THIS IS A NEW SPECIFICATION

RECOGNISING ACHIEVEMENT

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Wednesday 13 June 2012 – Morning

GCSE APPLICATIONS OF MATHEMATICS

A382/02 Applications of Mathematics 2 (Higher Tier)

Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:
- Scientific or graphical calculator
- Geometrical instruments
- Tracing paper (optional)

Duration: 2 hours

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Your answers should be supported with appropriate working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

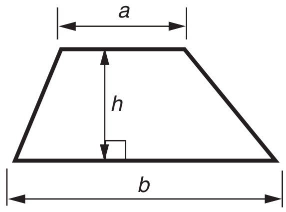
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- Your Quality of Written Communication is assessed in questions marked with an asterisk (*).
- The total number of marks for this paper is **90**.
- This document consists of **20** pages. Any blank pages are indicated.

You are permitted to use a calculator for this paper

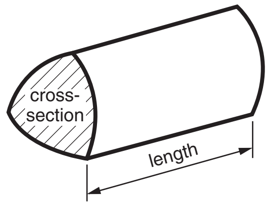
This paper has been pre modified for carrier language

Formulae Sheet: Higher Tier

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



Volume of prism = (area of cross-section) × length

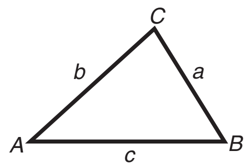


In any triangle *ABC*

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

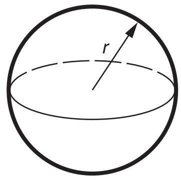
Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

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



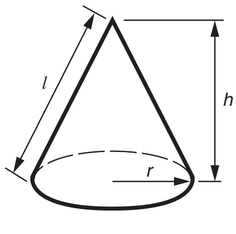
Volume of sphere $= \frac{4}{3}\pi r^3$

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



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

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



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$,
where $a \neq 0$, are given by

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

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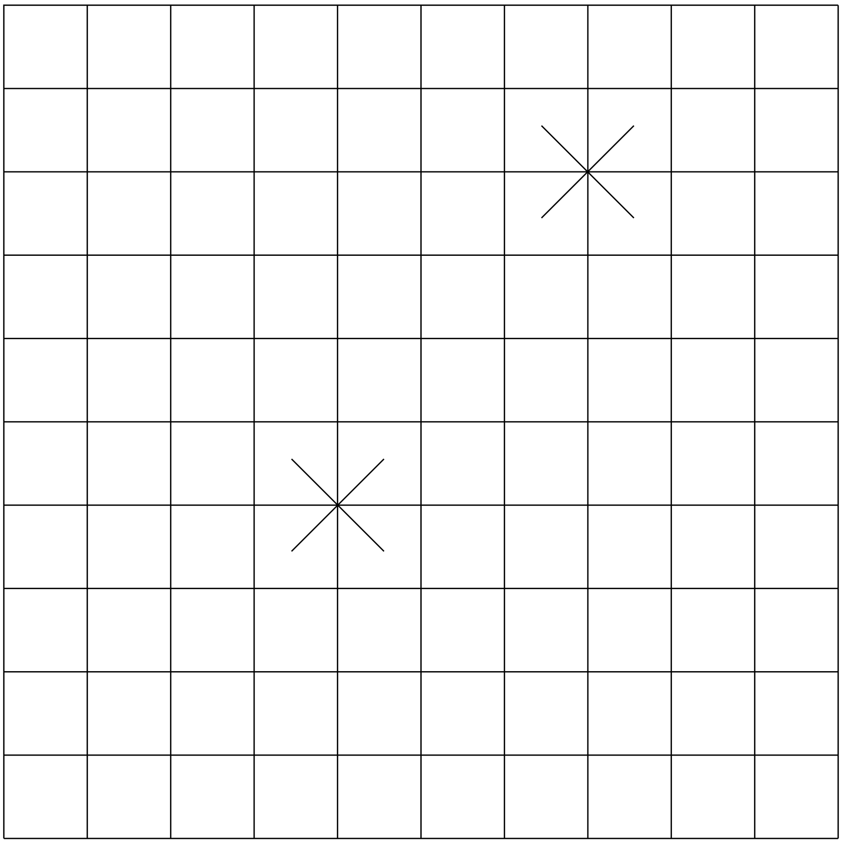
1 Josh and Reuben make a target with a square grid.

They each throw a dart at the target.
The crosses (X) mark the positions where the two darts hit the target.



