Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

3310U60-1

A20-3310U60-1

THURSDAY, 5 NOVEMBER 2020 – MORNING

MATHEMATICS – NUMERACY
UNIT 2: CALCULATOR-ALLOWED
HIGHER TIER

1 hour 45 minutes

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

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01

ADDITIONAL MATERIALS

A calculator will be required for this paper.

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 additional page at the back of the booklet. Question numbers must be given for the work written on the additional page.

Take π as 3·14 or use the π button on your calculator.

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 **1**, the assessment will take into account the quality of your linguistic and mathematical organisation, communication and accuracy in writing.

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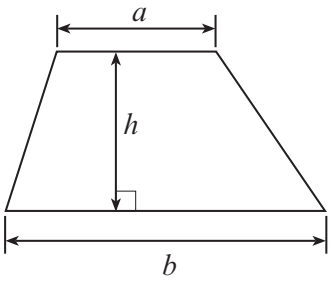
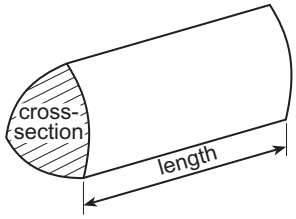
Formula List - Higher Tier

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

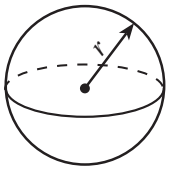


Volume of prism = area of cross-section × length



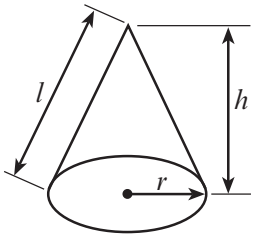
Volume of sphere $= \frac{4}{3}\pi r^3$

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



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

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

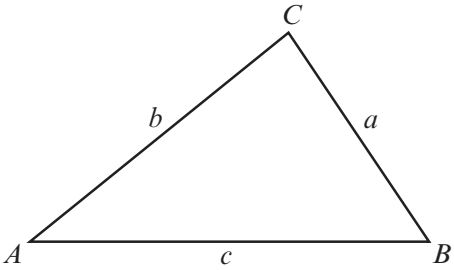


In any triangle ABC

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

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

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



The Quadratic Equation

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

Annual Equivalent Rate (AER)

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

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1. *In this question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

In Cuba, urban gardens are used for food production.

1 acre ≈ 0·00405 km^2

35 000 acres of urban gardens in Cuba produced 3·4 million tonnes of food in 2002.

Calculate the number of tonnes of food produced per km^2 in urban gardens in Cuba in 2002.
You must show all your working. [4 + 2 OCW]

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2. In May 2018, the population of Wales was approximately 3 150 000.
Of this population, approximately 286 500 people were aged 75 or over.

In May 2018, a survey in Wales found the following:

- 85% of the population of Wales used the internet,
- 99% of people aged 16 to 24 used the internet,
- 40% of people aged 75 or over used the internet.

Of all the internet users in Wales in May 2018, what percentage were aged 75 or over?
Give your answer correct to 2 significant figures.
You must show all your working. [5]

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3. Formula One cars are some of the fastest racing cars in the world.

The cars' top speeds are up to 375 km/h and their engines are limited to 15 000 rotations per minute.

The Monaco Grand Prix is the shortest Formula One race with 78 laps of the track and a total distance of 260·5 km.

Fernando Alonso won the Monaco Grand Prix in 2007.
He completed the race with an average speed of 155·552 km/h.

(a) Complete the following statement.

'Top speeds of Formula One cars are up to ..... mph.' [2]

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(b) Calculate Alonso's average lap time for the 2007 Monaco Grand Prix.
Give your answer in minutes.
You must show all your working. [4]

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(c) Which number from the list below would correctly complete the following statement?
Circle your answer. [1]

'Formula One engines are limited to ..... rotations **per second**.'

900 000 250 300 4·17 54 million

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(d) Typical exchange rates in 2018 were as follows.

- £1 = 1.38 US dollars
- £1 = 1.14 euros

In 2018, the average annual cost of running a Formula One race team was 250 million US dollars.

Complete the following statement.

'In 2018, the average **monthly** cost of running a Formula One race team was ..... million euros.'

You must show all your working. [4]

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4. Ruth measures the lengths of 5 square pictures.
The measurements she records are as follows.

21 cm 22 cm 23 cm 24 cm 26 cm

Each of these measurements is **correct to the nearest cm**.

