GCSE

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3310U50-1

S19-3310U50-1

MATHEMATICS – NUMERACY
UNIT 1: NON-CALCULATOR
HIGHER TIER

TUESDAY, 7 MAY 2019 – MORNING

1 hour 45 minutes

3310U501
01

ADDITIONAL MATERIALS

The use of a calculator is not permitted in this examination.

A ruler, a protractor and a pair of compasses may be required.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

If you run out of space, use the continuation page at the back of the booklet. Question numbers must be given for the work written on the continuation page.

Take π as 3·14.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

In question **4**(a), the assessment will take into account the quality of your linguistic and mathematical organisation, communication and accuracy in writing.

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	5	
2.	4	
3.	6	
4.	11	
5.	5	
6.	6	
7.	4	
8.	4	
9.	6	
10.	4	
11.	15	
12.	10	
Total	80	

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Formula List - Higher Tier

Area of trapezium $= \frac{1}{2}(a+b)h$
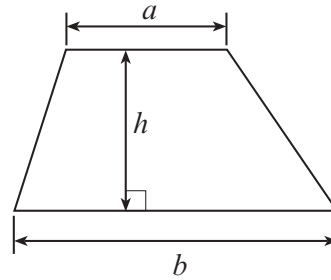
Volume of prism = area of cross-section × length
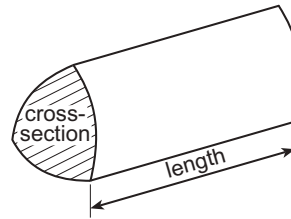
Volume of sphere $= \frac{4}{3}\pi r^3$

Surface area of sphere $= 4\pi r^2$
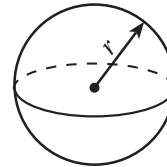
Volume of cone $= \frac{1}{3}\pi r^2 h$

Curved surface area of cone $= \pi r l$
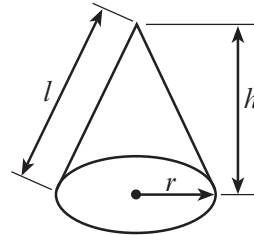
In any triangle ABC

    Sine rule $\quad \dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

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

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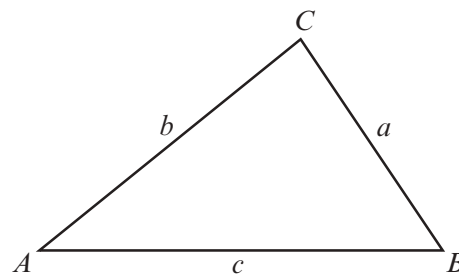
The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$ are given by $\quad x = \dfrac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

Annual Equivalent Rate (AER)

AER, as a decimal, is calculated using the formula $\left(1 + \dfrac{i}{n}\right)^n - 1$, where i is the nominal interest rate per annum as a decimal and n is the number of compounding periods per annum.

1. *Rupert Shoes* sells shoes online.
Pairs of shoes are packed in shoeboxes.
The dimensions of the shoebox used are given on the diagram below.

25 cm

15 cm

40 cm
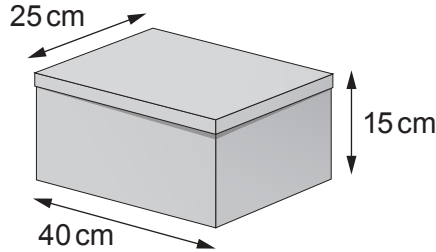
Diagram not drawn to scale

A customer orders 2 pairs of shoes.

The package for sending the shoes to the customer is made by:
 • placing one box on top of the other, and
 • taping the two boxes together.

This is shown in the diagram.