The origin (0, 0) is not marked on the grid.
The point where Josh's dart hits the target has the coordinates (3, 2).
Either of the crosses could be this point.

(a) On the target, mark the two possible positions of the origin. **[1]**

(b) Write down the coordinates of the two possible positions of Reuben's dart.

(b) (_____, _____) and (_____, _____) **[2]**

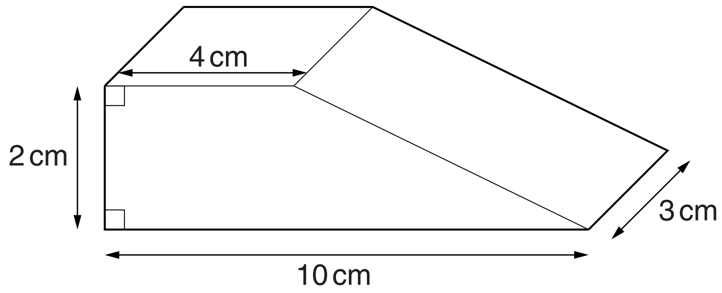
Anna throws a dart at the target.
It lands exactly half way between Josh's and Reuben's darts.

(c) Write down **one** possible set of coordinates for the position of Anna's dart.

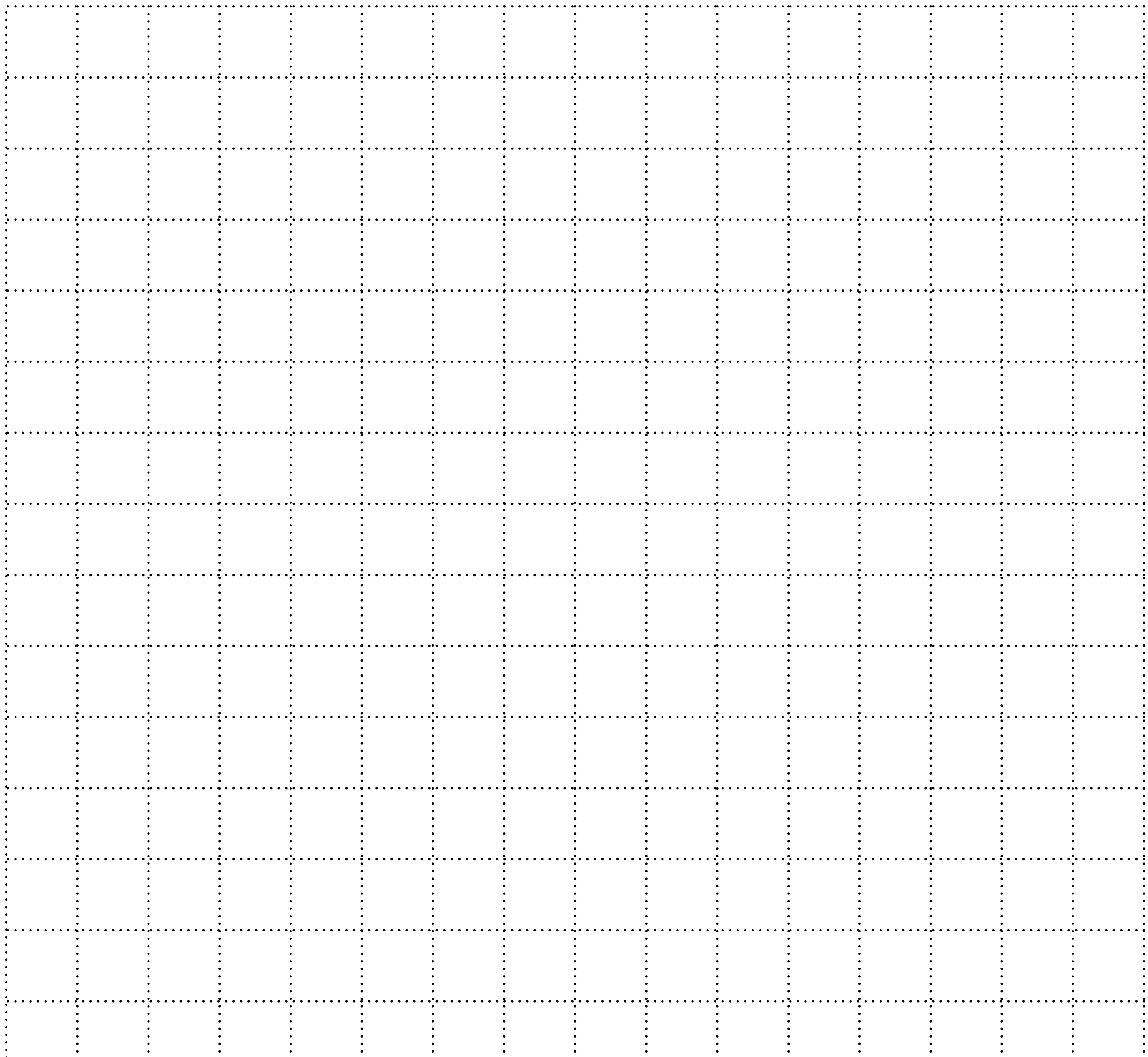
(c) (_________, _________) **[1]**

2 Anil designs this door wedge.
The top and the base are rectangles.

