OCR

H

Friday 13 June 2014 – Morning

GCSE APPLICATIONS OF MATHEMATICS

A382/02 Applications of Mathematics 2 (Higher Tier)

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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

A382 02

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.

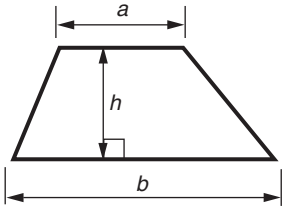
INFORMATION FOR CANDIDATES

- 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 **16** pages. Any blank pages are indicated.

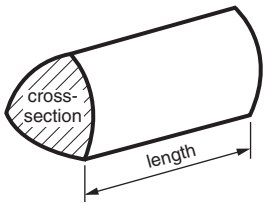
You are permitted to use a calculator for this paper

Formulae Sheet: Higher Tier

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



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

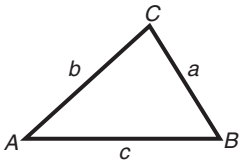


In any triangle *ABC*

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

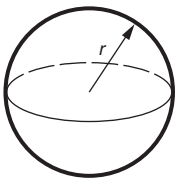
Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

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



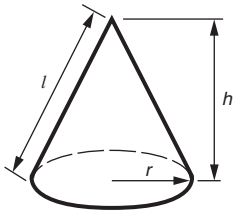
Volume of sphere $= \frac{4}{3}\pi r^3$

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



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

Curved surface area of cone $= \pi rl$



The Quadratic Equation

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

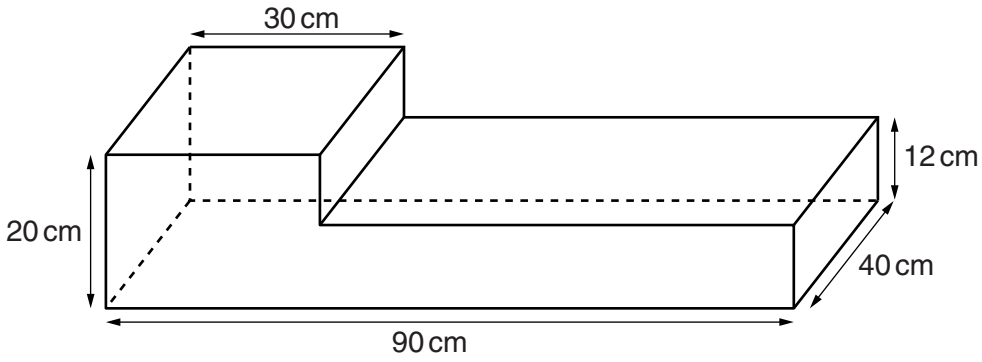
$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

1 Car petrol tanks are made in different shapes and sizes.

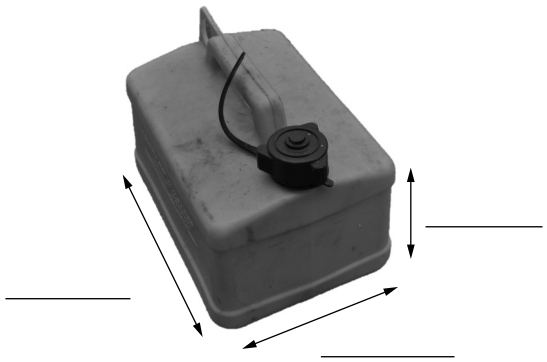
This is the shape of the petrol tank in Josh's car.



(a) Work out the volume of the tank in cubic centimetres.

(a) _____ cm^3 **[3]**

(b)* Josh has a portable 5-litre fuel can. 1 litre = 1000 cm^3.
This is a photo of Josh's 5-litre fuel can.



Estimate and write down suitable values for each of the **three** arrowed lengths.
Use calculations to show why your lengths are appropriate for Josh's fuel can.

_____

_____ **[4]**

(c) Josh investigates converting his car to use liquid petroleum gas (LPG).
He uses this information.

- A car uses 10% more LPG than petrol when driven for the same distance.
- Petrol costs 140p per litre.
- LPG costs 75p per litre.

In a typical week Josh uses 30 litres of petrol.

