

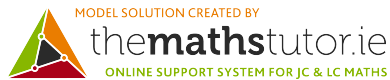
Question 1

(Suggested maximum time: 5 minutes)

(a) Find the value of each of the following.

(i) $372 + 119$

491



(ii) 3.4×7

23.8

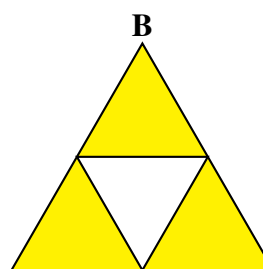
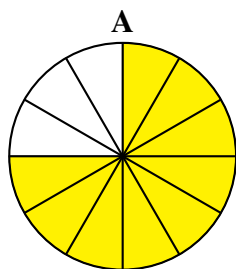


(iii) $3 \times (7 - 5)$

$3 \times (7 - 5) = 3 \times (2) = 6$



(b) Shade in $\frac{3}{4}$ of the area of each shape below. The shapes are labelled **A** and **B**.



(c) Write the numbers 3, 9, and 25 into the three empty boxes below to make the mathematical statement true. Use each number only once.

3		9	=	24
5	+	25	=	25

We can use a common denominator to check that

$$\frac{3}{5} + \frac{9}{25} = \frac{3(5) + 9(1)}{25} = \frac{15 + 9}{25} = \frac{24}{25}$$



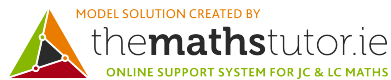
Question 2**(Suggested maximum time: 10 minutes)**

Tom is baking for the school bake sale. He buys the following ingredients:

Ingredient	Cost
A carton of milk	€1.22
A pound of butter	€3.75
A carton of eggs	€1.70

- (a) (i) Work out the total cost of the ingredients.

The total cost is $€1.22 + €3.75 + €1.70 = €6.67$.



- (ii) Tom pays for the ingredients with a €20 note. How much change should he get?

Tom gets $€20 - €6.67 = €13.33$.



Tom makes cookies with the ingredients.

- (b) Tom's recipe gives the quantities of each ingredient for 12 cookies and for 24 cookies. Some of these quantities are shown in the table below.

Fill in the two missing values in the table.

Ingredient	12 cookies	24 cookies
Eggs	2	4
Milk (ml)	50	100
Butter (g)	90	180

The amount of milk required to make 24 cookies is twice as much as the amount needed to make 12 cookies which is $50 \times 2 = 100$ ml.

The amount of butter required to make 12 cookies is half as much as the amount needed to make 24 cookies which is $180 \times \frac{1}{2} = 90$ g.



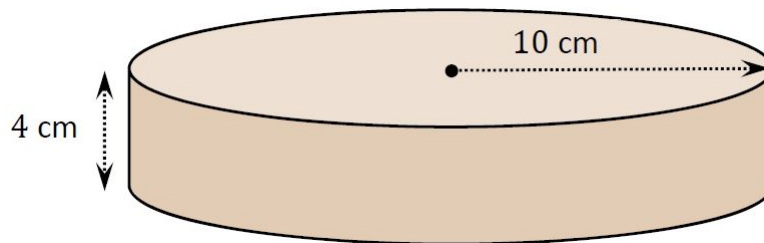
- (c) Tom puts the cookies in the oven at 10:50 a.m. He checks the oven 15 minutes later.
At what time does he check the oven?

11:00 a.m. is 10 minutes later. Since he checks the oven after 15 mins, he checks it at 11:05 a.m.



Tom also bakes a cake.

- (d) His cake tin is in the shape of a cylinder.
It has the dimensions shown in the diagram below.
Work out the **volume** of Tom's cake tin. Give your answer in terms of π .



The cylinder has height $h = 4$ cm and radius $r = 10$ cm. So the volume is

$$V = \pi r^2 h = \pi(10)^2(4) = \pi(100)(4) = 400\pi \text{ cm}^3$$



- (e) The recipe says the cake should be baked at a temperature of 210° .
Tom thinks that this is too hot.
He **reduces** this temperature by 10%.

Work out the temperature that Tom uses.

We need to find 10% of 210° . We can write 10% as the fraction $\frac{10}{100}$ which means

$$10\% \text{ of } 210^{\circ} = \frac{10}{100} \times 210^{\circ} = 21^{\circ}$$

If Tom reduces the temperature by this amount, the new temperature is

$$210^{\circ} - 21^{\circ} = 189^{\circ}.$$

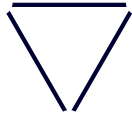
Alternatively, when Tom reduces the temperature by 10% the new temperature is 90% of the original temperature. This is

$$90\% \text{ of } 210^{\circ} = \frac{90}{100} \times 210^{\circ} = 189^{\circ}$$

Question 3

(Suggested maximum time: 10 minutes)

Camille uses sticks to make a sequence of patterns.
The first 3 patterns in her sequence are shown below.



