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Rewarding Learning

Centre Number

71

Candidate Number

General Certificate of Secondary Education
January 2014

Mathematics

Unit T3

(With calculator)
Higher Tier

[GMT31]

MV18

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-nine** 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 6(b) and 24(b)**.
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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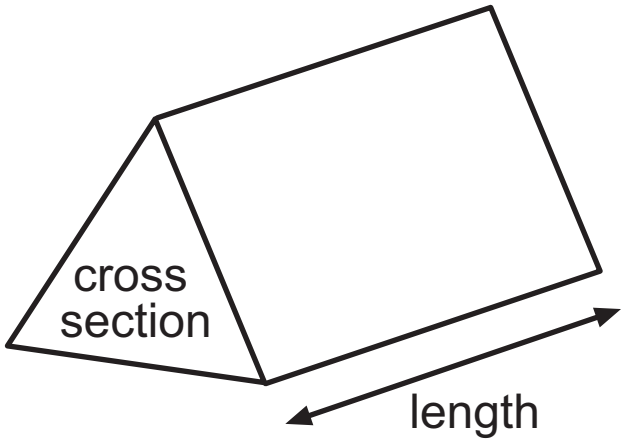
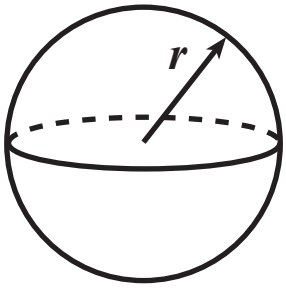
Formula Sheet

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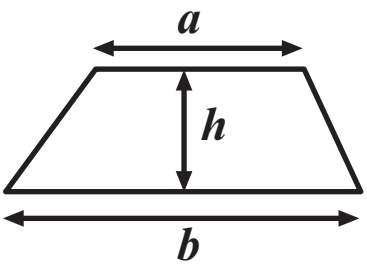
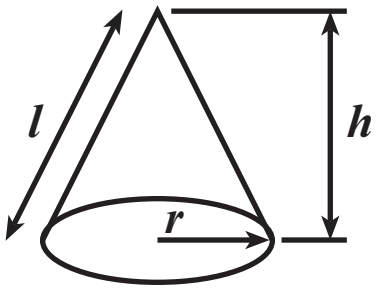
Area of trapezium $= \frac{1}{2}(a + b)h$

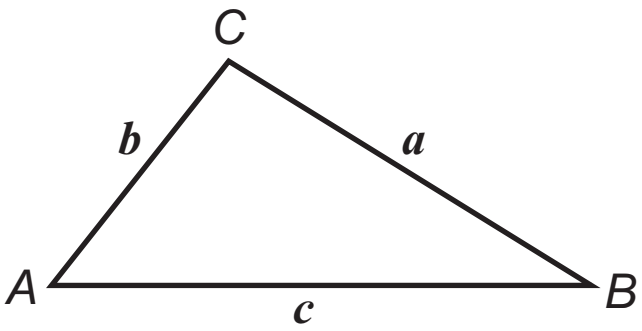


Volume of cone $= \frac{1}{3}\pi r^2 h$

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



In any triangle *ABC*



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

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

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

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1 Without using a calculator, show how to find the answer to $\frac{3}{7} - \frac{1}{5}$ [2 marks]

Answer _____

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2 Hugh is a travelling salesman. He claims 24.6**p** for each km he travels and **£**27.60 for meals on each day he is travelling.

If he travels more than 700 km in any week he adds 12.5**%** to his total claim.

Last week Hugh travelled 915 km in 5 days.

How much did Hugh claim for last week? [5 marks]

Show clearly how you arrived at your answer.

