Surname	Centre Number	Candidate Number
Other Names		0

GCSE

3310U60-1

A18-3310U60-1

MATHEMATICS – NUMERACY
UNIT 2: CALCULATOR-ALLOWED
HIGHER TIER

THURSDAY, 8 NOVEMBER 2018 – MORNING

1 hour 45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**10**	
3.	**5**	
4.	**8**	
5.	**6**	
6.	**4**	
7.	**9**	
8.	**14**	
9.	**7**	
10.	**9**	
Total	**80**	

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

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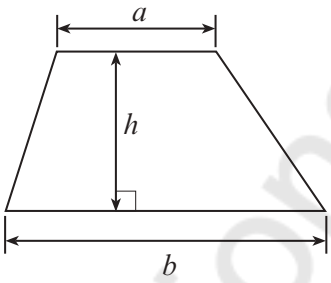
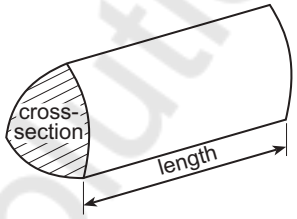
Formula List - Higher Tier

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



Volume of prism = area of cross-section × length

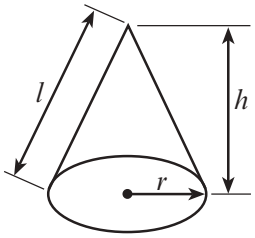


Volume of sphere = $\frac{4}{3}\pi r^3$

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

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

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

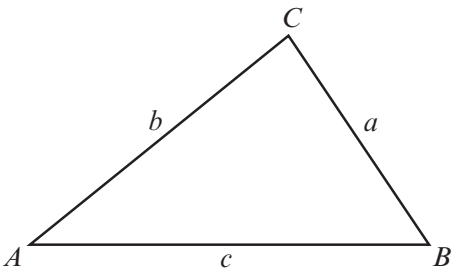


In any triangle ABC

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.

Examiner only

1. *Tube Cycles* makes a large number of bikes each day.

(a) On 1st December 2016, 4000 bikes were made at the *Tube Cycles* factory.
The *Tube Cycles* factory was working at 80% capacity on that day.
This means that only 80% of the maximum possible number of bikes were made.

When the factory works at 95% capacity, how many bikes are made in one day? [3]

$\frac{95 \times 4000}{80} = 4750$ cycles

(b) (i) In October 2018, the manager of the *Tube Cycles* factory recorded the number of bikes made each day.
Here are her results.

Number of bikes, b	Frequency
$1000 \leqslant b < 2000$	3
$2000 \leqslant b < 3000$	12
$3000 \leqslant b < 4000$	9
$4000 \leqslant b < 5000$	7

total = 31

Calculate an estimate of the mean number of bikes made per day during October 2018. [4]

$1500 \times 3 + 2500 \times 12 + 3500 \times 9 + 4500 \times 7 = 97500$

$\frac{97500}{31} = 3145.2$ cycles

(ii) Which group contains the **median** number of bikes made per day?
Circle your answer. [1]

$1000 \leqslant b < 2000$ $2000 \leqslant b < 3000$ $3000 \leqslant b < 4000$

$4000 \leqslant b < 5000$ Can't tell

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2. Emyr has set his lawn mower to work at a constant speed of 2000 m per hour.
He walks a distance of 300 m when he cuts his lawn.

(a) (i) Use this information to calculate how long Emyr takes to cut his lawn.
Give your answer in minutes. [2]

$\frac{300}{2000} \times 60 = 9$ minutes

It takes Emyr 9 minutes.

(ii) What assumption have you made? [1]

He walks in a straight line

(iii) What impact would this have on the time you calculated in answering *(a)*(i)? [1]

Could take longer

(b) Emyr cuts his lawn 25 times a year.
He uses 4·5 litres of petrol in his lawn mower each year.

How much petrol does the lawn mower use for every 100 metres that Emyr walks?
Give your answer in litres. [3]

$4.5 \times 25 \times 300 = 7500$ m

Cutting 100m uses $\frac{100 \times 4.5}{7500} = 0.06$ L

Examiner only

(c) Petrol costs £1.30 per litre.