This is a 3-D drawing of the door wedge.

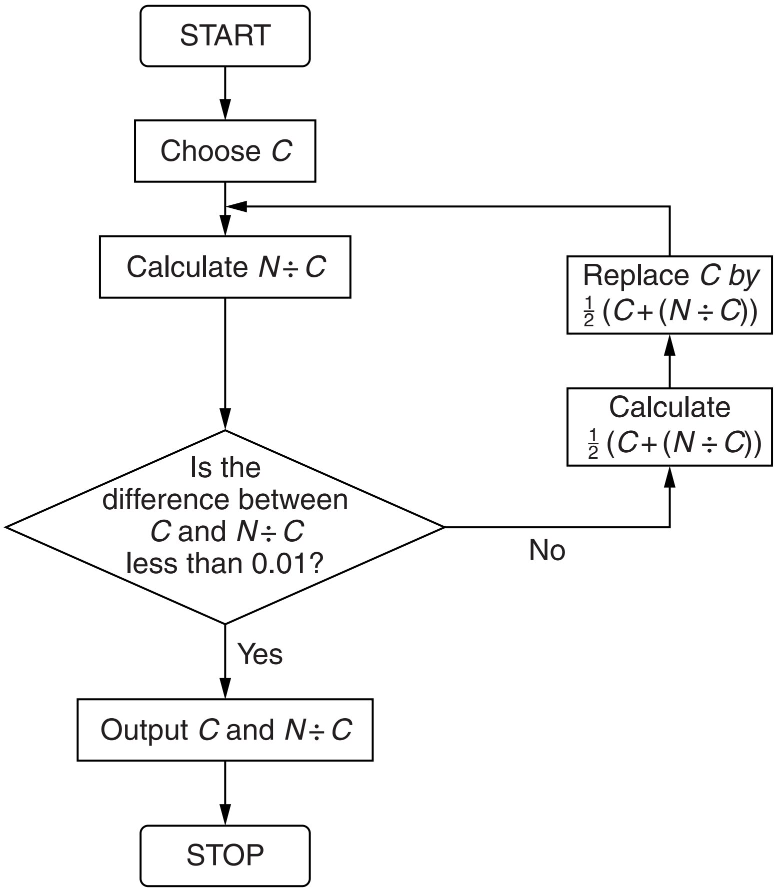


Draw full size the plan view, a front view and a side view of the door wedge.



[6]

3 Hero was a mathematician who lived in ancient Greece.
He used the method shown in this flow diagram to find an approximate square root, C, of a number N.



(a) Use the flow diagram to find the approximate square root of 29.
Start with $C = 5$ and $N = 29$.
Complete the table to show each step of your working.

C	***N* ÷ *C***	**Difference between *C* and *N* ÷ *C***	$\frac{1}{2}(C+(N \div C))$
5			

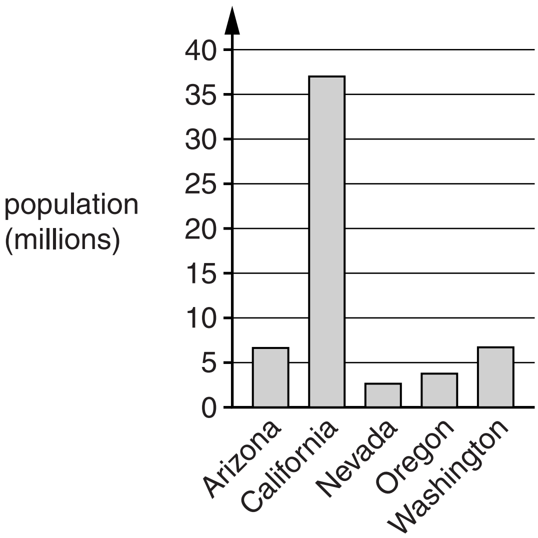
[5]

(b) Use the values in the bottom row of your table to write down $\sqrt{29}$ correct to 4 significant figures.