Answer **£** _____

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3 **(a)** Write down two numbers which are square roots of 49
[1 mark]

Answer _____ and _____

(b) Explain the meaning of $0.\dot{1}0\dot{3}$ [1 mark]

Answer _____

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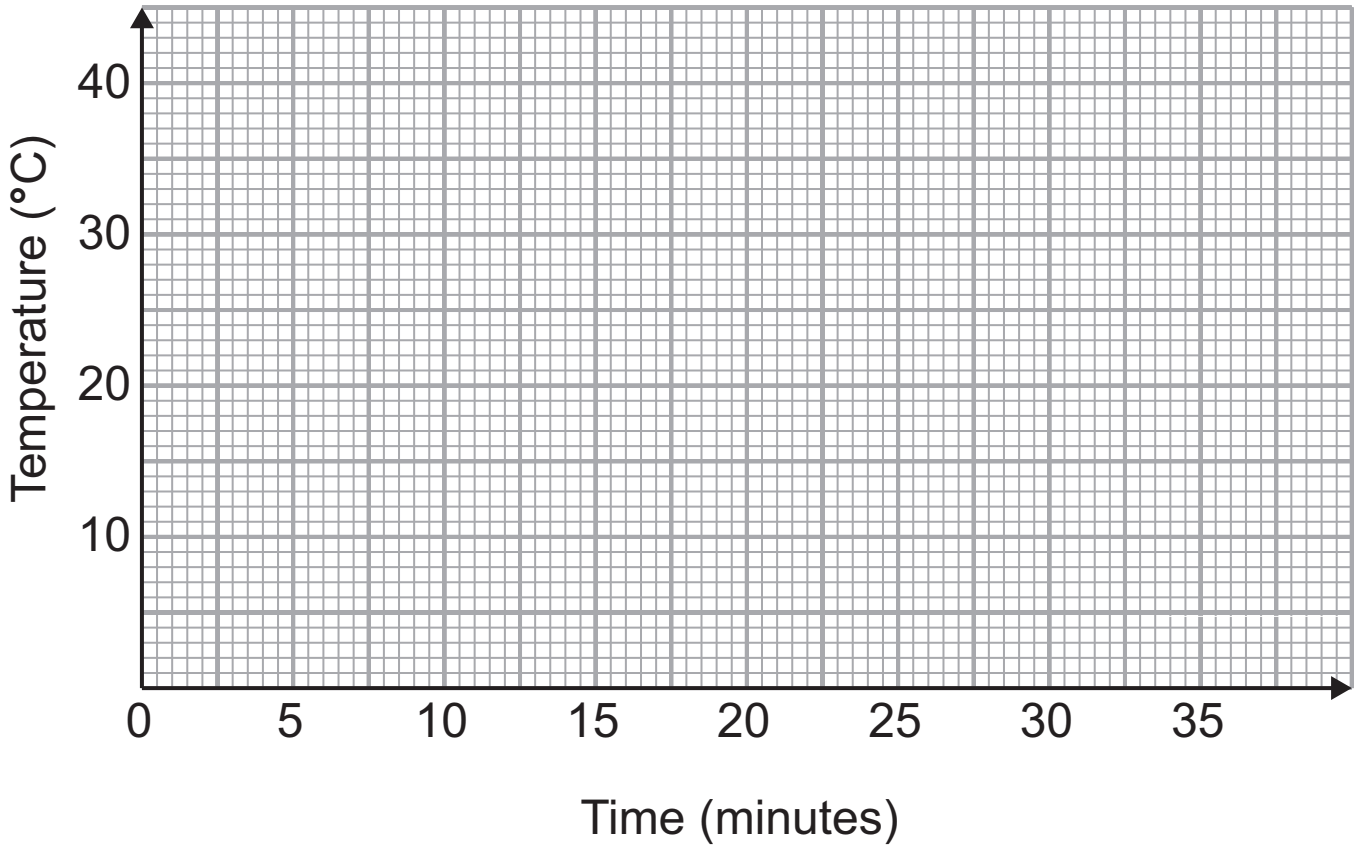
4 The table shows the temperature of some liquids as they cool in a freezer.