Emyr says,
"The petrol for my lawn mower costs me approximately 60p per pint."

Is Emyr correct?
You must show all your working. [3]

Yes ☐ No ☑

1L = 1.75 pints
1 pint = 568ml
1 gallon = 8 pints
∴ 1 gallon = 4.5L

£1.30 / 1.75 = £0.73
≈ 73p ≠ 60p

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3. Amrit is planning to go to Switzerland.
The table below shows the rates for exchanging British pounds (£) and Swiss francs (CHF) at a money exchange shop.

Buy Swiss francs (CHF)	£1 buys 1.24 CHF
Sell Swiss francs (CHF)	1.28 CHF buys £1

The exchange shop:
- has all possible British notes and coins,
- sells and buys CHF **notes only** (no coins are available or accepted),
- has 10 CHF, 20 CHF, 50 CHF, 100 CHF, 200 CHF and 1000 CHF notes.

Amrit has £480 to buy Swiss francs.
Calculate
- the maximum number of Swiss francs that Amrit can buy, and
- how much, to the nearest penny, this will cost him.

You must show all your working. [5]

Change To CHF = 480 × 1.24

No coins = 590 CHF

Cost For Amrit = $\frac{590}{1.24}$ = £475.81

£475.81

Examiner only

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Turn over.

Examiner only

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

Luned's tent is in the shape of a triangular prism.
The cross-section of her tent is an isosceles triangle.

She noted a few measurements on a diagram of her tent, as shown below.

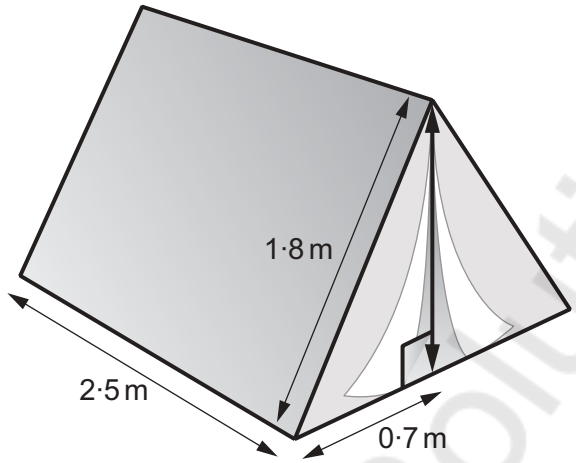


Diagram not drawn to scale

Calculate the volume of Luned's tent.
Give your answer in m^3.
You must show all your working. [5 + 2 OCW]

Pythagoras – $h^2 = 1.8^2 - 0.7^2$

$h = \sqrt{2.75} = 1.66\,m$

Volume of tent $= \frac{1}{2} \times (0.7) 2 + 1.66 \times 2.5$

$= 2.98\,m^3$

3

Volume of Luned's tent is ..... m^3

(b) Which of the following is equal to $0{\cdot}2\,m^3$?
Circle your answer. [1]

20 cm^3 200 cm^3 2000 cm^3 200 000 cm^3 2 000 000 cm^3

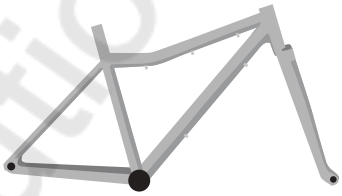
0.2×1000000

Examiner only

5. Cycle frames are made from steel, aluminium or carbon fibre.
The table below gives the density of steel, aluminium and carbon fibre.

Material	Density (g/cm^3)
Steel	7·8
Aluminium	2·7
Carbon fibre	1·6

Owain has a cycle frame made from aluminium.
His cycle frame has a mass of 9450 g.



(a) Calculate the volume of aluminium in Owain's cycle frame.
Give your answer in cm^3. [3]

Vol = $\frac{9450}{2.7}$ (aluminium)

= 3500 cm^3

Volume of aluminium in Owain's cycle frame is 3500 cm^3

(b) Bethan has a cycle frame that is identical to Owain's cycle frame.
However, her cycle frame is made from carbon fibre.
Calculate the mass of this frame.
Give your answer in grams. [3]

Mass = 1·6 × 3500

= 5600 g

Mass of this cycle frame is 5600 g

Examiner only

6. The diagram below is a sketch of the Eiffel Tower.
The sketch **is** drawn to scale.
The Eiffel Tower is 324 metres tall.
Visitors can climb up to the Level 2 viewing platform using the internal steps.

