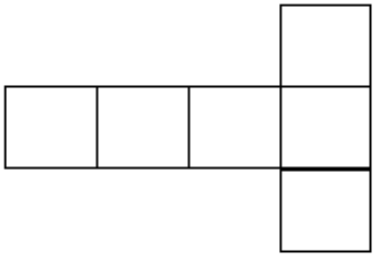
2014 Junior Cert Ordinary Level
Official Sample Paper 2

Question 1 **(Suggested maximum time: 2 minutes)**

The shape on the right consists of 6 squares. Each is 2 cm long. It can be folded to form a cube. Find the surface area of the cube.



The surface area of the cube is the total area of the 6 squares. One square is

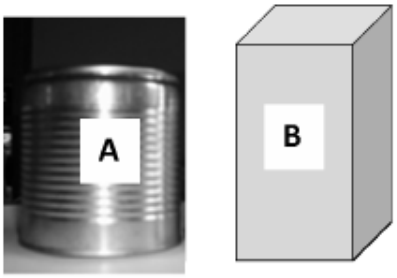
$$2 \text{ cm} \times 2 \text{ cm} = 4 \text{ cm}^2$$

which means the total for all 6 squares is

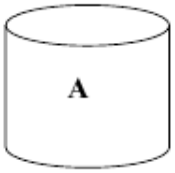
$$6 \times 4 = 24 \text{ cm}^2$$

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

A food production company has to decided between a closed cylindrical tin A or a rectangular carton B to hold a product they are marketing for the first time. Both containers have the same volume.



(i) Tin A has a radius of 3 cm and a height of 10.6 cm. Find the volume of tin A. Give your answer correct to the nearest whole number.

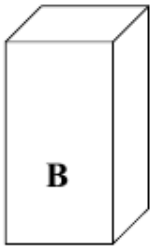


The volume of a cylinder is $\pi r^2 h$. This cylinder has radius $r = 3$ and height $h = 10.6$ so the volume is

$$\begin{aligned} \text{Volume of A} &= \pi(3^2)(10.6) \\ &= \pi(9)(10.6) \\ &= 299.707686 \\ &= 300 \text{ cm}^3 \end{aligned}$$

correct to the nearest whole number.

(ii) Carton B has a square base of length 5 cm. Use the answer you got in **(i)** above to find the height of carton B.



The volume of the carton is $5 \times 5 \times h$ where h is the height of the carton. Since this has the same volume as the cylinder from part **(i)** we have

$$\begin{aligned} \text{Volume of B} &= 300 \text{ cm}^3 \\ 5(5)(h) &= 300 \\ 25h &= 300 \\ h &= 12 \text{ cm} \end{aligned}$$

(iii) Which one of the above containers do you think the company might choose? Give a reason for your answer.

I think they might choose the carton. They can potentially use a smaller packing case to hold several cartons as compared with an equal number of tins of the same volume.
Alternative answer: they might choose the tin, as it may suit the shape of the product better.

Question 3 **(Suggested maximum time: 5 minutes)**

Mary is planning to fly to London. The table shows the flights leaving Dublin Airport (DUB) and arriving in London Heathrow Airport (LHR) on a particular day.

Departing			Arriving	
DUB	06:40		LHR	08:05
DUB	07:30		LHR	09:05
DUB	08:50		LHR	10:15
DUB	09:50		LHR	11:10
DUB	12:10		LHR	13:25
DUB	13:40		LHR	14:55
DUB	14:40		LHR	15:55
DUB	15:50		LHR	17:10

(a) **(i)** Mary needs to arrive in Heathrow by 10:30 a.m. What is the departure time of the latest flight that she can take from Dublin Airport?

Assuming on-time arrivals, the 08:50 flight is the last one Mary can take. This flight arrives in London at 10:15 a.m. All the later flights arrive after 10:30 a.m.

(ii) Find the time of her flight in hours and minutes.

The flight leaves at 08:50 and arrives at 10:15
10:15 - 08:50 = 09:75 - 08:50 = 01:25
So this flight takes 1 hour and 25 minutes.

(iii) Mary would like to arrive in Dublin Airport 75 minutes before the flight leaves. At what time should she arrive at the airport?

75 minutes is 1 hour and 15 minutes.
08:50 - 01:15 = 07:35
She should arrive at 07:35 i.e. 7:35 a.m.

(b) Mary checks in one bag. The fare summary for her journey is given in the table below. Find how much the taxes and charges amount to.