Time (minutes)	5	10	15	18	25	30	30
Temperature (°C)	35	31	24	22	12	7	6

(a) Draw a scatter graph for this data. [2 marks]



(b) Draw a line of best fit. [1 mark]

(c) Estimate the time taken for a liquid to reach freezing point (0 °C). [1 mark]

Answer _____ minutes

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5 Twenty two pupils were asked to record the time (in minutes) they spent on their homework last Monday night. Their responses are listed below.

40	55	80	60	50	55	65	40	120	100	90
55	60	110	100	120	75	50	80	85	60	45

Construct a stem and leaf diagram to illustrate this data.
[3 marks]

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

6 **(a)** Calculate the size of the interior angle of a regular pentagon. [2 marks]

Answer _____ °

(b) Three regular pentagons are placed together as shown below.

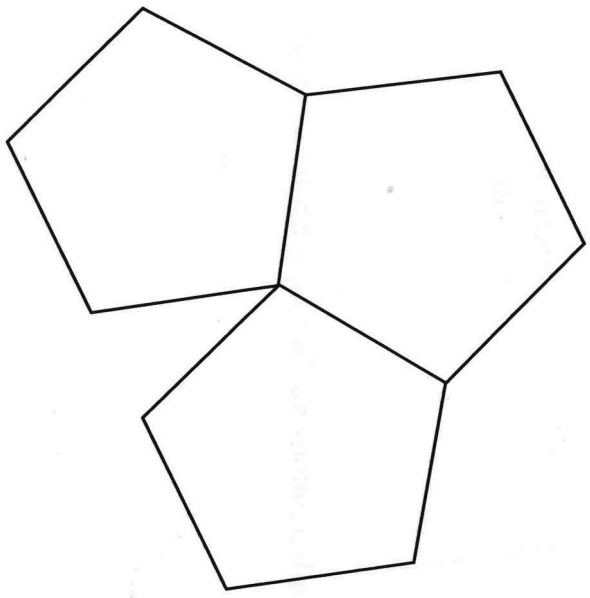

diagram not drawn accurately

Explain why you cannot cover a floor with regular pentagonal tiles. [2 marks]

Answer _____

_____

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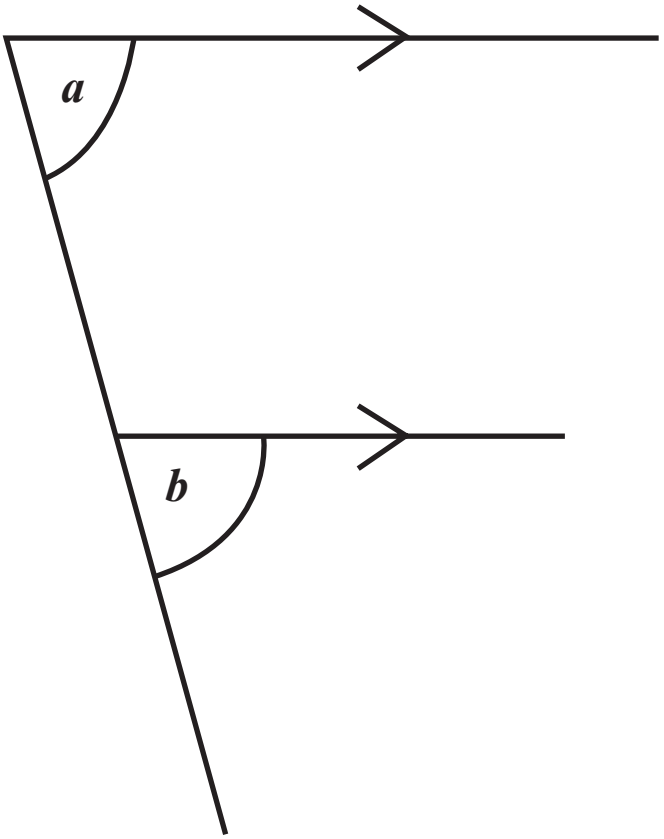
7 **(a)** What mathematical name is given to the pair of acute angles a and b below? [1 mark]



