OCR
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Hints

H

Monday 8 November 2021 – Morning

GCSE (9–1) Mathematics

J560/06 Paper 6 (Higher Tier)

Time allowed: 1 hour 30 minutes

You can use:
- a scientific or graphical calculator
- geometrical instruments
- tracing paper

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space, use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.
- Use the π button on your calculator or take π to be 3.142 unless the question says something different.

INFORMATION
- The total mark for this paper is **100**.
- The marks for each question are shown in brackets **[ ]**.
- This document has **20** pages.

ADVICE
- Read each question carefully before you start your answer.

Please note that these worked solutions have neither been provided nor approved by OCR and may not necessarily constitute the only possible solutions. Please refer to the original mark schemes for full guidance.

Any writing in blue indicates what must be written in order to answer the questions and get the marks. The worked solutions have been designed to show the smallest amount of work which needs to be done to answer the question.

Anything written in green in a cloud doesn't have to be written in the exam.

Anything written in orange in a rectangle doesn't have to be written in the exam and is there to show what should be put into a calculator or measured using a ruler or protractor.

If you find any mistakes or have any requests or suggestions, please send an email to curtis@cgmaths.co.uk

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Answer **all** the questions.

1 This table shows the names and areas of five lakes.

Name of Lake	Area in km^2
Ladoga	1.81×10^4
Mweru	5.12×10^3
Tana	3.20×10^3
Topozero	9.86×10^2
Victoria	6.89×10^4

(a) Write the area of Lake Mweru as an ordinary number.

Typing the standard form into the calculator converts it into ordinary form

(a) ..... km^2 **[1]**

(b) Write the lakes in the order of their area, starting with the **smallest**.

Convert all of the areas into ordinary form to compare their areas. It is possible to compare them without doing this as they are all in standard form

.... **[2]**

smallest *largest*

(c) Calculate the difference between the areas of Lake Ladoga and Lake Tana.
Give your answer in standard form, correct to **2** significant figures.

Difference = largest - smallest. Standard form is a x 10^n, where $1 \leq a < 10$ and n is an integer. Significant figures are first figures after any 0s. To round to 2 significant figures, look at the third significant figure to decide whether to round the second significant figure up or down. Round down if the third figure is 0, 1, 2, 3, 4 or up if it is 5, 6, 7, 8, 9. Then set everything after the second significant figure to 0 and ignore them

(c) ..... km^2 **[4]**

2 Azmi, Beth and Callum share a flat.

(a) The monthly rent is £760.
They share the rent in the ratio 2 : 3 : 3.

How much does Beth pay for rent each month?

2 + 3 + 3 expresses how many parts there are in total in the ratio. This many parts represent the total monthly rent so dividing the £760 by this many parts works out the value of 1 part of the ratio. Multiplying this by the 3 parts representing the rent Beth pays works out how much Beth pays for rent each month

(a) £ ..... **[2]**

(b) Azmi, Beth and Callum also share the fuel bill in the ratio 2 : 3 : 3.
Callum pays £36 for fuel each month.

How much does Azmi pay for fuel each month?

3 parts of the ratio represent the amount Callum pays for fuel each month. Dividing the £36 by the 3 parts works out what 1 part of the ratio represents. Multiplying the value of 1 part by the 2 parts representing Azmi works out how much Azmi pays