Pattern 1



Pattern 2



Pattern 3

(a) Draw Pattern 4 in the sequence.

Two more triangles are added each time. The fourth pattern will look like this:



Pattern 4



(b) Fill in the table below to show the number of **triangles** in each of the first five patterns.

One is already done for you.

Pattern	Number of triangles
1	1
2	3
3	5
4	7
5	9

(c) What kind of sequence is made by the number of **triangles** in each pattern?

Tick (✓) one box only. Give a reason for your answer.

linear



non-linear



Reason: The difference between each term is the same (+2 each time) so it's a linear sequence.



(d) One pattern has exactly 21 triangles.

Tick the correct box to show which pattern this is. Show your working out.

The pattern with 21 triangles is: **Pattern 11** **Pattern 21** **Pattern 41**
(tick (✓) **one** box only)

The number of triangles in each pattern number can be calculated by multiplying the pattern number by 2 and then subtracting 1 e.g. pattern 4 has $8 - 1 = 7$ triangles. In general, pattern n has $2n - 1$ triangles.

Pattern 11 will have $2(11) - 1 = 22 - 1 = 21$ triangles.



(e) There are also parallelograms in these patterns.

The number of parallelograms in Pattern n is:

$$n^2 - n$$

Use this to work out the number of parallelograms in Pattern 30 (when $n = 30$).

Substitute $n = 30$ into the formula to see that the number of parallelograms in pattern 30 is

$$30^2 - 30 = 900 - 30 = 870$$



Question 4

(Suggested maximum time: 10 minutes)

The graph below shows the total number of times Peter checked his phone from 8 a.m. to 6 p.m. on a given day. For example, by 6 p.m. Peter had checked his phone a total of 65 times.

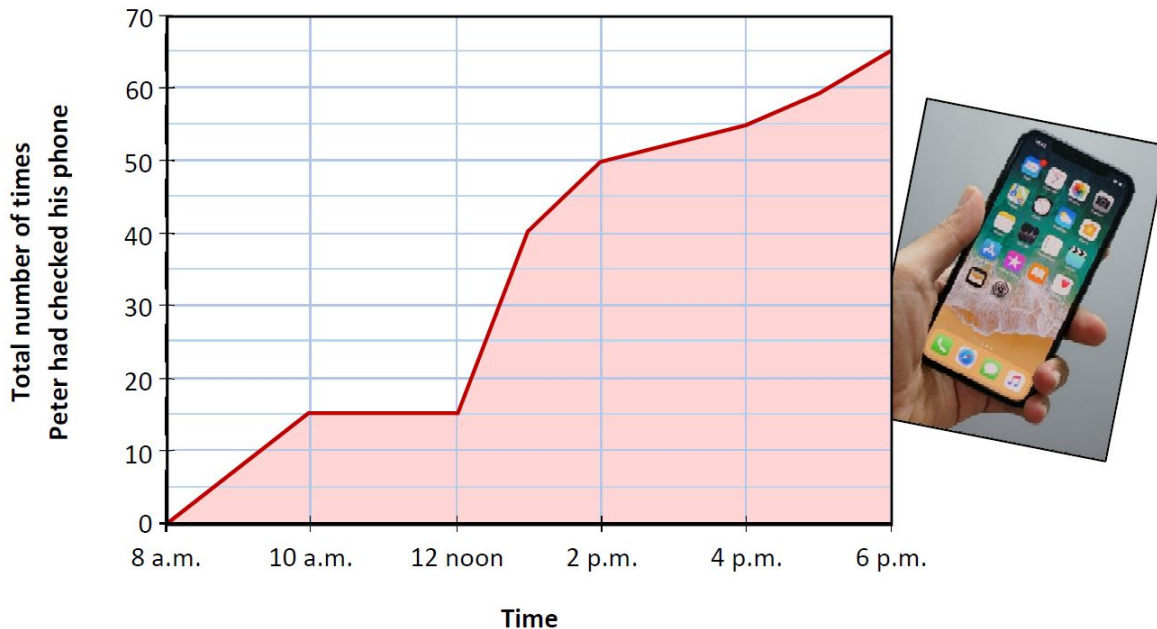


Figure 1: Credit to Bagus Hernawan, www.unsplash.com

(a) Use the graph to answer each of the following questions.

In each case, tick (✓) the correct box only.