The cost for sending the package is calculated using the formula below.
All dimensions are measured in cm.
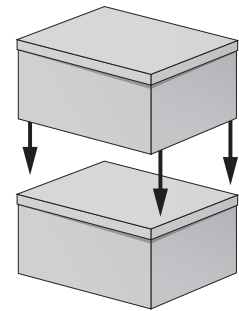
$$\text{Cost in £} = \frac{1}{5} \times (S + F) \times 0\cdot02$$

S = value of the sum of the 3 dimensions of the package
F = value of the area of one of the **largest** faces of the package

How much does it cost *Rupert Shoes* to send the package?
Give your answer in pounds.
You must show all your working. [5]

2. A builder has drawn a plan for building 3 office blocks on a plot of land.
They are numbered 1, 2 and 3, as shown below.

The scale of the plan is **1 cm represents 20 m**.
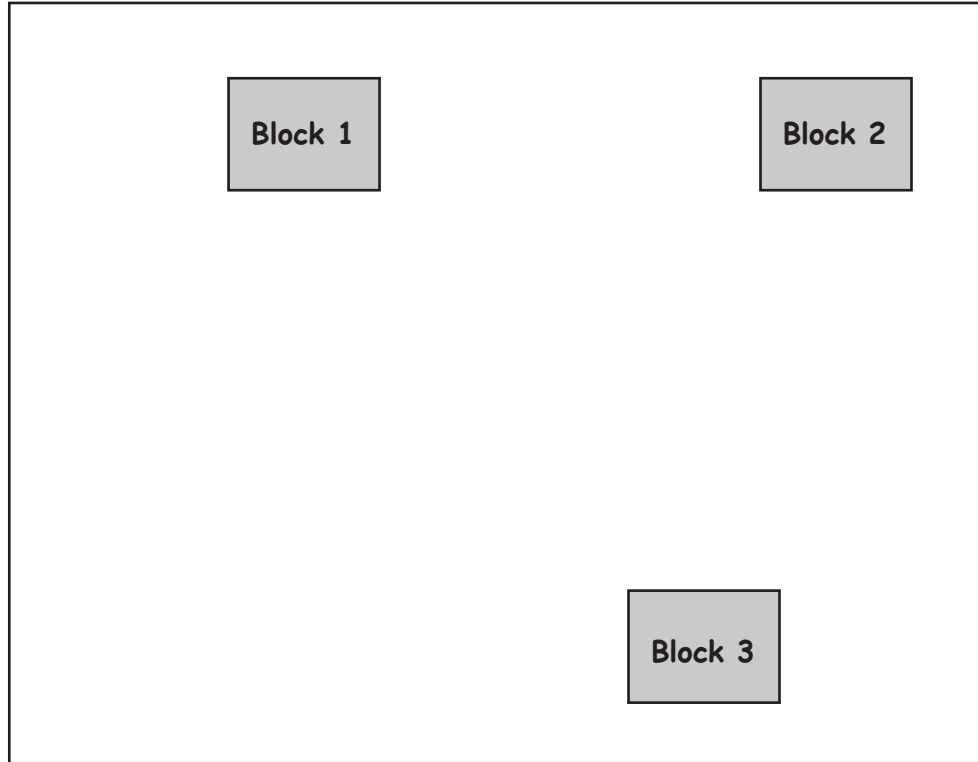
(a) The builder is planning to plant a tree so that it is:
- the same distance from Block 1 as it is from Block 2,
- 80 metres from the top left hand corner of Block 3.

Mark the position for the planting of the tree. [3]

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(b) What is the shortest possible distance between Block 2 and Block 3? [1]

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.... metres

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3. *(a)* *Sam's Garden Centre* buys trees to sell.

Sam bought 200 trees.
Each tree cost Sam £25.

22% of the trees were not sold.
Sam sold all the other trees for £40 each.

How much profit did Sam make?

You must show all your working. [5]

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(b) The trees are planted in identical pots. They each have a uniform cross-section in the shape of a regular hexagon.