(b) $\sqrt{29}$ = ________________________ **[1]**

4 The diagram shows a sketch map of five states in the USA.
It is drawn approximately to scale.

The bar chart shows the population of each of the five states.



Nevada has the smallest number of people per square kilometre of the five states.

Use the information from the sketch map **and** the bar chart to write the names of the five states in the order of their number of people per square kilometre.

Number of people per square kilometre **State**

smallest: Nevada

____

____

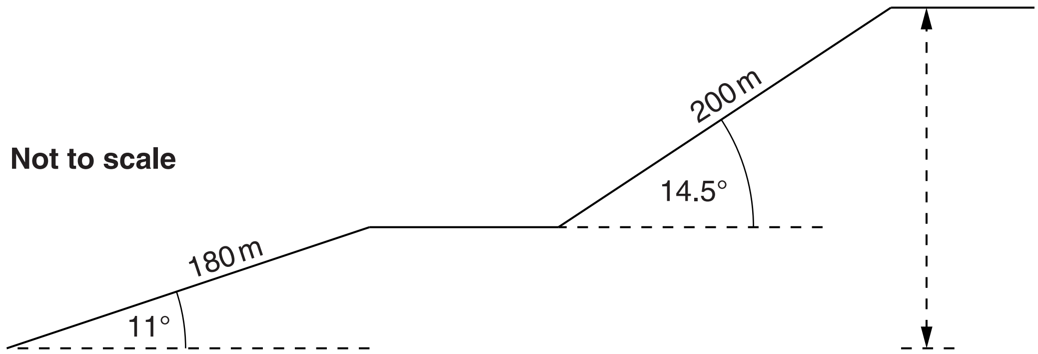
____

largest: ______________________

[4]

5 Drag lifts at ski resorts allow skiers to travel up ski slopes.
At a ski resort there is a drag lift with two places for skiers to get off.

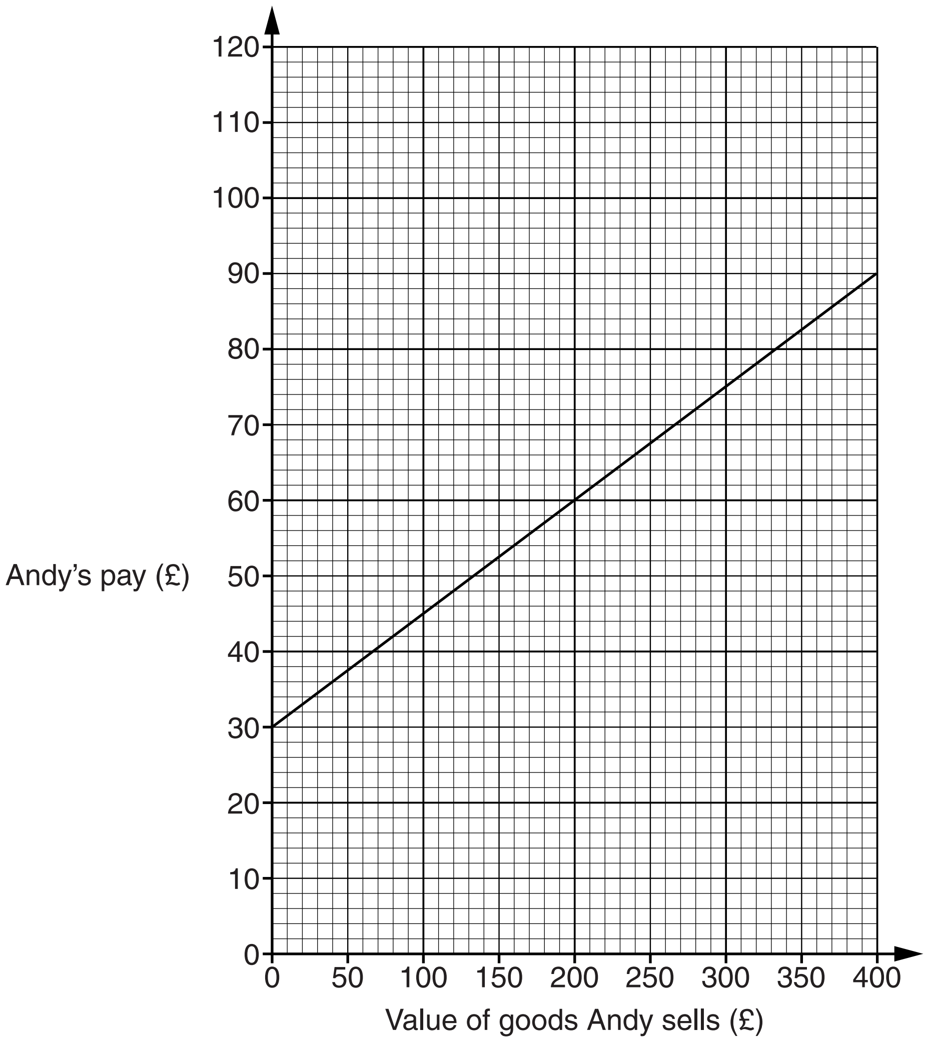
The first section of the drag lift is 180 m long. It is inclined at 11° to the horizontal.
The second section of the drag lift is 200 m long. It is inclined at 14.5° to the horizontal.