She plans to display all 5 pictures in a line, edge to edge, on a shelf of a bookcase.
The length of the shelf is 120 cm, **correct to the nearest 5 cm**.

Show that the shelf could be 1 cm too short to display all 5 of these pictures.
You must show all your working. [4]

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5. *(a)* In March 2014, there were an estimated 6 550 000 000 two pence coins in circulation.

Calculate the value of these 2p coins in **pounds** (£).
Give your answer in standard form.
You must show all your working. [3]

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(b) The 2p coin is made from a mixture of metals.
It has a diameter of 25·9 mm and a thickness of 2·03 mm.

The 2p coin can be considered to be a cylinder.
Calculate the volume of metal in a 2p coin.

[3]

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6. The Leaning Tower of Pisa stands on horizontal ground.
The vertical height of the tower on the higher side is 56·7 m.
The top of the tower is displaced 3·9 m horizontally.

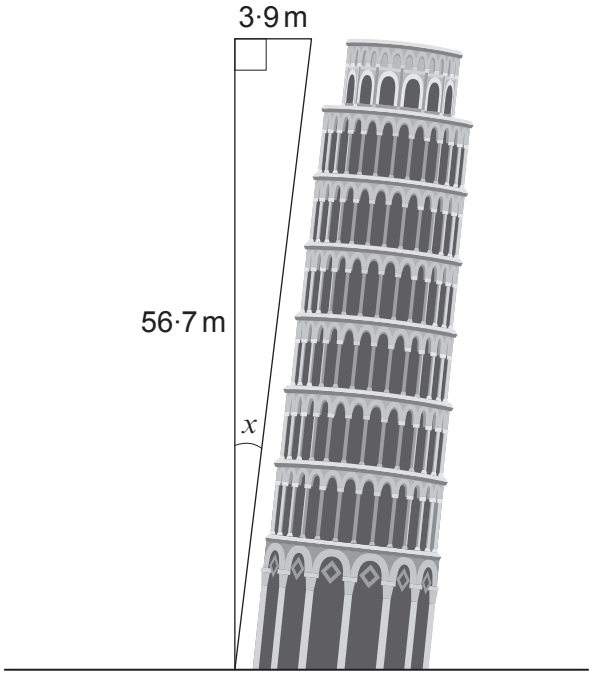

Diagram not drawn to scale

(a) Calculate the angle, x, at which the tower leans.
Give your answer correct to 2 decimal places.
You must show all your working. [4]

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(b) Ceri plans to make a poster that is mathematically similar to the Leaning Tower of Pisa.

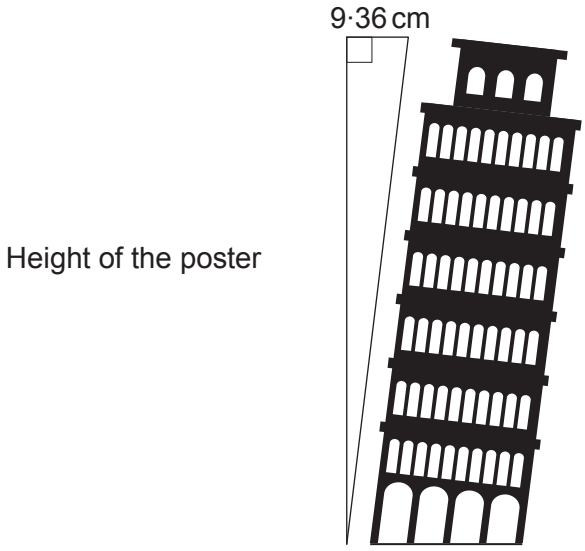

Diagram not drawn to scale

Calculate the height of the poster Ceri plans to make. [2]