(b) £ ..... **[2]**

3 Multiply out and simplify.

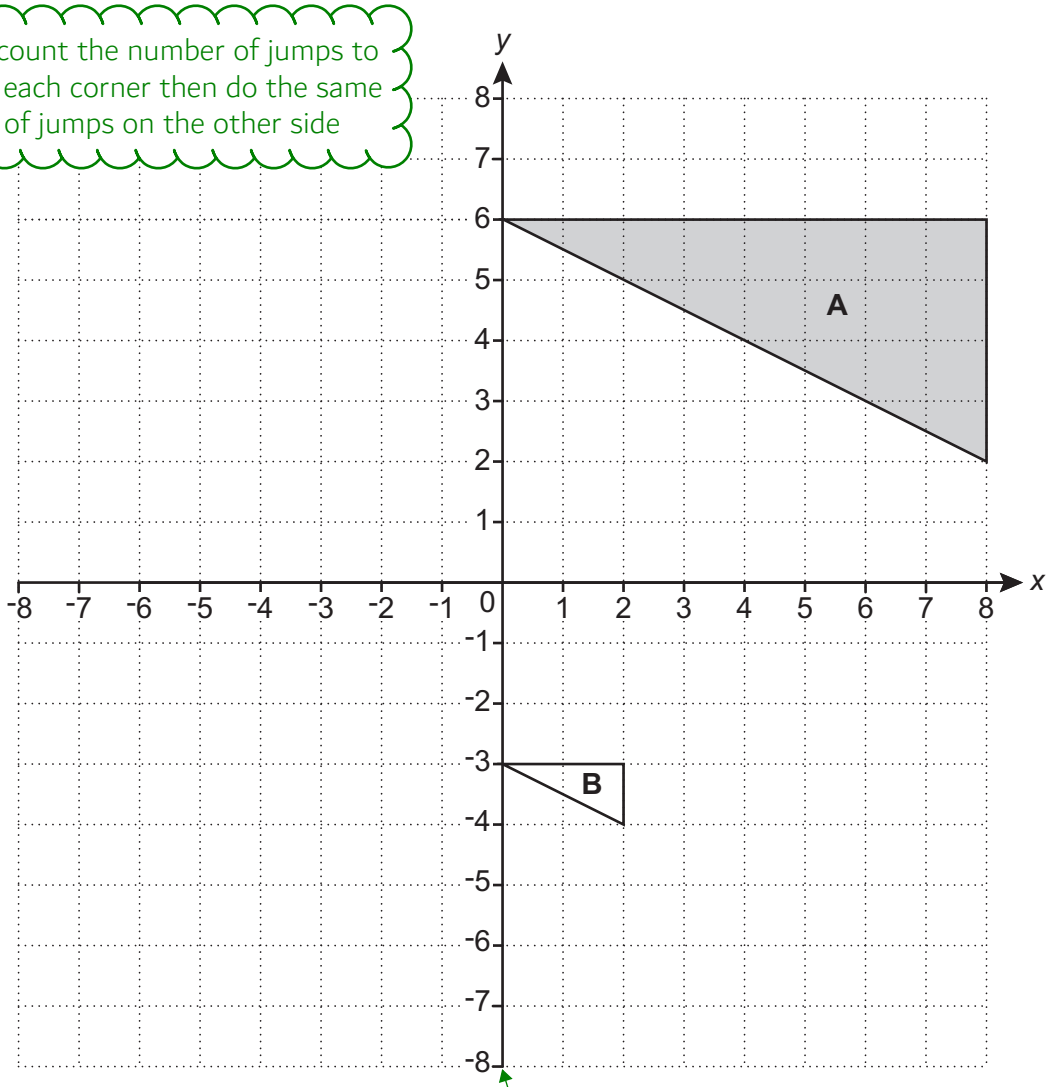
$3(x+2)-(x-1)$

Expand the brackets then collect like terms

..... **[2]**

4 Triangle **A** and triangle **B** are drawn on the coordinate grid.

To reflect, count the number of jumps to the line for each corner then do the same number of jumps on the other side



The y-axis is the line x = 0

(a) Reflect triangle **A** in the line $x = 0$. **[2]**

(b) Describe fully the **single** transformation that maps triangle **A** onto triangle **B**.

Enlargement, scale factor ..., centre ...

..... **[3]**

It is an enlargement as it has changed size. The scale factor is what the sides on A have been multiplied by to get the sides on B. It is a fraction. The centre of enlargement is found by drawing straight lines through the corners of both shapes and seeing where they meet

The fraction (or proportion, which can be expressed as a decimal) of the times it lands on each number is the relative frequency

5 Ling throws a six-sided dice 300 times.
The table shows the frequencies of their results.

(a) Complete the table to show the relative frequencies.

Number on dice	1	2	3	4	5	6
Frequency	42	27	57	60	39	75
Relative frequency			0.19			

[2]

(b) Ling thinks that the dice may be biased.

(i) Explain why evidence from the table could support their opinion.

Biased means that there wasn't the same probability for each outcome

..... **[1]**

(ii) Explain why the dice may, in fact, **not** be biased.

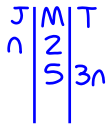
Is it possible for a fair coin which is not biased to be tossed 5 times in a row and all be heads?

