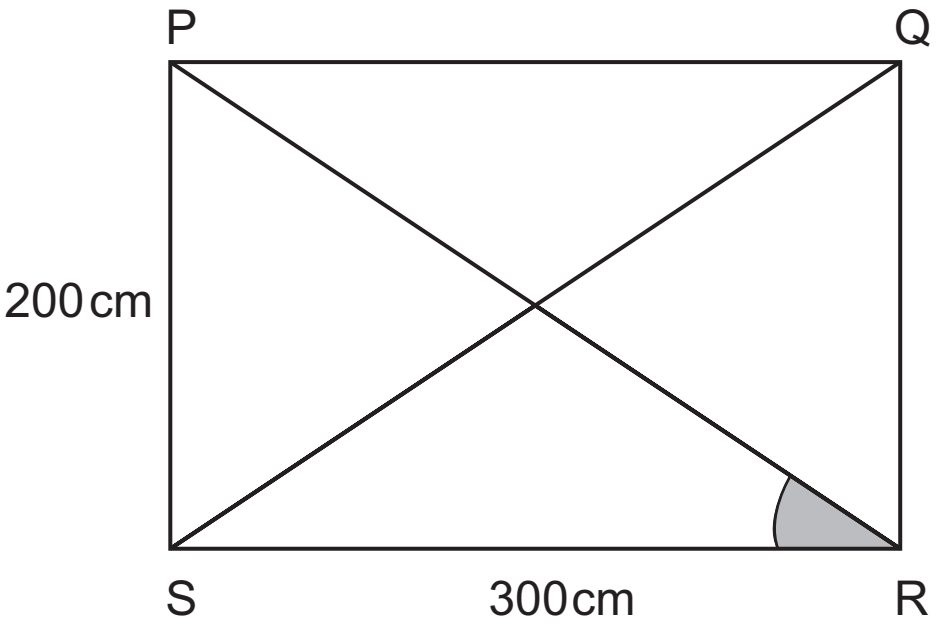

diagram not drawn accurately

(a) Calculate the size of angle PRS. [3 marks]

Answer _____ °

(b) The measurements of the gate are all to the nearest centimetre. What is the smallest possible perimeter of the gate? [2 marks]

Answer _____ cm

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(Questions continue overleaf)

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6 **(a)** R, S, T and U are points on the circumference of a circle, centre O.
The angle RUS is 46° and the angle URT is 36°