Answer _____

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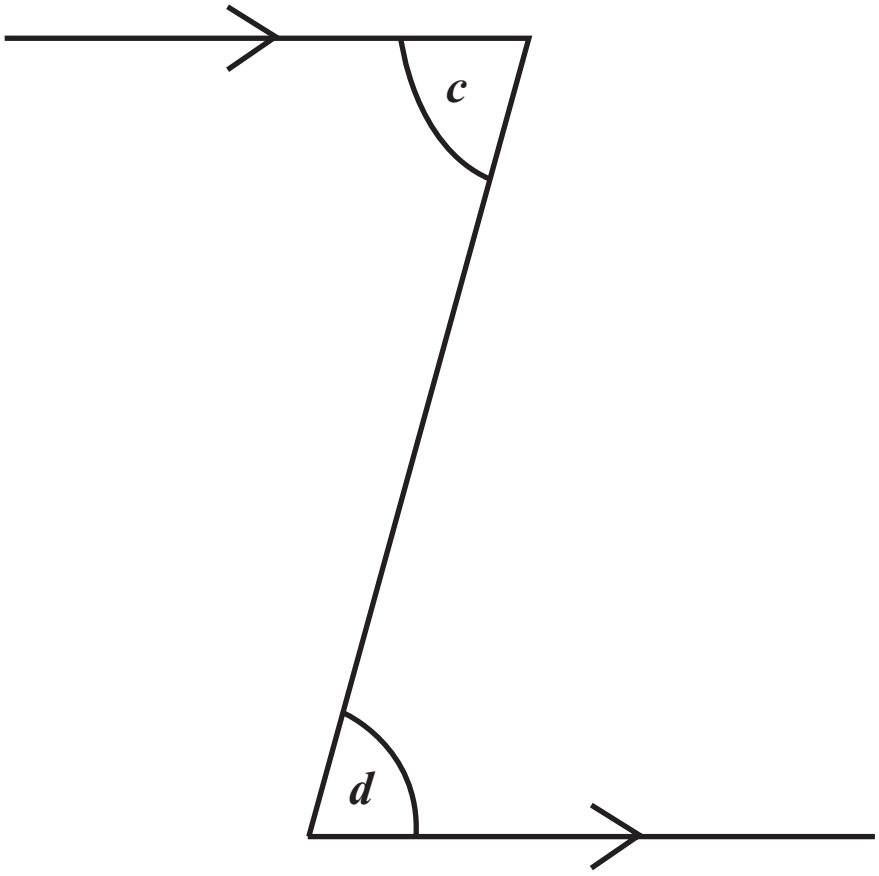
(b) What mathematical name is given to the pair of acute angles c and d below? [1 mark]



Answer _____

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8 **(a)** Factorise $c^2 - 5c$ [1 mark]

Answer _____

(b) Simplify $\frac{d}{4} - \frac{d}{5}$ [3 marks]

Answer _____

9 Solve $7e + 3 = 4e + 5$ [3 marks]

Answer e = _____

10 The n^{th} term of a sequence is given by $n^2 - 1$

(a) Write down the first 3 terms of this sequence. [2 marks]

Answer _____ , _____ , _____

(b) Explain why 101 cannot be a term in this sequence.
[1 mark]

Answer _____

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11 Angela buys 5 DVDs and 4 CDs.
Each DVD costs d pounds.
Each CD costs c pounds.
Write down an expression for the total cost. [2 marks]

Answer _____

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12 **(a)** Express 84 as a product of its prime factors **in index form**. [3 marks]

Answer _____

(b) Find the Lowest Common Multiple (LCM) of 63 and 84 [2 marks]

Answer _____

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13 £4000 is invested in a bank for 3 years and earns 5% per annum compound interest.

How much will it earn in interest over the 3 years? [3 marks]

Show clearly all your working.

Answer £ _____

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

The pendulum swings 1.8 metres on its first swing.

How far does it swing during the third swing? [2 marks]

Answer _____ m

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15 The table below shows the weights of fish caught in a competition.