..... **[1]**

6 A bag of sweets contains jellies, mints and toffees.

The ratio of jellies to mints is n : 2.
The ratio of mints to toffees is 5 : 3n.

Work out the ratio of jellies to toffees.
Give your answer in its simplest form.

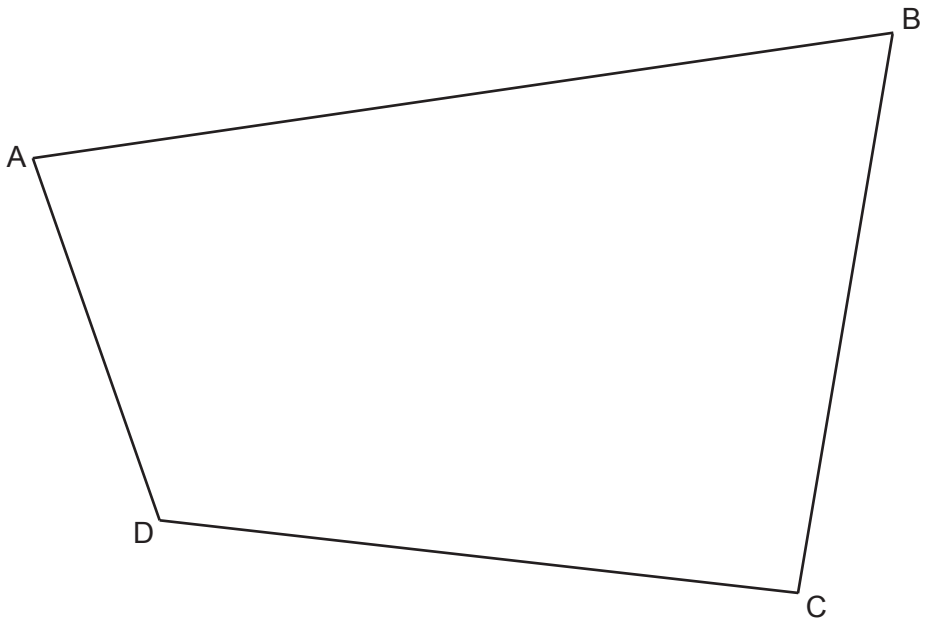


Writing the given ratios in a column. Mints is in common to both ratios. Find a common multiple of the 2 and 5. Multiply both sides of the first ratio to give the common multiple parts for mints and multiply both halves of the second ratio to get the common multiple parts for mints. Combine the ratios once the number of parts for mint is the same. Ignore mints to get the ratio of the jellies to toffees and simplify the ratio by dividing both sides by the same amount until they cannot be divided any further without getting decimals

..... : ..... **[4]**

7 The scale drawing represents a park, ABCD.

Scale: 1 cm represents 10 m



For (a): Construct an angle bisector on angle ABC. Use a compass to scribe two arcs on AB and BC from B which have the same radius. Then scribe an arc from each of the first two arcs with a radius which is greater than half of the distance between the first two arcs. Draw a straight line from B to the cross where the second two arcs meet.

For (b): 50m is represented by 5cm. Scribe an arc with a radius of 5cm which crosses the path twice. Put crosses where the arc and the path meet. The bench can be placed on the path between these two crosses

A straight path goes across the park from B.
The path is always the same distance from side AB and side BC.

(a) Construct the route followed by the path.
Show all your construction lines. **[2]**

(b) A bench is to be placed on the path.
The bench must be no more than 50 m from C.

Construct the locus of the possible positions of the bench.
Indicate clearly on the diagram where the bench can be placed. **[3]**

8 **(a)** Train A travels 120 km at a constant speed of 80 km/h.
Train B travels 120 km at a constant speed of 50 km/h.

How many more minutes does train B take to travel 120 km than train A?

Use the formula triangle to work out time. The time for each train calculated using the distance in km and the speed in km/h should give the time in hours as the speed is in terms of kilometres and hours. There are 60 minutes in an hour, use this to convert the times in hours to minutes. Subtracting the time taken for train A in minutes from the time taken for train B in minutes gives how many more minutes train B takes than train A

(a) ..... minutes **[4]**

(b) Train C has a speed of x km/h.

Write an algebraic expression for train C's speed in metres per second.