Show that these pots will tessellate. [1]

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120°

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4. A helicopter pilot is planning a route from Milford Haven to Ruabon and then on to Swansea.
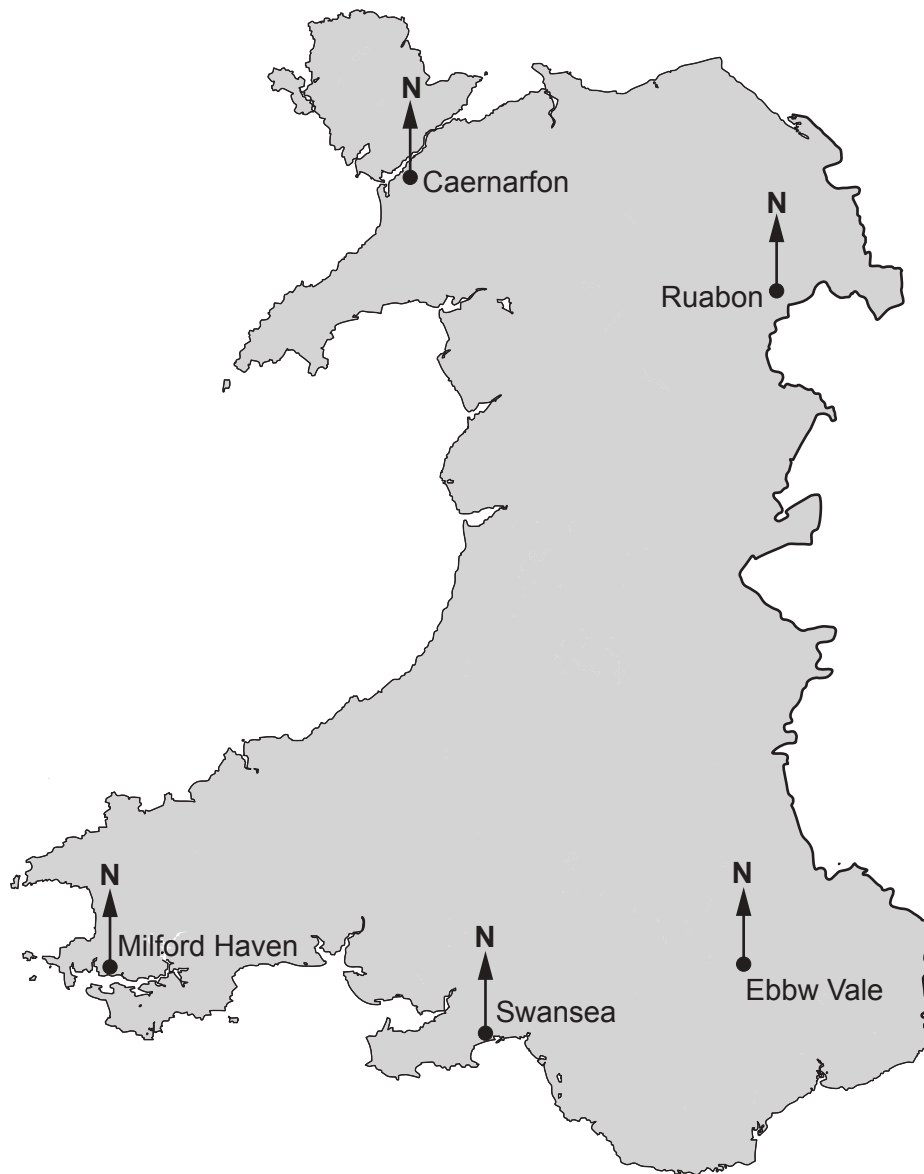
(a) *In this part of the question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

The plan for the flight is shown below.

Journey	Average speed	Time
Milford Haven to Ruabon	90 mph	1 hour 20 minutes
Ruabon to Swansea	80 mph	1 hour 15 minutes

Calculate the total distance of the flight.
Give your answer in miles.
You must show all your working. [4 + 2 OCW]

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(b) On average, the helicopter uses 0·4 gallons of fuel per minute.