(i) How much LPG would Josh use in a typical week?

(c)(i) _____ litres **[2]**

(ii) How much would Josh save each week if he converted his car to use LPG?

(ii) £_____ **[4]**

(d) Josh is told the total cost to convert his car to use LPG is £510.

(i) How many weeks would it take for Josh to get back the cost of the conversion?

(d)(i) _____ weeks **[2]**

(ii) The conversion costs are in this ratio.

tank cost : labour : safety test = 5 : 9 : 3

How much would Josh save if he does the fitting himself and does not pay the labour charge?

(ii) £_____ **[3]**

(e)* Josh wants to install an LPG tank in his car's spare wheel space.
If he does, he will not have a spare wheel in his car to use in case he has a puncture.
If Josh has a puncture, the estimated car recovery cost will be up to £240.

Josh has been driving for $1\frac{1}{2}$ years and has had 1 puncture during that time.

Use the information and your answer to part **(c)(ii)** to explain why Josh should risk not having a spare wheel in his car.

_____

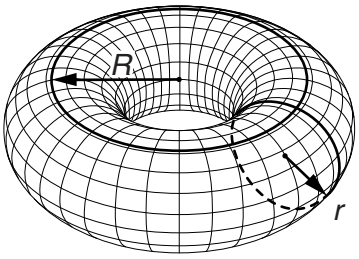
_____

_____

_____

_____ **[3]**

(f) Josh decides he will install an LPG tank in his car's spare wheel space.
Here is a picture and a sketch of the tank.



R is the radius centred on the top of the tank

r is the radius of a cross section of the tank.

(i) The volume, *V*, of the tank is given by this formula.

$$V = 2 \times \pi^2 \times R \times r^2$$

The largest LPG tank that Josh can fit has $R = 210$ mm and $r = 87$ mm, each given correct to the nearest mm.

Work out the **minimum** volume of this tank.
Use the π button on your calculator or use $\pi = 3.142$.
Give your answer correct to 3 significant figures.

(f)(i) _____ mm^3 **[4]**

(ii) It is dangerous to fill an LPG tank to more than 80% of its volume.
One litre = $1 \times 10^6 mm^3$.

Work out the greatest number of litres of LPG that Josh should put in this tank.

(ii) _____ litres **[3]**

2 A census is a record of all people and households in a country.

In the 2011 UK census there were these two new questions:

- What type of central heating does this accommodation have?
- How many rooms are bedrooms?

(a) Donna wanted to find out information about local households.
She asked a sample of 80 local households these two questions.

In Donna's sample there were no households with more than 6 bedrooms, and there were only three types of central heating: gas, electric and oil.

(i) Design a two-way table for Donna to use to record this information. **[3]**

(ii) In Donna's sample there were 14 households with 3 bedrooms and oil central heating.

Show this information in your table in part **(a)(i)**. **[1]**

(b) The census also asked for the number of people living in each household.
The government thinks that many households will have bedrooms that are not used.

How could the census data show whether this is true?

_____

_____

_____ **[1]**

3 Bashra wants to swim at her local sports centre.
She is not a member of the centre.
The cost is different if Bashra buys a member card or a student card.
The table shows the costs.

	Cost of a card	Cost per swim
Non-member		£3.25
Member	£100	free
Student	£11	£2.05

The cost, in £, of x swims for a non-member is $3.25x$.
The cost, in £, of x swims with a student card is $2.05x + 11$.

Bashra writes this inequality to show when the cost for a student card holder will be less than the cost for a non-member.

$$2.05x + 11 < 3.25x$$

(a) Work out the **least** number of times Bashra must swim for it to cost less if she buys a student card instead of paying each time as a non-member.

(a) _____ **[3]**

(b) (i) Write an inequality to show when the cost for a member card holder will be less than the cost for a student card holder.