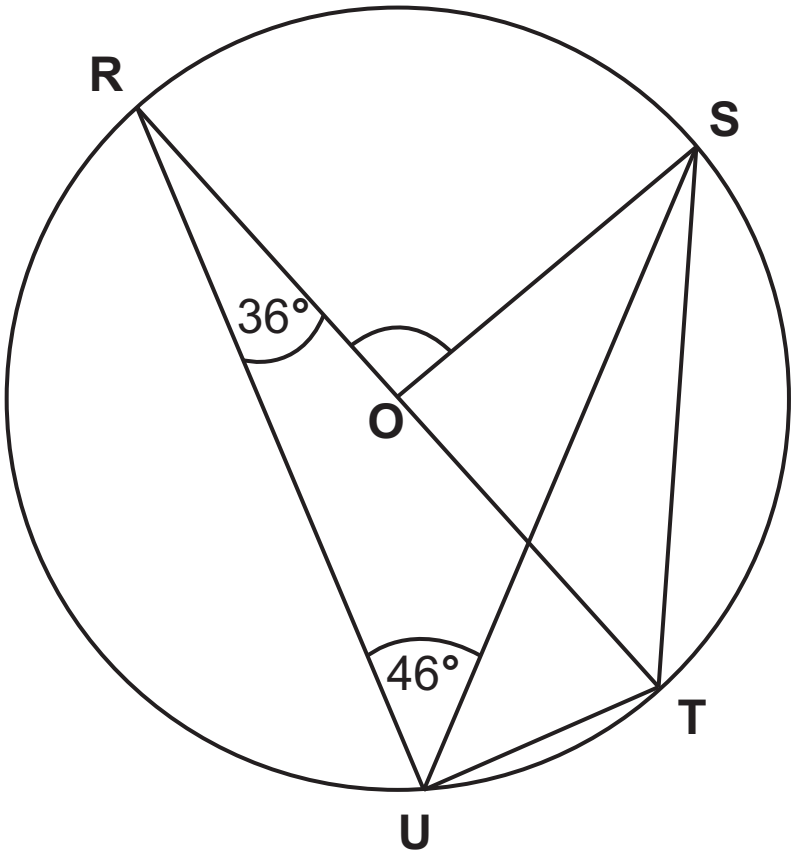

Diagram not drawn accurately

Calculate

(i) the angle RTS, [1 mark]

Answer _____ °

(ii) the angle ROS, [1 mark]

Answer _____ °

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(iii) the angle SUT. [1 mark]

Answer _____ °

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(b) D, E, F and G are points on the circumference of the circle below.
The angle FDG = 62° and the angle DFG = 31°
HG is a tangent to the circle.