How much higher is the top of the drag lift than the bottom of the drag lift?

_____________________________ m **[5]**

6 Andy works part time as a salesman. He is paid each week.
His pay is a fixed amount plus a percentage of the value of the goods he sells.
The graph shows Andy's pay for different values of goods that he sells.



(a) What is Andy's pay when the value of goods he sells is £300?

(a) £ ______________________________ **[1]**

(b) One week Andy's pay is £48.

What is the value of the goods Andy sells?

(b) £ ______________________________ **[1]**

(c) How much is the fixed amount of Andy's pay?

(c) £ ______________________________ **[1]**

(d) Andy gets a percentage of the value of the goods he sells.

What percentage is this?

(d) ______________________________ % **[2]**

Andy's manager introduces a new method to work out Andy's pay each week.
Now Andy is paid 35% of the value of the goods he sells, but no fixed amount.

(e) **(i)** Draw a line on the graph to show Andy's pay using this new method.

[3]

(ii) What value of goods must Andy sell to receive the same pay using either method?

(e)(ii) £ ______________________________ **[1]**

(f) Andy works 7 hours each week.
He should be paid at least a minimum wage of £6.08 per hour.

(i) What is the minimum that Andy should be paid each week?

(f)(i) £ ______________________________ **[1]**

(ii) Work out the exact value of the goods Andy must sell to receive the minimum pay using the manager's new method.

(ii) £ ______________________________ **[3]**

7 Peter recorded the speeds of 200 motorbikes travelling along a road in a built up area in 2009. The table summarises his results.

Speed, v (mph)	**Number of motorbikes**
$0 < v \leqslant 10$	16
$10 < v \leqslant 20$	32
$20 < v \leqslant 30$	44
$30 < v \leqslant 40$	68
$40 < v \leqslant 50$	32
$50 < v \leqslant 60$	8

(a) Write down the modal class for the speeds of these motorbikes.

(a) ______________________________ **[1]**

(b) Calculate an estimate of the mean speed of these motorbikes.

(b) __________________________ mph **[4]**

The speed limit on the road is 30 mph.

(c) Do motorcyclists on this road generally ride within the speed limit?
Explain your answer.