(i) By 2 p.m., the total number of times Peter had checked his phone was:

- | | | | |
|--------------------------|--------------------------|-------------------------------------|--------------------------|
| 15 | 40 | 50 | 55 |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

(ii) Peter did **not** check his phone at all from:

- | | | | |
|-------------------------------------|--------------------------|--------------------------|--------------------------|
| 10 – 12 noon | 12 – 2 p.m. | 2 – 4 p.m. | 4 – 6 p.m. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

(iii) Peter checked his phone **most often** from:

- | | | | |
|--------------------------|-------------------------------------|--------------------------|--------------------------|
| 10 – 12 noon | 12 – 2 p.m. | 2 – 4 p.m. | 4 – 6 p.m. |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

- (b) From 8 a.m. to 6 p.m. on that day, Peter checked his phone on average 6.5 times each hour. He uses this to estimate N , the total number of times he had checked his phone, as:

$$N = 6.5 \times H$$

where H is the number of hours after 8 a.m. on that day.

- (i) Use this formula to find the value of N when H is 8.

Substitute $H = 8$ into the formula to get:

$$N = 6.5 \times 8 = 52$$



- (ii) Peter uses his formula to estimate that he will have checked his phone 156 times by 8 a.m. the following day (when $H = 24$).

Do you think that this is a reasonable estimate? Tick (\checkmark) **one** box only. Give a reason for your answer.

It is reasonable



It is **not** reasonable



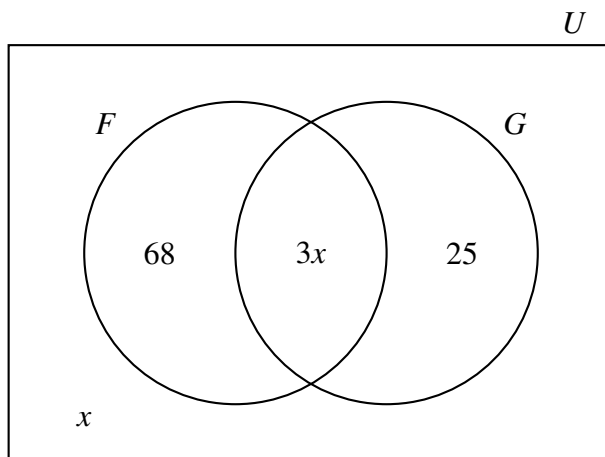
Reason: The formula is based on a day-time usage pattern from 8am to 6pm. It is unlikely that the usage pattern will be the same during the other 14 hours. Peter may check his phone more often in the evening, or he may not check it at all. He will not check his phone when asleep. Because the usage pattern is likely to be different, it is not a reasonable way to estimate the overall number of times he checks his phone in a 24 hour period.



Question 5

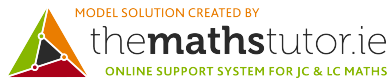
(Suggested maximum time: 10 minutes)

Kate carried out a survey on the students in her year (U) to see how many study French (F) or German (G). Her results are shown in the Venn diagram below, where $x \in \mathbb{N}$.



(a) How many students study German but **not** French?

25



(b) In **total**, how many students study French? Give your answer in terms of x .

$68 + 3x$



(c) Complete the sentence below correctly:

“ $3x$ students study

both French and German

.”

- (d) Explain what the following statement means, in the context of Kate's survey:

$$\#(F \setminus G) = 68$$

The # symbol means the number of students. $F \setminus G$ means "F without G".

This statement says that the number of students who study French but not German is 68.



- (e) One student is picked at random from the $3x + 25$ students who study German.

Write down the **probability** that this student also studies French.

Give your answer as a fraction, in terms of x .

$$\text{Probability} = \frac{3x}{3x + 25}$$

- (f) Kate finds out that there are 141 students in total in her year.
She writes the following equation in x :

$$68 + 3x + 25 + x = 141$$

Work out the value of x .

$$\begin{aligned} 68 + 3x + 25 + x &= 141 \\ 93 + 4x &= 141 \\ 4x &= 141 - 93 \\ 4x &= 48 \\ x &= 12 \end{aligned}$$



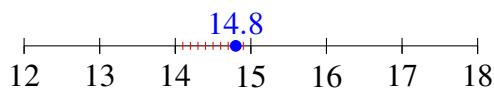
Question 6

(Suggested maximum time: 5 minutes)

The students in a class run a race.

(a) It takes Ali 14.8 seconds to run the race.

(i) Plot the point 14.8 on the number line below.



Credit to www.activekids.com

(ii) Write 14.8 seconds correct to the **nearest second**.

15 seconds.



(b) Fill in the missing description and graph in the table below, labelled **A** and **B**.
In each case, $t \in \mathbb{R}$.

	Description	Graph $t \in \mathbb{R}$
1.	t is greater than 12	
2.	A. t is <u>less than 15</u>	
3.	t is between 12 and 17	B.

