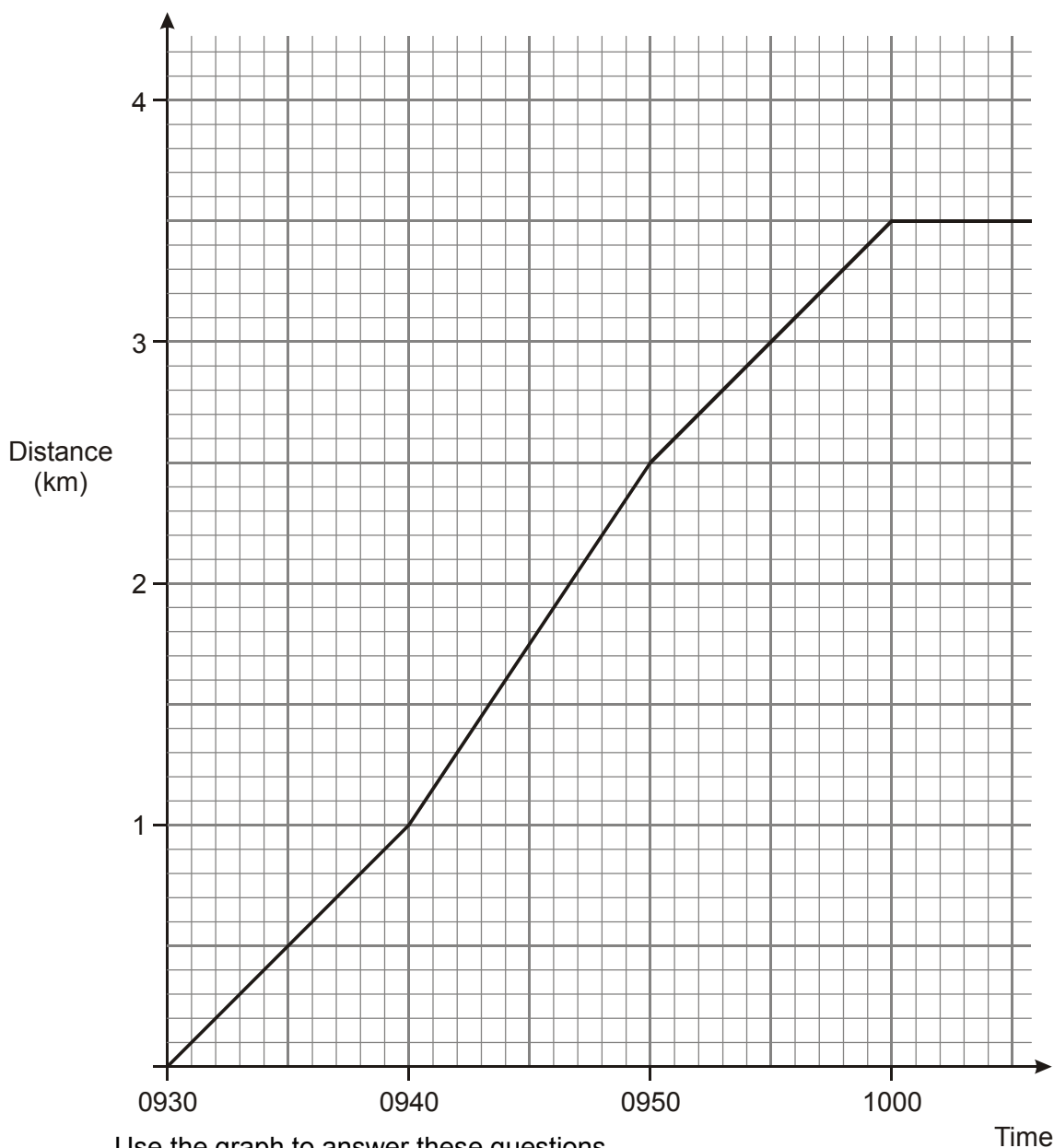


KEY STAGE 3: LEVEL 7 QUESTIONS

- 1) Kali uses a running machine to keep fit.
The simplified distance-time graph shows how she used the machine during one run.



- (a) Between 0930 and 0940, what was her speed in **kilometres per hour**?
- (b) Throughout the run, for how many **minutes** did she travel at this speed?
- (c) At 0940, she increased her speed.
By how many kilometres per hour did she increase her speed?

- 2) Some numbers are **smaller** than their squares.
For example: $7 < 7^2$

Which numbers are **equal to** their squares?

- 3) Look at these expressions.

$$5y - 8$$

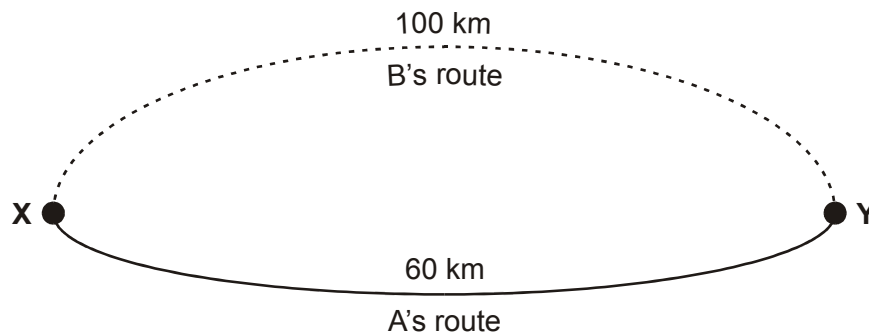
first
expression

$$3y + 5$$

second
expression

What value of y makes the two expressions equal?

- 4) Two people, A and B, travel from X to Y along different routes.
Their journeys take the same amount of time.



B travels at an average speed of **40 km/h**.

What is A's average speed?

- 5) (a) Ring the expression below that is the same as $y^2 + 8y + 12$

$$(y + 3)(y + 4)$$

$$(y + 7)(y + 1)$$

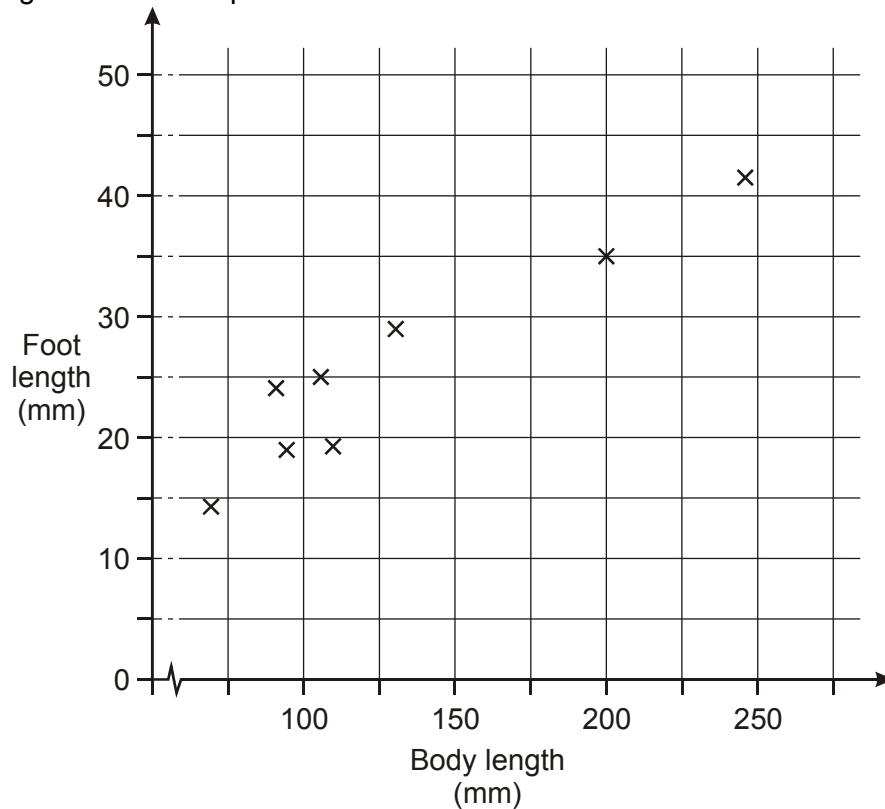
$$(y + 2)(y + 6)$$

$$(y + 1)(y + 12)$$

$$(y + 3)(y + 5)$$

- (b) Multiply out the expression $(y + 9)(y + 2)$

- 6) The scatter graph shows the average body length and average foot length of different species of rodents.



- (a) What does the scatter graph tell you about the **type of correlation** between the body length and foot length for these rodents?
- (b) Draw a **line of best fit** on the scatter graph.
- (c) If body length increased by **50 mm**, by approximately how many millimetres would you expect foot length to increase?

Ring the correct value below.