Fare Summary (€)	
From Dublin to London Heathrow	
Fare	74.99
Taxes and Charges	
Baggage	25.00
Total	**133.88**

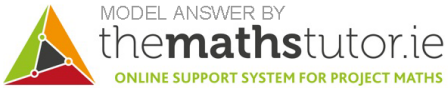
Let x represent the price for taxes and charges. We know that

$$74.99 + x + 25.00 = 133.88$$

which means

$$x = 133.88 - 74.99 - 25.00 = 33.89$$

So taxes and charges amount to €33.89



(c) The distance from Dublin to London is 464 km. Find the average speed of the airplane during the flight in km/h.

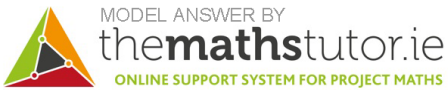
The time of the flight is 1 hour 25 minutes. In hours, that is $1\frac{25}{60} = 1.4167$ hours.

Since

$$Speed = \frac{Distance}{Time}$$

we get

$$\begin{aligned} Speed &= \frac{464}{1.4167} \\ &= 327.5 \text{ km/h to one decimal place} \end{aligned}$$



Question 4 **(Suggested maximum time: 5 minutes)**

A survey was conducted among third-year students. The answers to the survey questions can be classified as:

(i) Categorical data where the categories are not ordered

(ii) Ordered categorical data

(iii) Discrete numerical data

(iv) Continuous numerical data

In each row in the table below, write a short question that will give that type of data stated.

Question:	Type of data:
Q1:	Categorical data where the categories are not ordered
Q2:	Ordered categorical data
Q3:	Discrete numerical data
Q4:	Continuous numerical data

Question:		Type of data:
Q1:	What subjects do you study at school?	Categorical data where the categories are not ordered
Q2:	How would you rate your school: Bad / Good / Excellent?	Ordered categorical data
Q3:	What is your shoe size?	Discrete numerical data
Q4:	What is your height in centimetres?	Continuous numerical data

Q1. Some possible answers are French, Irish, Maths, Geography, Woodwork, which have no particular order.

Q2. The possible answers are Bad, Good and Excellent which can be ordered.

Q3. The possible answers are whole numbers or half-sizes e.g. $2, 2\frac{1}{2}, 3, 3\frac{1}{2}, 4$ etc but NOT continuous values in-between.

Q4. Some possible answers are 140 cm, 175.67 cm, 164.34567822 cm or other real number values.

Question 5 **(Suggested maximum time: 10 minutes)**

The following question was asked on the phase 9 *CensusAtSchool* questionnaire:
“Approximately how many hours per week do you spend on social networking sites?"

The data below are from samples of students chosen at random from the UK and Ireland.

Number of hours	UK Number of Students	Ireland Number of Students
1	0	0
2	1	1
3	2	3
4	1	2
5	2	2
6	7	2
7	0	3
8	0	0
9	1	5
10	0	2
11	0	3
12	0	3
13	4	4
14	1	2
15	5	0
16	5	5
17	2	1
18	4	2
19	5	4
20	3	2
21	2	0
22	3	0
23	1	0
24	0	0
25	1	4

(i) How many students are in each sample?

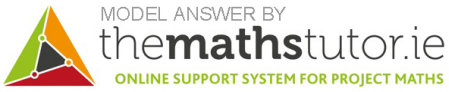
If we add the total for each column we see that there are