(c) It takes Ben 12.1 seconds to run the race.

It takes Ciara 11 seconds to run the race.

Which one of these numbers is a natural number (\mathbb{N})?

Tick (\checkmark) **one** box only. Give a reason for your answer.

12.1 11

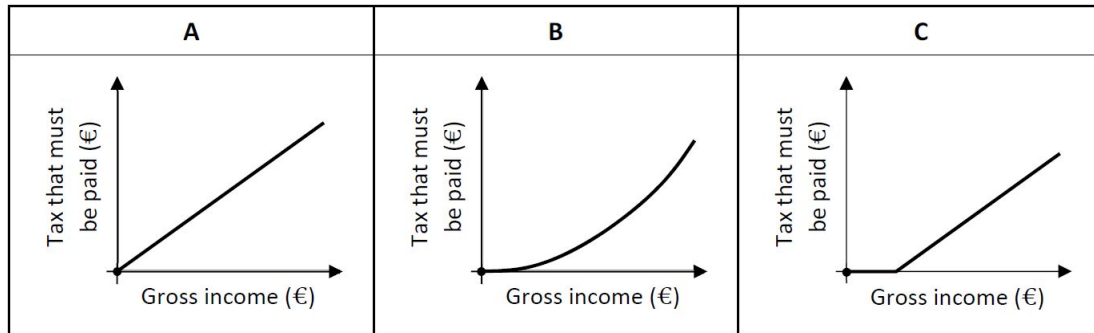
Natural numbers (\mathbb{N}) are positive whole numbers.



Question 7

(Suggested maximum time: 5 minutes)

The table below shows the three graphs **A**, **B**, and **C**. Each graph shows the tax that someone must pay depending on their gross income. Each graph begins at $(0, 0)$.



Jean's tax rate is 20% of her gross income. She has a tax credit of €3000.

Which graph shows the tax that Jean must pay depending on her gross income, taking her tax credit into account? Tick (✓) **one** box only. Justify your answer.

- | | | |
|--------------------------|--------------------------|-------------------------------------|
| A | B | C |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

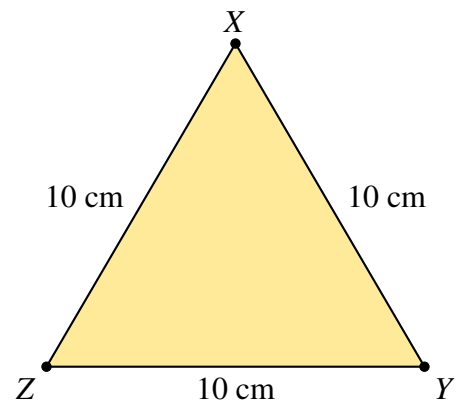
Justification: Jean has a tax credit of €3000 on which she pays no tax. Graph C is the only graph where tax initially stays at zero while gross income increases. Once her income exceeds her tax credit of €3000, the graph starts to increase.

Question 8

(Suggested maximum time: 15 minutes)

An equilateral triangle XZY has sides of length 10 cm.

- (a) Write down the size of each **angle** in the triangle.



In an equilateral triangle, each angle is 60° . So

$$\angle XYZ = 60^\circ$$

$$\angle YZX = 60^\circ$$

$$\angle ZXY = 60^\circ$$



- (b) Work out the length of the **perimeter** of the triangle XZY . Give your answer in cm.

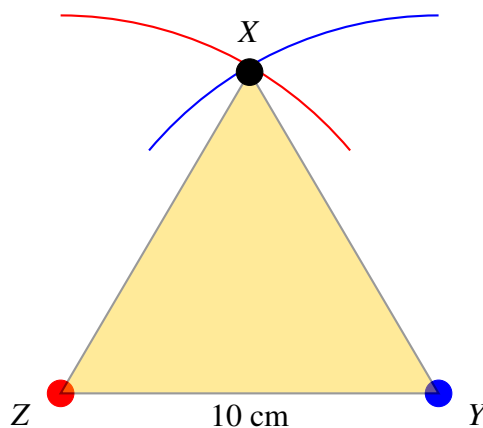
Since the triangle has three sides of length 10 cm, the perimeter is $10 + 10 + 10 = 30$ cm.



- (c) **Construct** the triangle XZY in the space below.
Show all of your construction lines clearly.