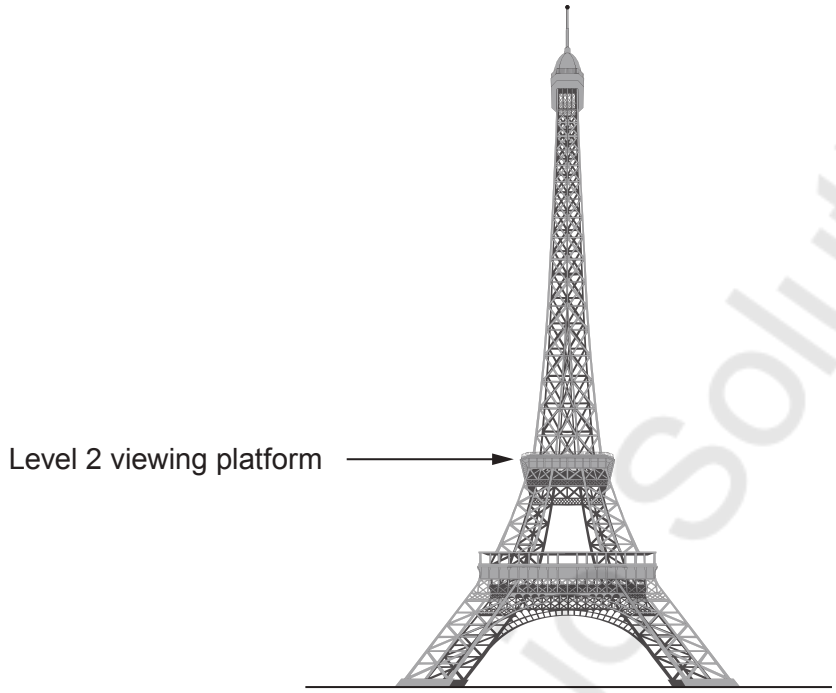


Diagram is drawn to scale

(a) Which of the following is a reasonable estimate of the number of steps from the ground to the Level 2 viewing platform? [1]

150 650 2500 3500 6500

324 x 2 = 648 ≈ 650 steps
(in feet)

Examiner only

(b)