(b)(i) _____ **[2]**

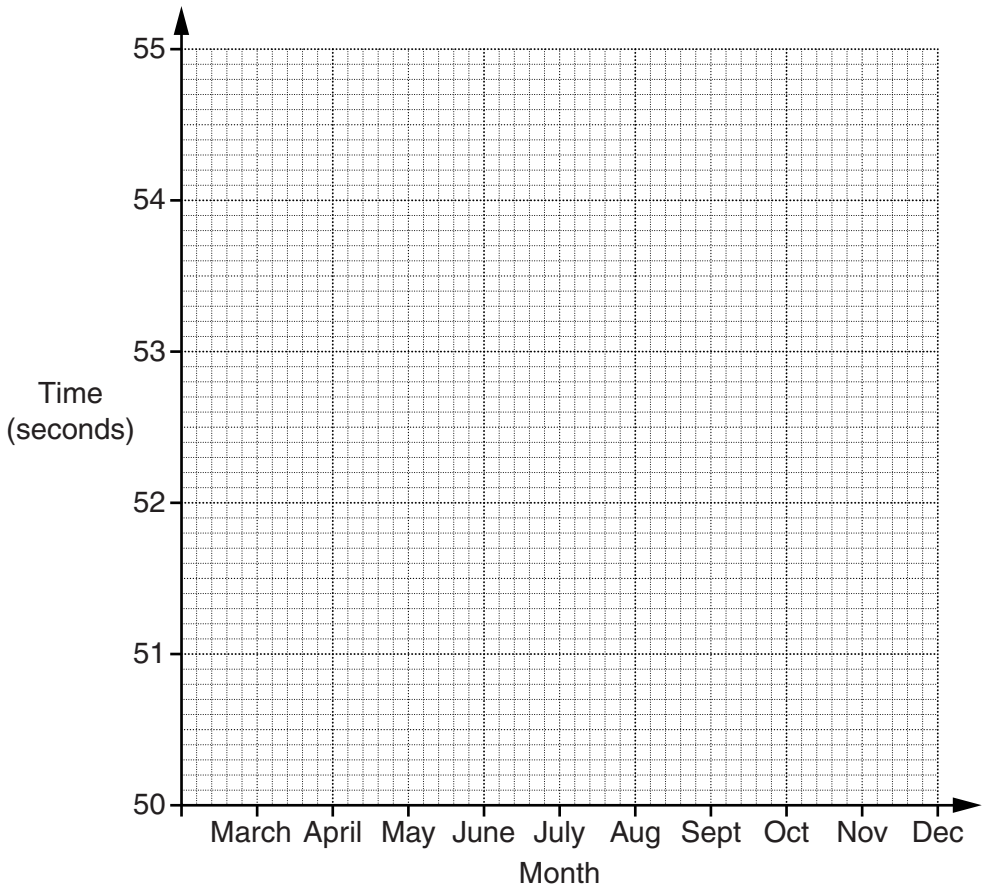
(ii) Work out the **least** number of times Bashra must swim for it to cost less if she buys a member card instead of a student card.

(ii) _____ **[3]**

(c) The sports centre hosts a swimming time trial one day each month.
These are Bashra's times, in seconds, for swimming 50 m freestyle.
Bashra did not attend the swimming time trial in August.

Month	March	April	May	June	July	Aug	Sept	Oct
Time (seconds)	54.4	54.0	53.2	52.8	52.6		51.8	51.2

(i) Draw a time series graph for these data.



[2]

(ii) Use your graph to estimate what Bashra's time to swim 50 m freestyle might have been if she had attended the swimming time trial in August.