Weight (g)	Frequency
$0 < w \leqslant 150$	10
$150 < w \leqslant 300$	25
$300 < w \leqslant 450$	18
$450 < w \leqslant 600$	12
$600 < w \leqslant 750$	10
$750 < w \leqslant 900$	5

(a) Write down the modal class interval. [1 mark]

Answer _____

(b) Write down the class interval which contains the median weight. [1 mark]

Answer _____

(c) Calculate an estimate for the mean weight of a fish caught in this competition. [4 marks]

Answer _____ g

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16 A student wishes to carry out a survey relating to television viewing by the general public.
Her first question is
"What age are you?" **Answer** [ ]

(a) Give one criticism of this question. [1 mark]

_____

(b) Design a more suitable question with appropriate response boxes for her to record the age of those being surveyed. [2 marks]

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17 The radius of the base of a cylindrical oil tank is 60 cm.

(a) Calculate the area of the base of the oil tank. [2 marks]

Answer _____ cm^2

The height of the oil tank is 70 cm.

(b) Calculate the volume of the oil tank. Give your answer in **litres**. [3 marks]

Answer _____ litres

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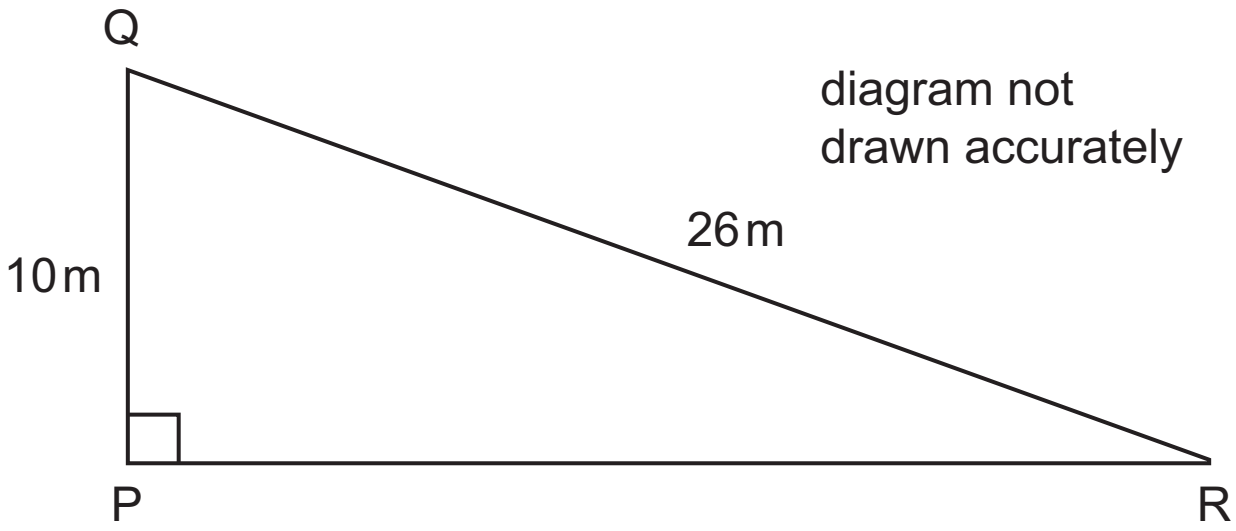
18 The sketch shows a field which is in the shape of a right-angled triangle.
The side PQ = 10 m and the side QR = 26 m.

Calculate the length of the side PR. [3 marks]



Answer _____ m

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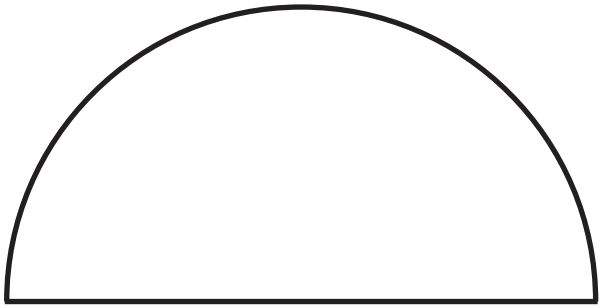
19 A glass window is in the shape of a semi-circle with diameter 40 cm.