There are 1000 metres in a kilometre. There are 60 minutes in an hour. There are 60 seconds in a minute. First convert into metres per hour, then metres per minute, then metres per second

(b) ..... m/s **[2]**

9 The width, w, of a kitchen cupboard is 60 cm, correct to the nearest centimetre.

(a) Complete the error interval for the width, w.

The resolution is 1cm. Adding and subtracting half of this to the 60cm works out the upper and lower bound

(a) ..... $\leqslant w <$ ..... **[2]**

(b) Six of these kitchen cupboards are to be placed side by side along a kitchen wall. The wall is 363 cm long, correct to the nearest centimetre.

(i) Show that the six cupboards may **not** fit along the wall. **[3]**

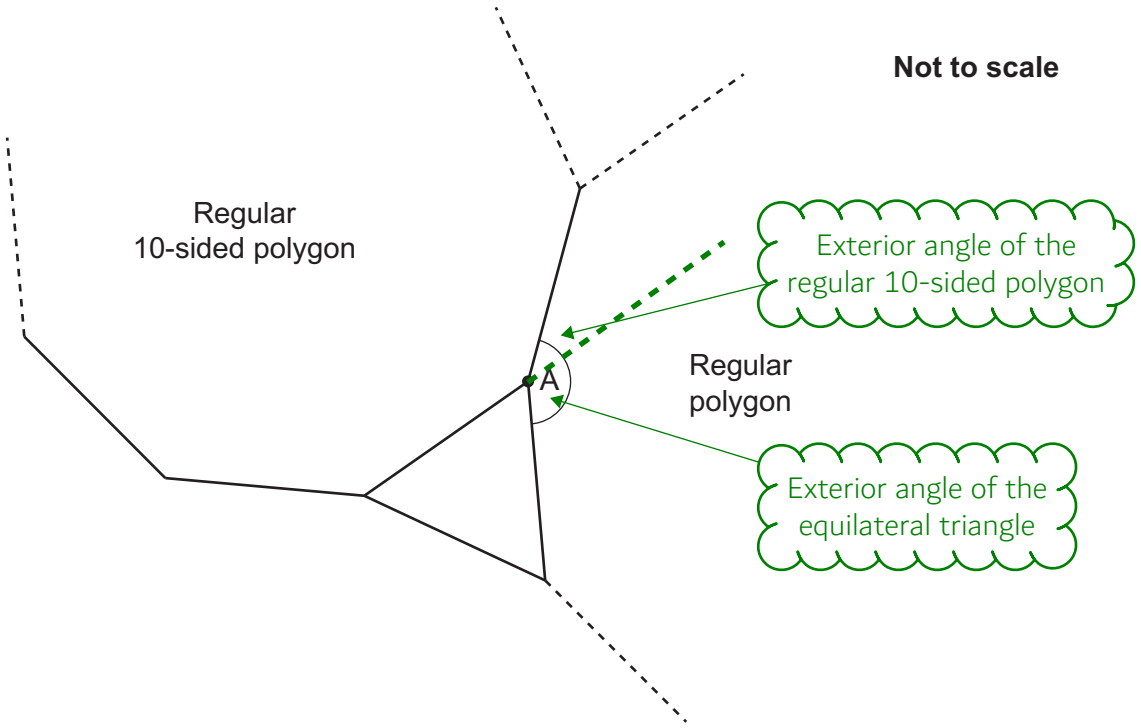
Subtracting the upper bound of the length of 6 of the kitchen cupboards from the lower bound of the length of the wall should give a negative result, meaning that the cupboards could be longer than the wall and therefore may not fit. The resolution of the measurement of the wall is 1cm. Subtracting half of this from the 363cm works out the lower bound of the length of the wall

(ii) Find the upper bound of the space remaining if six cupboards do fit along the wall.

Subtracting the lower bound of the length of 6 of the kitchen cupboards from the upper bound of the length of the wall gives the upper bound of the space remaining. The resolution of the measurement of the wall is 1cm. Adding half of this to the 363cm works out the upper bound of the length of the wall

(b)(ii) ..... cm **[3]**

10 An equilateral triangle, a regular 10-sided polygon and another regular polygon meet at a point.



(a) Show that angle A is 156°. **[3]**

The exterior angles of any polygon add up to 360°. Adding the exterior angle of the regular 10-sided polygon and the exterior angle of the equilateral triangle gives angle A

(b) Work out the number of sides of the other regular polygon.