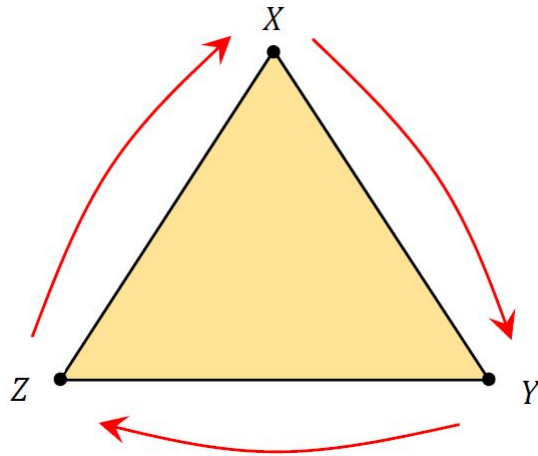
Using a ruler, draw a line of length 10 cm which will be the base of the triangle. Centre your compass at one end of the line and draw an arc of radius 10 cm. Then centre your compass at the other end of the line and draw another arc of radius 10 cm.

Finally, join the two endpoints of the line segment to the point of intersection of the two arcs.



(d) Maria plays a game using the triangle XZY . She starts with a counter at the point X . She flips a coin and moves the counter around the triangle in the direction XZY , as shown in the diagram below, using the following rule:

- if she gets **heads (H)**, she moves the counter along 1 side of the triangle (e.g. X to Y)
- if she gets **tails (T)**, she moves the counter along 2 sides of the triangle (e.g. X to Z)



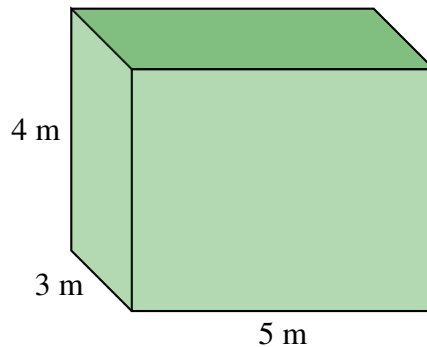
Maria's first 4 flips of the coin are **H H H T**.

Fill in the table below to show which point the counter is at after each flip of the coin. Some are already done for you.

	Outcome of flip (H or T)	Number of sides the counter moves	After this flip, the counter is at:
Start			X
1st flip	H	1	Y
2nd flip	H	1	Z
3rd flip	H	1	X
4th flip	T	2	Z

Question 9**(Suggested maximum time: 5 minutes)**

Clive estimates the dimensions of a rectangular tank to be 5 m by 4 m by 3 m.



- (a) Use Clive's values to work out the **volume** of the tank, in m^3 .

This tank has length $l = 5$ m, width $w = 3$ m and height $h = 4$ m. The volume of the tank is given by

$$V = l \times w \times h = 5 \times 3 \times 4 = 60 \text{ m}^3.$$



- (b) Clive's estimates are all correct to the nearest metre.

The actual volume of the box is $K \text{ m}^3$, where $K \in \mathbb{N}$.

Work out the **largest** value that K could have.

Since Clive has rounded his answers to the nearest metre, we know that:

$$l < 5.5$$

$$w < 3.5$$

$$h < 4.5$$

So the volume of the box must be less than

$$5.5 \times 3.5 \times 4.5 = 86.625 \text{ m}^3$$

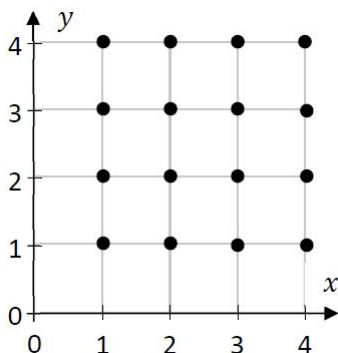
We are told that the actual volume is $K \text{ m}^3$ where $K \in \mathbb{N}$. So the largest value of K is 86.



Question 10

(Suggested maximum time: 5 minutes)

In the co-ordinate diagram below, 16 points are marked with a dot (•).

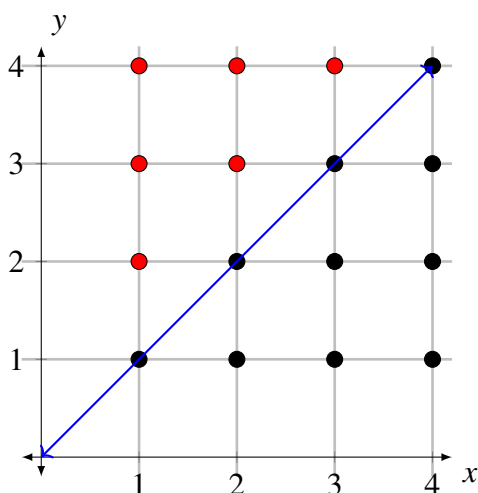


Louise picks 1 point at random from the 16 points marked with a dot in the diagram. She then finds the equation of the line that goes through this point and through (0, 0).