$$1+2+1+2+7+1+4+1+5+5+2+4+5+3+2+3+1+1=50$$

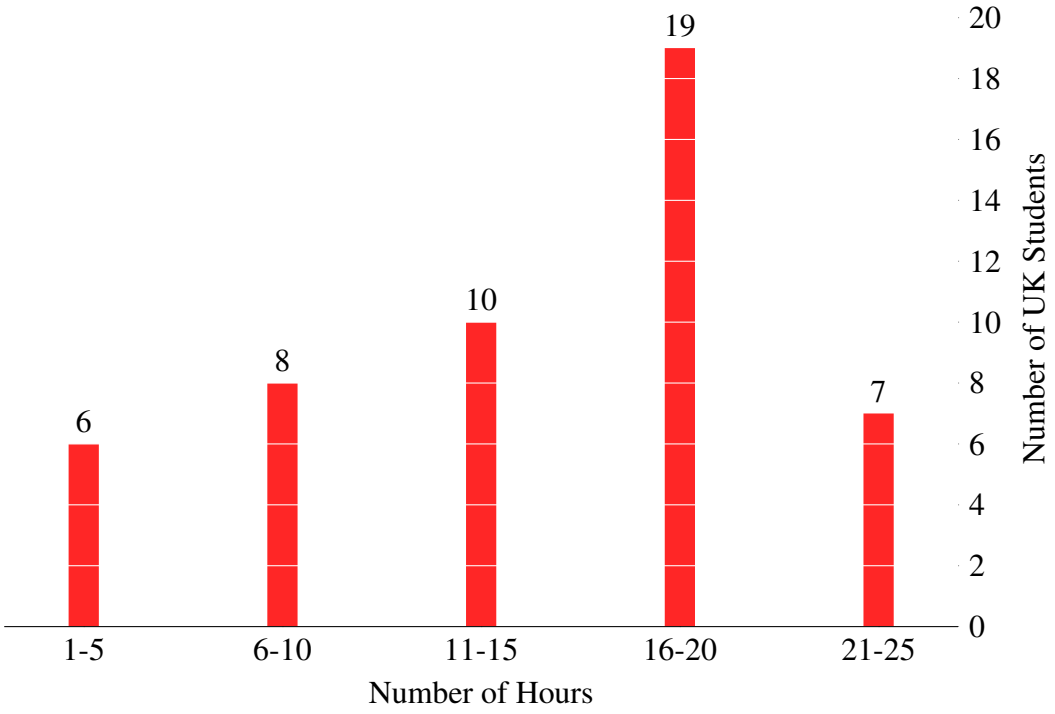
in the UK sample and

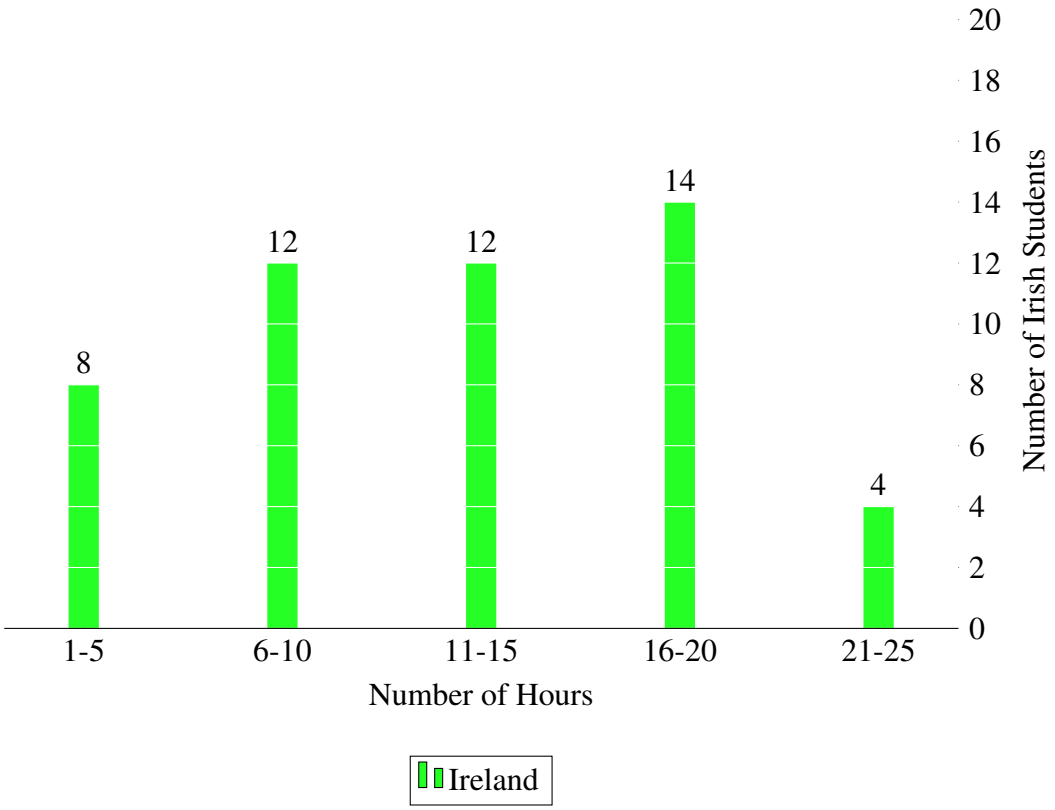
$$1+3+2+2+2+3+5+2+3+3+4+2+5+1+2+4+2+4=50$$

in the Irish sample.



(ii) Display the data in a way that allows you to compare the two samples. (Use a separate display for each sample).

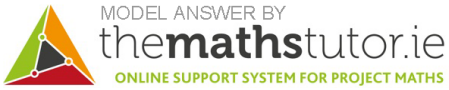




(iii) Based on your answer to part **(ii)**, write down one similarity and one difference between the two samples.

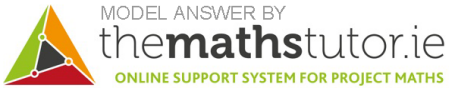
Similarity: In both sets of data the 16-20 hour range contains the highest number of students.

Difference: The Irish data is more evenly distributed about the mean. The UK data has more of the heavier users of social media.