____

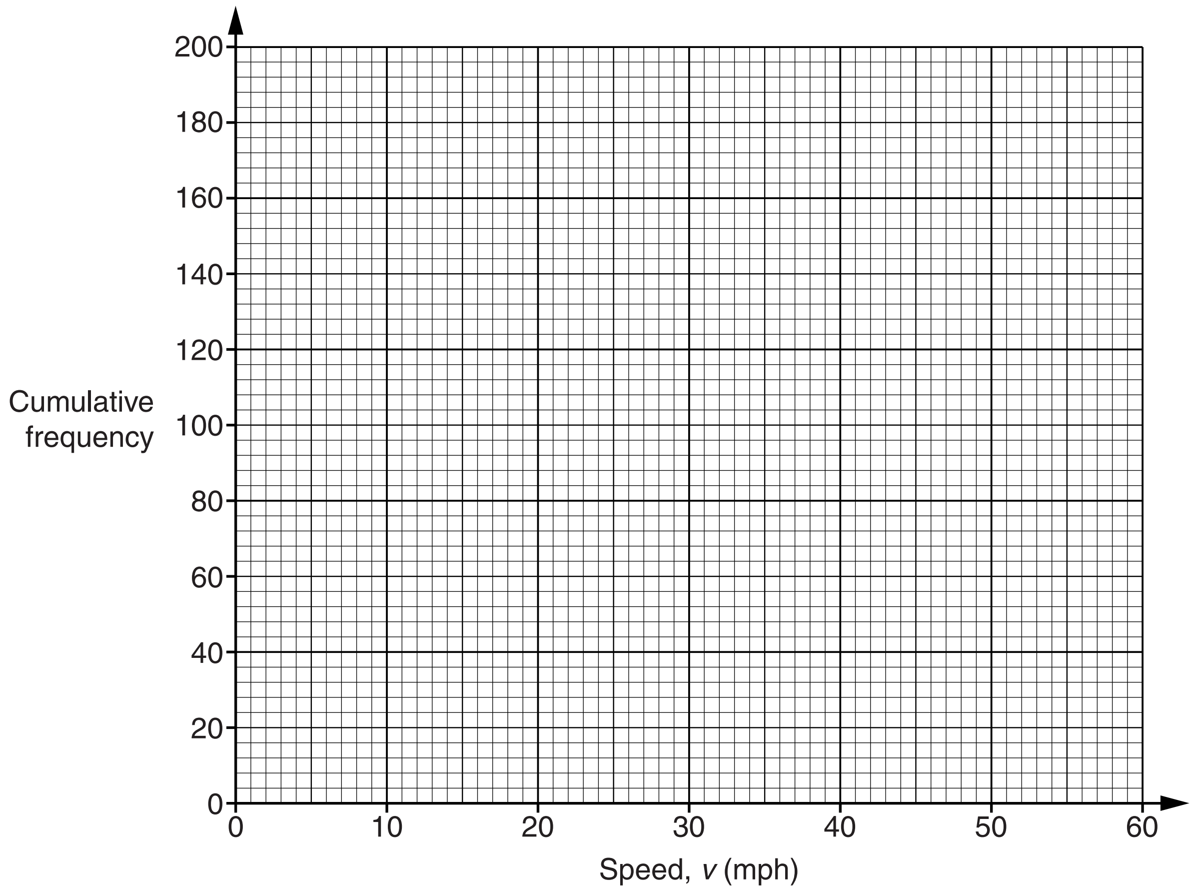
____ **[1]**

(d) **(i)** Complete the cumulative frequency table for Peter's results.

Speed, v (mph)	$v \leqslant 10$	$v \leqslant 20$	$v \leqslant 30$	$v \leqslant 40$	$v \leqslant 50$	$v \leqslant 60$
Number of motorbikes						

[1]

(ii) Use your table to draw a cumulative frequency graph.



[3]

(iii) Use your graph to estimate the median speed.

(d)(iii) ________________________ mph **[1]**

(e) A Department for Transport report stated that

> 'In 2009, over half of all motorcycles travelled faster than the 30 mph speed limit in built up areas. Forty three per cent exceeded the speed limit by 5 mph or more.'
>
> *Road Statistics 2009: Traffic, Speeds and Congestion*

Does Peter's data for the 200 motorcyclists support the Department for Transport report? Justify your answers for each of the two statements in the report.

____

____

____

____ **[4]**

8 In this question use $\pi = 3.142$.
Cyclists use different gear ratios to go at different speeds.
On a bicycle with a 1:1 gear ratio, each time the rider turns the pedals once, the back wheel rotates once.

(a) The back wheel of Sheena's bicycle has diameter 650 mm.
The gear ratio is 1:1 and Sheena turns the pedals 40 times each minute.

How far does Sheena travel in one hour?
Give your answer in kilometres.

(a) ______________________ km **[4]**

(b) On a bicycle with a 3:1 gear ratio, each time the rider turns the pedals once, the back wheel rotates three times.

The back wheel of Jane's bicycle also has a diameter of 650 mm.
The gear ratio is 3:1 and Jane turns the pedals 40 times each minute.

How far does Jane travel in one hour?
Give your answer in kilometres

(b) ______________________ km **[1]**

(c)* Chris cycles on a velodrome track.

A velodrome track bicycle has only one gear ratio.

Gear ratio is the ratio

number of teeth on the front sprocket : number of teeth on the back sprocket

The back wheel of Chris's bicycle has diameter 710 mm.

He trains to turn the pedals 120 times each minute.

If Chris uses sprockets with 51 teeth and 15 teeth will he achieve his target speed of 60 kilometres per hour?

