Surname	Centre Number	Candidate Number
Other Names		0

GCSE LINKED PAIR PILOT

4361/02

W16-4361-02

APPLICATIONS OF MATHEMATICS

UNIT 1: Applications 1
HIGHER TIER

A.M. WEDNESDAY, 13 January 2016

2 hours

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**4**	
2.	**6**	
3.	**7**	
4.	**8**	
5.*(a)(b)*	**7**	
5.*(c)(d)*	**9**	
6.	**9**	
7.	**9**	
8.*(a)(b)*	**9**	
8.*(c)*	**6**	
9.	**11**	
10.	**15**	
Total	**100**	

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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.

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.

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.

You are reminded that assessment will take into account the quality of written communication (including mathematical communication) used in your answer to question **5***(d)*.

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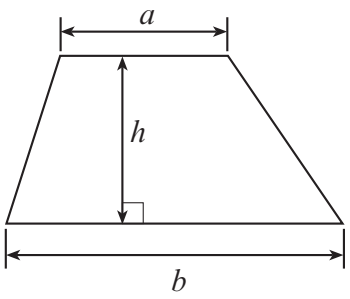
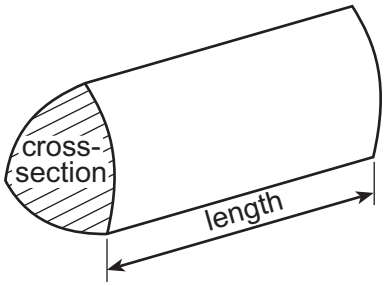
Formula List

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

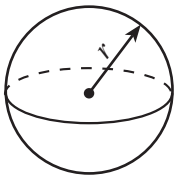


Volume of prism = area of cross-section × length



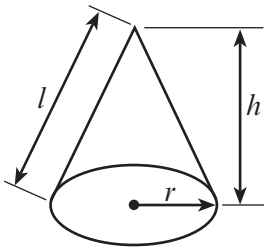
Volume of sphere = $\frac{4}{3}\pi r^3$

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



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

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

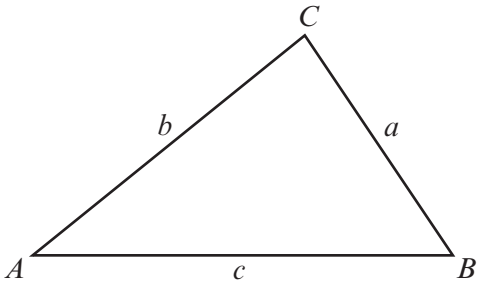


In any triangle ABC

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

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1. The diagram below shows a plan of paths within a park.
Write down the sizes of the missing angles. [4]

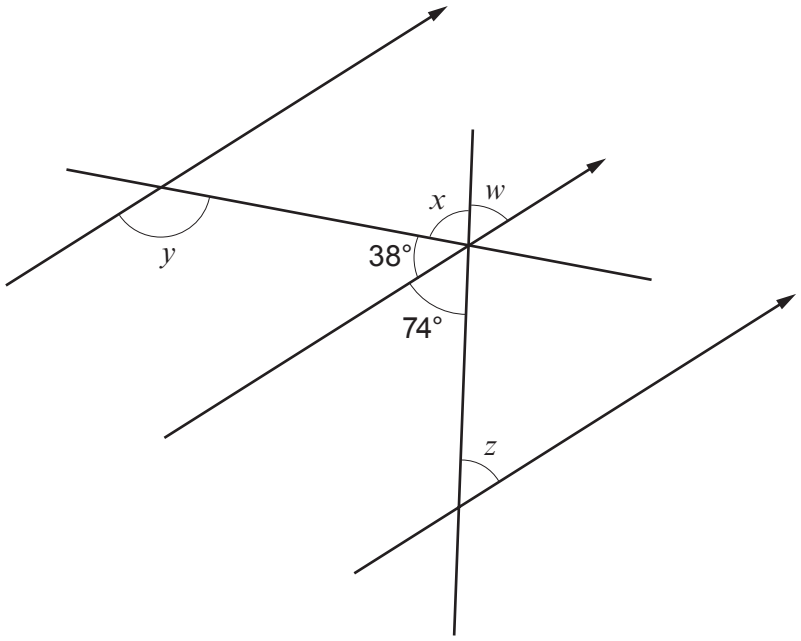

Diagram not drawn to scale

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w = ... ° x = ... ° y = ... ° z = ... °