(iv) Based on the data in the table, is it true to say that there are differences between Irish and UK people regarding the time they spend on social networking sites? Explain your answer.

We can not say that for sure, regarding Irish and UK **people**, as the sample is based on students only.
However, we can say that there are differences between Irish and UK **students** in this regard. The modal student in the UK data spends somewhere between 16 and 20 hours on social networking sites whereas the modal student in the Irish data spends somwehere between 11 and 15 hours on social networking sites.



Question 6 **(Suggested maximum time: 10 minutes)**

A bag contains red disks, blue disks, and white disks. In an experiment, each student in a class of 24 takes out a disk, records the colour, and replaces it. This is repeated ten times. The results from the class are recorded in the table below.

Colour	**Red**	**Blue**	**White**	**Total**
Frequency	123	78	39	
Relative Frequency $\left(\frac{\text{frequency}}{\text{total}}\right)$				
% of total (relative frequency $\times$ 100)				

(i) In your opinion, why is the number recorded for red greater than for blue or white?

In my opinion, it is likely that there are more red disks in the bag than blue or white. This would explain why they got selected more often than the others.

(ii) Complete the above table.

Colour	**Red**	**Blue**	**White**	**Total**
Frequency	123	78	39	240
Rel. Frequency $\left(\frac{\text{frequency}}{\text{total}}\right)$	$\frac{123}{240} = 0.5125$	$\frac{78}{240} = 0.325$	$\frac{39}{240} = 0.1625$	
% of total (rel. freq $\times$ 100)	51.25	32.5	16.25	

(iii) Use the results taken from the table to estimate the probability of getting each colour when a disk is taken from the bag.

Colour	**Red**	**Blue**	**White**
Probability	0.5125	0.325	0.1625

(iv) Anne says she thinks there are 10 disks in the bag. Is this a reasonable suggestion? Explain your answer.

PLEASE NOTE: we believe that this question is mathematically unsound. As such, it is our opinion that it should not be on this sample paper.

If you are a Junior Cert Ordinary level student, please do not worry about this question. Probability questions on past Project Maths papers have been much easier to answer than this.

Having said that, we might guess that perhaps the examiner was possibly looking for a answer something like the following (but beware that this method is incorrect):

ANSWER:
In my opinion, Anne's suggestion is somewhat improbable. So I would say it is NOT reasonable.

We can see that, based on 240 selections, approximately $\frac{1}{6}$ of the disks that came out are white.
This might suggest that if there are 10 disks, we might expect to have $\frac{10}{6} = 1.666$ white disks in the bag. But this is not a whole number, and the number of white disks must be a whole number.

Therefore, I think that Anne's suggestion is NOT reasonable.

ALTERNATIVE ANSWER:
I think this IS a reasonable suggestion, because it IS possible that there are 10 disks in the bag.
We can not say for sure how many disks are in the bag, based on the information given. We can not rule out the possibility that there are indeed 10 disks on the bag, as stated by Anne.
Therefore, this IS a reasonable suggestion by Anne.

(v) Based on the information in the table, how many disks of each colour are in the bag? Give a reason for your answer.

PLEASE NOTE: we believe that this question is mathematically unsound. As such, it is our opinion that it should not be on this sample paper.

If you are a Junior Cert Ordinary level student, please do not worry about this question. Probability questions on past Project Maths papers have been much easier to answer than this.

Having said that, we might guess that perhaps the examiner was possibly looking for a answer something like the following (but beware that this method is incorrect):

ANSWER:

About $\frac{1}{6}$ of the disks that came out are white.
Approximately $\frac{1}{2}$ of the disks that came out are red.
Roughly $\frac{1}{3}$ of the disks that came out are blue.

The number of disks in the bag must be divisible by 6, 2 and 3. The lowest common multiple of these numbers is 6.

So, there could be 6 disks in the bag, with 1 of them white, 3 of them red, and 2 blue.

Equally, it is reasonable to believe that it could be any other multiple of 6 disks, divided in the same proportions.

For example, 12 disks, with 2 white, 6 red and 4 blue. Other multiples of 6 such as 24 are also possible.

Question 7 **(Suggested maximum time: 10 minutes)**

(i) Estimate the probability for each of the events **A, B, C, D** and **E** listed below, and write your answers into the table.

	Probability
A name is picked at random from a list of 50 girls and 50 boys. **A** = A girl's name is picked.	
A fair coin is tossed once. **B** = A head is the outcome.	
One card is drawn at random from a pack of playing cards. **C** = The card is a diamond.	
A day is chosen at random from a list of the days of the week. **D** = The name of the day contains the letter **a**.	
One number is picked at random from the set {1, 2, 3, 4, 5, 7, 11, 13}. **E** = The number chosen is a prime number.	