Calculate the perimeter of the semi-circle. [3 marks]



40cm

diagram not drawn accurately

Answer _____ cm

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20 Use the method of trial and improvement to find the solution of the equation $x^3 + 3x = 47$
Give your answer correct to 1 decimal place. [4 marks]
Show all your working.

Answer x = _____

21 Expand and simplify $3(2w - 1) - 2(w - 4)$ [2 marks]

Answer _____

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22 The first five terms of a sequence are 9, 13, 17, 21, 25.
Find an expression, in terms of n, for the n^{th} term of this sequence. [2 marks]

Answer _____

23 During a very cold winter a glacier increased in volume by 32%.
At the end of the winter its volume was found to be 6864 km^3
What was its volume at the start of that winter? [3 marks]

Answer _____ km^3

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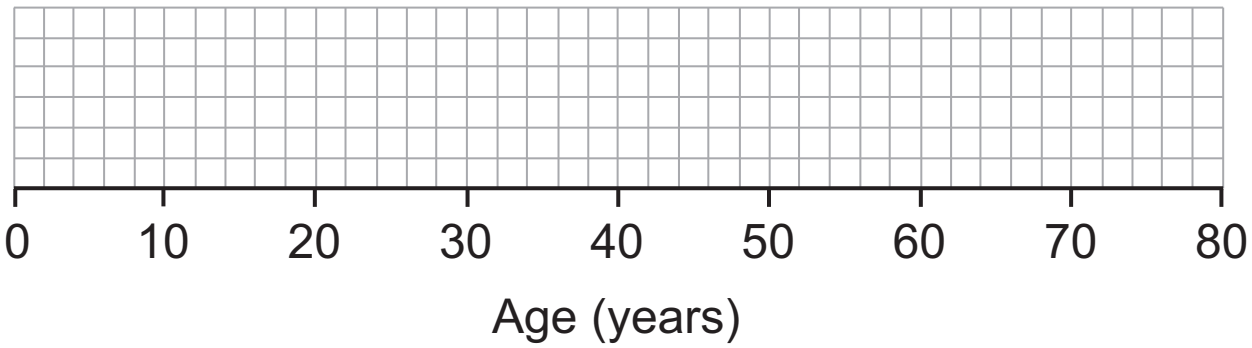
Quality of written communication will be assessed in part (b) of this question.

24 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]



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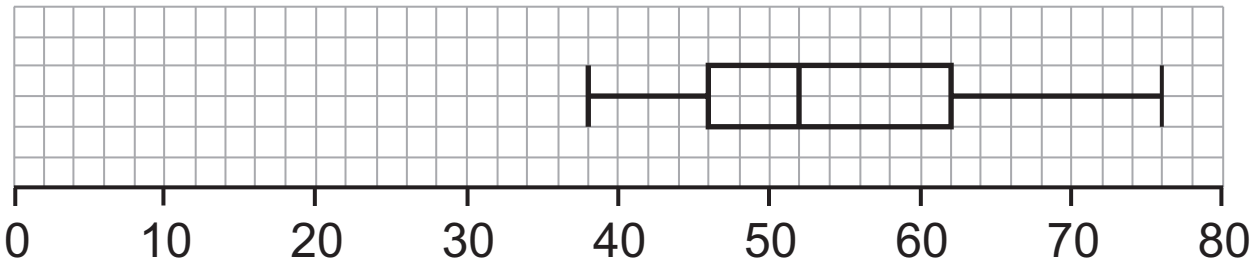
(b) The box plot below shows the age distribution of members of a bowls club.