(c)(ii) _____ s **[1]**

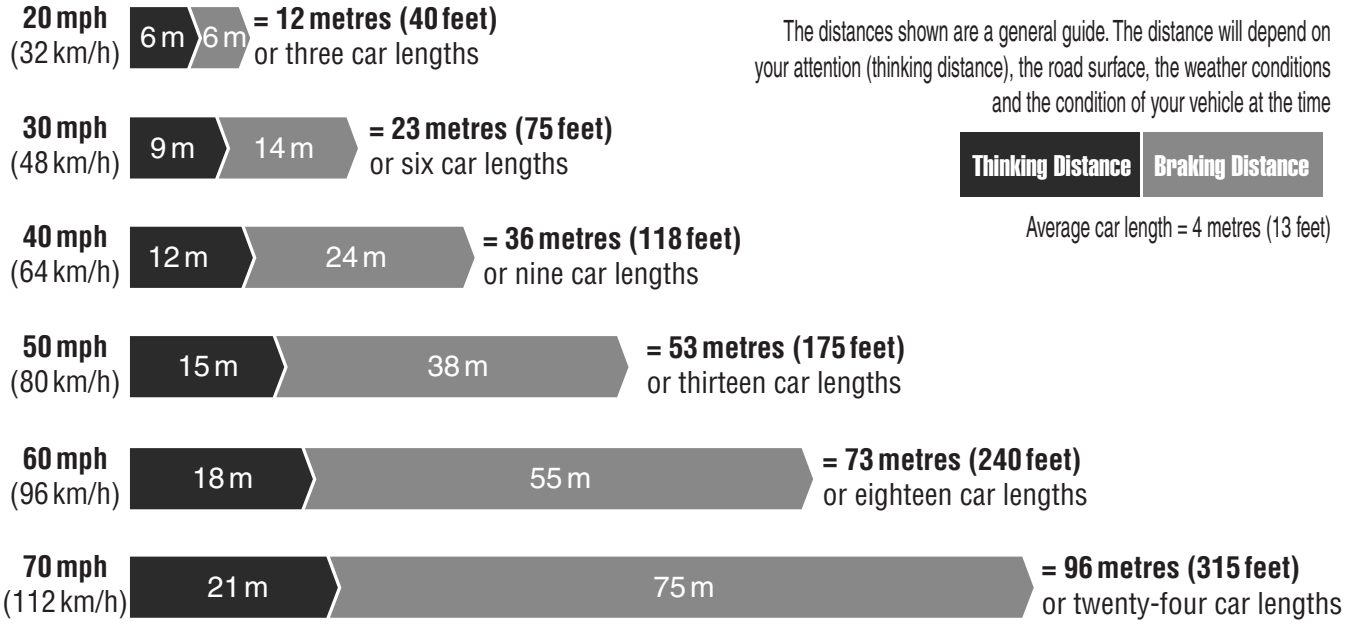
(iii) Explain why it may not be sensible to use the graph to estimate Bashra's time to swim 50 m freestyle in December.

_____

_____ **[1]**

4 The Highway Code has this chart of typical stopping distances for cars travelling at different speeds.

Typical stopping distance



Stopping Distance = Thinking Distance + Braking Distance

(a) Describe fully how thinking distance is related to speed.

_____

_____ **[2]**

(b) The stopping distances given in the Highway Code chart are for a **dry** road.
It will take longer to stop if the road is wet.

Which part of the stopping distance will **not** change if the road is **wet**?
Give a reason for your answer.

_____

_____ **[1]**

(c) Ali finds this formula for stopping distances on **dry** roads.

$$d = \frac{v^2}{20} + v$$

d is the total stopping distance in feet and v is the speed in miles per hour (mph).

Ali uses this formula to draw a graph of speed and stopping distance.

(i) Complete this table **using the formula**.

v (mph)	20	30	40	50	60	70
d (feet)	40	75			240	315

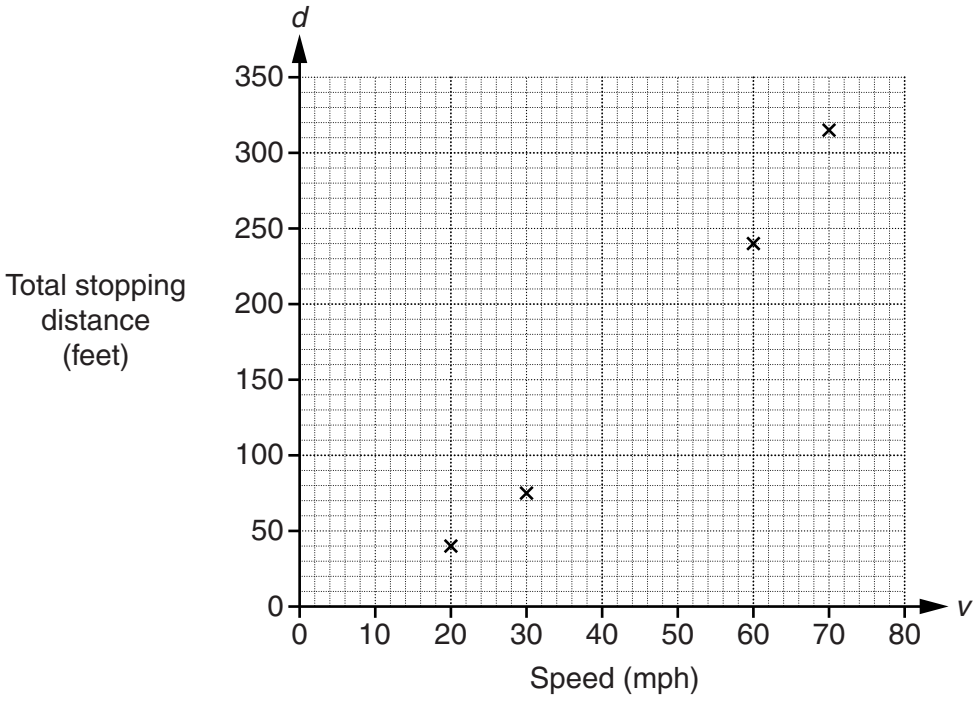
[2]