	Probability
A name is picked at random from a list of 50 girls and 50 boys. **A** = A girl's name is picked.	0.5
A fair coin is tossed once. **B** = A head is the outcome.	0.5
One card is drawn at random from a pack of playing cards. **C** = The card is a diamond.	0.25
A day is chosen at random from a list of the days of the week. **D** = The name of the day contains the letter **a**.	1
One number is picked at random from the set {1, 2, 3, 4, 5, 7, 11, 13}. **E** = The number chosen is a prime number.	0.75

A. There are 100 people and 50 of those are girls so the probability of choosing a girl is

$$\frac{50}{100} = 0.5$$

B. There are 2 outcomes and one of those is heads so the probability of getting heads is

$$\frac{1}{2} = 0.5$$

C. There are 52 cards and 13 of those are diamonds so the probability of choosing a diamond is

$$\frac{13}{52} = 0.25$$

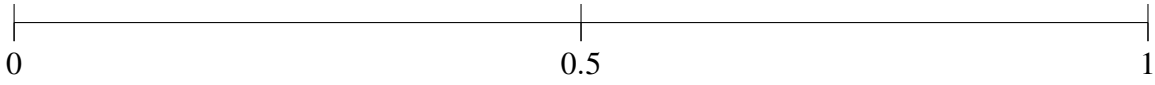
D. There are 7 days in the week and all 7 have the letter 'a' in them so the probability of choosing a day with 'a' in it is

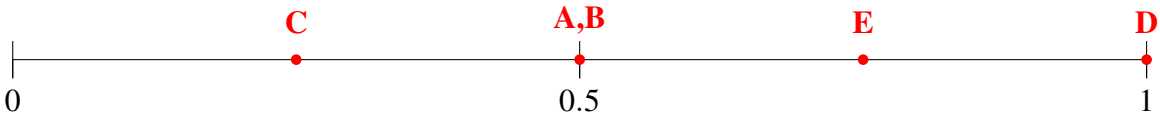
$$\frac{7}{7} = 1$$

E. There are 8 numbers and 6 of them are prime (1 and 4 are not prime) so the probability of choosing a prime number is

$$\frac{6}{8} = 0.75$$

(ii) Place a letter for each of the events at the most appropriate position on the probability scale below.





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(iii) Write down another event you think has a probability similar to that of **C** in the table.

A card is drawn at random from a pack of playing card.
The event that the card is a heart has a probability of $\frac{1}{4} = 0.25$, the same as event **C**.

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(iv) Write down another event you think has a probability similar to that of **D** in the table.

Consider the set of three numbers $\{4, 6, 8\}$. All three of these are even numbers, so the event of picking an even number from this set has probability = $\frac{3}{3} = 1$.

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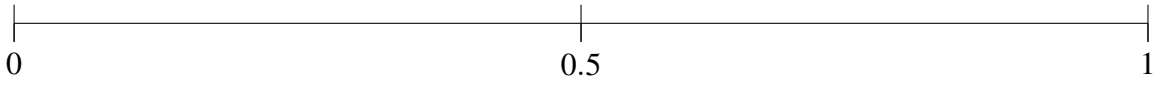
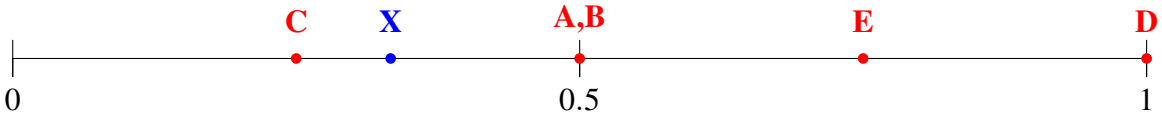
(v) In a multiple-choice quiz, three possible answers are given to a question. James does not know the answer and guesses which one is correct. Put an X on the same scale to show the probability that he has chosen the correct answer.



There are three answers and only one correct one, which means the probability James picked the correct answer is $\frac{1}{3} = 0.3333$ so the scale looks like this:



Question 8 **(Suggested maximum time: 5 minutes)**

(a) The mean of a list of five numbers is 8.
Write down two different lists of numbers for which the above statement is true.

The list must have 5 numbers. The mean is the total divided by 5 so we have

$$\frac{total}{5} = 8$$

$$total = 40$$

So any list of 5 numbers that adds up to 40 will do. For example:

1. $\{6,7,8,8,11\}$ the mean of this list is $\frac{6+7+8+8+11}{5} = 8$
2. $\{2,5,10,10,13\}$ the mean of this list is $\frac{2+5+10+10+13}{5} = 8$

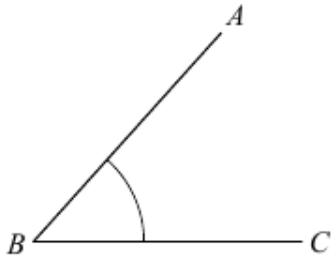
(b) The mode of a list of six numbers is 7.
Write down two different lists of numbers for which the above statement is true.