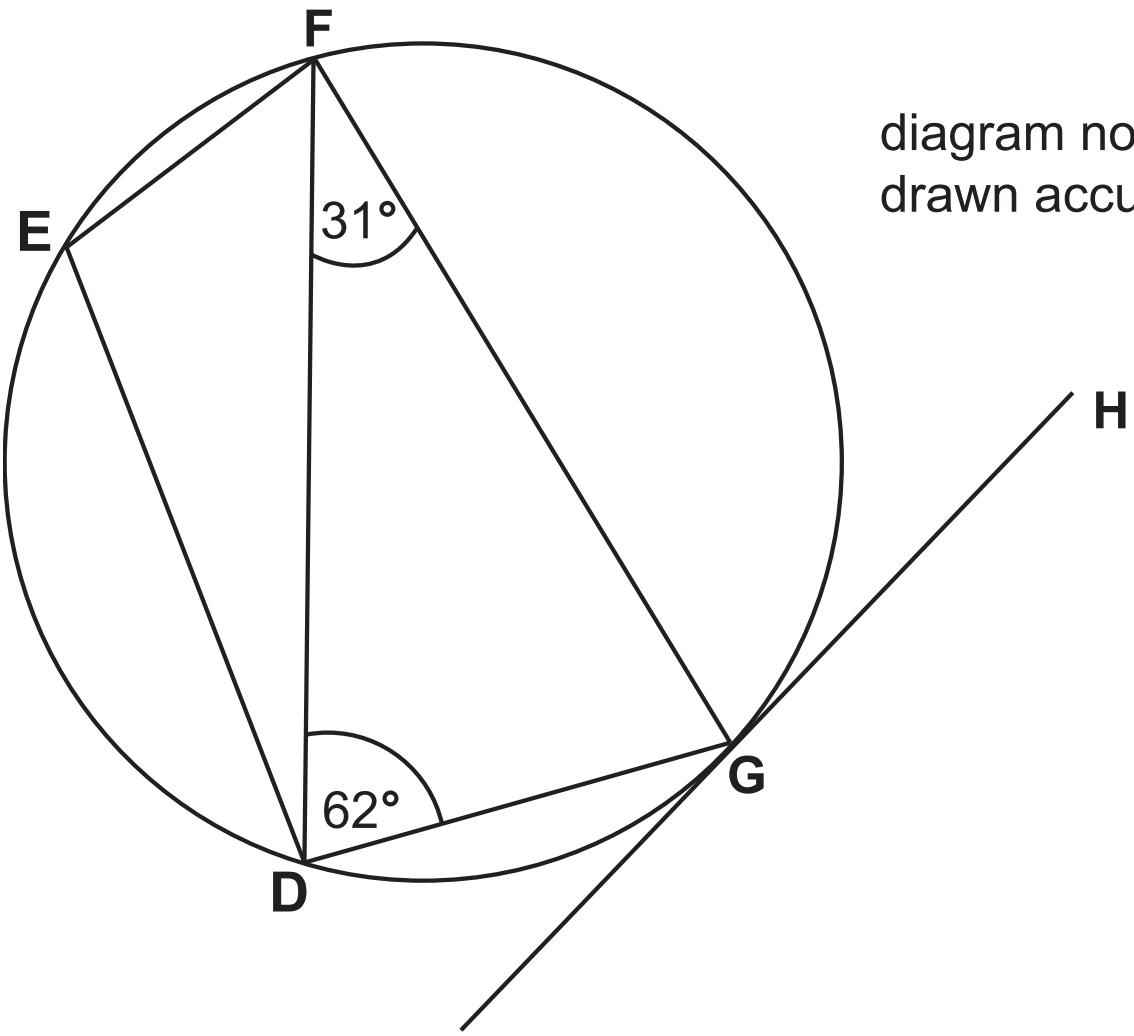

diagram not drawn accurately

(i) Write down the size of angle FGH. [1 mark]

Answer _____ °

(ii) Calculate the size of angle DEF. [2 marks]

Answer _____ °

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7 The straight line, L, passes through the points (0, **–**2) and (3, 2).

(a) Work out the gradient of L. [2 marks]

Answer _____

(b) Show that the equation of L is $4x - 3y = 6$ [2 marks]

(c) Write down the equation of another line that is parallel to L. [1 mark]

Answer _____

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(d) Write down the gradient of a line perpendicular to L.
[1 mark]

Answer _____

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8 **(a)** Solve the simultaneous equations. [3 marks]

$3x + 2y = 10$
$2x - 6y = 3$

Show your working.
A solution by trial and improvement will not be accepted.

Answer $x =$ _____ , $y =$ _____

(b) Hence write down the coordinates of the point of intersection of the two lines whose equations are

$3x + 2y = 10$ and $2x - 6y = 3$ [1 mark]

Answer (_____ , _____)

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9 The breadth of a cuboid is 1 cm less than the length y cm.
The height is 6 cm.
The volume of the cuboid is 72 cm^3.

(a) Show that $y^2 - y - 12 = 0$ [3 marks]

(b) Solve the equation $y^2 - y - 12 = 0$ by factorising.
Explain why only one answer makes sense in the question. [3 marks]

Answer _____

_____

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Quality of written communication will be assessed in this question.

10 (a) The test results for a class are recorded as

26 26 29 32 37 38 40 41 99

Why would the mean **not** be the **most suitable** average to use when commenting on these results? [1 mark]

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(b) In another test the results are recorded as

18 18 18 18 19 27 29 36 39 47 59 62

Which average would be **least suitable** to use when commenting on these results? Give a reason for your answer. [1 mark]

_____ because _____

_____

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11 A park keeper wishes to estimate the number of frogs in a large pond.
He catches 180 frogs, tags them and returns them to the pond.
Later he catches 80 frogs and records that 24 of them are tagged.
Estimate the number of frogs in the pond. [2 marks]

Answer _____

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12 The electrical resistance, R ohms, of a wire varies inversely as the square of its diameter, d mm.
A wire, 6 mm in diameter, made from a certain alloy has a resistance of 36 ohms.

(a) Express R in terms of d. [3 marks]

Answer $R =$ _____

(b) (i) Work out the electrical resistance of a wire made from the same alloy whose diameter is 9 mm. [1 mark]

Answer _____ ohms

(ii) Another wire made from the same alloy has an electrical resistance of 20 ohms.
Work out the diameter of this wire. [2 marks]