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

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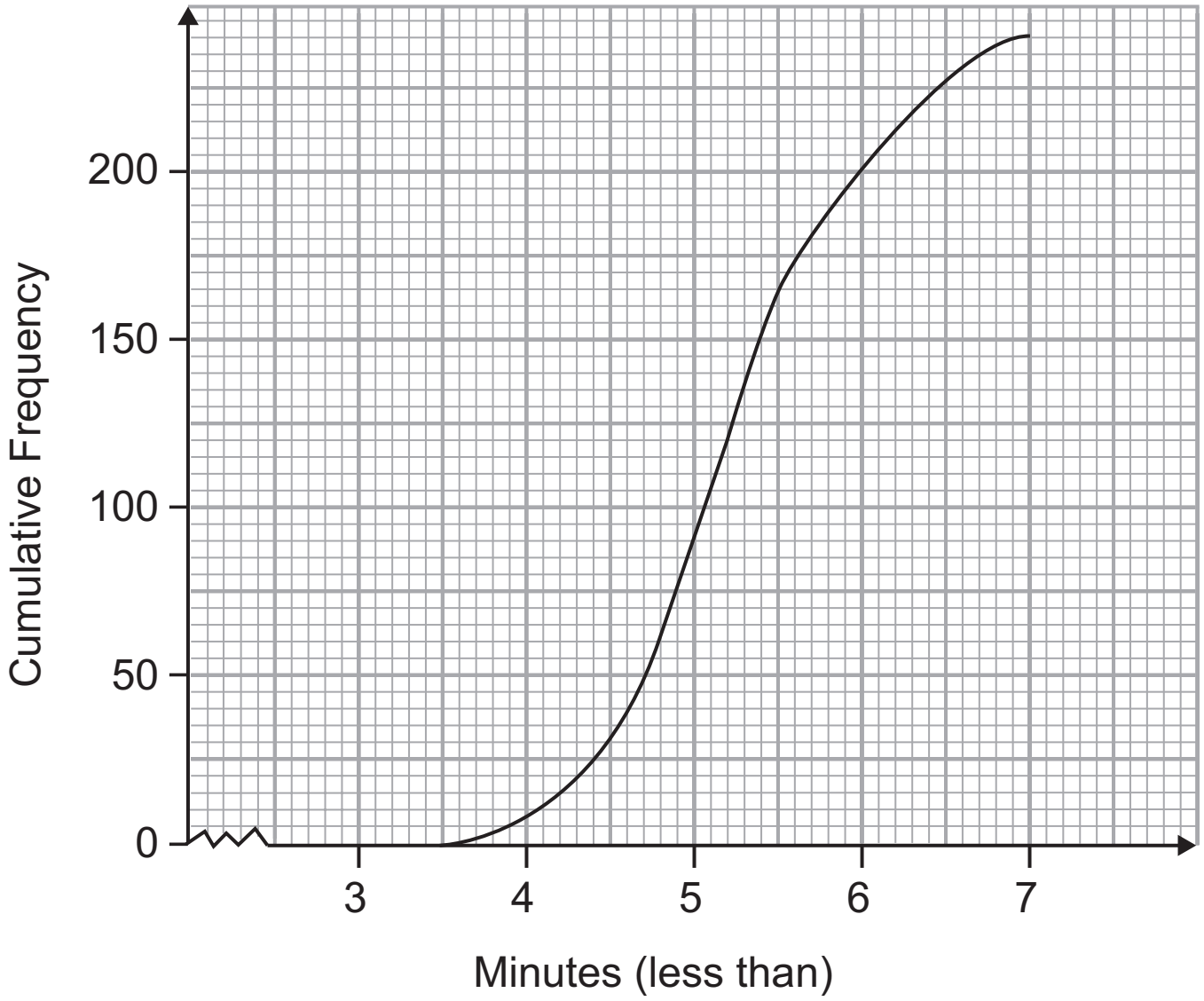
25 The cumulative frequency curve represents the times taken to run 1500 m by each of the members of a running club.