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2. A company makes stainless steel cutlery.

Each production run takes 35 minutes.

There are 6 forks, 7 knives, 4 soup spoons and 21 teaspoons made in each production run.

There is a 5 minute break between each production run.

The first production run starts at 9 a.m.

(a) How many soup spoons have been produced by 11 a.m.?
You must show all your working. [2]

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(b) 252 teaspoons are produced by the end of the working day.
How many knives have been produced? [2]

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(c) After how many production runs will there be 52 more forks than soup spoons? [2]

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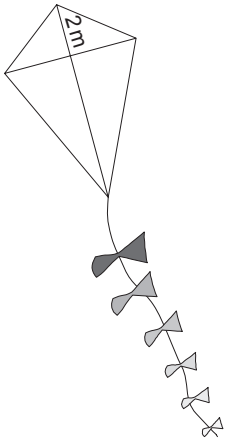
3. Rowena decides to make a scale drawing of a kite without its tail.



The lengths of the diagonals of this kite are 3 m and 5 m.
The two diagonals meet at a point.
The length of the longer diagonal above this point is 2 m.

(a) Rowena decides to use a scale of 2 cm to represent 1 m.

Draw the scale drawing of the kite for Rowena. [5]

Scale:
2 cm to represent 1 m

(b) To cut the fabric to make the kite, Rowena needs to measure the size of the angle at each of the vertices.
Write down the size of these angles. [2]

..... ° ..... ° ..... ° and ..... °

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Turn over.

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4. Luke plans to make a bird feeder box with a completely open front.

Luke has made a sketch of the **back** of the bird feeder box, as shown.

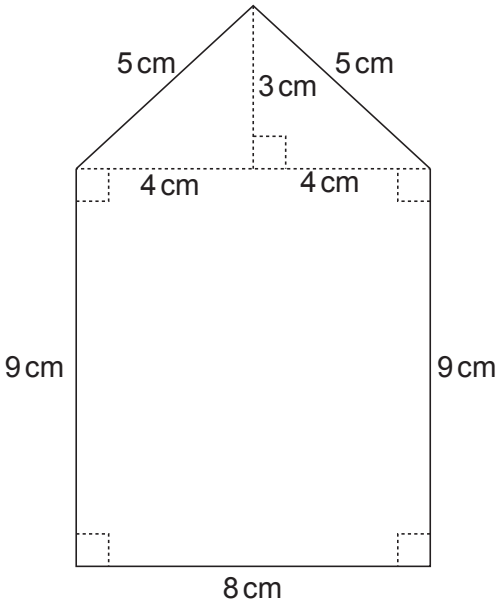

Diagram not drawn to scale

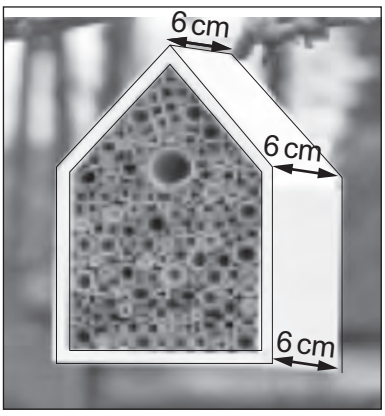

Diagram not drawn to scale

The **depth** of the bird feeder box is 6 cm.