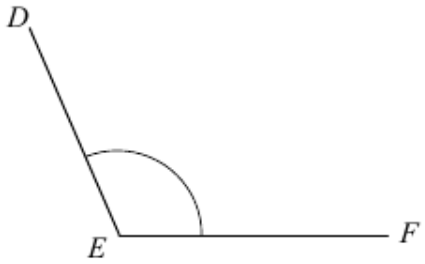
The mode is the most common value in the list (the value that occurs most often). The following lists both have mode= 7:

1. $\{5,7,7,8,9,24\}$
2. $\{7,7,7,10,19,19\}$

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

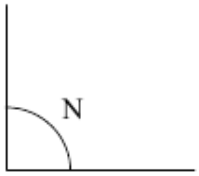
(a) Use a protractor to measure $|\angle ABC|$ and $|\angle DEF|$.

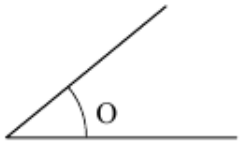




$|\angle ABC| = 49°$ and $|\angle DEF| = 66°$.

(b) The four angles $\angle M, \angle N, \angle O$ and $\angle P$ are shown in the diagrams below.



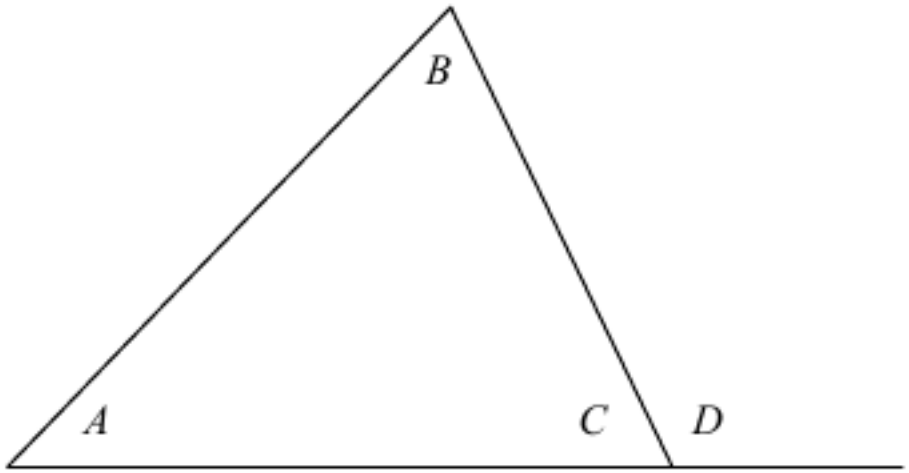


Starting with the smallest, arrange the four angles in order of magnitude.

O	N	M	P

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

(i) From the diagram below write down three angles which together add up to 180°.



A, B, C since the three angles inside a triangle always add up to 180°.

(ii) From the diagram above write down two angles which together add up to 180°.

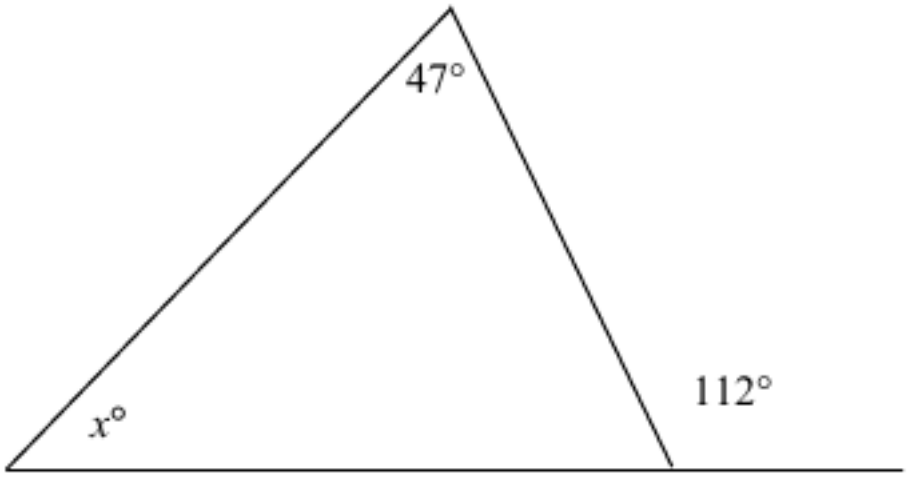
C, D since they lie on one side of a straight line.