Remember: 1 gallon = 4·55 litres

Use this information to calculate how many litres of fuel the helicopter would be expected to use for the flight planned in *(a)*.
You must show all your working. [5]

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Fuel = ... litres

(3310U50-1) **Turn over.**

5. You are given that:
1 gigalitre = 1 000 000 m³
1 megalitre = 1 million litres

Lake Vyrnwy is a reservoir in mid Wales.

(a) Lake Vyrnwy can release between 25 and 45 megalitres of water per day from the dam.

The lake also supplies water through underground pipes to another reservoir at a rate of 230 000 m³ per day.

(i) How many litres are there in 25 megalitres?
Circle your answer. [1]

25×10^{8} 25×10^{-6} 25×10^{7} $2\cdot5 \times 10^{6}$ $2\cdot5 \times 10^{7}$

(ii) Which is the best estimate for the volume of water passing through the underground pipes **per hour**?
Circle your answer. [1]

$8500 \, m^{3}$ $9600 \, m^{3}$ $10\,040 \, m^{3}$ $10\,400 \, m^{3}$ $11\,000 \, m^{3}$

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(b) Lake Vyrnwy has a surface area of approximately $4\,540\,000\,\text{m}^2$.
Lake Vyrnwy contains 59·7 gigalitres of water.

Calculate an estimate of the average depth of the lake.
Give your answer in metres.

[3]

Estimate of average depth is .... m

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6. *(a)* Maesystrad, Rhewlteg and Glanmawr are three colleges.
Each college recorded the times Year 12 students took to travel to college.
The results are displayed in the box-and-whisker plots below.

Maesystrad
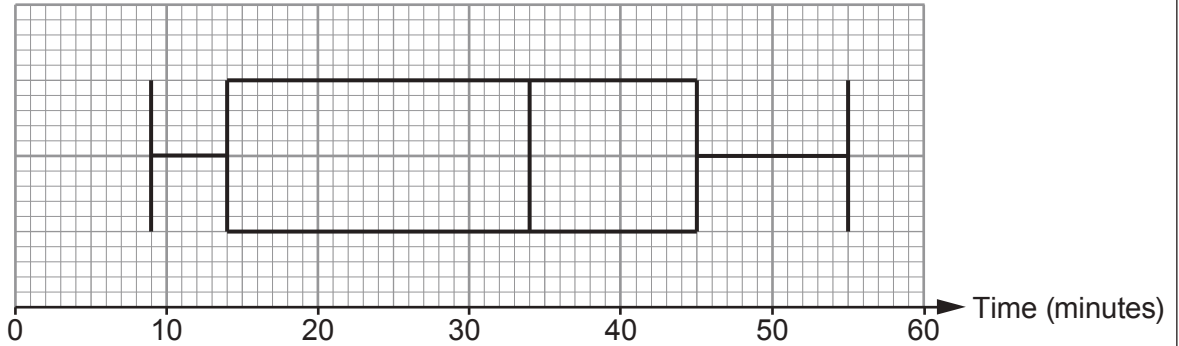
Rhewlteg
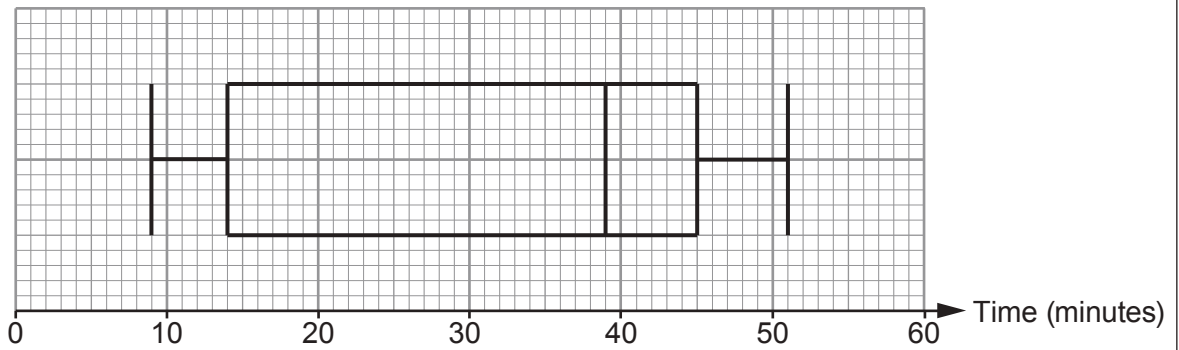
Glanmawr
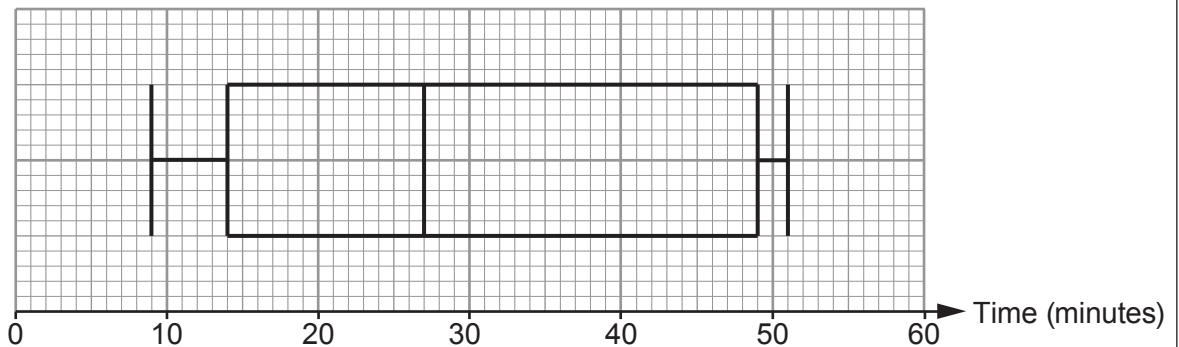
(i) Which of the three colleges has the greatest range of times?
What is the range of times for this college? [1]