(ii) Show that the formula is a good fit for the stopping distances given in the Highway Code chart.

_____

_____ **[1]**

(iii) Complete the graph of $d = \frac{v^2}{20} + v$.



[2]

(d) This is a formula for the stopping distance on **wet** roads.

$$d = \frac{v^2}{n} + v$$

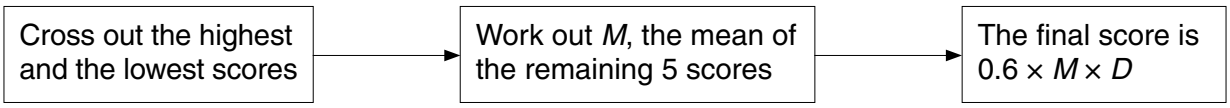
d is the total stopping distance in feet, v is the speed in mph and n is a number.

Suggest a **possible** value for n.

(d) _____ **[1]**

5 In a diving competition there are 7 judges.
A dive has a difficulty rating, D, and each judge gives the dive a score out of 10.

The flow diagram shows how the judges' scores and the difficulty rating, D, are combined to work out a competitor's final score.



The table gives the difficulty rating and the judges' scores for four competitors.

Competitor	Difficulty rating, *D*	Judge 1	Judge 2	Judge 3	Judge 4	Judge 5	Judge 6	Judge 7
Tapani	2.5	8.0	9.0	8.0	8.0	7.5	8.5	8.5
Chu	3.5	8.5	5.5	6.0	5.5	5.0	5.5	6.0
Lewis	3.5	6.0	6.0	6.5	6.5	6.5	6.0	6.0
George	3.0	6.5	6.0	7.0	6.5	7.0	7.0	6.5

(a) (i) Show that the final score for George is 12.06.

_____

_____

_____ **[3]**

(ii) A gold medal is won by the competitor with the highest final score.
Silver and bronze medals are won by the competitors with the second and third highest final scores respectively.
George won a bronze medal.