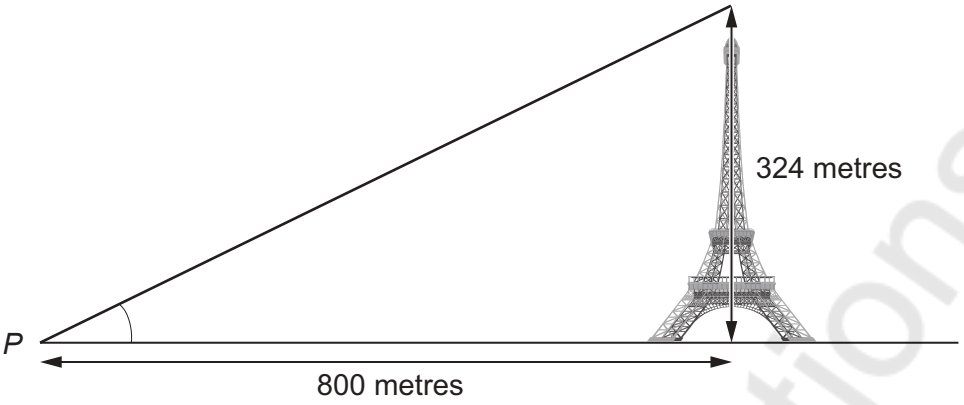


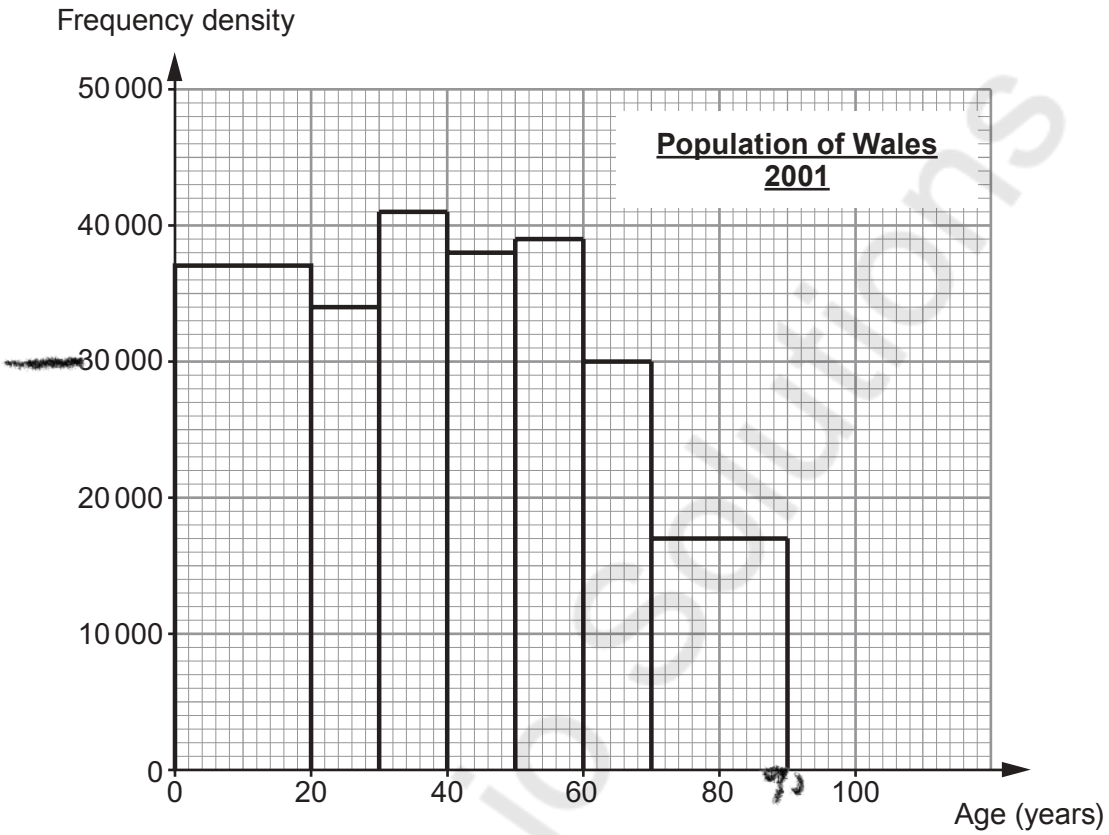
Diagram not drawn to scale

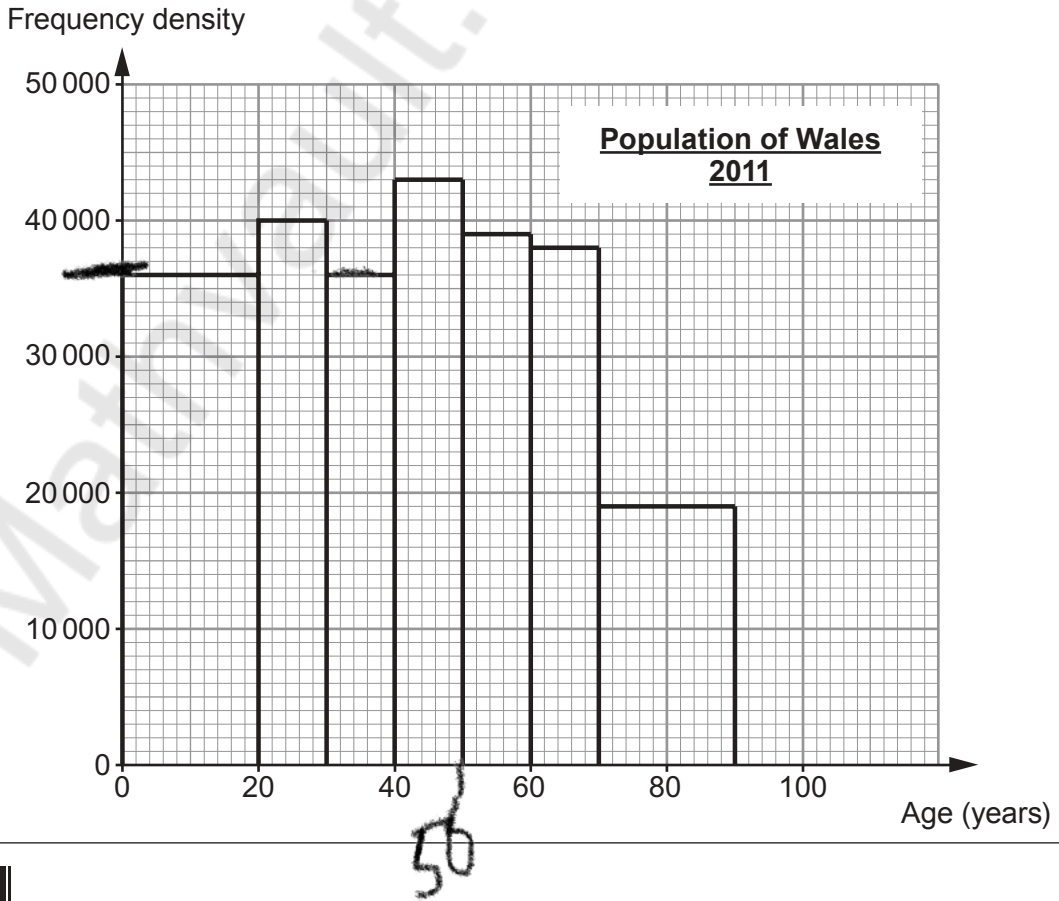
Calculate the angle of elevation of the top of the Eiffel Tower from the point *P*. [3]

$\tan^{-1}\left(\frac{324}{800}\right) = 22.0^\circ$

Examiner only

7. Danielle is studying the growth of the population of Wales.
She used the 2001 and 2011 Census data to draw these histograms.





Examiner only

(a) Use Danielle's histograms to answer the following questions:

(i) Circle the earliest decade in which anyone included in the histograms could have been born. [1]

1890–1899 1900–1909 1910–1919 1920–1929 1930–1939

2011 − 90 = 1911

(ii) From Danielle's histogram, the population of under-50s in Wales was 1 870 000 in 2001.
Calculate the **increase** in the population of under-50s in Wales from 2001 to 2011. [3]

Pop of <50s in 2011

36000 * 20 + 40000 × 10 + 36000 × 10

+ 43000 × 10 = 1 910 000

Increase = 1910000 − 1870000 = 40,000

(iii) The 60 to 69-year-olds saw the biggest increase in population from 2001 to 2011.
Calculate the **percentage** increase in the number of 60 to 69-year-olds from 2001 to 2011.
Give your answer to the nearest whole number. [3]

In 2001, 60–69 yr olds = 30 000

In 2011, 60–69 yr olds = 38000

Difference = 8000

% Increase = $\frac{8000}{30000} \times 100 = 27\%$

Examiner only

(b)

Age group	Population in 2001	Population in 2011
90 and over	19300	25200

The data in this table was also available to Danielle.
Explain why Danielle did not include this data in her histograms. [1]

- She did not know how wide to make the bars

OR

- It does not tell how old the oldest people were

(c) The number of 40 to 49-year-olds in 2011 was different to the number of 30 to 39-year-olds in 2001.
Give a full explanation for what could have caused this. [1]

An increase in the population in this age group could have caused this. Eg More people came to live in Wales than left Wales

Examiner only

8. Heledd is the captain of a cargo ship. She is planning her next voyage.

(a) Heledd has been employed to deliver 3×10^5 tonnes of sand.