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College .... Range .... minutes

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(ii) On average, in which college did Year 12 students have the longest travel times? You must give a reason for your answer. [1]

College: ....

Reason: ....

....

(iii) Which college has the greatest difference between the median and the lower quartile?
What is this difference? [1]

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College .... Difference .... minutes

(iv) Which of the three colleges has the greatest number of Year 12 students?
Give a reason for your answer. [1]

Maesystrad ☐   Rhewlteg ☐   Glanmawr ☐   Don't know ☐

Reason: ....

....

....

(b) At another college, Wynne College, there are 240 students in Year 12.

The interquartile range of the times taken for these students to travel to college is 32 minutes.

(i) How many of these students have travel times within this interquartile range? [1]

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.... students

(ii) 75% of the Year 12 students at Wynne College take less than 55 minutes to travel to college.
Complete the following statement.

'25% of the Year 12 students at Wynne College take less than

.... minutes to travel to college.' [1]

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Turn over.

7. The table below shows the approximate land area and population for 5 countries in 2014.

Country	Approximate land area, km^2	Approximate population
Argentina	2 800 000	40 000 000
Austria	84 000	8 400 000
Canada	10 000 000	34 000 000
Pakistan	800 000	170 000 000
United Kingdom	240 000	62 000 000

(a) Which of the 5 countries had a population density of approximately 100 people per km^2?
Circle your answer. [1]

Argentina   Austria   Canada   Pakistan   United Kingdom

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(b) Which of these countries had the greatest population density?
Circle your answer. [1]

Argentina   Austria   Canada   Pakistan   United Kingdom

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(c) Which of these countries had a population density that is approximately 4 times the population density of Canada?
You must show all your working. [2]

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8. Bronwen is investigating the increase in the growth of algae on the surface of a pond.
The surface area covered by the algae is measured in cm^2.
She finds the surface area covered by the algae t **days** after the start of her investigation is given by the following expression.

$$400 + 4^{\frac{t}{2}}$$

(a) What surface area was covered by algae at the start of her investigation?
Circle your answer. [1]

$404\,cm^2$ $\qquad$ $401\,cm^2$ $\qquad$ $4\,cm^2$ $\qquad$ $402\,cm^2$ $\qquad$ $400\,cm^2$

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(b) Bronwen calculated the surface area covered by the algae 5 days after the start of the investigation.
She also calculated the surface area 7 days after the start of the investigation.
By how much did the surface area covered by the algae increase between these two times? [3]

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Turn over.