(iii) What can you conclude from your two statements about the relationship between $|\angle D|$ and $(|\angle A| + |\angle B|)$?

We know that $|\angle A| + |\angle B| + |\angle C| = 180°$ and $|\angle C| + |\angle D| = 180°$ and therefore

$$\begin{aligned} |\angle A| + |\angle B| + \cancel{|\angle C|} &= \cancel{|\angle C|} + |\angle D| \\ |\angle A| + |\angle B| &= |\angle D| \end{aligned}$$

(iv) Find the value of x in the diagram.

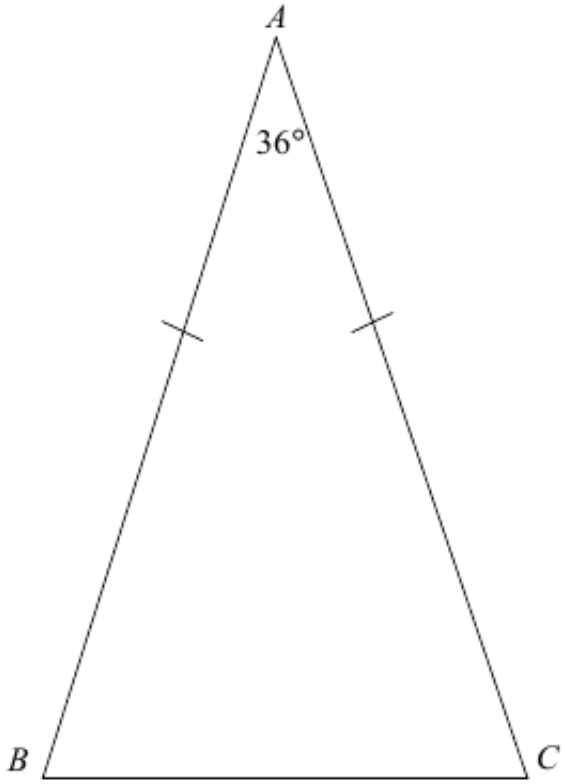


From part (iii) we know that:

$$\begin{aligned} 47^\circ + x^\circ &= 112^\circ \\ x^\circ &= 65^\circ \end{aligned}$$

Question 11 **(Suggested maximum time: 15 minutes)**

The triangle ABC is isosceles, as shown. $|\angle BAC| = 36°$.



(i) Calculate $|\angle ACB|$.

Since the triangle is isosceles we know that $|\angle CBA| = |\angle ACB|$ and since the three angles in the triangle add up to 180° we get

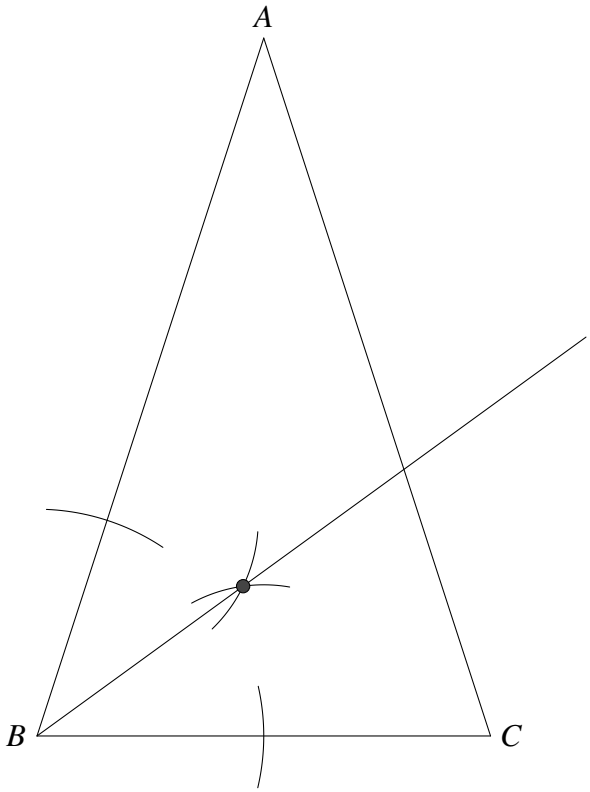
$$\begin{aligned} |\angle CBA| + |\angle ACB| + |\angle BAC| &= 180° \\ |\angle CBA| + |\angle ACB| + 36° &= 180° \\ |\angle CBA| + |\angle ACB| &= 144° \\ |\angle ACB| + |\angle ACB| &= 144° \\ 2|\angle ACB| &= 144° \\ |\angle ACB| &= 72° \end{aligned}$$

(ii) On the diagram construct the bisector of $\angle ABC$. Show all construction lines clearly.