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

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

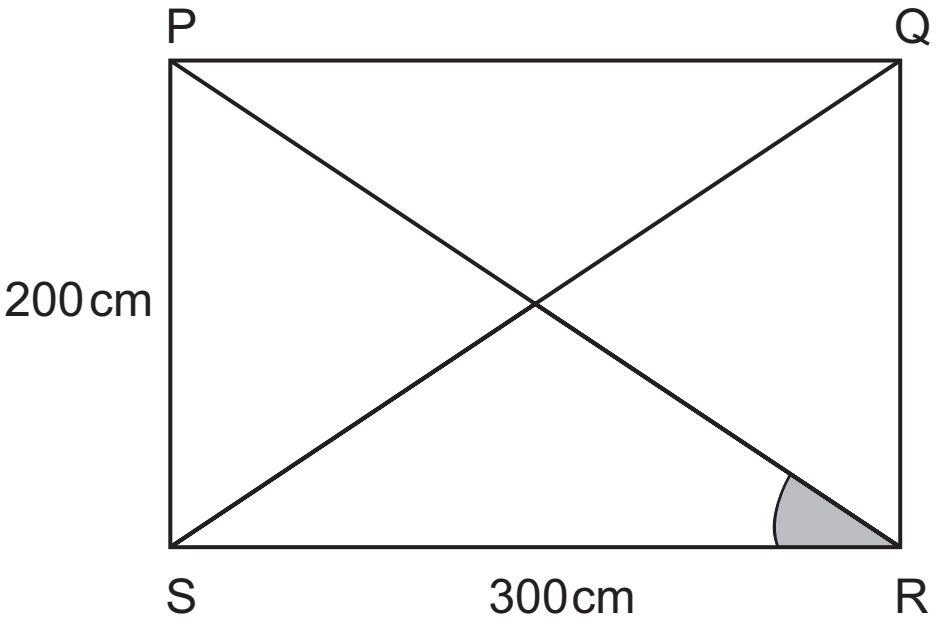

diagram not drawn accurately

(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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27

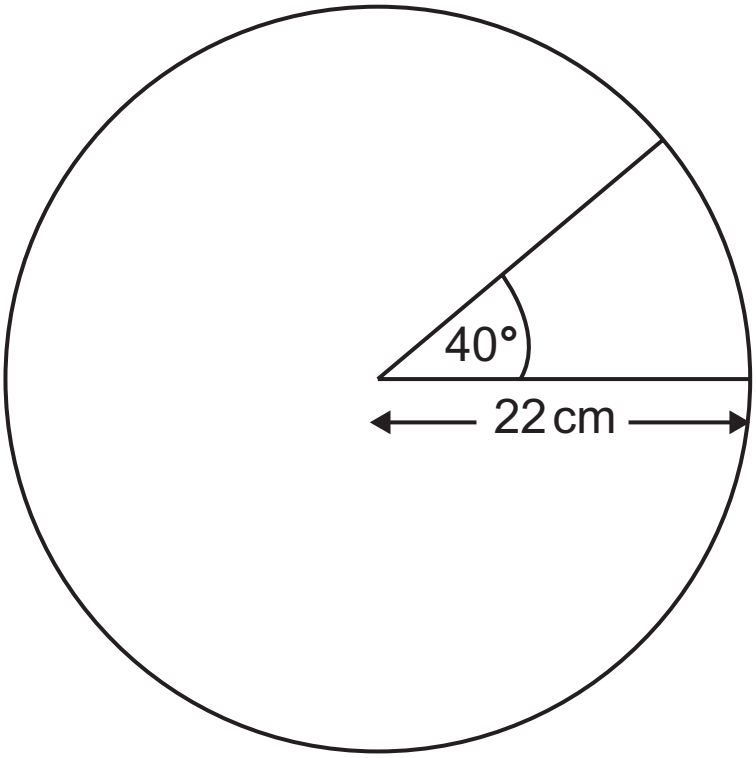

diagram not
drawn accurately

A large circular pizza has radius 22 cm.
Josh cuts a sector with angle 40° from the pizza.
Calculate the area of this sector. [3 marks]

Answer _____ cm^2

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28 Solve the simultaneous equations

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

Show your working.
A solution by trial and improvement will not be accepted. [3 marks]

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

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29 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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Question Number	Marks
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Examiner Number

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