Find the **probability** that Louise's line has a slope that is **greater than 1**.

$$\text{Probability} = \frac{3}{8}$$

The line that goes through the origin and the points (1, 1), (2, 2), (3, 3) and (4, 4) has slope 1. To have a slope **greater than 1**, Louise must pick one of the 6 red points out of the total 16 points.

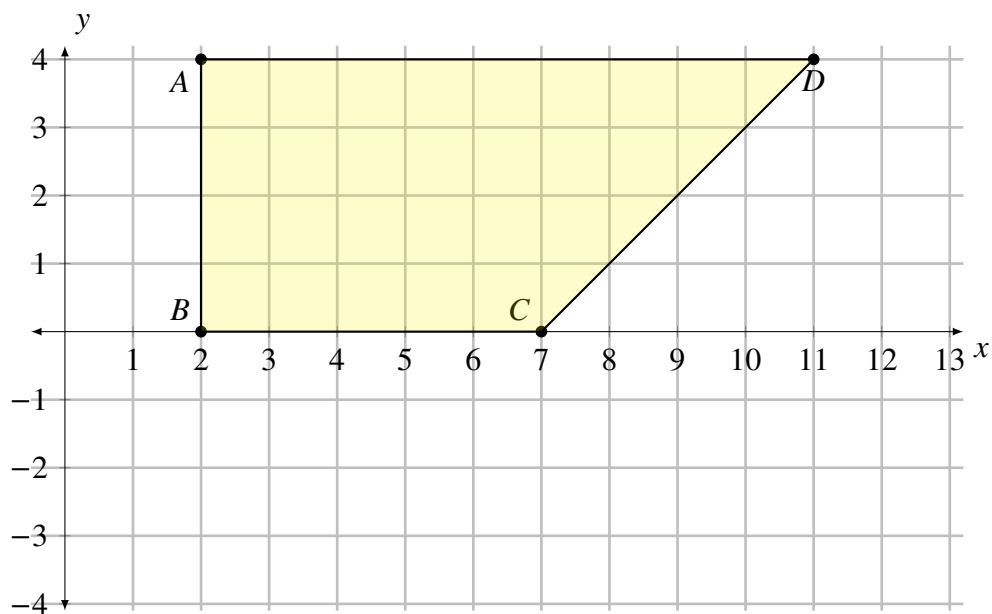


The probability of Louise randomly picking a line of slope greater than 1 is $\frac{6}{16} = \frac{3}{8}$.

Question 11

(Suggested maximum time: 10 minutes)

The quadrilateral $ABCD$ is shown in the co-ordinate diagram below.



(a) Complete the table below to show the co-ordinates of the four corners of $ABCD$.

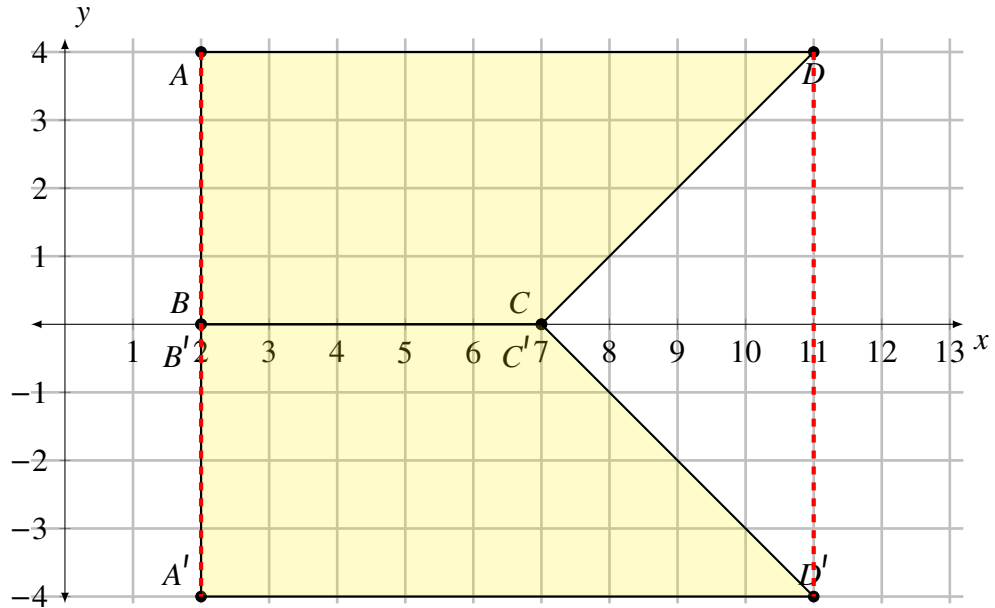
Point	A	B	C	D
Co-ordinates	$(2, 4)$	$(2, 0)$	$(7, 0)$	$(11, 4)$

- (b) On the diagram above, draw the image of $ABCD$ under **axial symmetry** in the x -axis.