The interior angle and exterior angle lie on a straight line and angles around a point on a straight line add up to 180°. Work out the exterior angle of the other regular polygon. The exterior angles of any polygon add up to 360°. Work out how many exterior angles there are. There must be just as many sides

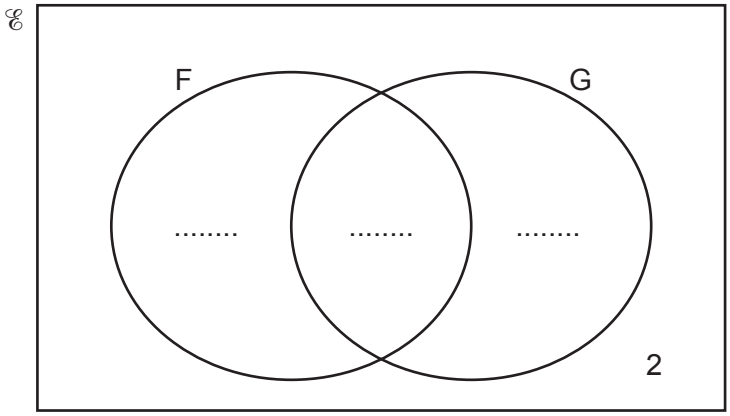
(b) ..... **[2]**

11 In a class of 30 students

- 17 study French (F)
- 20 study German (G)
- 2 do not study either subject.

Subtracting the 2 on the outside from the 30 students works out that there must be 28 in total inside the rings. 17 + 20 works out that there would be 37 in total in the rings if there was nothing in the centre. Every 1 put in the centre takes 1 off the total

(a) Complete the Venn diagram.



[3]

(b) Two of the 30 students are chosen at random.

Calculate the probability that one of these two students studies French but not German and the other studies German but not French.
You must show your working.

French but not German AND German but not French OR German but not French AND French but not German. AND means to multiply the probabilities, OR means to add the probabilities. The number of students in total decreases by 1 for the second pick

(b) ..... **[5]**

12 A solid metal sphere has mass 235 g.
The density of the metal is 7.78 g/cm^3.

Show that the surface area of this sphere is 46.9 cm^2, correct to **3** significant figures.
You must show your working.

[For a sphere with radius r: Volume $= \frac{4}{3}\pi r^3$ Surface area $= 4\pi r^2$.] **[6]**

From the formula triangle, covering v tells us how to find volume. Set the formula of the volume of the sphere equal to this. Rearrange to find r, the radius. Use the exact value of the radius in the formula for the surface area of the sphere and give the answer truncated to 4 significant figures to show that it rounds to 46.9 to 3 significant figures

13 A straight line passes through the point (8, 1) and is perpendicular to the line $y = 4x - 2$.

Find the equation of the line, giving your answer in the form $y = mx + c$.

The equation is in the form y = mx + c, where m is the gradient and c is the y-intercept. Work out the gradient of the line y = 4x - 2. The gradient of the perpendicular line must be the negative reciprocal of this. Rearrange y = mx + c to make c the subject and substitute the y-coordinate of the point for y, the x-coordinate of the point for x and the gradient of the perpendicular line for m. This works out c. Substitute in the value of m and c into the equation y = mx + c

..... **[4]**

14 y is inversely proportional to the square root of x.
$y = 5$ when $x = 36$.

(a) Find a formula linking x and y.

$y \propto \frac{1}{\sqrt{x}}$ ← Writing out the proportion. Inversely means '1 over'

Convert the proportion into an equation by multiplying the right side by k, which represents an unknown constant. Rearrange to find k, substitute in the given values of x and y then substitute the value of k for k in the equation

(a) ..... **[3]**

(b) Find the value of x when $y = 20$.

Rearrange to make x the subject in the formula made in (a). x should be a denominator so the first step will be to eliminate it as a denominator. Then do the opposite operations to both sides to eliminate everything apart from x. Substitute in the value of y to find x

(b) $x =$ ..... **[3]**

15 **(a)** Show that the equation $x^3 - 5x - 1 = 0$ has a solution between $x = 2$ and $x = 3$. **[3]**

Substitute both 2 and 3 into the equation to show there is a change in sign in what the left side is equal to

There is a change in sign, therefore the solution is between 2 and 3

(b) Find this solution correct to **1** decimal place.
You must show your working.