2 **7** **15** **50**
275

- (d) An animal has a body length of **228 mm**, and foot length of **22 mm**.
 Is this animal likely to be one of these species of rodents?
 Yes or No? Explain your answer.

- 7) I have two fair 4-sided dice.

One dice is numbered **2, 4, 6 and 8**

The other is numbered **2, 3, 4 and 5**

I throw both dice and **add** the scores.
 What is the probability that the total is **even**?
 You **must** show working to explain your answer.

- 8) The table shows a recipe for a fruit drink.

Type of juice	Amount
Orange	$\frac{1}{2}$ litre
Cranberry	$\frac{1}{3}$ litre
Grape	$\frac{1}{6}$ litre
Total 1 litre	

I want to make $1\frac{1}{2}$ litres of the same drink.

Copy and complete the table below to show how much of each type of juice to use. Show your working.

Type of juice	Amount
Orange	litre
Cranberry	litre
Grape	litre
Total $1\frac{1}{2}$ litres	

- 9) Think about triangles that have

a perimeter of 15 cm,
two or more equal sides,
and each side a whole number of centimetres.

Prove that there are only **four** of these triangles.

You do not need to construct the triangles.

- 10) Doctors sometimes use this formula to calculate how much medicine to give a child.

$$c = \frac{ay}{12 + y}$$

c is the correct amount for a child, in ml
 a is the amount for an adult, in ml
 y is the age of the child, in years

- (a) A child who is **4 years old** needs some medicine.
The amount for an adult is **20 ml**.

Use the formula to work out the correct amount for this child.

- (b) Another child needs some medicine.
The amount for an adult is **30 ml**.
The correct amount for this child is **15 ml**.

How old is this child? Show your working.

- 11) The heights of Russian dolls are in the ratio **4 : 6 : 7**



- (a) In a set of dolls, the height of the **middle** doll is **9 cm**.
What are the heights of the other dolls?
- (b) In another set of dolls, the height of the **tallest** doll is **9 cm**.
What are the heights of the other dolls?

- 12) Altogether, I have **10** bags of sweets.

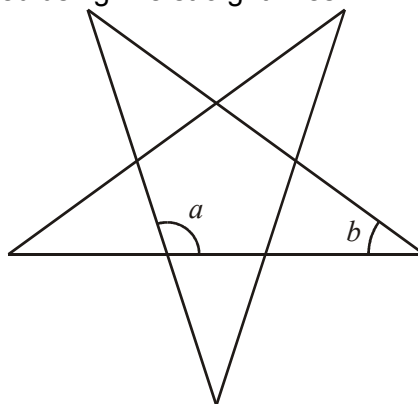
The mean number of sweets in the bags is **41**

The table shows how many sweets there are in **9** of the bags.

Number of sweets in a bag	Frequency
39	3
40	2
41	1
42	1
43	0
44	2

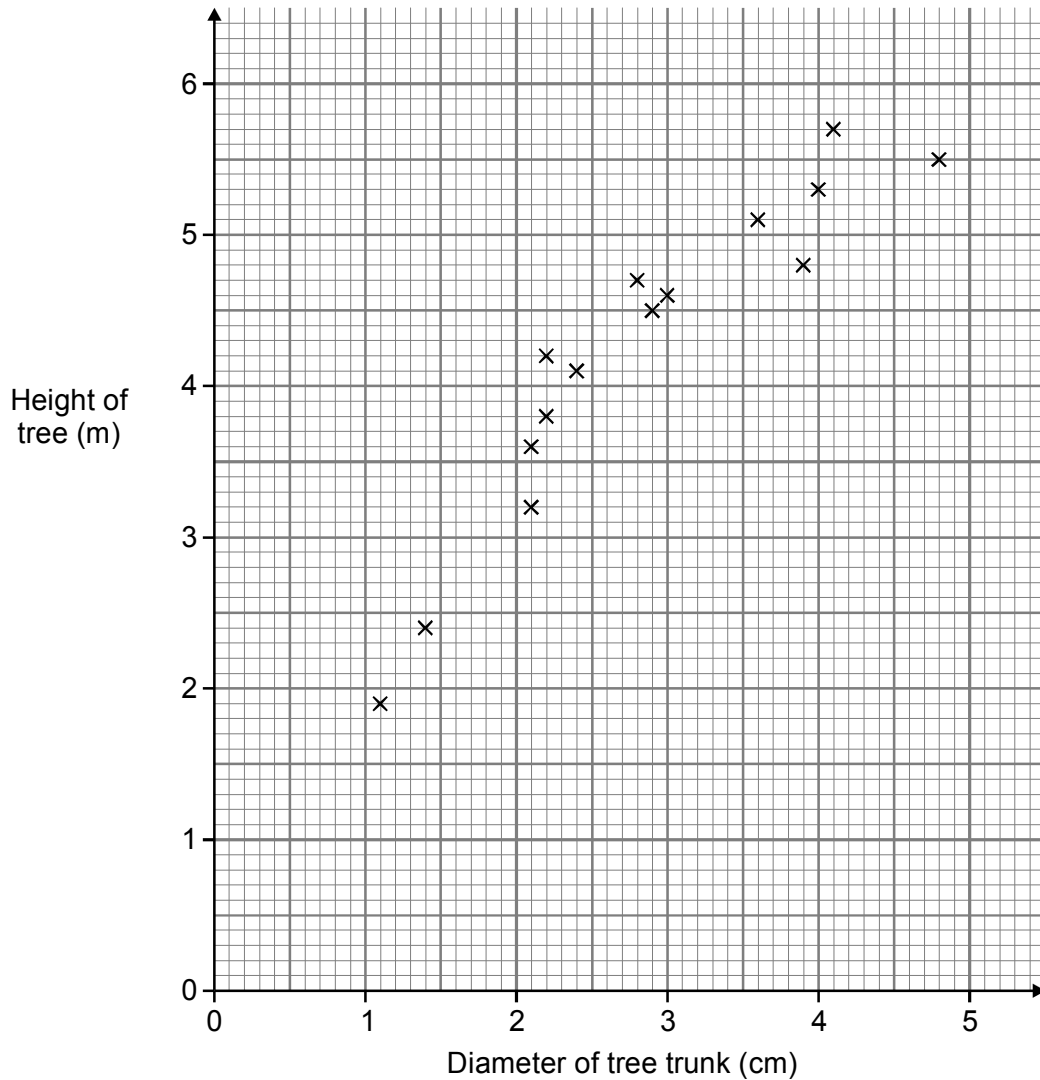
Calculate how many sweets there are in the 10th bag.
You **must** show your working.

- 13) The diagram shows the net for a right-pyramid with a regular pentagon as its base.
The net is constructed using five straight lines.



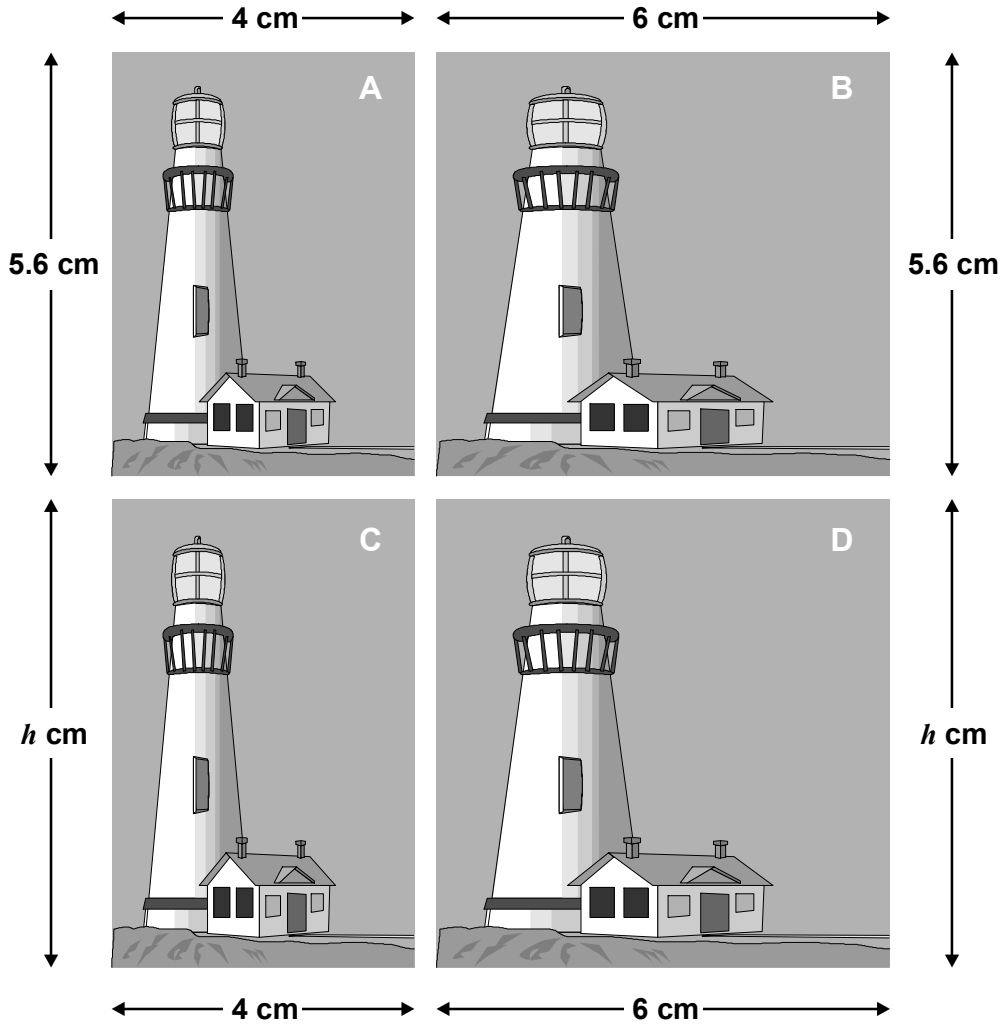
- (a) Without measuring, explain why angle **a** must be 108° .
(b) Calculate the size of angle **b**.

