Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

3310U60-1

A23-3310U60-1

THURSDAY, 9 NOVEMBER 2023 – MORNING

MATHEMATICS – NUMERACY
UNIT 2: CALCULATOR-ALLOWED
HIGHER TIER

1 hour 45 minutes

ADDITIONAL MATERIALS

A calculator will be required for 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** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

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 **3**(c), 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.	**4**	
2.	**8**	
3.	**12**	
4.	**15**	
5.	**4**	
6.	**7**	
7.	**6**	
8.	**12**	
9.	**8**	
10.	**4**	
Total	**80**	

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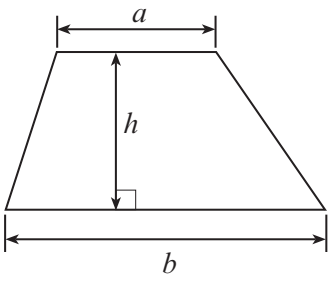
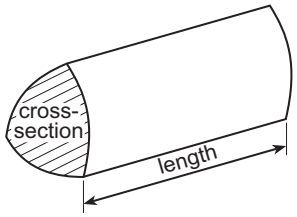
Formula List – Higher Tier

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

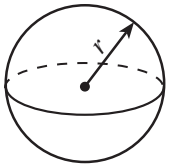


Volume of prism = area of cross-section × length



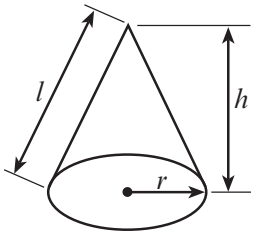
Volume of sphere $= \frac{4}{3}\pi r^3$

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



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

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

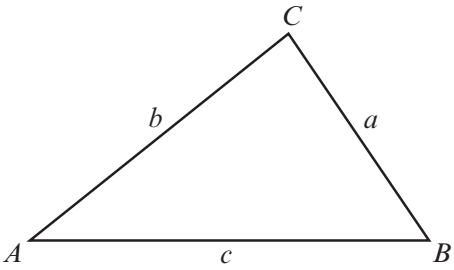


In any triangle ABC

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

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.

Examiner only

1. Treviso is a company that designs and builds bicycles.
Each wheel on Treviso's new bike has a diameter of 29 inches.

Remember:	1 foot = 12 inches

Ollie tests Treviso's new bike over a distance of 1000 feet.
How many times will a wheel rotate during the test? [4]