Answer _____ mm

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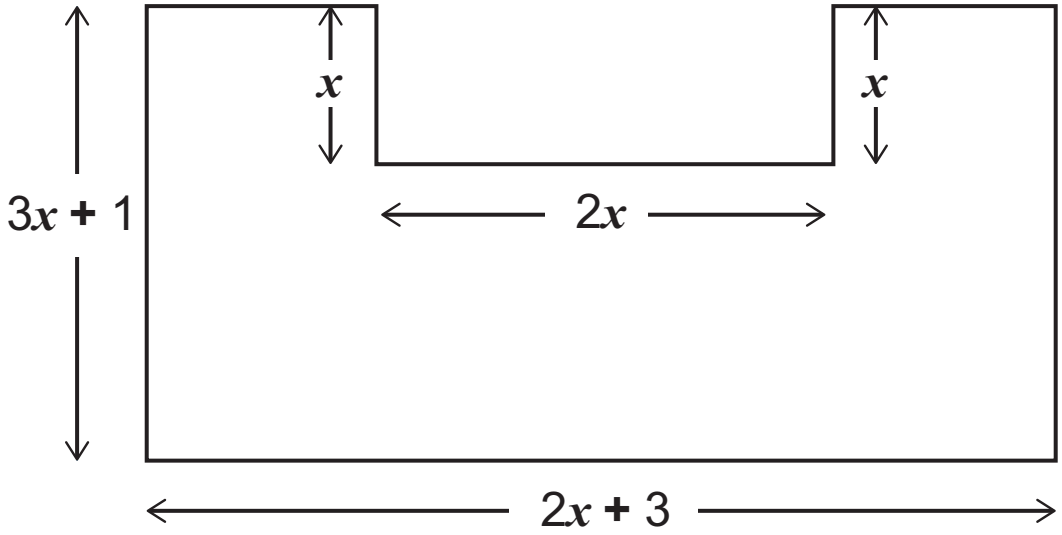
13 A rectangular piece of card has a length of $(2x + 3)$ cm and a width of $(3x + 1)$ cm.
A rectangle of length $2x$ cm and width x cm is cut from it as shown in the diagram.
The remaining piece of card, shown below in the diagram, has an area of 25 cm^2.



(a) Show that $4x^2 + 11x - 22 = 0$ [3 marks]

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(b) Solve the equation $4x^2 + 11x - 22 = 0$ to find the value of x.

Give your answer to 3 significant figures. [3 marks]

Answer $x =$ _____

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14 Without using a calculator and showing **every** step clearly in your working, find the value of [4 marks]

$$\left(2\frac{1}{4}\right)^{-1.5}$$

Answer _____

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15 Town B is 73 km from Town A on a bearing of 069°

Town C is 64 km from A on a bearing of 112°

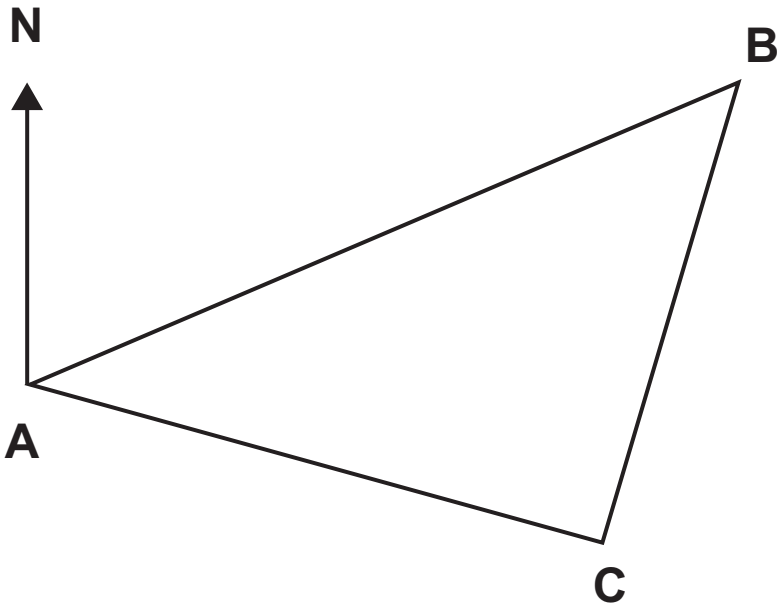

diagram not drawn accurately

Calculate

(a) the distance between B and C, [3 marks]