Heledd needs to know the volume of the sand before the sand can be loaded on to the ship.
She has been given the following information about the sand:

Mass of a grain of sand	Volume of a grain of sand
$1{\cdot}2 \times 10^{-3}$ grams	$0{\cdot}32\,mm^3$

(i) Calculate the number of grains of sand in 3×10^5 tonnes of sand.
Give your answer in standard form. [3]

$\frac{3 \times 10^{14}}{1.2 \times 10^{-3}}\,g = 2.5 \times 10^{17}$

(ii) Calculate the volume of the 3×10^5 tonnes of sand in $\mathbf{m^3}$. [3]

Vol of sand

$= \frac{2.5 \times 10^{14} \times 0.32}{10^9}$

$= 80\,000\,m^3$

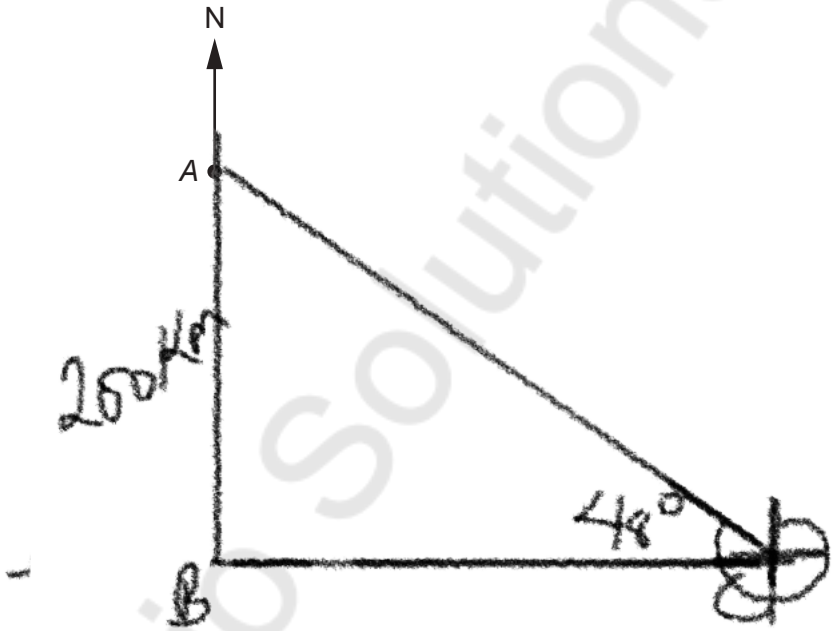
80000 m^3

Examiner only

(b) Heledd has been given the following instructions for her voyage:

- From port *A*, sail 200 km due south to port *B*.
- From port *B*, sail due east to port *C*.
- From port *C*, sail on a bearing of 318º back to port *A*.

Use the space below to draw a sketch of the ship's voyage.



Calculate the distance from port *C* directly back to port *A*. [4]

distance = $\frac{200}{\cos(42°)}$ = 269.1 km

Examiner only

(c) The last time the cargo ship was unloading sand in port *B*, it took 3 cranes 45 hours to unload 250 000 tonnes of sand.

Port *B* now has 5 cranes.
Calculate the time it will take 5 cranes to unload 300 000 tonnes of sand.

You can assume that all cranes unload sand at the same rate, and that all other conditions remain the same.

Give your answer in **hours** and **minutes**.
You must show all your working. [4]