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Examiner only

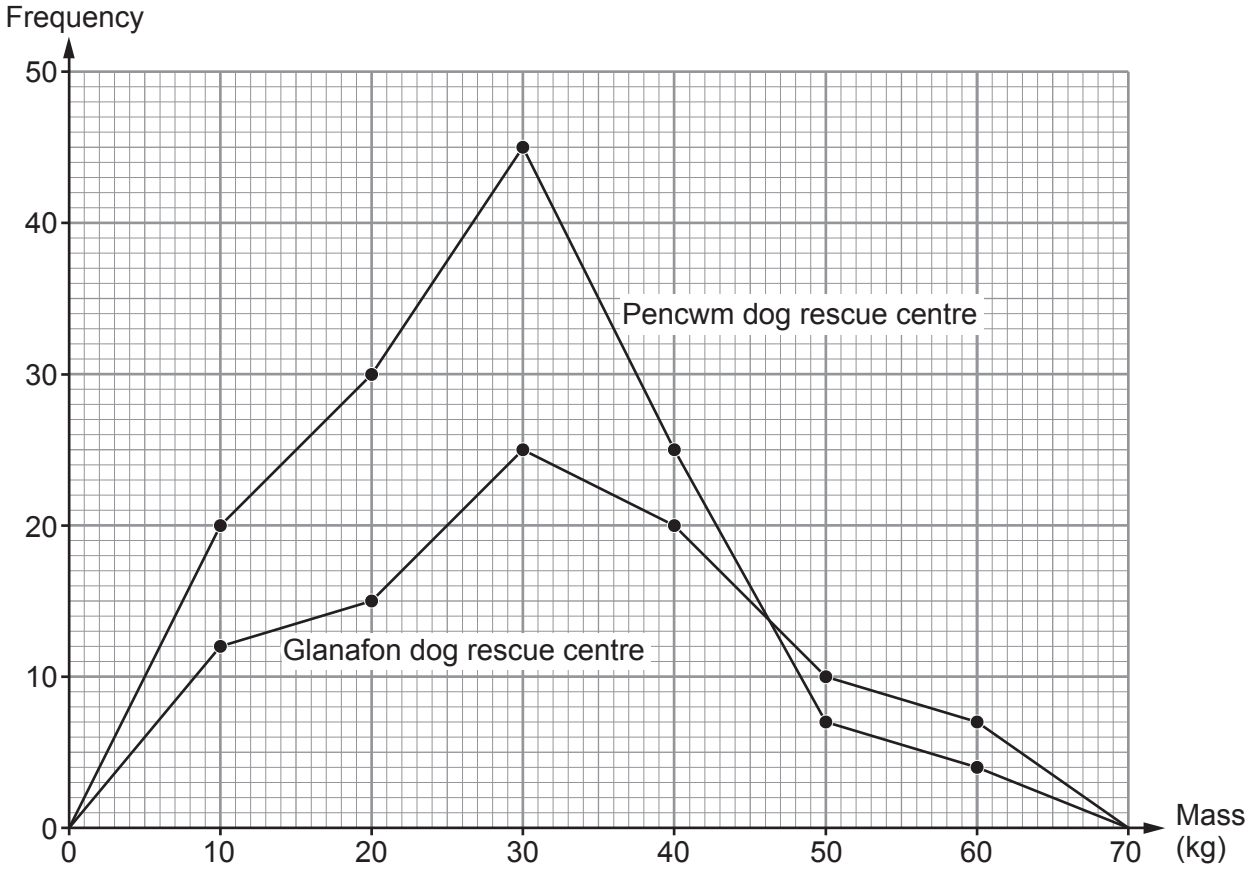
2. Glanafon and Pencwm dog rescue centres take in unwanted dogs.

The mass of each dog in the two dog rescue centres was recorded.

Groups of width 10 kg were used:

$5\,\text{kg} \leqslant \text{mass} < 15\,\text{kg}, \quad 15\,\text{kg} \leqslant \text{mass} < 25\,\text{kg}, \quad \ldots, \quad 55\,\text{kg} \leqslant \text{mass} < 65\,\text{kg}$

The results are shown in the frequency polygons below.



(a) Doreen, Rory and Muzhir look at these frequency polygons.

(i) Doreen says,

"The modal group of the masses of dogs in each dog rescue centre is the same."

Is Doreen correct?

Yes ☐ No ☐ Can't tell ☐

You must give a reason for your answer. [1]

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Examiner only

(ii) Rory says,
"28 of the dogs in Pencwm each have a mass of 18 kg."

Is Rory correct?

Yes ☐ No ☐ Can't tell ☐

You must give a reason for your answer. [1]

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(iii) Muzhir says,
"There is a higher proportion of dogs that are heavier than 35 kg in Glanafon than in Pencwm."

Without doing any calculations, decide if Muzhir is correct.

Correct ☐ Incorrect ☐ Can't tell ☐

You must give a reason for your answer. [1]

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(b) The estimate of the mean mass of the dogs in Glanafon was 32·5 kg.
How much less was the estimate of the mean mass of the dogs in Pencwm?
You must show all your working. [5]

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Estimate of the mean mass of the dogs in Pencwm is ..... kg less than in Glanafon.

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Examiner only

3. Jac is planning to visit the Empire State Building in New York.

(a) Planners had an original budget of \$60 million to construct the Empire State Building.
It actually cost \$41 000 000 to construct.

Complete the following statement.
Give your answer correct to 2 decimal places. [3]

Constructing the Empire State Building cost ..... % less than the original budget.