Answer _____ km

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(b) the area of triangle ABC, [2 marks]

Answer _____ km^2

(c) the bearing of B from C. [4 marks]

Answer _____ °

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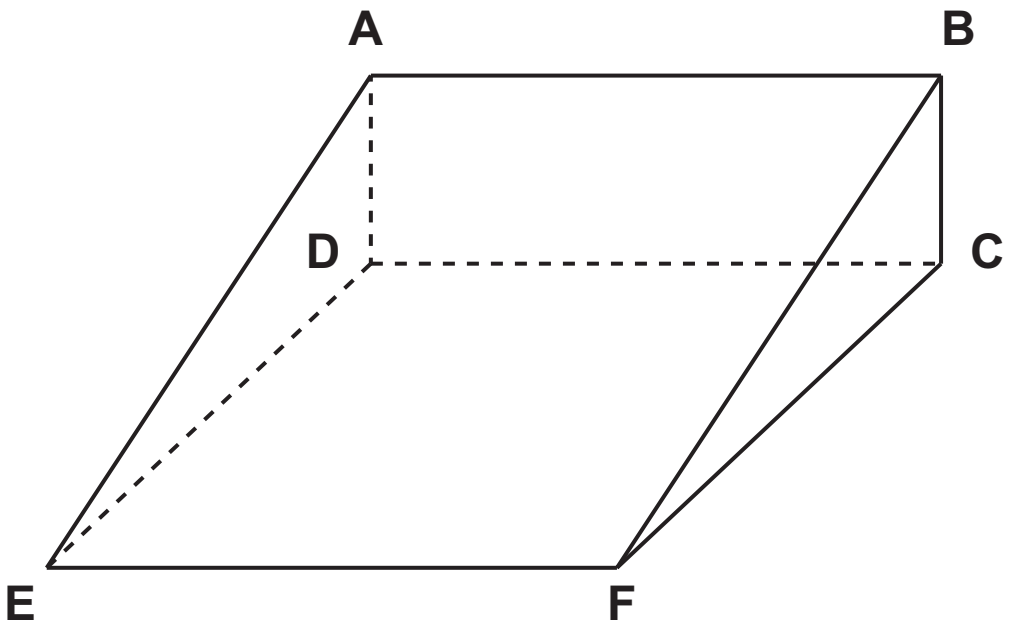
16 ABCDEF is a ramp which is in the shape of a triangular prism.
AB = 120 cm, FC = 90 cm and BC = 30 cm.
Angle FCB = 90°
Calculate the angle between EB and the base DCFE.
[3 marks]



Answer _____ °

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(Questions continue overleaf)

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17 (a) The weights of packages passing through a Post Office in one day are recorded below.

Weight (g)	Frequency
$0 < w \leqslant 100$	80
$100 < w \leqslant 150$	200
$150 < w \leqslant 250$	160
$250 < w \leqslant 400$	540
$400 < w \leqslant 550$	360
$550 < w \leqslant 600$	130