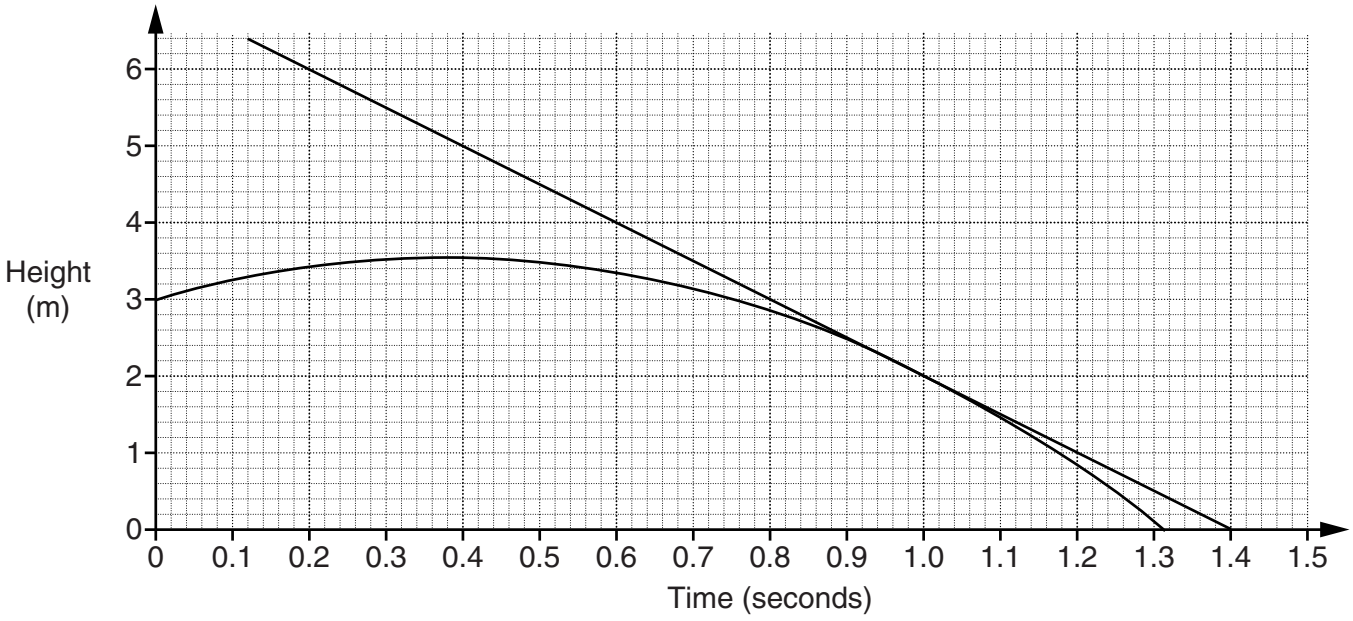
Complete the table to show the competitors who won the gold and silver medals and their final scores.

Medal	Competitor	Final score
Gold		
Silver		
Bronze	George	12.06

[4]

(b) Joe dived from a diving board into a swimming pool.

The curve shows how high, in metres, Joe's feet were above the water during his dive.
The straight line is a tangent to the curve at the point (1.0, 2).



(i) How high was the diving board?

(b)(i) _____ m **[1]**

(ii) After how many seconds did Joe's feet first enter the water?

(ii) _____ s **[1]**

(iii) Work out the gradient of the tangent.

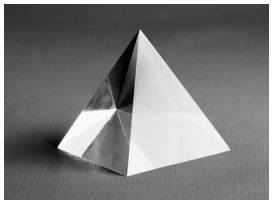
(iii) _____ m/s **[3]**

(iv) What does the gradient of the tangent represent?

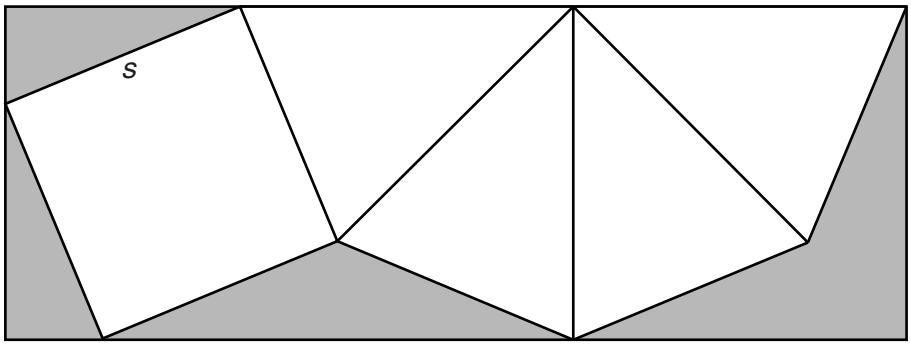
_____

_____ **[1]**

6 A paperweight is made in the shape of a square based pyramid.



A box for the paperweight is made from card and is the same shape as the paperweight.
A net for the box is drawn on a rectangle of card.

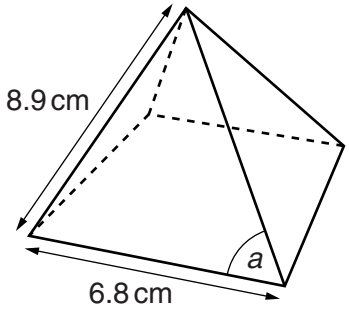


Not to scale

(a) One side of the net is marked *s*.