$$\frac{45 \times 3 \times 300000}{5 \times 250000}$$

$$= 32.4$$

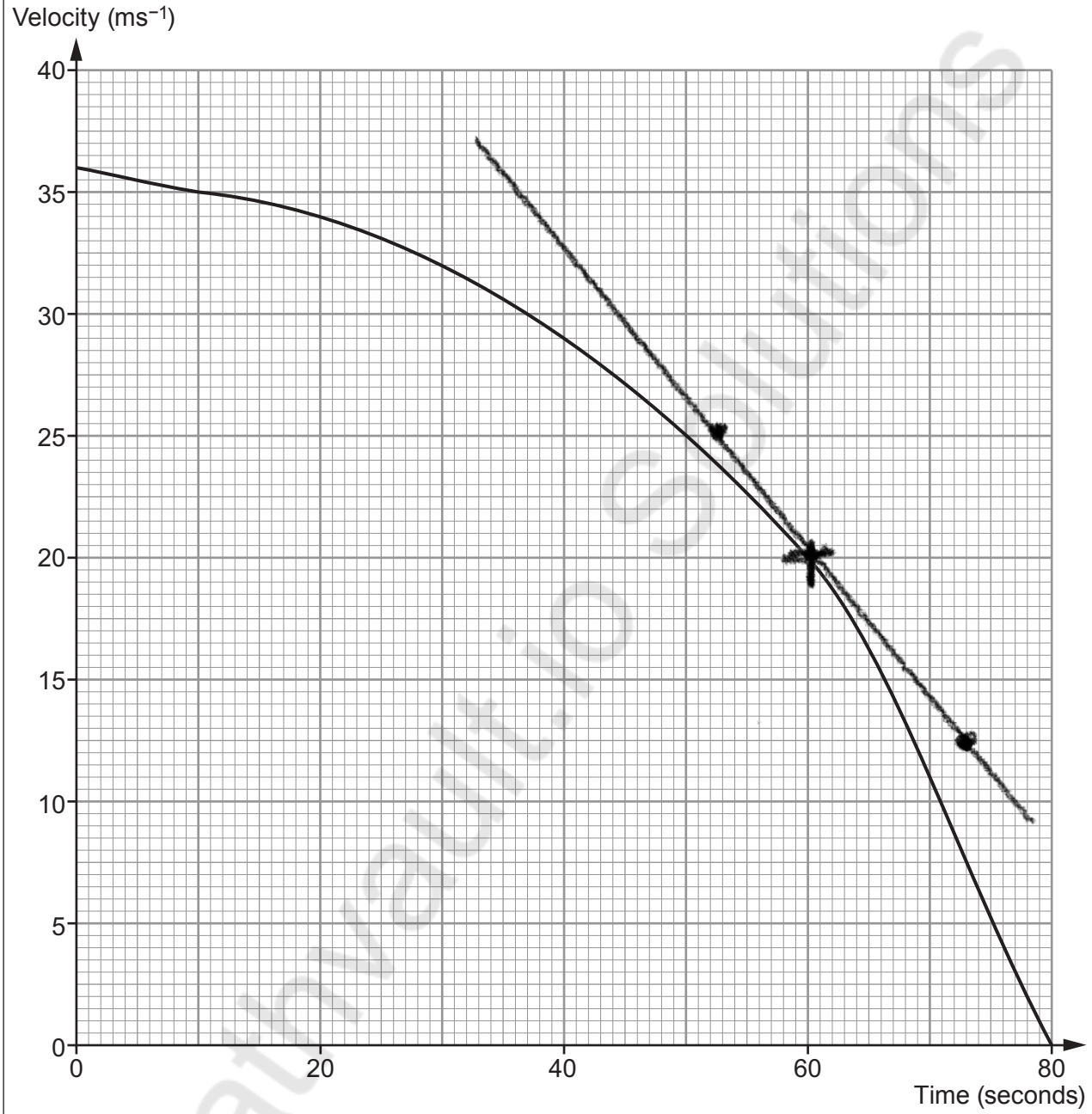
Convert to hours & mins

$= 32$ hrs $(0.4 \times 60) = 24$ mins

Time it will take is 32 hours and 24 minutes

Examiner only

9. A train manufacturer has developed a new braking system.
The velocity-time graph shows the velocity of a train from when the new brakes are applied until it comes to rest.



(a) Estimate the train's deceleration at time 60 seconds. [3]

(52, 25) (63, 12.5)

$\frac{\Delta v}{\Delta t} = \frac{12.5 - 25}{63 - 52} = \frac{-12.5}{13}$

Deceleration = 0.96

Examiner only

(b) (i) Calculate an estimate of the distance travelled by the train from the instant the brakes are applied until it comes to rest.
You must use exactly 4 strips of equal width. [3]

Using 4 strips of equal width

$\frac{(36+34)}{2} \times 20 + \frac{(34+29)}{2} 20 + \frac{29+20}{2} \times 20$

$+ \frac{20+0}{2} \times 20$

$= 2020\text{m}$

(ii) Explain how you could use the graph to gain a more accurate estimate of the distance travelled. [1]

- increase the number of strips
ie make the strips smaller

Examiner only

10. Gardeners can apply weedkiller to large areas of land by using a spray gun. Weedkiller is stored in a large bottle that gardeners carry on their backs, and this feeds the spray gun.

A gardening company has designed the bottle shown below.
It consists of a hollow cylinder and cone that are joined.