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(a) Calculate the **area** of the back of the bird feeder box. [3]

(b) Calculate the **perimeter** of the floor of the bird feeder box. [2]

(c) Calculate the **area** of each of the following. [3]

- One of the vertical sides.

- One of the roof pieces.

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5. *(a)* An air parcel company, *FlyPack*, wants to build a helicopter base.

The helicopter base is to be
- equidistant from Shrewsbury and Hereford, **and**
- equidistant from Aberystwyth and Newtown.

The map below is drawn to scale, but the scale has been left out.
Using a pair of compasses and a ruler, indicate the position of the helicopter base on the map.
You must show any lines that you use. [3]

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(b) The distance from Haverfordwest to Carmarthen is approximately 33 miles.
Complete each of the following sentences. [4]

Rhyl is approximately ..... miles from Shrewsbury.

The bearing of Rhyl from Shrewbury is ..... °.

Carmarthen is approximately ..... miles from Newtown.

The bearing of Carmarthen from Newtown is ..... °.

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(c) The costs of running a helicopter are given below.

- Fuel costs £f for every mile.
- The daily rate to pay the helicopter crew is £c.
- Landing charges are £b per day.
- Insurance costs £n per day.

(i) A helicopter flies x miles in one day.
Write down the formula for working out the cost of fuel, £F, for one day. [2]

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(ii) Hence, write down the formula for working out the total cost, £T, for running a helicopter for a day. [1]

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(d) *You will be assessed on the quality of your written communication in this part of the question.*
Helicopter fuel costs £8.25 per gallon.
Helicopters consume 30 gallons of fuel for every 25 miles.

A helicopter in Haverfordwest has £600 worth of fuel on board.
Will the helicopter have enough fuel to fly to Hereford?
You must show all your working. [6]

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6. Charlotte runs a snack bar.
She makes and packs 3 varieties of sandwiches to sell.

All her sandwiches sell for £1.50 per pack.

She keeps a list of sandwiches sold during the first hour one Monday morning.

Time sold	Number of sandwiches sold			Total number of sandwiches sold
	Salmon	Cheese	Chicken	
09:00 up to 09:15	4	2	4	10
09:15 up to 09:30	2	8	0	10
09:30 up to 09:45	3	3	4	10
09:45 up to 10:00	5	3	2	10

(a) What is the best estimate of the probability that the next sandwich Charlotte sells will be a cheese sandwich? [2]

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(b) Charlotte is thinking she might reduce the price of the least favourite sandwich in order to sell more of them to her customers.
Which sandwich would this be?
Do you think by doing this Charlotte will take more money?
You must explain your answer. [1]

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Charlotte decides not to introduce a special offer.

All sandwiches £1.50 per pack

(c) Express the ratio of the total number of salmon to cheese to chicken sandwiches sold during the first hour on Monday morning in its simplest form. [2]

(d) Early on Tuesday morning Charlotte prepares the sandwiches for the day.
She uses the same ratio as the sales for the first hour of Monday morning.

She makes a total of 220 sandwiches.
How many of these sandwiches should be salmon? [2]

(e) The following day Charlotte finds she sells the same number of salmon sandwiches as she does chicken sandwiches.
She also notices that she sells twice as many cheese sandwiches as either salmon or chicken sandwiches.

- Why might making sandwiches ready for sale in the same ratio as those sold during the first hour on Monday morning be a problem?
- How could Charlotte improve her strategy for making sandwiches in advance?

You must clearly explain your answers. [2]

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7. *(a)* A Ferris wheel is a popular tourist attraction and a way of getting views of a city. People pay to travel in pods positioned on the circumference of the Ferris wheel.

The table below gives some information comparing two Ferris wheels.