9. The voltage, V volts, of an electric circuit is given by the formula

$$V = IR,$$

where I is the current measured in amps, and R is the resistance measured in ohms.

During an experiment,
- V was measured at 280 volts, correct to the nearest 10 volts,
- I was measured at 0·2 amps, correct to the nearest 0·1 amps.

Calculate the least possible value and greatest possible value of the resistance R. [6]

Least possible value of R = ... ohms

Greatest possible value of R = ... ohms

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Turn over.

10. A tent company is designing a new 2-person tent.
The base of the tent is in the shape of a kite, as shown below.
The width of the kite is 160 cm, and the two shorter sides are of length 100 cm.
The point where the diagonals of the kite intersect has been marked O on the diagram below.
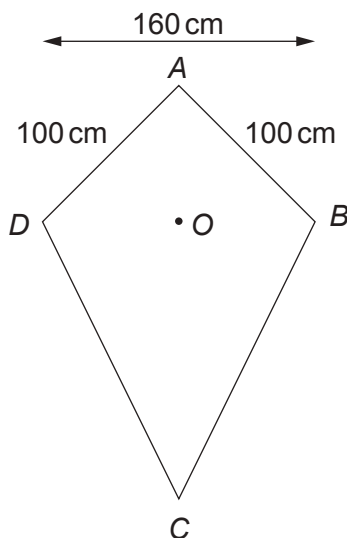

Diagram not drawn to scale

E is the highest point of the tent, and is 110 cm vertically above O.
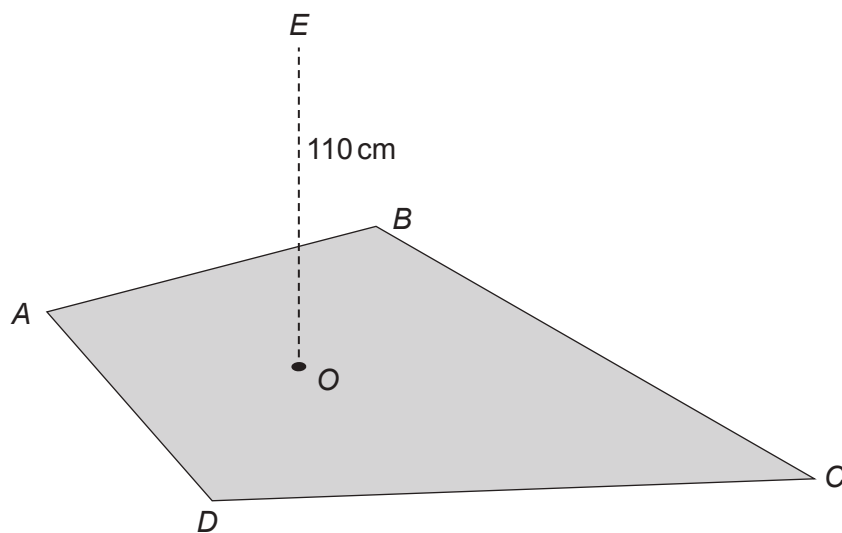Part of the frame that supports the tent cover is a straight pole that goes from A to E.

Diagram not drawn to scale

Calculate the length of pole AE.
Give your answer as a surd.
You do not need to simplify your answer. [4]

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11. *(a)* Alun is a jeweller.
He is designing a symmetrical pendant, as shown below.
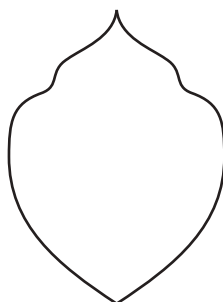
Diagram not drawn to scale

The pendant will be made from solid silver, with a uniform thickness of 3 mm.
In order to calculate the cost of making the pendant, Alun wants to calculate an estimate of the volume of the pendant.
He has accurately drawn one of the symmetrical halves of the shape on graph paper.