- 14) One hundred pet owners had a dog or a cat, or both. Fifty-five of the hundred had a dog. Sixty-five had a cat. How many had both a dog and a cat?
- 15) What must I multiply n squared by to get five n cubed?
- 16) The scatter graph shows information about trees called poplars.



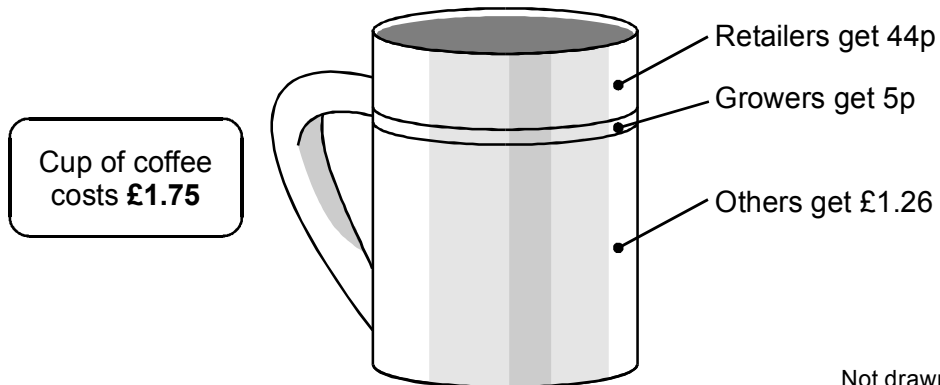
- (a) What does the scatter graph show about the **relationship** between the diameter of the tree trunk and the height of the tree?
- (b) The height of a different tree is 3 m. The diameter of its trunk is 5 cm. Use the graph to explain why this tree is **not** likely to be a poplar.
- (c) Another tree **is** a poplar. The diameter of its trunk is 3.2 cm. Estimate the height of this tree.

17) Here are four pictures, A, B, C and D. They are not to scale.



- (a) Picture A can be stretched horizontally to make picture B.
Show that the horizontal factor of enlargement is **1.5**
- (b) Picture A can be stretched vertically to make picture C.
The vertical factor of enlargement is **1.25**
What is the height, h , of picture C?

18) A cup of coffee costs £1.75
The diagram shows how much money different people get when you buy a cup of coffee.

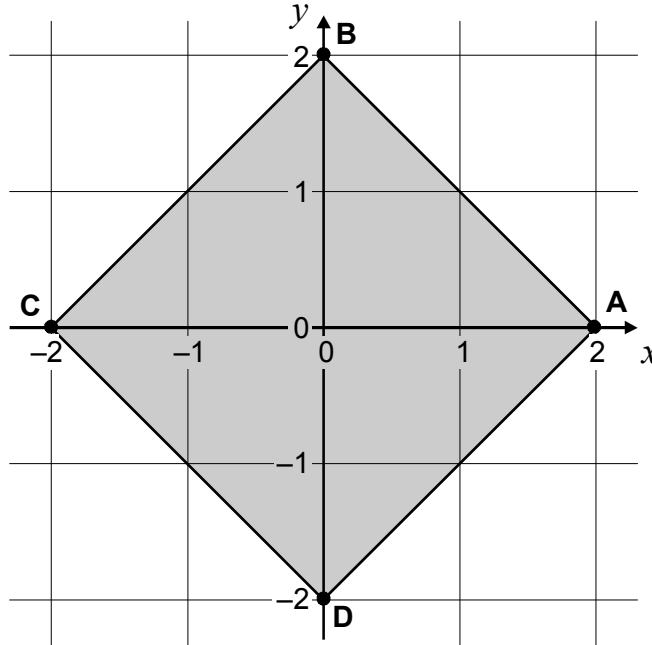


Not drawn accurately

Copy and complete the table to show what **percentage** of the cost of a cup of coffee goes to retailers, growers and others.

Retailers		%
Growers		%
Others		%

19) The diagram shows a square drawn on a square grid.



(a) The points A, B, C and D are at the vertices of the square. Match the correct line to each equation. One is done for you.



$y = 0$

Line through C and D

$x = 0$

Line through A and C

$x + y = 2$

Line through A and D

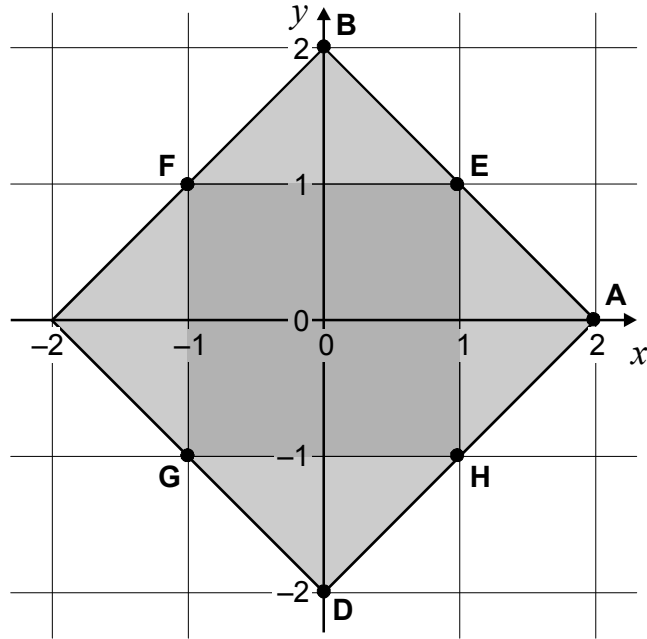
$x + y = -2$

Line through B and D

Line through B and C

Line through A and B

The mid-points of each side, E, F, G and H, join to make a different square.



- (b) Write the equation of the straight line through **E** and **H**.
- (c) Is $y = -x$ the equation of the straight line through **E** and **G**?
Yes or No? Explain how you know.

- 20) A headteacher wants to choose a pupil from year 7, 8 or 9 to appear on television.
The headteacher gives each pupil **one** ticket.
Then she will select the winning ticket at random.
The table shows information about the ticket used.

	Colour of the ticket	Numbers used
Year 7	red	1 to 80
Year 8	blue	1 to 75
Year 9	yellow	1 to 90

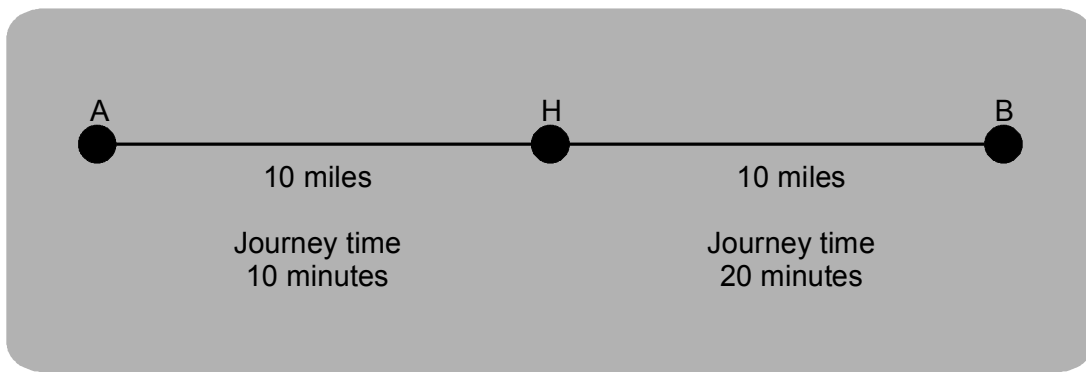
- (a) What is the probability that the winning ticket will be **blue**?
- (b) What is the probability that the winning ticket will show number **39**?
- (c) The headteacher selects the winning ticket at random.