$f(x) = x^3 - 5x - 1$ ← Using table mode, setting f(x) = x^3 - 5x - 1

Start: 2. End: 3. Step: 0.1 ← This gives all of the values of f(x) for x from 2 to 3 to 1 decimal place. The solution must be between the two values of f(x) which have a change in sign

Start: the lower of the two numbers. End: the greater of the two numbers. Step: 0.01 ← This gives all of the values of f(x) for x between the two values found in the previous step to 2 decimal places. The solution must be between the two values of f(x) which have a change in sign

Once we have found what the solution is between to 2 decimal places, consider what the solution must round to to 1 decimal place

(b) $x =$ ..... **[4]**

16 The following kinematics formulas may be used in this question.

$v = u + at$

$s = ut + \frac{1}{2}at^2$

$v^2 = u^2 + 2as$

The initial velocity of a particle is 20 m/s.
The acceleration of the particle is $-8\,\text{m/s}^2$.
After t seconds, the particle has travelled 25 m.

(a) Show that $4t^2 - 20t + 25 = 0$. **[3]**

The second formula can be used as the distance (s) is given, the initial velocity (u) is given and the acceleration (a) is given and we are looking for an equation in terms of t

(b) Solve $4t^2 - 20t + 25 = 0$.

Solve using the quadratic formula.
The solutions to $ax^2 + bx + c = 0$ are

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

(b) $t =$ ..... **[3]**

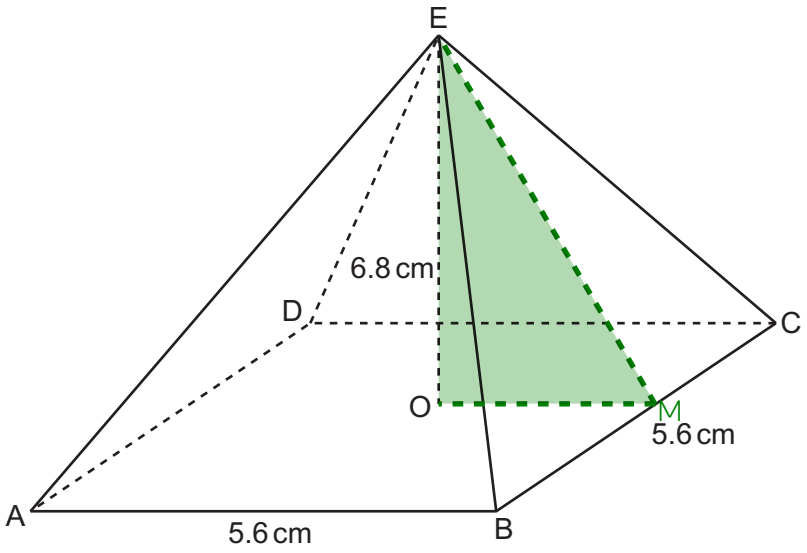
(c) Show that the particle is stationary when it has travelled 25 m.

The third formula can be used as the initial velocity (u) is given, acceleration (a) is given, distance (s) is given and we are looking for the final velocity (v)

.....

..... **[3]**

17 The diagram shows a pyramid ABCDE.



Not to scale

The pyramid has a square horizontal base ABCD with side 5.6 cm.

The vertex E is vertically above the centre O of the base.
The height OE of the pyramid is 6.8 cm.

Calculate the surface area of the pyramid.
You must show your working.

$a^2+b^2=c^2$ ← Pythagoras' Theorem can be used to work out the height of each triangle, EM, as it is the missing side in the green right-angled triangle. a and b are the two shorter sides and c is the longest side

Surface area is the areas of all of the faces added together.
Area of triangle = 1/2 x base x height.
Area of square = length x width

..... cm^2 **[5]**

18 Rearrange this formula to make y the subject.

$$\frac{5y+2}{y} = \frac{3t-7}{2}$$

Multiplying both sides by the denominators eliminates them. Get all the y terms on the same side and all the others on the other side. Bring y out as a factor on the side with all the y terms. Divide both sides by the resulting bracket to make y the subject

..... **[5]**

END OF QUESTION PAPER