		Wheel diameter	Number of pods
	Wiener Riesenrad Ferris wheel	64 metres	15
	Dubai Eye Ferris wheel	210 metres	36

On which of the two Ferris wheels are two adjacent pods positioned closer together? Approximately how much closer together are these pods around the circumference of the wheel?
You must show all your calculations. [7]

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(b)

		Cost to build in euros, €
	London Eye	$8{\cdot}4 \times 10^7$
	Singapore Flyer	$1{\cdot}08 \times 10^8$

Complete the following statement. [2]

The Singapore Flyer cost ..... million euros **more** to build than the London Eye.

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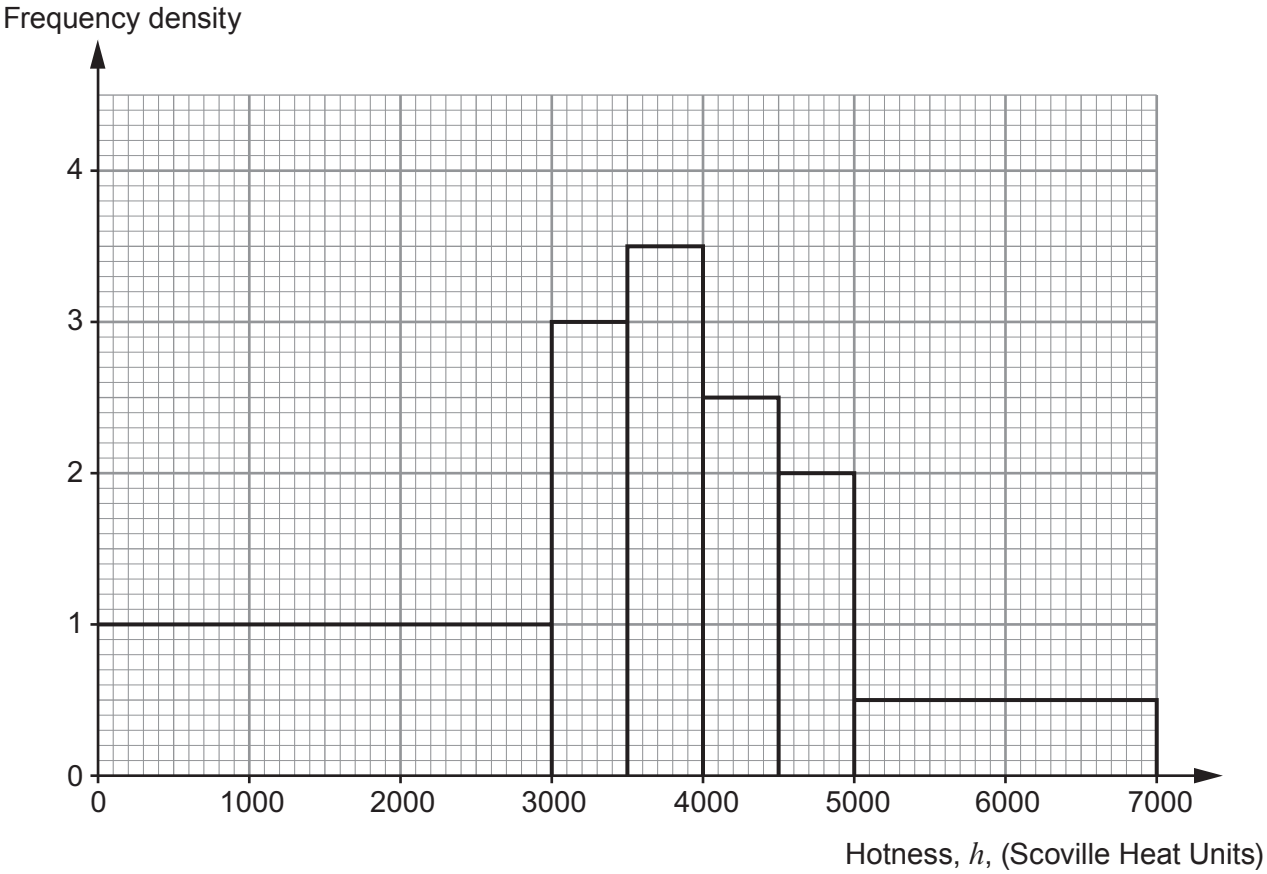
8. The Scoville Heat Unit is used to measure the hotness of a chilli pepper.