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(b) More than 4 million people visit the Empire State Building each year.
What is 4 million written in standard form?
Circle your answer. [1]

4×10^{-5} $0\cdot4\times10^{5}$ 4×10^{5} 4×10^{6} 4×10^{7}

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Examiner only

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

The conversion rate at the exchange shop is £1 = $1.25.
The exchange shop only has $10 notes and $50 notes.

Jac has exactly £350.
He wants to exchange as close to £350 as possible for US dollars ($).
He asks for as **few** notes as possible.

Calculate:
- how many $10 notes and how many $50 notes Jac gets
- how much he pays for his currency.

You must show all your working. [6 + 2 OCW]

Examiner only

4. (a) (i) A single tree can absorb 48 **pounds** of carbon dioxide per year.
Calculate the carbon dioxide absorbed per year by a forest of 440 of these trees.
Give your answer in **kilograms**. [2]

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Carbon dioxide absorbed per year is ..... kg

(ii) A forest of trees absorbs $2{\cdot}3 \times 10^{11}$ grams of carbon dioxide per year.
Which of the following is $2{\cdot}3 \times 10^{11}$?
Circle your answer. [1]

230 000 000 000 23 000 000 000 2 300 000 000 000

0·000 000 000 002 3 0·000 000 000 023

(b)

Remember:	$10\,000\,m^2 \approx 2{\cdot}47$ acres

A report states that a fire in a forest has a high risk of spreading when there are more than 60 trees per acre.

There are 615 trees in Grancwm Forest.
The forest covers an area of $40\,000\,m^2$.

Would a fire in Grancwm Forest have a high risk of spreading?

Yes ☐ No ☐

You must show all your working to support your answer. [4]

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Examiner only

(c) A vertical pine tree stands on horizontal ground.
From a point on the ground 21 metres from its base, the angle of elevation of the top of the pine tree is 39°.

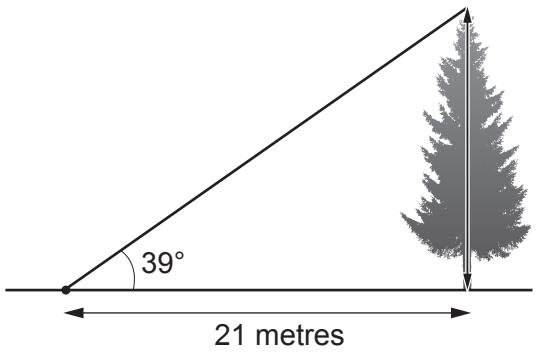

Diagram not drawn to scale

(i) Show that the pine tree has a vertical height of 17 metres. [3]

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(ii) A cylindrical log is cut from this pine tree.
The **circumference** of the cross-section of the log is 1·75 m.
The length of the log is half the height of the tree.

Calculate the volume of the log.
Give your answer in m^3.
You must show all your working. [5]

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Volume of the log is ..... m^3

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Examiner only

5. A car was bought in 1973 for £2500.

In the first year, this car depreciated by 23% of its value.
In each of the following 39 years, it depreciated by 4% of its value in the previous year.

The car then started to increase in value.
In each of the next 10 years, it increased by 14% of its value in the previous year.

Calculate the value of the car after these 50 years.
You must show all your working. [4]

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The value of the car after 50 years is £ .....

Examiner only

6. A solid statue is made from an alloy of copper and tin.
It has a volume of 150 cm^3.

(a) In the statue, the volume of copper and the volume of tin are in the ratio 22 : 3.

The density of copper is 8·96 g/cm^3.
The density of tin is 7·31 g/cm^3.

Calculate the mass of the statue.
You must show all your working. [4]

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(b) The height of the statue is 12 cm.
A larger statue is mathematically similar to this statue.
It has a height of 21·6 cm.
Calculate the volume of this larger statue. [3]

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Examiner only

7. Carys is buying a new caravan, priced at £20 000.
She is going to take out a loan to buy the caravan.

The table below shows her finance options.
The monthly payment is missing from Option B.