Which side will join to side *s* when the box is made?
Label it *t*. **[1]**

The box has base length 6.8 cm.
The length of each slant edge of the box is 8.9 cm.
The top of the pyramid is above the centre of the square base.
This is a sketch of the box.



(b) Show that the angle, *a*, at the bottom of each triangular face is 67.5°.

_____

_____

_____

_____ **[3]**

(c) The formula for the volume of a square based pyramid is

$$\text{Volume} = \frac{1}{3}Ah$$

where A is the area of the base and h is the vertical height of the pyramid.

Work out the volume of the box.

(c) _____ cm^3 **[6]**

(d) Calculate the dimensions of the rectangular card needed for this net.

(d) Length _____ cm

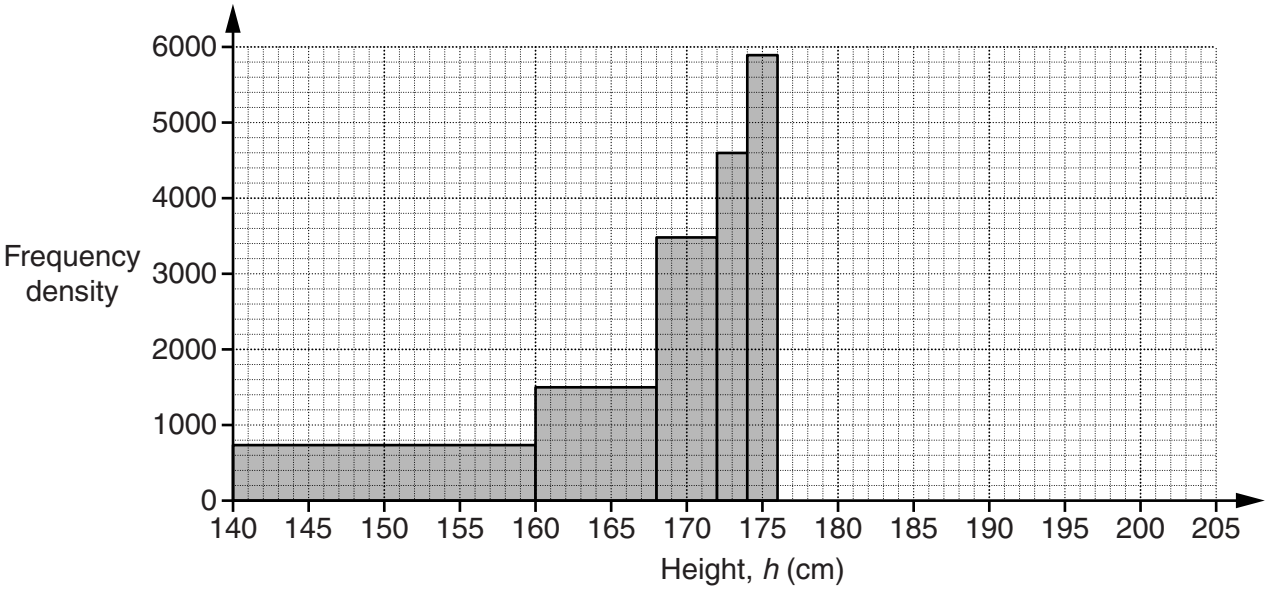
Width _____ cm **[5]**

7 Quentin collected this information on the heights of potential recruits to the armed forces.

Height, h (cm)	Frequency	Frequency density
$140 \leqslant h < 160$	15000	750
$160 \leqslant h < 168$	12000	1500
$168 \leqslant h < 172$	14000	3500
$172 \leqslant h < 174$	9200	4600
$174 \leqslant h < 176$	11800	5900
$176 \leqslant h < 180$	11200	
$180 \leqslant h < 190$	6000	
$190 \leqslant h < 205$	3000	

(a) Complete the frequency density column. **[3]**

(b) Complete the histogram.



[2]

(c) To become an aircraft handler you need to be at least 166 cm tall.

How many of these potential recruits could become an aircraft handler?

(c) _____ **[3]**

END OF QUESTION PAPER