For example,
a poblano pepper has a hotness of anywhere between 1000 and 1500 Scoville Heat Units.

A supermarket records the hotness of the varieties of chilli peppers sold each month.

(a) A report on the sales of chilli peppers in November contains the histogram shown below.



Calculate the total number of chilli peppers sold by the supermarket in November. [3]

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(b) The table below shows the hotness of chilli peppers sold by the supermarket in December.

Hotness of chilli peppers in Scoville Heat Units, h	December sales: number of chilli peppers
$1000 < h \leqslant 3000$	1500
$3000 < h \leqslant 3500$	3000
$3500 < h \leqslant 4000$	5500
$4000 < h \leqslant 4500$	7000
$4500 < h \leqslant 5000$	2500
$5000 < h \leqslant 7000$	500

Calculate estimates of the mean and the median hotness of chilli peppers sold during December.
You must show all your working. [6]

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Estimated mean = ... Scoville Heat Units

Estimated median = ... Scoville Heat Units

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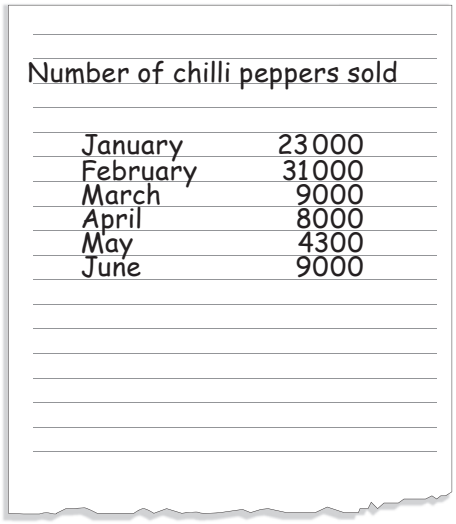
(c) In the following year, the manager was given the list shown below.
She uses 3-month moving averages to write a report.



Number of chilli peppers sold

January	23000
February	31000
March	9000
April	8000
May	4300
June	9000

(i) Calculate the first four 3-month moving averages for the number of chilli peppers sold. [3]

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(ii) The 3-month moving average for the number of chilli peppers sold, for the period from May to July, is 8000.
How many chilli peppers were sold in July? [3]

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9. In an experiment, a ball is dropped from a height of 20 metres on to level ground.

It bounces back up to half the original height.
The next bounce is to a height of half the previous height and so on.

(a) What height does the ball reach after the 4th bounce? [2]

(b) The ball falls vertically and bounces back up vertically.
What is the total distance travelled by the ball as it hits the ground for the 5th time? [3]

(c) Use the graph paper opposite to draw a graph to show the maximum height that the ball reached after each of the first 8 bounces. [3]