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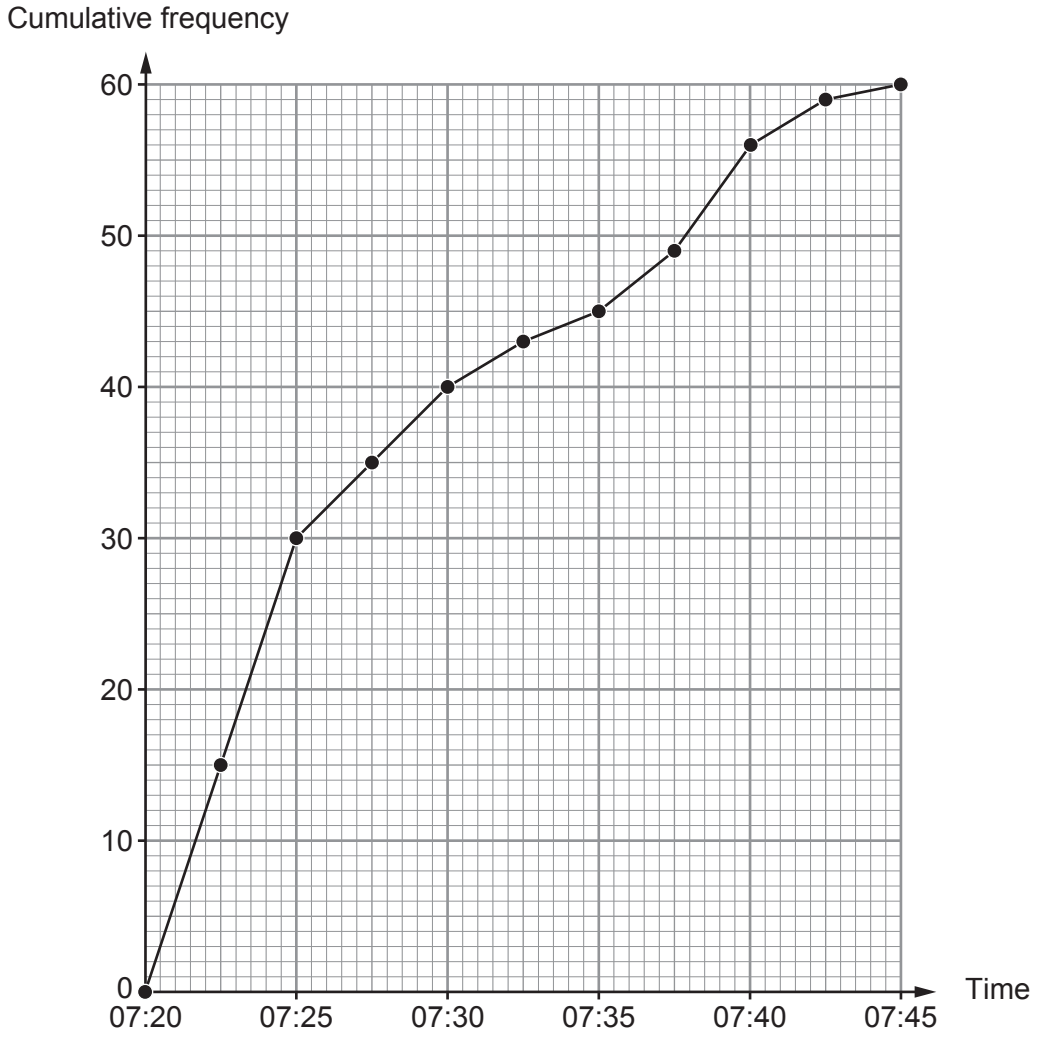
7. On Wednesday, there were no cars in a car park when it opened at 7:00 a.m.
From 7:00 a.m., the number of cars entering the car park was recorded.

The cumulative frequency diagram has been drawn from the results.



(a) How many cars had entered the car park by 7:35 a.m.? [1]

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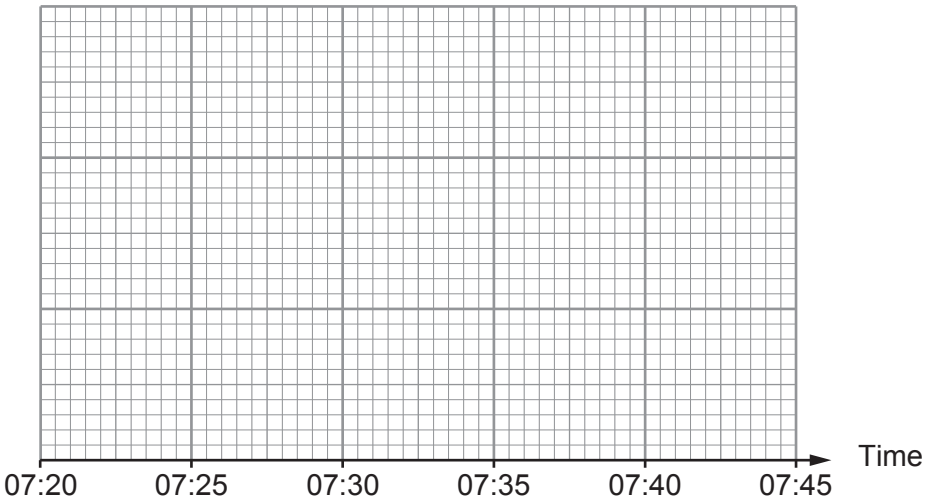
(b) The first car entered the car park at 7:21 a.m.
The last car entered the car park at 7:44 a.m.