Axial symmetry in the x -axis means the y -values will be changed by a factor of -1 so the new points are:

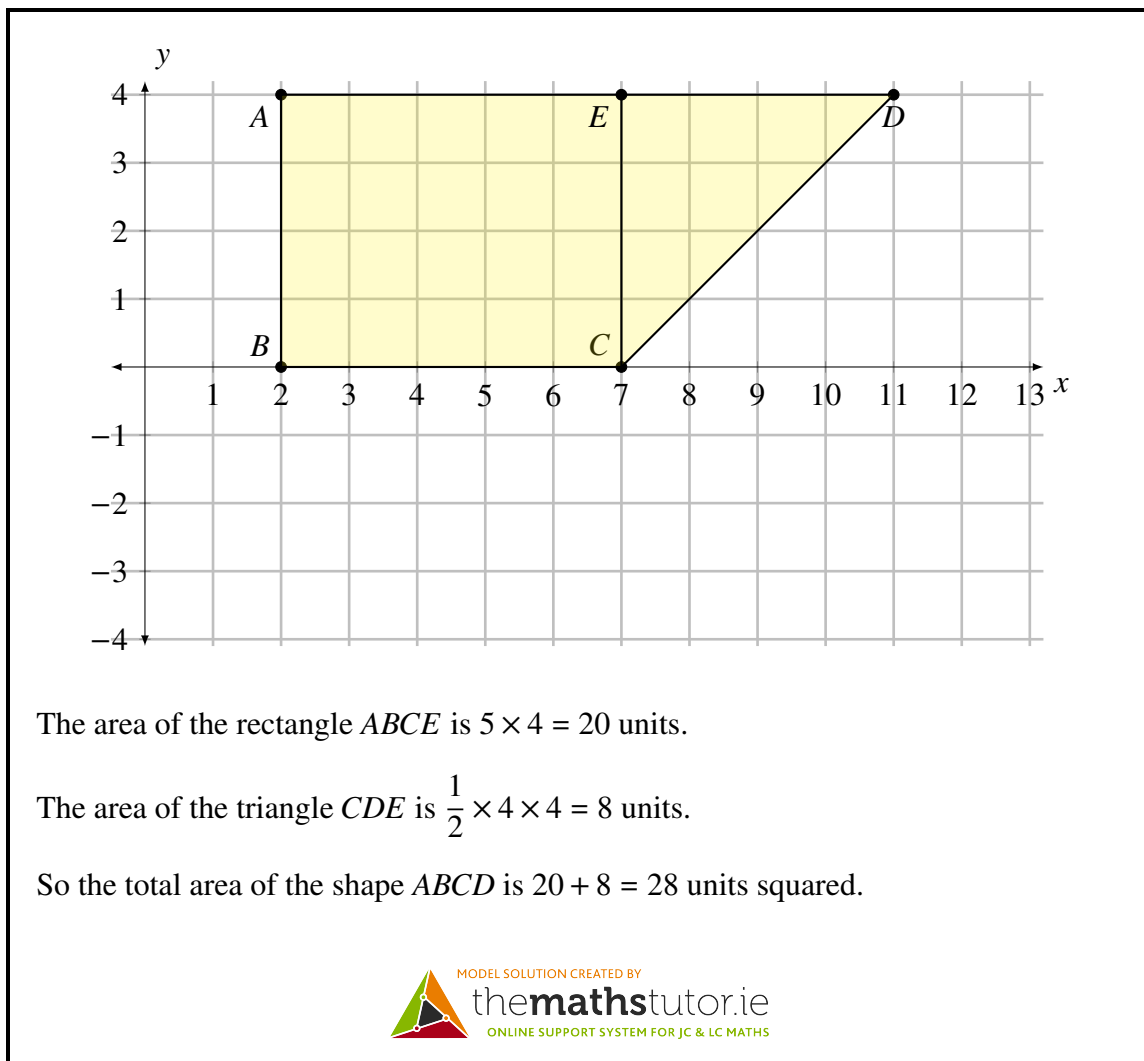
$$A' = (2, -4) \quad B' = (2, 0) \quad C' = (7, 0) \quad D' = (11, -4)$$

We can also do this graphically by drawing perpendicular lines to the x -axis and continuing them by the same distance on the other side.



(c) Work out the area of the shape $ABCD$.

To do this, you might need to find the **area** of a rectangle and a triangle.



(d) The perimeter of $ABCD$ is made up of these four line segments:

[AB] [BC] [CD] [AD]

Write each line segment from the list above into the correct place in the table below, to match each line segment to its equation. Use each line segment only once. [BC] is already done for you.