She says:

‘The winning ticket number is 39’.

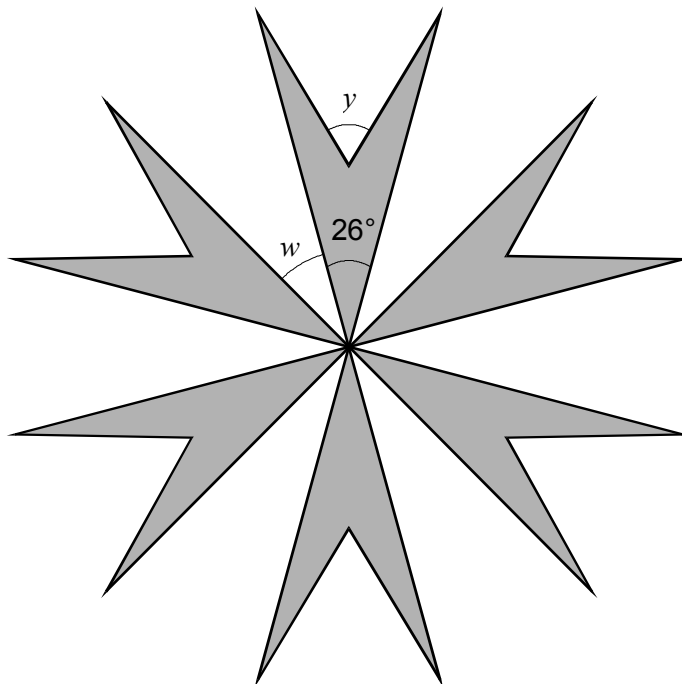
What is the probability that this winning ticket is blue?

- 21) The diagram shows the distance between my home, H, and two towns, A and B.
It also show information about journey times.



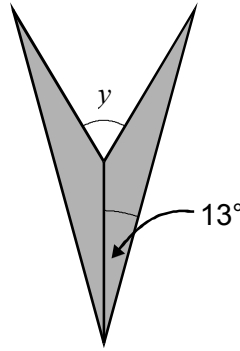
- (a) What is the average speed of the journey from my home to **town A**?
- (b) What is the average speed of the journey from my home to **town B**?
- (c) I drive from town A to my home and then to town B.
The journey time is 30 minutes.
What is my average speed?
- 22) This pattern has rotation symmetry of order 6

- (a) What is the size of angle w ?



- (b) Each quadrilateral in the pattern is made from two congruent **isosceles** triangles.

What is the size of angle y ?



- 23) A book gives this information:

A baby giraffe was born that was 1.58 metres high.
It grew at a rate of 1.3 centimetres **every hour**.

Suppose the baby giraffe continued to grow at this rate.

About how many days old would it be when it was **6 metres** high?

- 24) Owls eat small mammals.

They regurgitate the bones and fur in balls called pellets.

The table shows the contents of **62** pellets from long-eared owls.

Number of mammals found in the pellet	1	2	3	4	5	6
Frequency	9	17	24	6	5	1

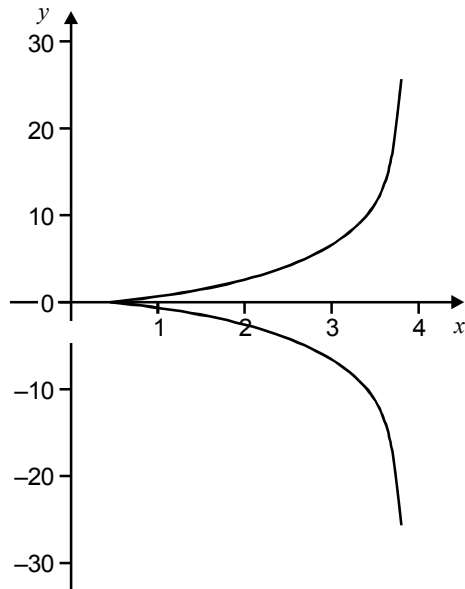
- (a) Show that the **total** number of mammals found is **170**
- (b) Calculate the **mean** number of mammals found in each pellet. Show your working and give your answer correct to 1 decimal place.
- (c) There are about **10 000** long-eared owls in Britain. On average, a long-eared owl regurgitates **1.4 pellets** per day.

Altogether, how many **mammals** do the 10 000 long-eared owls eat in **one day**?

Show your working and give your answer to the nearest thousand.

25) The equation of the curve shown is

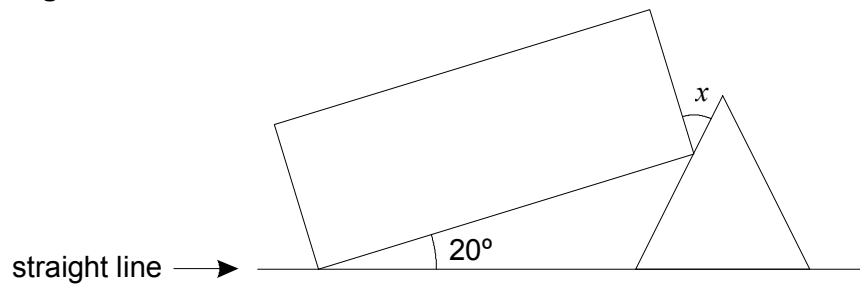
$$y = \pm \sqrt{\frac{x^3}{4-x}}$$



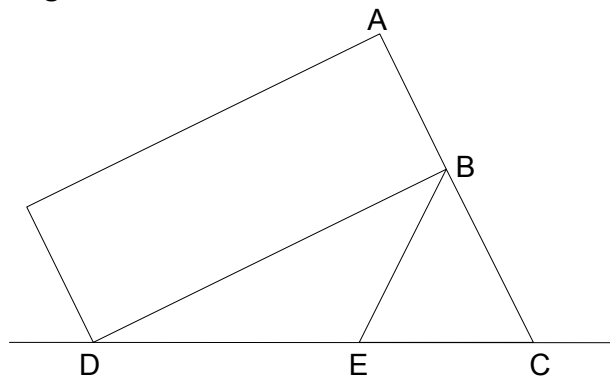
When $x = 2.5$ calculate the **positive** value of y
Show all the digits on your calculator display.

When $x = 2.5$ give **both** values of y correct to **3 significant figures**.

26) The diagram shows a **rectangle** that just touches an **equilateral triangle**.

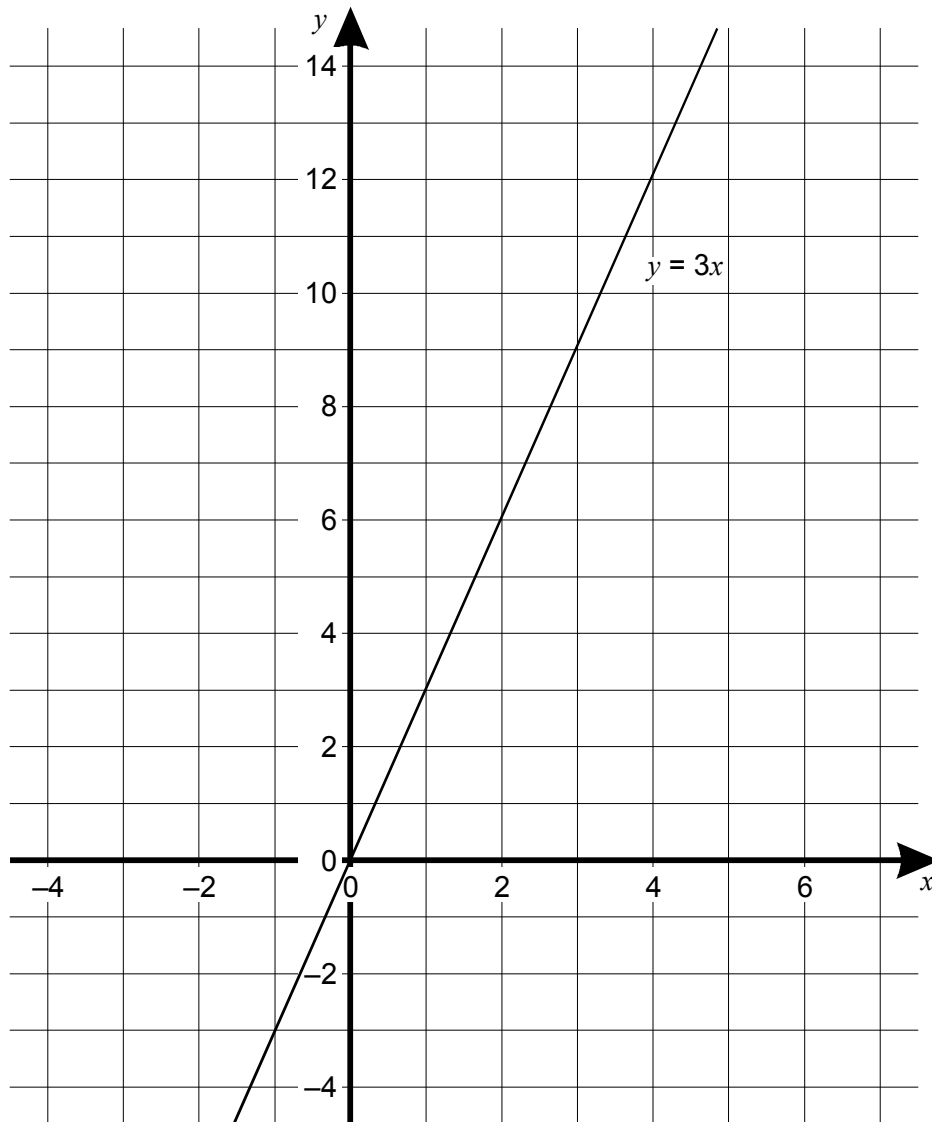


- Find the size of the angle marked x .
- Now the rectangle just touches the equilateral triangle so that **ABC** is a **straight line**.