	Option A	Option B
Deposit	£0	£2000
Loan amount	£20 000	£18 000
Loan period	5 years	4 years
APR of the loan	3·3%	3·3%
Monthly payment	£362.05	

The formula for calculating the monthly payment on a loan is

$$M = \frac{r \times L}{1-(1+r)^{-n}}$$

where:

- M is the amount of each monthly payment
- L is the loan needed
- r is the **monthly** interest rate as a decimal
- n is the number of **months** taken to pay back the loan.

(a) Show that Carys's monthly payment for Option B would be £400.81, correct to the nearest penny. [3]

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(b) Carys chooses Option B, rather than Option A.
Calculate how much Carys would save on the total amount paid for the caravan. [3]

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Carys would save £ .....

Examiner only

8. Form-A-Part is a company that makes metal parts for use in engineering.

(a) A metal part is made from a circular disc with a piece cut out.
The part has uniform thickness, a diameter of 60 mm, and centre O.
The diagram below shows the cross-section of the metal part.

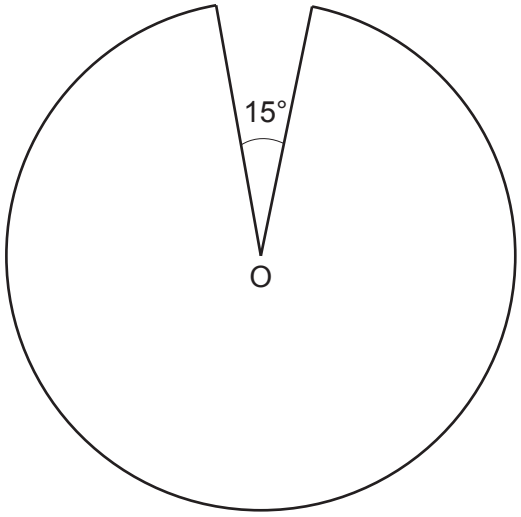

Diagram not drawn to scale

Calculate the perimeter of the cross-section of this metal part.
Give your answer correct to the nearest millimetre. [3]

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Perimeter of the metal part is ..... mm, correct to the nearest millimetre.

Examiner only

(b) The diagram below shows a metal part made by Form-A-Part.
Each part consists of a cone sitting on top of a hemisphere.
The diameter of the base of the cone and the diameter of the hemisphere are equal.

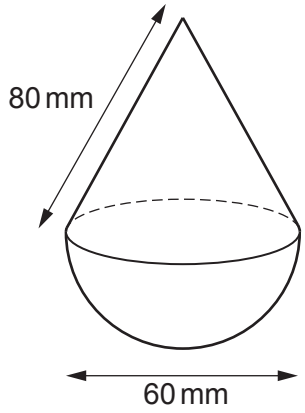

Diagram not drawn to scale

A customer has ordered 20 000 of these parts.

Form-A-Part has guaranteed that they will make all of the parts with the measurements shown in the diagram being **correct to the nearest mm**.

All 20 000 parts will be given a protective coating that comes in tins.
Each tin covers an area of 4 000 000 mm^2, **correct to the nearest 100 000 mm^2**.

Form-A-Part must **guarantee** that they have enough tins of protective coating to coat all 20 000 parts.
Calculate the minimum number of tins they will need.
You must show all your working. [6]

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Minimum number of tins needed to guarantee having enough coating = ...

Examiner only

(c) Form-A-Part has decided to randomly sample these 20 000 metal parts to check their quality.

Use the following list of random numbers to select the first 5 parts for the sample.
You must start with the first number in the list.
Explain clearly how you are using the numbers to select the sample. [3]

66923	01325	58552	86923
48925	72712	58033	18266
95775	51056	01325	81036
05929	10429	26883	45630
88925	24800	02891	38441

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The 5 parts selected will be

1st ..... 2nd ..... 3rd .....

4th ..... 5th .....