Equation	Line segment
$x = 2$	[AB]
$y = 0$	[BC]
$y = 4$	[AD]
$y = x - 7$	[CD]

The line $x = 2$ is a vertical line $[AB]$. The horizontal lines $y = 0$ and $y = 4$ correspond to the sides $[BC]$ and $[AD]$ respectively. The remaining line $y = x - 7$, which we can see has a slope of 1, must be the equation of the segment $[CD]$.



Question 12

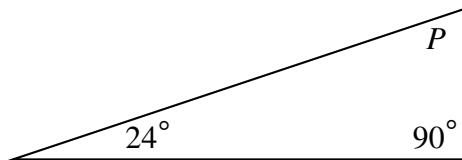
(Suggested maximum time: 10 minutes)

The photograph below shows a house.



Figure 2: Credit to www.interiordesign.net

Part of the roof of this house is shown in the diagram below. One angle is marked P .



(a) What kind of angle is 24° ?

Tick (\checkmark) one box only.

obtuse

acute

reflex

(b) Work out the size of the angle P .

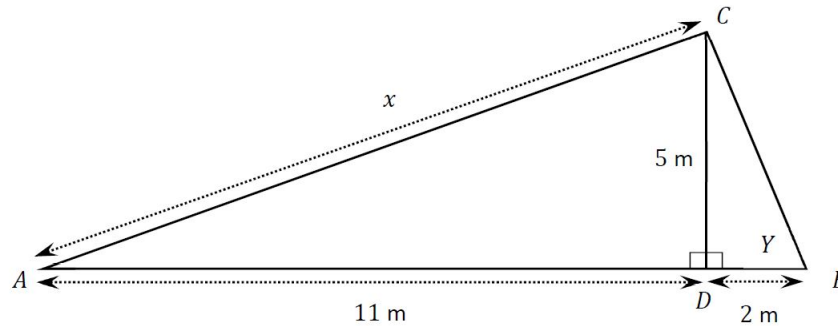
The three angles in any triangle add up to 180° . So we have:

$$24^\circ + 90^\circ + P^\circ = 180^\circ$$

$$P^\circ = 180^\circ - 24^\circ - 90^\circ$$

$$P^\circ = 66^\circ$$

The diagram below shows more of the roof of this house.
 AB is perpendicular to DC . The lengths of some of the sides are shown on the diagram.
 Note: $\angle ACB$ is **not** a right angle.

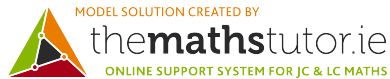


- (c) Use the theorem of **Pythagoras** to work out the length x .
 Give your answer in metres, correct to one decimal place.

Since ADC is a right-angled triangle, the theorem of Pythagoras says that:

$$\begin{aligned} x^2 &= 11^2 + 5^2 \\ x^2 &= 121 + 25 \\ x^2 &= 146 \\ x &= \sqrt{146} \\ x &= 12.083 \text{ m} \end{aligned}$$

So $x = 12.1$ m correct to one decimal place.



- (d) Y is one of the angles in the triangle DBC .
 (i) Write down the length of the side opposite Y and the side adjacent to Y in DBC .

Opposite $Y =$ Adjacent to $Y =$

- (ii) Use your answer from part (d)(i) to write $\tan Y$ as a fraction.

$$\tan Y = \frac{\text{input box with 5}}{\text{input box with 2}}$$

- (iii) Hence, use a calculator to find the size of the angle Y , correct to the nearest degree.

Since $\tan Y = \frac{5}{2}$ we can take \tan^{-1} of both sides to get:

$$\begin{aligned}\tan Y &= \frac{5}{2} \\ Y &= \tan^{-1}\left(\frac{5}{2}\right) \\ Y &= 68.199^\circ\end{aligned}$$

So the angle $Y = 68^\circ$ correct to the nearest degree.



Question 13**(Suggested maximum time: 5 minutes)**Maryam writes down the following 6 numbers, where $A \in \mathbb{N}$ and $A \geq 20$:11, 11, 12, 18, 19, A **(a)** Work out the **median** of Maryam's 6 numbers.

To find the median, we must list the values in order and find the middle one.

11, 11, 12, 18, 19, A

However, since there are 6 values there is no exact middle, so we take the mean of the 3rd value and the 4th value which is:

$$\frac{12 + 18}{2} = \frac{30}{2} = 15$$

The median is 15.

**(b)** Maryam works out the mean of the 6 numbers.
She then increases the value of A by 60.

What will this increase do to the mean of the 6 numbers?

This will increase the mean by $\frac{60}{6} = 10$ since there are 6 numbers in the list.

The mean will increase by 10.