Draw a box-and-whisker plot using this information and the data from the cumulative frequency diagram. [3]



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8. Imogen has £2000 to invest.
Details of two savings accounts are shown below.

Account name	Nominal annual rate	Interest paid
Online Saver	4·38%	Daily
Platinum Plus	4·5%	Monthly

(a) If Imogen invested the £2000 in the *Online Saver* account, how much money would be in the account after 30 days?
You must show all your working. [3]

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(b) Calculate the AER for the *Platinum Plus* account.
Give your answer as a percentage correct to 2 decimal places. [3]

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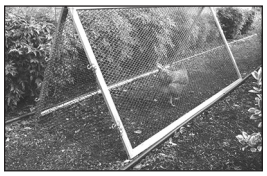
9. *(a)* A company makes a chicken run in the shape of a triangular prism, as shown below. The uniform cross-section of the chicken run is an isosceles triangle.

The run covers a rectangular ground area of $5{\cdot}46\,\text{m}^2$.

The vertical height of the run is $1{\cdot}5\,\text{m}$.



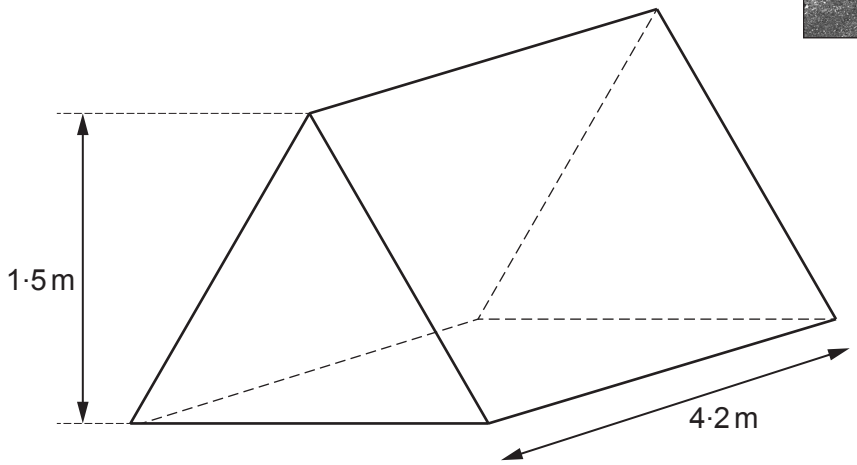


Diagram not drawn to scale

Each face of the chicken run is to be covered in wire mesh, apart from the base. The wire mesh costs £5.60 per m^2.

Calculate the cost of the wire mesh that is needed for the chicken run. [7]

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Cost of the wire mesh = £ .....

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(b) The company also makes chicken coops that are mathematically similar.

Diagrams not drawn to scale

Medium coop
Capacity = $8\,m^3$
Area of wire mesh = $3\,m^2$

Large coop
Capacity = $27\,m^3$

Use the above information to calculate the area of wire mesh in the large coop. [4]

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10. Dafydd has bought a new van.
To pay for the van, he has taken out a loan for £18 000.
The loan has an APR of 3%, and will be repaid by monthly payments of £237.84.

The amount that is still to be repaid on a loan is known as the *remaining balance*.
The formula below can be used to calculate the *remaining balance* on a loan after a period of time from the start date of the loan:

$$\textit{remaining balance} = L(1+r)^n - M\left(\frac{(1+r)^n - 1}{r}\right)$$

where,

r is the **monthly** interest rate written as a decimal,
L is the loan amount in pounds,
M is the monthly payment in pounds,
n is the number of months after the start date of the loan.

Dafydd plans to sell the van in 5 years' time for £5000.
Will he have enough money from the sale of the van to pay off the *remaining balance* on the loan?
You must show all your working. [4]

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11. A square trapdoor has sides of length 110 cm.
When the trapdoor is fully opened, it makes an angle of 85º with the horizontal.