[5]

9 An insurance company calculates annual insurance premiums using this formula.

$$\text{Annual premium} = N \times \mu \times \left(1 + \frac{p}{100}\right)$$

where N is the probability of having a claim
μ is the likely amount paid out per claim
p is the percentage profit the company charges

The company calculated these annual insurance premium quotes for some customers.

Insurance type	Summary of information	N	μ	p	Annual premium
Car	Sam, 55 years old, drives a Golf, no accidents in past 5 years	0.12	£2080	25%	£312
Car	Ann, 55 years old, drives a Golf, no accidents in past 5 years	0.075	£3200	30%	
Pet	Tabitha, 4 year old cat	0.05		20%	£150
Alien abduction	Customer requests £1 million to be paid out if abducted by aliens				£80

(a) Does the insurance company think that Sam is more likely than Ann to have an accident? Use figures from the table to explain how you know.

__________ because ____

____ **[1]**

(b) Show that Ann's annual premium is £312.

____

____ **[1]**

(c) Work out the likely amount the insurance company will pay out on a claim for Tabitha, the cat.

(c) £ ______________________ **[3]**

(d) The company works out the alien abduction annual premium. It is £80.

Write down the value they used for μ.

The company chose a value of 0.000 005 for N. Give a reason why this value of N is appropriate.

Work out the value for p.

μ = £ ______________________

N = 0.000 005

because ____

____

p = ______________________ % **[5]**

10 In this question use $\pi = 3.142$.
A timer is made by joining two congruent frustums of cones.

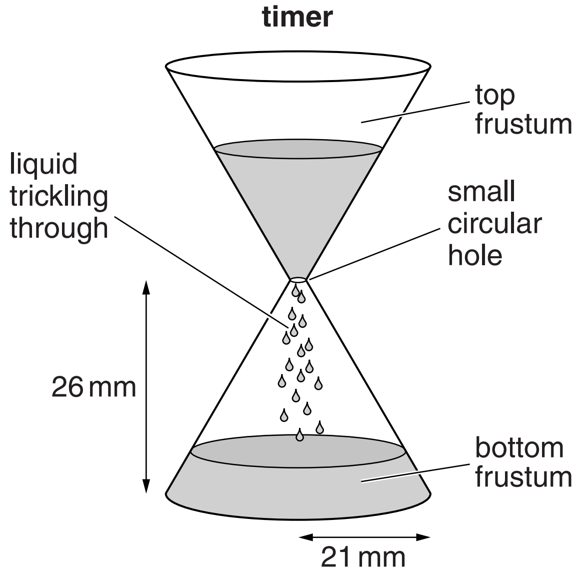
There is liquid in the top frustum.
The liquid trickles down through a small circular hole into the bottom frustum.

All the liquid trickles through the hole in exactly 60 seconds.

The radius of the top and bottom of the timer is 21 mm.

The radius of the small circular hole is 1.5 mm.

The height of each frustum is 26 mm.



(a) Show that the **full** height of each cone is 28 mm.

____

____

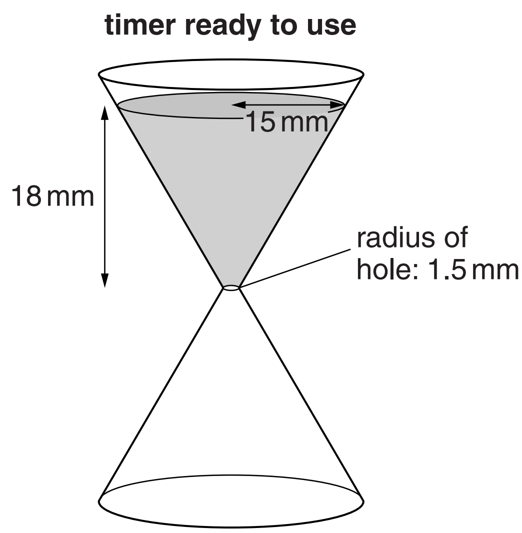
____ **[2]**

There is not enough liquid in the timer to completely fill one frustum.

When the timer is ready to use all the liquid is in the top frustum.

The depth of liquid in the top frustum is 18 mm.