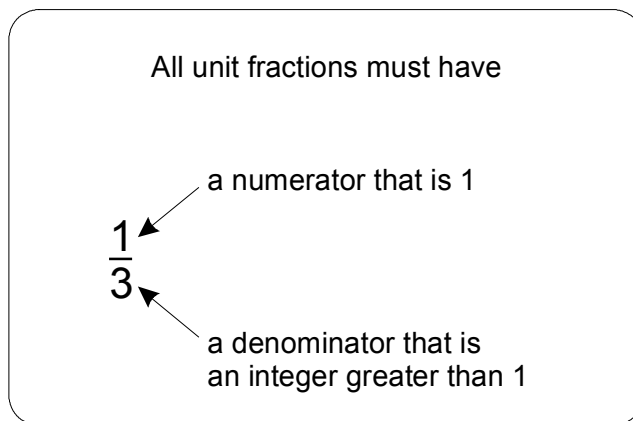
Show that **triangle BDE** is **isosceles**.

- 27) The graph shows a straight line. The equation of the line is $y = 3x$



- (a) Does the point $(25, 75)$ lie on the straight line $y = 3x$?
Yes or No?
Explain how you know.
- (b) Write the coordinates of the point that lies on both the straight lines $y = 4x + 1$ and $y = 6x - 4$.
You **must** show your working.
- (c) Explain how you can tell there is no point that lies on both the straight lines $y = \frac{1}{2}x + 3$ and $y = \frac{1}{2}x + 5$

- 28) $\frac{1}{3}$, $\frac{1}{8}$, $\frac{1}{5}$ are all examples of unit fractions.



The ancient Egyptians used only unit fractions.

For $\frac{3}{4}$, they wrote the sum $\frac{1}{2} + \frac{1}{4}$

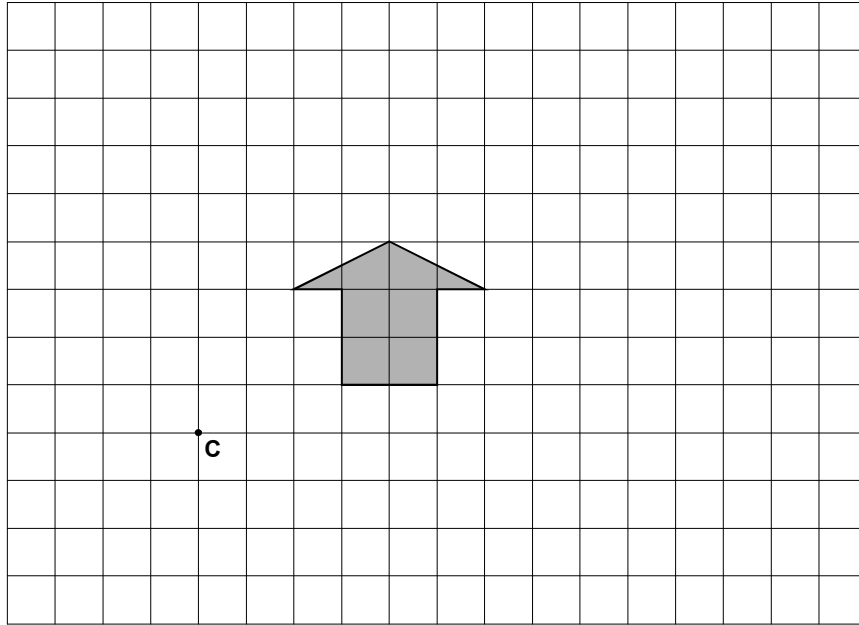
- (a) For what fraction did they write the sum $\frac{1}{2} + \frac{1}{5}$?
- (b) They wrote $\frac{9}{20}$ as the sum of two unit fractions.
One of them was $\frac{1}{4}$. What was the other?
- (c) What is the biggest fraction you can make by adding two **different** unit fractions?
- 29) The subject of the equation below is p

$$p = 2(e + f)$$

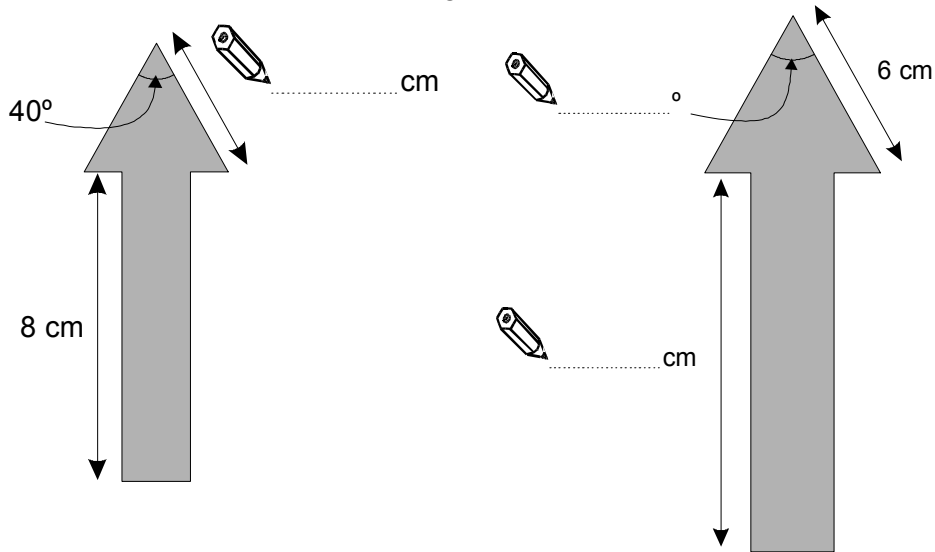
Rearrange the equation to make e the subject.

- 30) Using square paper, draw a set of axes with both x and y from 0 to 14.
- (a) Each point on the straight line $x + y = 12$ has an x coordinate and a y coordinate that **add together** to make **12**.
Draw the straight line $x + y = 12$ on your diagram.
- (b) Plot on the same diagram as part (a), at least 6 points whose x coordinate and y coordinate **multiply together** to make 12.
Then draw the curve $xy = 12$.

- 31) (a) The grid shows an arrow.
Copy the diagram and draw an **enlargement of scale factor 2** of the arrow. Use **point C** as the centre of enlargement.



- (b) The sketch below shows two arrows.
The bigger arrow is an **enlargement of scale factor 1.5** of the smaller arrow.
Write down the **three** missing values.



32) A box contains cards with one question on each card.

There are 4 categories of questions.

Each category has some easy and some difficult questions.

The table shows the probability of selecting a card at random from the box.

Category	Easy	Difficult
Music	0.2	0.15
Sport	0.2	0.1
History	0.1	0.05
Nature	0.15	0.05

(a) I am going to take one card at random from the box.

What is the probability that it will be

a **history** question?

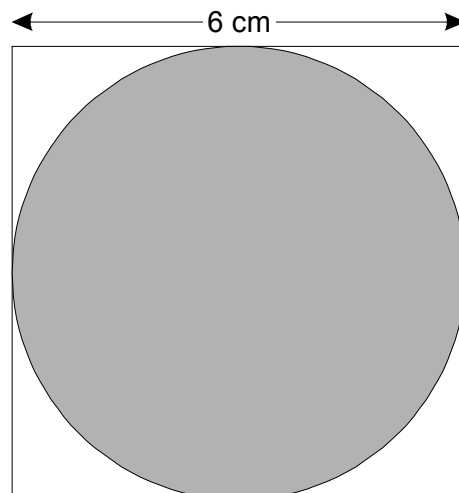
an **easy** question?

(b) There are **40** cards in the box.