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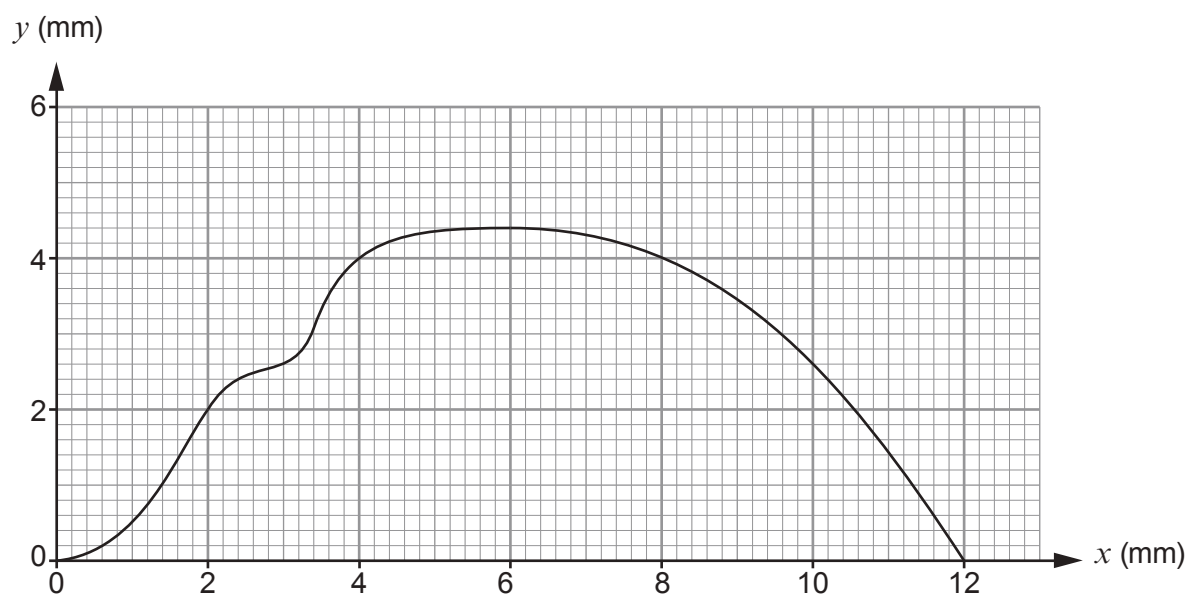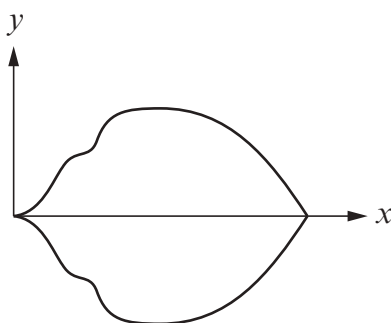
Calculate an estimate of the volume of the whole pendant.
Use the graph opposite, with 6 strips of equal width. [5]

(3310U50-1) **Turn over.**
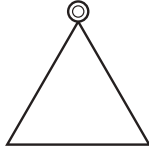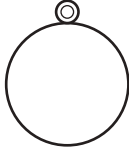
(b) Alun makes pendants that are mathematical shapes.
The following table shows the pendants and the number of these pendants that Alun made last month.

	Triangle	Circle	Rectangle	Trapezium
Pendant				
Number made last month	52	96	30	62

At the end of last month, Alun took a stratified sample of 30 of these 240 pendants to check their quality.