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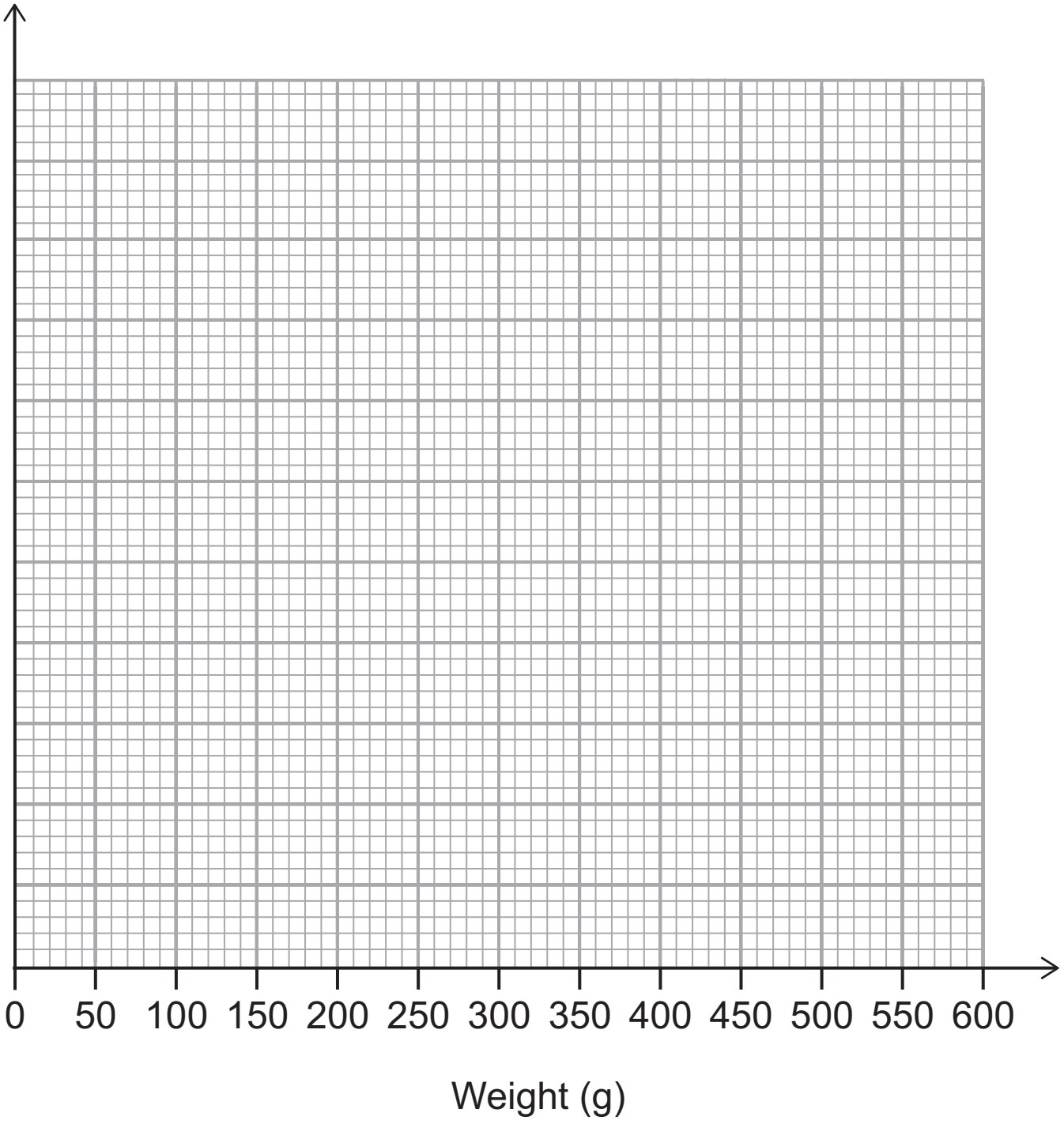
On the axes below draw a clearly labelled histogram to illustrate this information. [3 marks]