How many of these are **music** questions?

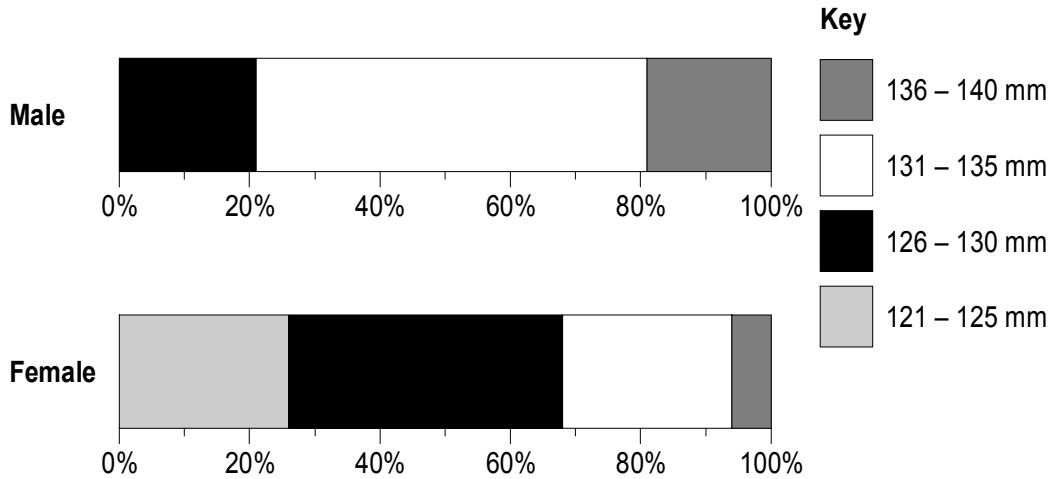
33) The diagram shows a square and a circle.

The circle touches the edges of the square.



What **percentage** of the diagram is shaded? Show your working.

- 34) The percentage charts show information about the wing length of adult blackbirds, measured to the nearest millimetre.



Use the data to decide whether these statements are **true** or **false**, or whether there is **not enough information to tell**.

The smallest male's wing length is larger than the smallest female's wing length.

The biggest male's wing length is larger than the biggest female's wing length.

- 35) (a) One calculation below gives the answer to the question **What is 70 increased by 9%?**

Write down the correct one.

70×0.9
 70×1.9
 70×0.09
 70×1.09

Choose one of the other calculations.

Write a question **about percentages** that this calculation represents.

Now do the same for one of the remaining two calculations.

- (b) Fill in the missing decimal number.

To decrease by 14%, multiply by

- 36) (a) m is an **odd** number.
Copy the quantities below and state whether each is even or odd?

$$2m$$

$$m^2$$

$$3m - 1$$

$$(m - 1)(m + 1)$$

- (b) m is an **odd** number.

Is the number $\frac{m+1}{2}$ odd, or even, or is it not possible to tell?

- 37) (a) Alan has a guessing game on his computer.

He estimates that the probability of **winning** each game is **0.35**.

Alan decides to play **20** of these games.

How many of these games should he expect to **win**?

- (b) Sue played the same computer game.

She won **12** of the games she played, and so she estimated the probability of winning each game to be **0.4**

How many games did Sue play?

- (c) The manufacturers of another guessing game claim that the probability of winning each game is **0.65**.

Karen plays this game **200** times and **wins 124** times.

She says: 'The manufacturers must be wrong'.
Do you agree with her? Yes or No.

- 38) Here are six different equations, labelled A to F

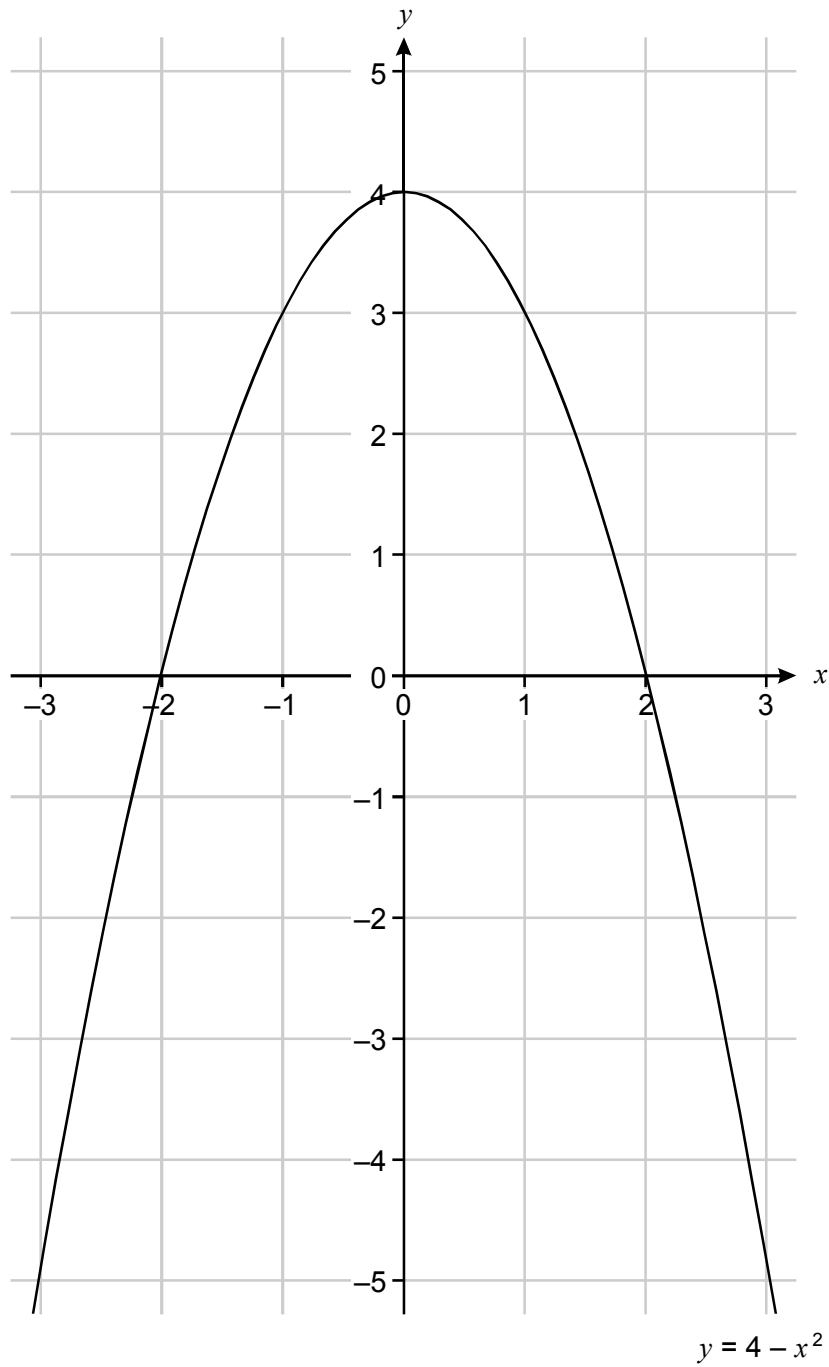
A	$y = 3x - 4$	B	$y = 4$	C	$x = -5$
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D	$x + y = 10$	E	$y = 2x + 1$	F	$y = x^2$
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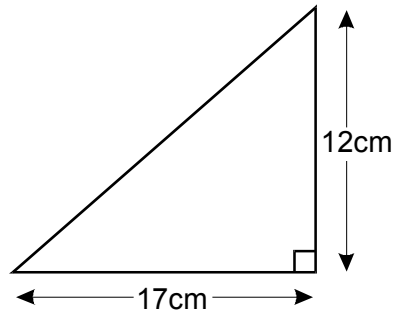
Think about the graphs of these equations.

- (a) Which graph goes through the point **(0, 0)**?
- (b) Which graph is **parallel** to the y -axis?
- (c) Which graph is **not a straight line**?
- (d) Which **two** graphs pass through the point **(3, 7)**?
- (e) The diagram shows the graph of the equation $y = 4 - x^2$.

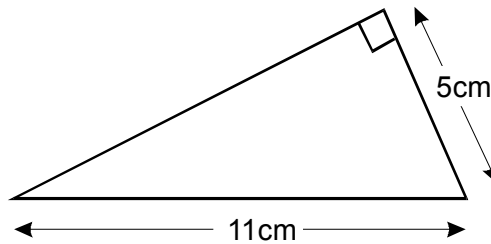
What are the coordinates of the points where the graph of this equation meets the graph of equation **E**?



- 39) (a) Calculate the length of the unknown side of this right-angled triangle.