9. A helicopter flies from Swansea to Neath and on from Neath to Port Talbot.

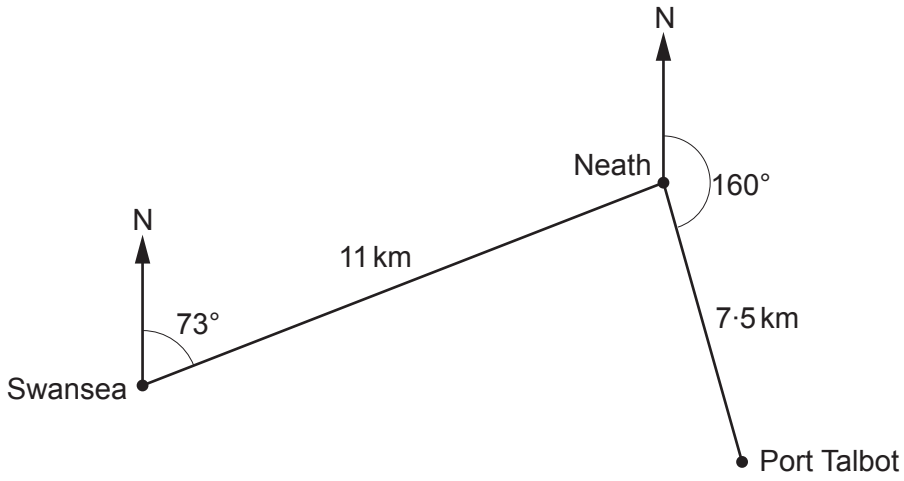

Diagram not drawn to scale

The bearing of Neath from Swansea is 073°.
The bearing of Port Talbot from Neath is 160º.

(a) By calculation, show that the bearing of Swansea from Neath is 253°. [1]

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(b) From Port Talbot, the helicopter flies directly back to Swansea.
Calculate the bearing of this flight from Port Talbot to Swansea. [7]

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Examiner only

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The bearing of the flight from Port Talbot to Swansea is ..... °

Examiner only

10. The diagram below shows the dimensions of a goal in football.
Players take a penalty kick from the penalty spot.
The penalty spot is 10·97 m from the goal line and central to the goal.

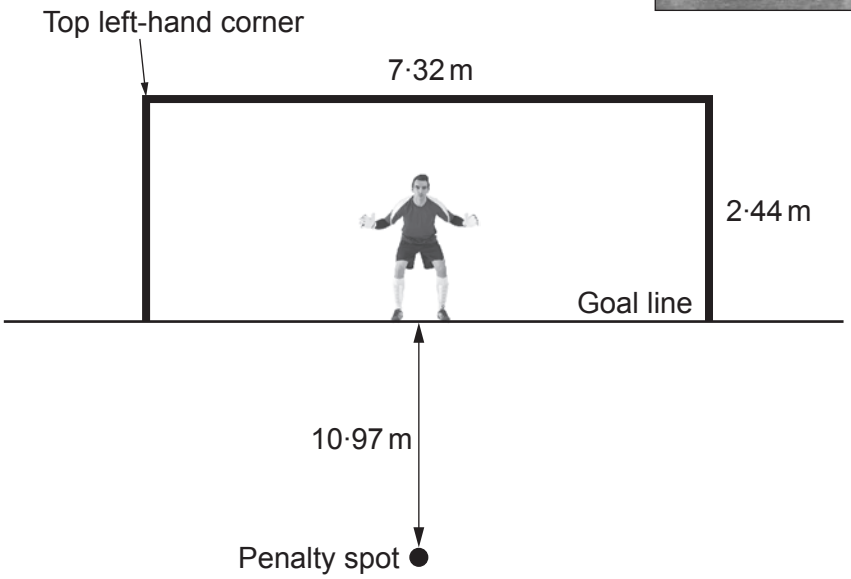

Diagram not drawn to scale

Mark takes a penalty kick.
He misses, and the ball hits the top left-hand corner of the goal.

Calculate the straight-line distance from the penalty spot to the top left-hand corner of the goal. [4]

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END OF PAPER

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

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