Calculate how many pendants of each shape were in Alun's sample.
You must show all your working. [4]

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Pendant	Triangle	Circle	Rectangle	Trapezium
Number in sample				

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(c)   Alun has 5 identical metal cylinders, each of length 40 mm.
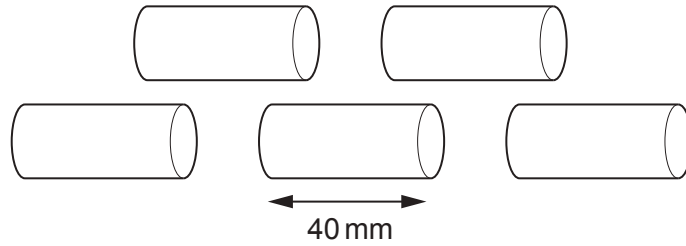
Diagram not drawn to scale

He has been asked to make a solid sphere of radius 30 mm.
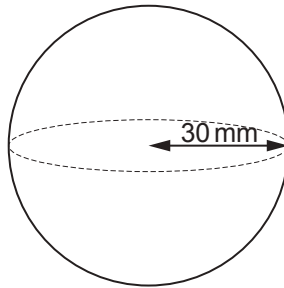
Diagram not drawn to scale

He melts the 5 cylinders and recasts all the metal to make the sphere.

Calculate the radius of each of the cylinders.

Give your answer in mm, in the form $a\sqrt{b}$, where a and b are integers, and b is as small as possible.   [6]

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12. A new athletics stadium is to be built in Alltycapel.

(a) A throwing circle is to be built for the shot put and discus events.
There are lines drawn from the centre of the circle. They show the athletes where the boundaries are for their throws.
The lines form a sector of the circle.
This sector is to be painted, as shown in the diagram.
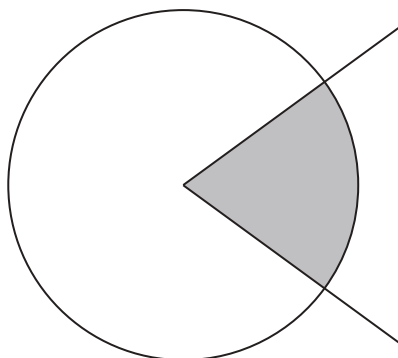
Diagram not drawn to scale

The radius of the throwing circle is 120 cm.

The area of the sector is 0·08$\dot{3}$ of the area of the circle.

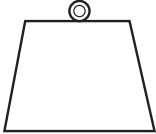(i) Write 0·08$\dot{3}$ as a fraction in its simplest form. [3]

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(ii)   Use your answer to (i) to calculate the area to be painted.
Give your answer in terms of π in its simplest form.   [2]

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(b) A new running track is to be built at the stadium.

Athletes in a 200-metre race run in lanes.
The inside line of one of the lanes is shown below.

The inside line consists of:
- a straight section of length 90 m,
- an arc of a circle with radius 36 m.

The length of this inside line is 200 m.

36 m

$x°$

90 m
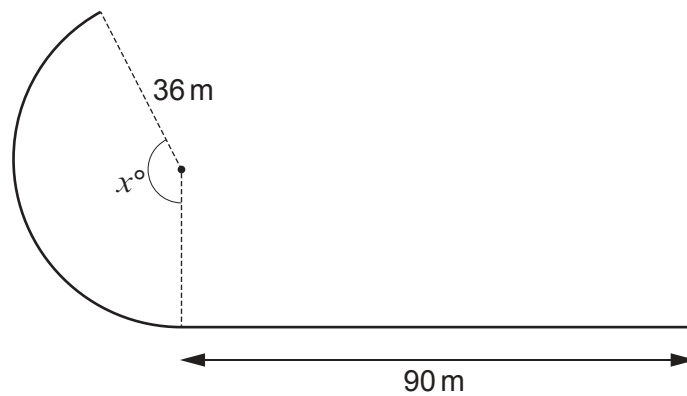
Diagram not drawn to scale

Show that the value of x is $\dfrac{550}{\pi}$. [5]

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