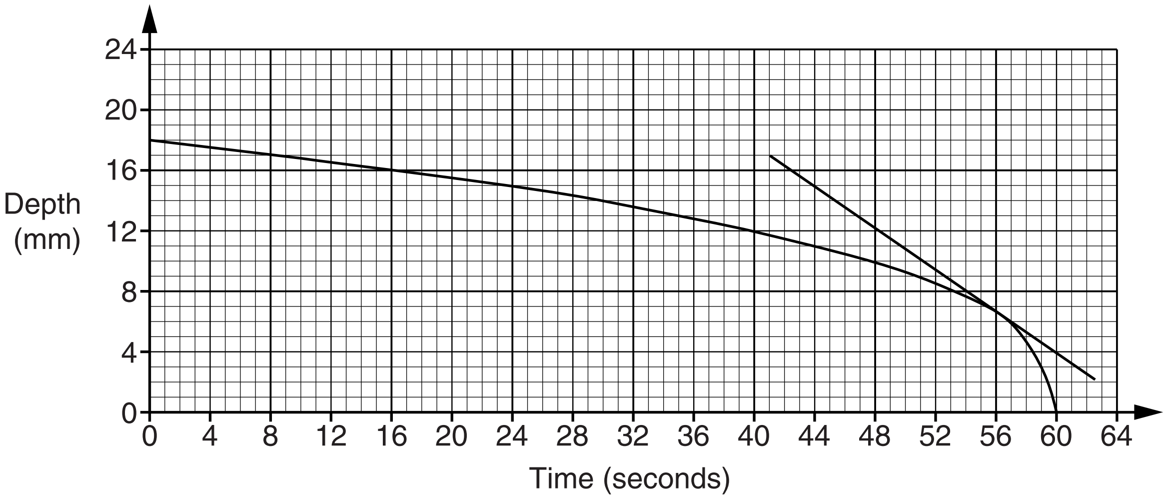
The radius at the top of the liquid is 15 mm.



(b) Work out the volume of liquid in the timer.

(b) ________________________ mm^3 **[4]**

(c) The graph shows the depth of liquid in the top frustum of the timer in the minute it takes to trickle down.



A tangent to the curve has been drawn at 56 seconds.

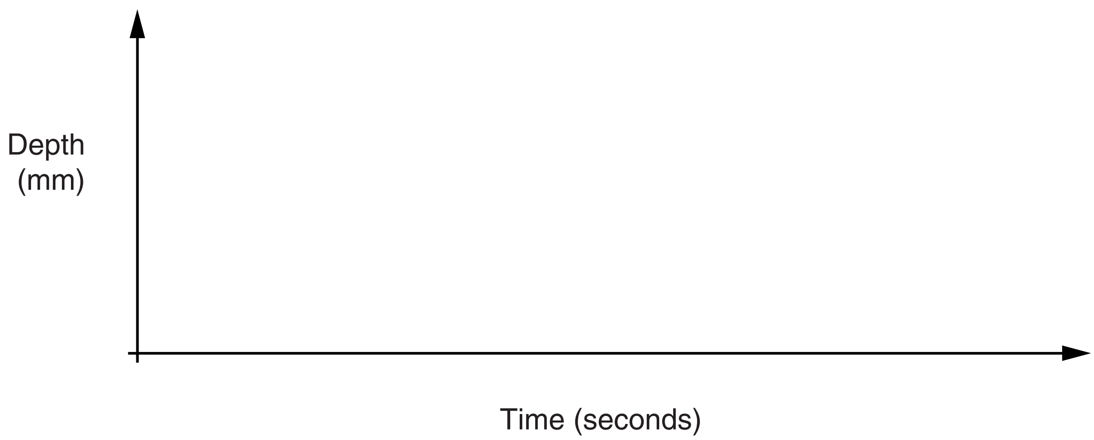
(i) Work out the gradient of the tangent.

(c)(i) __________________________ **[3]**

(ii) What does the gradient represent?

____ **[1]**

(d) Sketch a graph of the depth of liquid in the bottom frustum of the timer from the time that it begins to trickle down.



[2]

11 In 1851, 12 wild rabbits were released in Australia and allowed to breed.
In 1950, 99 years later, the rabbit population in Australia was estimated to be 600 million.

Jason models the population, P, of rabbits in Australia using this formula.

$$P = \mathrm{a} \times \mathrm{b}^t$$

where t is the number of years since 1851 and a and b are constants.

(a) Explain why a = 12.

____

____ **[1]**

(b) Work out the value of b and hence state the annual percentage increase from 1851 to 1950 in the rabbit population in Australia using this model.

(b) b = ______________________________ and

annual percentage increase = ______________________________ % **[4]**

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