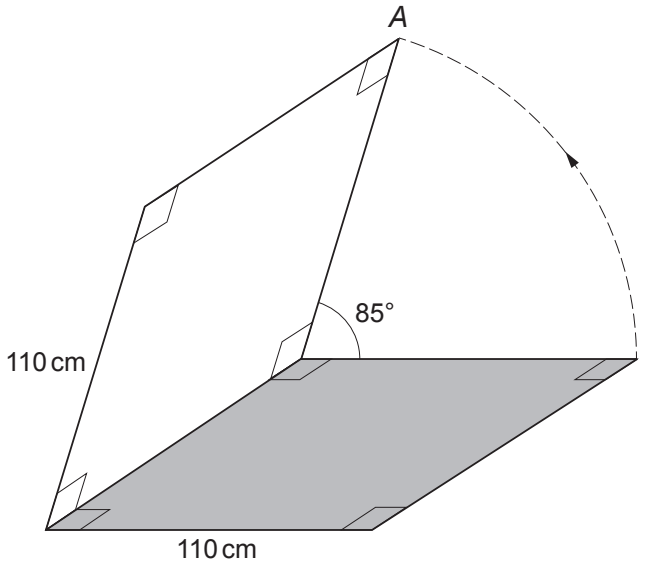

Diagram not drawn to scale

(a) Calculate the distance that point *A* travels as the trapdoor moves from being closed to being fully opened. [2]

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(b) A thin rod is used to hold the trapdoor open in this position.
The rod goes from the closed position of point *A* to a point on the edge of the trapdoor, 16 cm from point *A*.

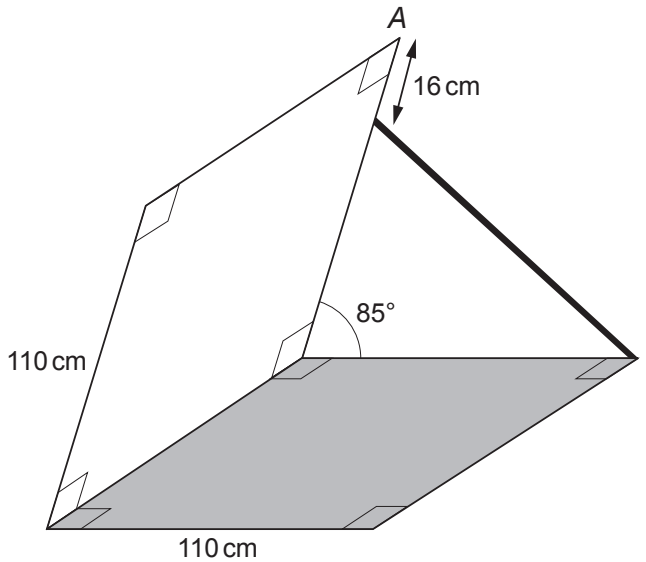

Diagram not drawn to scale

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Calculate both the length of the rod and the angle the rod makes with the horizontal. [6]

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Length of rod = ... cm

Angle the rod makes with the horizontal = ... °

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12. A water trough has a uniform semi-circular cross-section with a radius of 30·9 cm.
It has a length of 600 cm.

Water has been poured into the trough.

The diagram below shows the cross-section of the trough.
The water level is shown by the line *AB*.

O is the centre of the semi-circle and $A\hat{O}B$ = 150º.

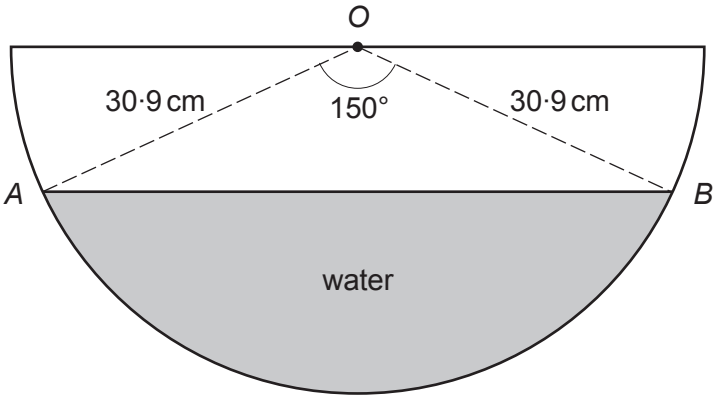

Diagram not drawn to scale

(a) Calculate the area of the triangle *AOB*. [2]

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(b) Calculate how many more litres of water can be poured into the trough before the trough is full. [7]

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Volume of water that can be added = ... litres

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.	Examiner only

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