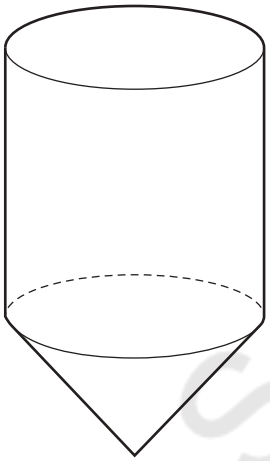


Diagram not drawn to scale

The base radius of the cone and the radius of the cylinder are both 9 cm.
The height of the cylinder is four times the vertical height of the cone.

The bottle has been designed so that it has a capacity of 10 litres.

(a) Calculate the total height of the bottle. [7]

Vol of Cone $= \frac{1}{3} \times \pi \times 9^2 \times h$

Vol of cylinder $= \pi \times 9^2 \times 4h$

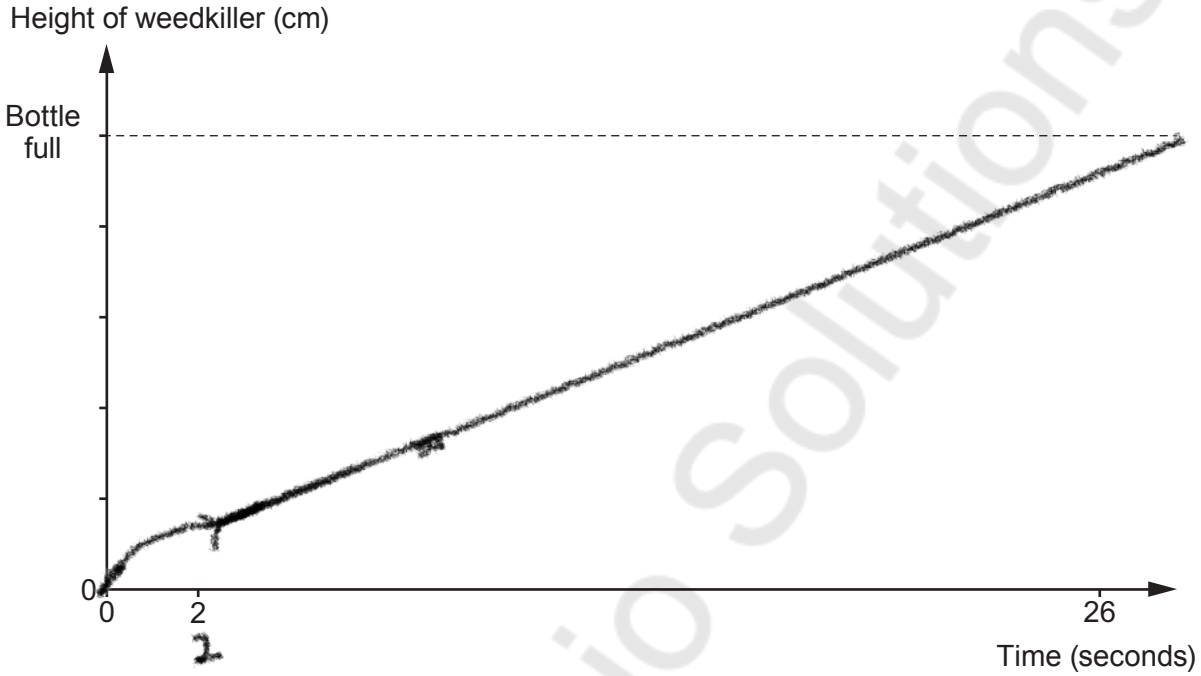
$10000 = \pi \times 9^2 \times 4h + \frac{1}{3} \times \pi \times 9^2 \times h$

$h = \frac{10000 \times 3}{13 \times \pi \times 9^2} = 45.38$

Total height of the bottle = 45.4 cm

Examiner only

(b) Weedkiller is poured into the bottle at a constant rate.
The cone is full of weedkiller after 2 seconds.
The bottle as a whole is full after 26 seconds.
Using the axes below, sketch a graph of the height of weedkiller in the bottle during the 26 seconds it takes to fill. [2]



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

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