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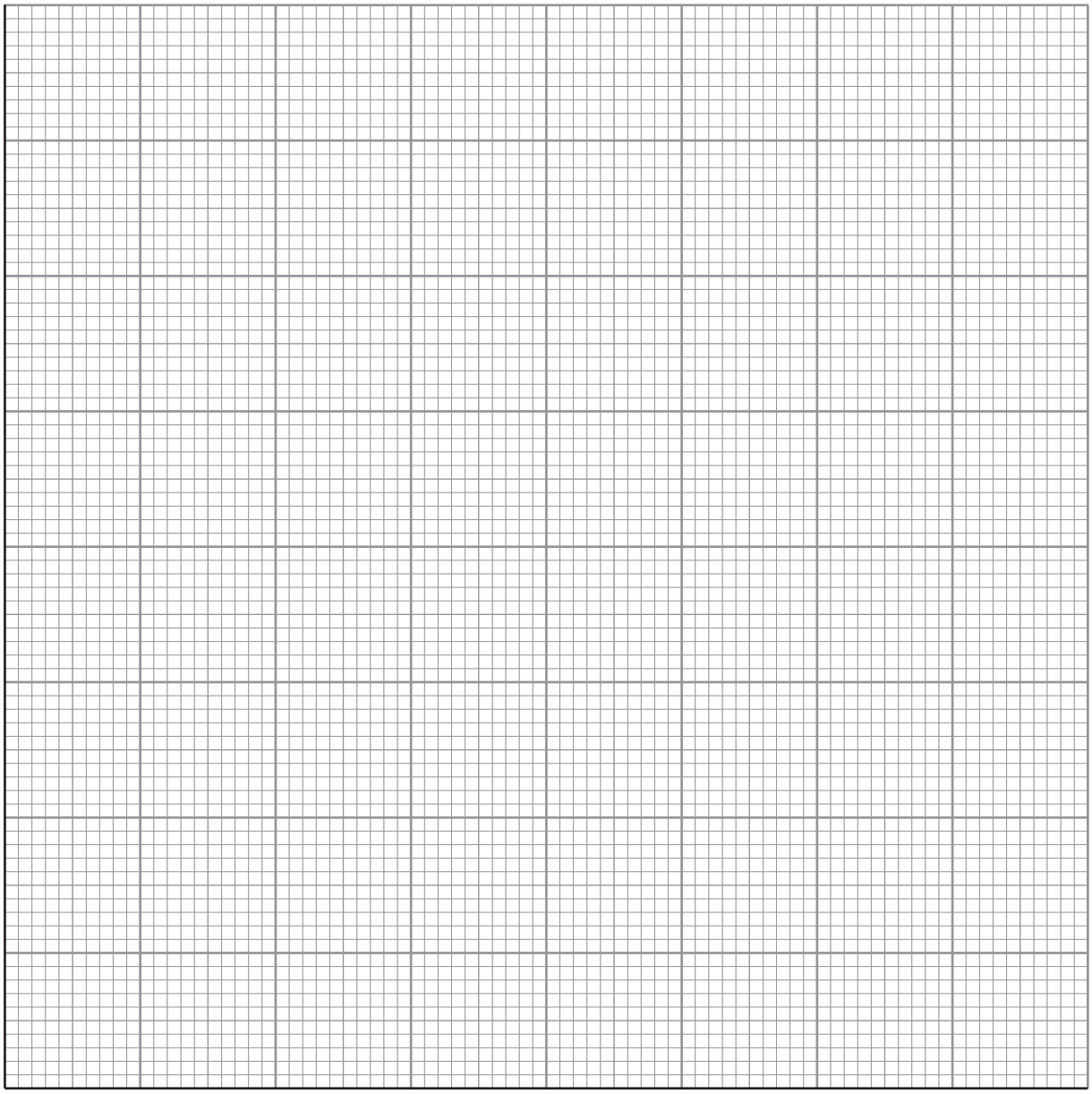

(d) The ball is dropped from a height of h metres.
Derive a formula to calculate the maximum height, M metres, that the ball reaches after the nth bounce. [3]