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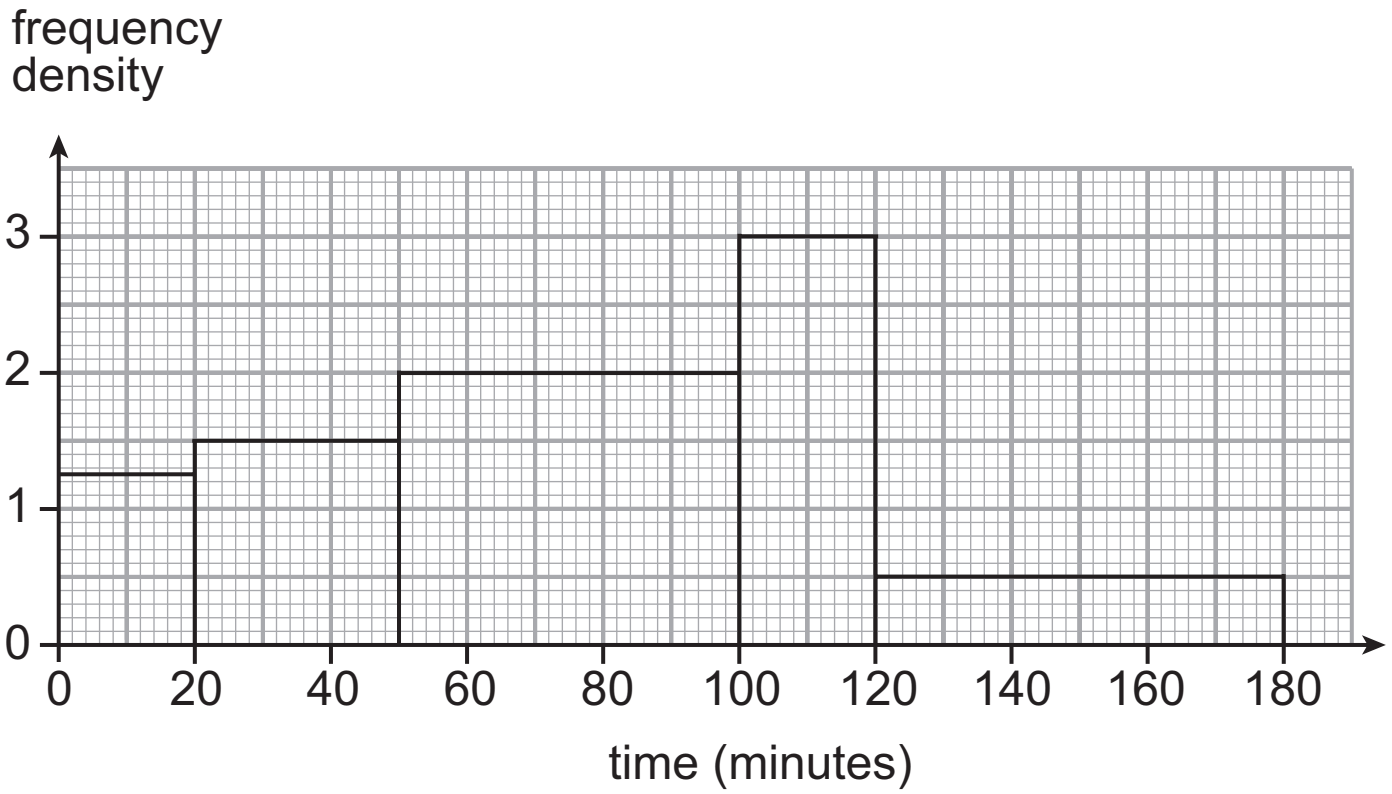
(b) The histogram illustrates how much time cars spent in a car park.



(i) Calculate an estimate for the mean time. [4 marks]

Answer _____ minutes

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(ii) Half the cars using the car park were there for more than M minutes.
Calculate an estimate for the value of M. [3 marks]

Answer _____ minutes

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18 Solve the simultaneous equations [7 marks]

$y - 2x = 6$
$x^2 + y^2 = 20$

Answer _____

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19 Simplify fully [5 marks]

$$\frac{3}{x+3} + \frac{2x+21}{x^2+x-6}$$

Answer _____

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20 Given that

$$\frac{16^{a}}{9^{b}} = 54^{\frac{1}{2}}$$

find the values of a and b. [5 marks]

Answer a = _____ , b = _____

THIS IS THE END OF THE QUESTION PAPER

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Question Number	Marks
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Total Marks	

Examiner Number

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