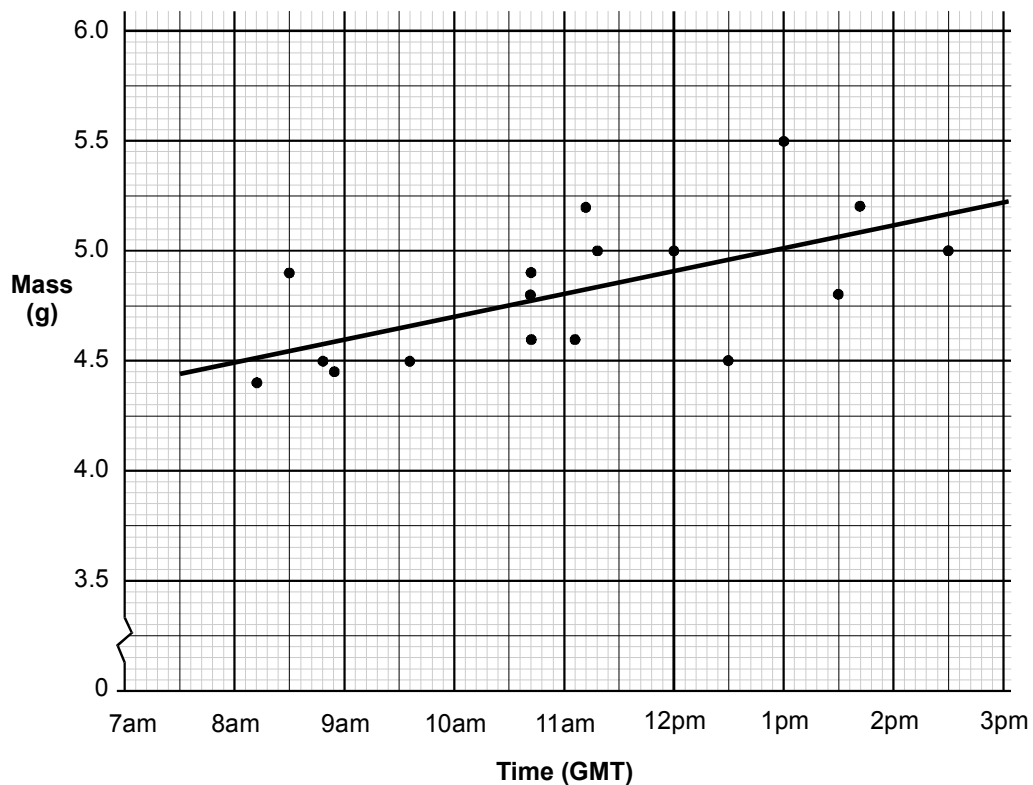


- (b) Calculate the length of the unknown side of the right-angled triangle below.



- 40) The goldcrest is Britain's smallest species of bird. On winter days, a goldcrest must eat enough food to keep it warm at night. During the day, the mass of the bird increases.

The scatter diagram shows the mass of goldcrests at different times during winter days. It also shows the line of best fit.



- (a) Estimate the mass of a goldcrest at **11 : 30 am**.
- (b) Estimate how many grams, on average, the mass of a goldcrest **increases** during **one hour**.
- (c) Which goldcrest represented on the scatter diagram is **least likely** to survive the night if it is cold?

Explain your answer.

- 41) The table shows the average weekly earnings for men and women in 1956 and 1998.

	1956	1998
Men	£11.89	£420.30
Women	£6.16	£303.70

- (a) For **1956**, calculate the average weekly earnings for women as a percentage of the average weekly earnings for men. Show your working and give your answer to 1 decimal place.
- (b) For **1998**, show that the average weekly earnings for women were a **greater proportion** of the average weekly earnings for men than they were in 1956.
- 42) Equations may have different numbers of solutions.
For example: $x + 2 = 7$ has only one solution, $x = 5$,
but $x + 1 + 2 = x + 3$ is true for all values of x

Copy the table below and tick (✓) the correct box for each algebraic statement.

	Correct for no values of x	Correct for one value of x	Correct for two values of x	Correct for all values of x
$3x + 7 = 8$				
$3(x + 1) = 3x + 3$				
$x + 3 = x - 3$				
$5 + x = 5 - x$				
$x^2 = 9$				

- 43) Each year a school has a concert of readings and songs.

In 1999 the concert had 3 readings and 9 songs. It lasted 120 minutes.
In 2000 the concert had 5 readings and 5 songs. It lasted 90 minutes.
In 2001 the school plans to have 5 readings and 7 songs.

Use simultaneous equations to estimate how long the concert will last.
Call the time estimated for a reading x minutes, and the time estimated for a song y minutes.

You **must** show your working.

- 44) (a) Estimate the answer to $72.34 \div 8.91$ by selecting an answer from the following list:

6 7 8 9 10 11

- (b) Estimate the answer to 32.7×0.48 by selecting an answer from the following list:

1.2 1.6 12 16 120 160

- (c) Estimate the answer to $\frac{8.62 + 22.1}{5.23}$.

Give your answer to **1 significant figure**.

- (d) **Estimate** the answer to $\frac{28.6 \times 24.4}{5.67 \times 4.02}$.

- 45) Look at these number cards.

0.2

2

10

0.1

0.05

1

- (a) Choose two of the cards to give the **lowest possible answer** to the calculation shown:

$$\boxed{} \times \boxed{} = \dots\dots\dots$$

- (b) Choose two of the cards to give the answer **100**.

$$\boxed{} \div \boxed{} = 100$$

- 46) (a) Look at these cards.
You can see two of the expressions. The third is hidden.

$$3x - 10$$

$$3x$$



The **mean** value of the expressions is **$3x$** ,
What is the hidden expression?

- (b) Write a set of three expressions that has a mean value of **$4x$**
(c) What is the mean value of these three expressions?

$$2x + 3$$

$$5x - 9$$

$$5x + 12$$

Show your working.
Write your expression as simply as possible.

- 47) Look at these expressions.

$$n - 2$$

$$2n$$

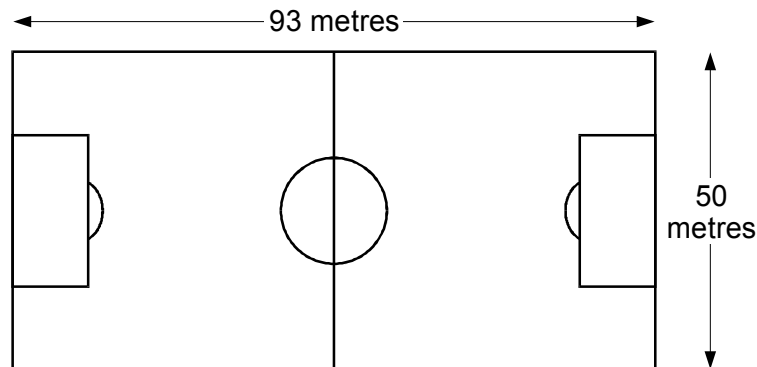
$$n^2$$

$$\frac{n}{2}$$

$$\frac{2}{n}$$

- (a) Which expression gives the greatest value when n is **between 1 and 2**?
(b) Which expression gives the greatest value when n is **between 0 and 1**?
(c) Which expression gives the greatest value when n is **negative**?

- 48) A groundsman marks out a football pitch.



- (a) He makes the pitch 93 metres long, to the nearest metre.
What is the **shortest possible** length of the pitch?

- (b) He makes the pitch 50 metres wide, to the nearest metre.
What is the **shortest possible** width of the pitch?
- (c) Des wants to know how many times he should run around the outside of this pitch to be sure of running **at least 3km**.

Use your answer to parts (a) and (b) to find how many times Des should run around the pitch.

49) **Copy the grid below onto square paper.**

I am thinking of a point on the dotted grid below.

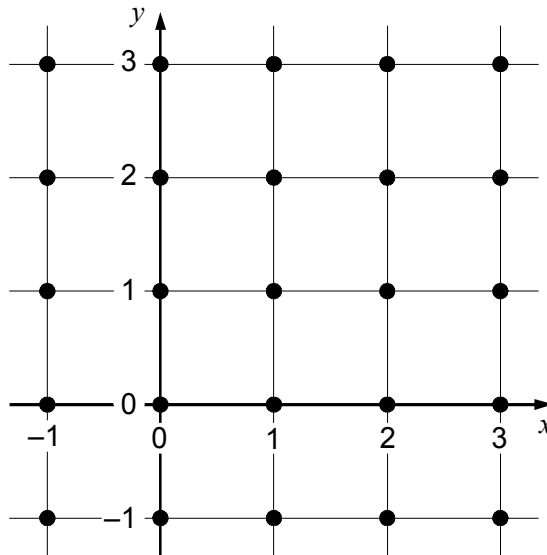
The co-ordinates of my point are (x, y)

You have 3 clues to find which of the dots is my point.