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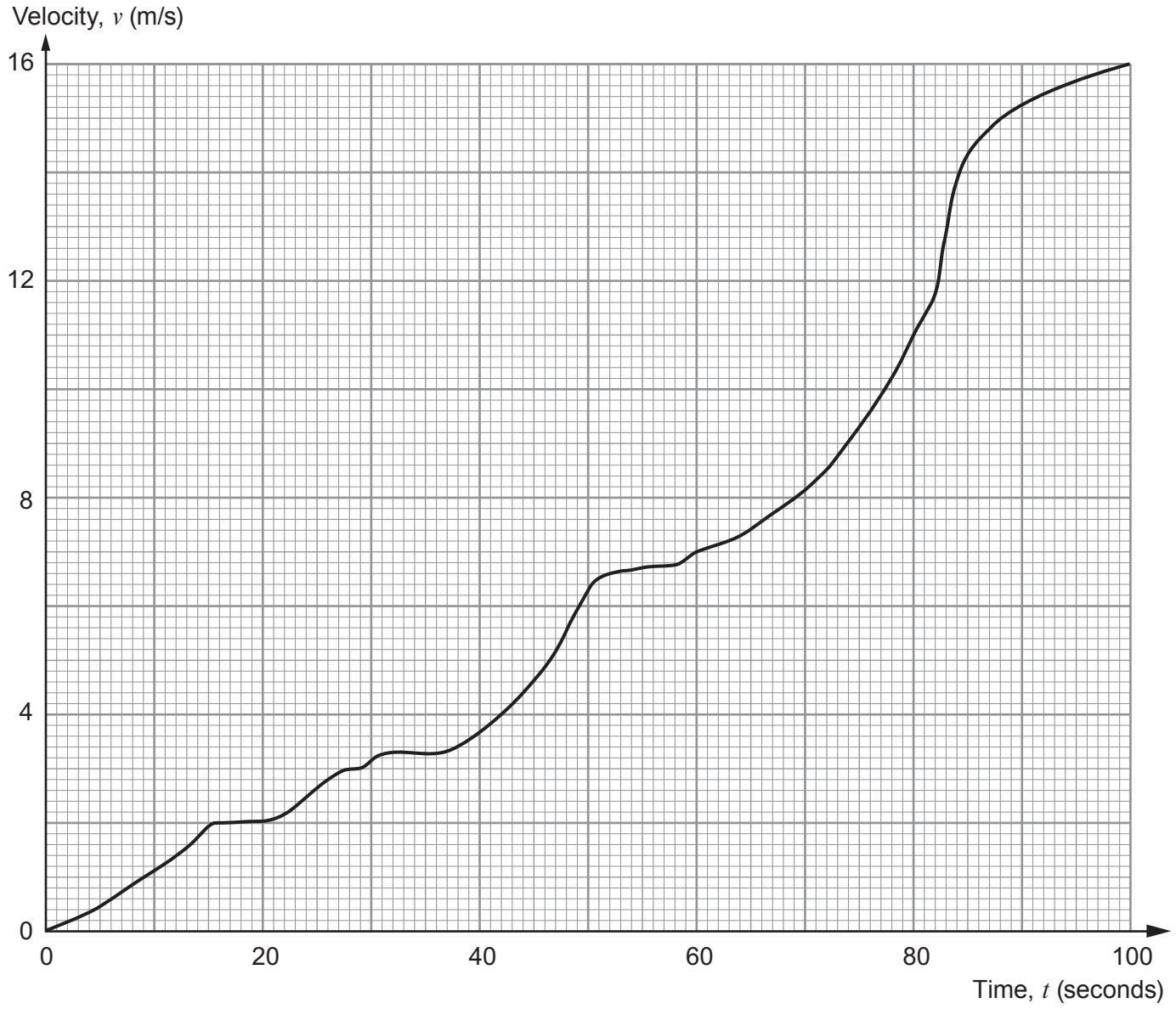
10. A velocity-time graph, representing a 100-second journey of a truck accelerating from 0 m/s, is shown below.



(a) After how many seconds is the velocity of the truck 25 **km/h**? [4]

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After ..... seconds

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(b) Calculate an estimate for the acceleration at t = 70 seconds.
You must give the units for your answer. [4]

Acceleration is .....

(c) Calculate an estimate for the distance travelled by the truck in the first 80 seconds. [3]

Distance travelled is ..... metres

(d) Over the same period, the velocity of another truck is given by the equation

$$v = 4 + 0{\cdot}0012t^2.$$

The velocities of the two trucks are the same at 100 seconds.
There is another time for which the velocities of the trucks are the same.
Give this time correct to the nearest second. [4]

Time is ..... seconds

END OF PAPER

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