- (a) **First clue: $x > 0$ and $y > 0$**

Which dots **cannot** represent my point?

On your grid, **cross them out** like this ✕



- (b) **Second clue: $x + y < 4$**

Which other dots **cannot** represent my point?

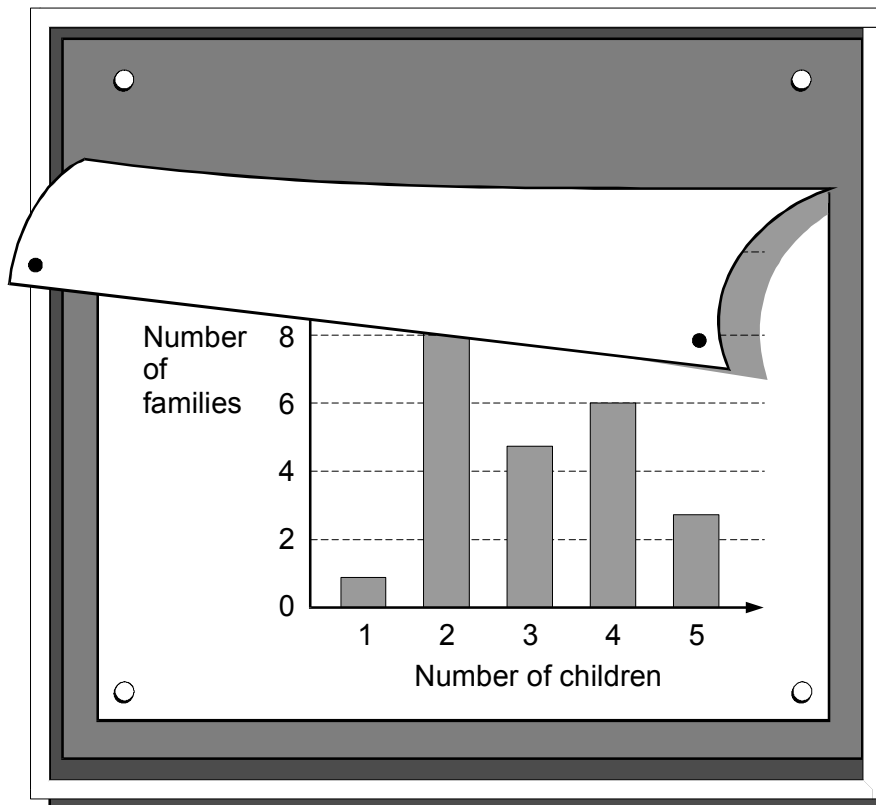
This time, put a **square around them** like this

- (c) **Third clue: $x > y$**

What are the co-ordinates of my point?

- 50) A class collected information about the number of children in each of their families.

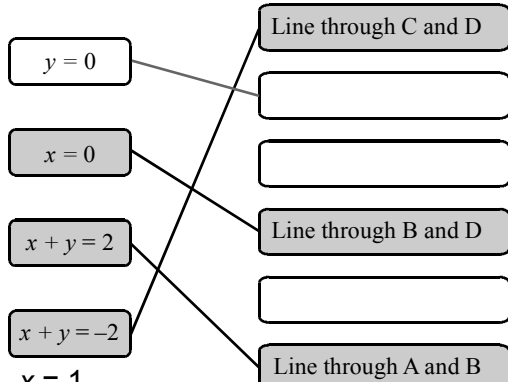
The information was displayed in a frequency chart, but you cannot see all the information.



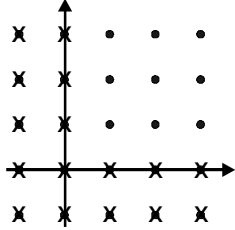
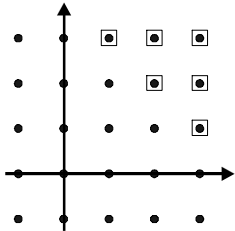
Call the number of families that have **two** children n .

- (a) Show that the **total** number of children in all the families is $55 + 2n$
- (b) Write an expression for the **total number of families**.
- (c) The **mean** number of children per family is **3**
 What is the value of n ?
 Show your working.

ANSWERS.

- 1) (a) 6.
(b) 20.
(c) 3.
- 2) 0 and 1.
- 3) Solve $5y - 8 = 3y + 5$ to get $y = 6.5$.
- 4) 24 km/h.
- 5) (a) $(y + 2)(y + 6)$.
(b) $y^2 + 11y + 18$.
- 6) (a) Positive correlation.
(b) Draws a line of best fit.
(c) 7.
(d) No.
- 7) $\frac{1}{2}$.
- 8) Orange $\frac{3}{4}$, cranberry $\frac{1}{2}$, grape $\frac{1}{4}$.
- 9) Possible triangles: 4, 4, 7
5, 5, 5
6, 6, 3
and 7, 7, 1.
- 10) (a) 5 ml.
(b) 12 years.
- 11) (a) 6 cm and 10.5 cm.
(b) 5.1...cm and 7.7...cm.
- 12) 42.
- 13) (b) 36° .
- 14) 20.
- 15) $5n$.
- 16) (a) Positive correlation.
(b) Since the accompanying point on the scatter graph would sit well below the plotted points.
(c) About 4.8 m.
- 17) (a) $6 \div 4$ etc.
(b) 7 cm.
- 18) Retailers 25.1%, growers 2.9%, others 72%.
- 19) (a) 
- (b) $x = 1$.
(c) No.
- 20) (a) $\frac{75}{245} = \frac{15}{49}$.
(b) $\frac{3}{245}$.

- (c) $\frac{1}{3}$.
- 21) (a) 60 miles per hour or 1 mile per minute.
 (b) 30 miles per hour.
 (c) 40 miles per hour.
- 22) (a) $w = 34^\circ$.
 (b) $y = 42^\circ$.
- 23) About 14 days.
- 24) (b) 2.7 mammals to 1 decimal place.
 (c) 37800 which equals 38000 to the nearest thousand.
- 25) $y = 3.227486122$.
 $y = 3.23$ or -3.23 to 3 significant figures.
- 26) (a) $x = 50^\circ$.
- 27) (a) Yes since if we put $x = 25$, then $y = 3 \times 25 = 75$.
 (b) $x = 2.5$, $y = 11$.
- 28) (a) $\frac{7}{10}$.
 (b) $\frac{1}{5}$.
 (c) $\frac{5}{6}$.
- 29) $e = \frac{p - 2f}{2}$.
- 31) (b) 4 cm, 40° and 12 cm.
- 32) (a) $P(\text{History}) = 0.15$. $P(\text{Easy question}) = 0.65$.
 (b) 14.
- 33) 79%.
- 34) True.
 Not enough information to tell.
- 35) (a) 70×1.09 .
 (b) 0.86.
- 36) (a) $2m$ is even.
 m^2 is odd.
 $3m - 1$ is even.
 $(m - 1)(m + 1)$ is even.
 (b) Not possible to tell.
 Sometimes odd, sometimes even.
- 37) (a) 7.
 (b) 30.
 (c) No. E.g. in 200 games it would be possible (but unlikely) to win all 200 games!
- 38) (a) F.
 (b) C.
 (c) F.
 (d) D and E.
 (e) $(-3, -5)$ and $(1, 3)$.
- 39) (a) 20.808... cm.
 (b) 9.797... cm.
- 40) (a) 4.7 g.
 (b) 0.2 g.
 (c) The one which at 12.30 is only 4.5 g. This one will lose even more mass through the night.

- 41) (a) 51.8%.
 (b) {72.3%}.
- 42) Correct for one value, correct for all values, correct for no values, correct for one value, correct for two values.
- 43) $3x + 9y = 120$
 $5x + 5y = 90$.
 Solve to get $x = 7$, $y = 11$.
 Therefore 5 readings and 7 songs will take $5 \times 7 + 7 \times 11 = 112$ minutes.
- 44) (a) 8.
 (b) 16.
 (c) 6.
 (d) 25.
- 45) (a) $0.1 \times 0.05 = 0.005$.
 (b) $10 \div 0.1 = 100$.
- 46) (a) $3x + 10$.
 (b) E.g. $4x - 10$, $4x$, $4x + 10$. {Any 3 expressions which total $12x$.}
- 47) (a) $2n$.
 (b) $\frac{2}{n}$.
 (c) n^2 .
- 48) (a) 92.5 m.
 (b) 49.5 m.
 (c) 11 times.
- 49) (a) 
- (b) 
- (c) (2, 1).
- 50) (a) Number of children = 1 family with 1 child
 + n families with 2 children
 + 5 families with 3 children
 + 6 families with 4 children
 + 3 families with 5 children
- = $1 + 2n + 15 + 24 + 15$ children
 = $55 + 2n$ children
- (b) $n + 15$.
 (c) $n = 10$.