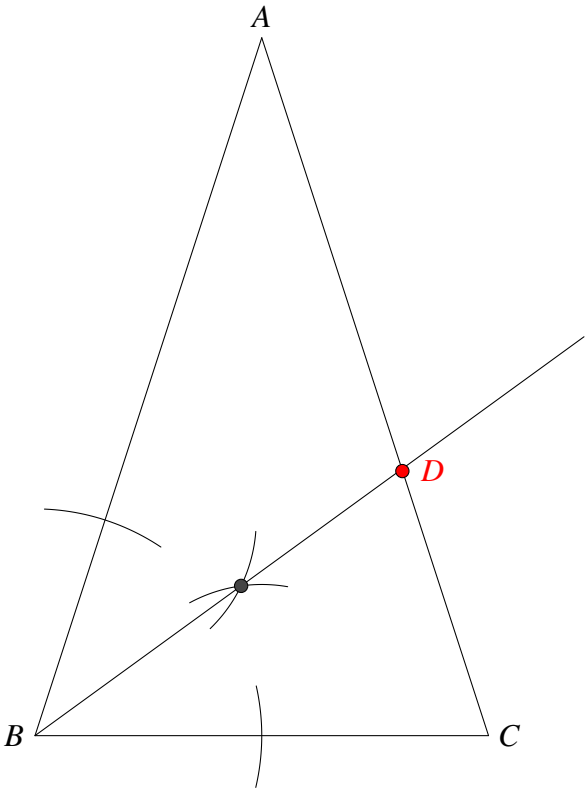
First use a compass to mark an arc on the line BA and BC.

Then using the new points on these lines, mark two more arcs inside the triangle.

The point of intersection of these two arcs allows us to draw a line which bisects $\angle ABC$ as required.



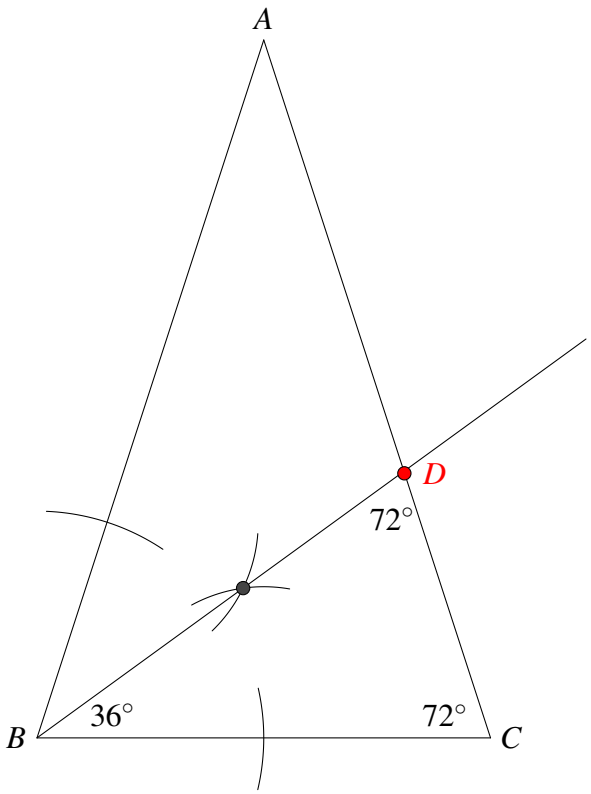
(iii) Mark in the point D where your bisector meets the line AC.



(iv) Calculate all angles in the triangle BCD and write them into the diagram.

We already know that $|\angle DCB| = 72°$. Since we've bisected the angle opposite, we know that $|\angle CBD| = 36°$. Finally since the three angles must add up to $180°$ we have

$$\begin{aligned} 72° + 36° + |\angle BDC| &= 180° \\ |\angle BDC| &= 72° \end{aligned}$$



(v) Can you conclude that the triangle BCD is also isosceles? Give a reason for your answer.

Yes BCD is isosceles, as it has two equal angles.

(vi) Measure $|AC|$ and $|BC|$.

$|AC| = 95$ mm and $|BC| = 60$ mm.

(vii) Calculate the ratio $\frac{|AC|}{|BC|}$, correct to three places of decimals.

$\frac{95}{60} = 1.58333 = 1.583$ to three places of decimals.

Question 12 **(Suggested maximum time: 5 minutes)**

During a trigonometry lesson a group of students makes some predictions about what they expected to find for the values of the trigonometric functions of some angles. They then found the sine, cosine and tangent of $25°$ and $50°$.

(i) In the table given, show correct to three decimal places, the values they found.

$\sin 25° =$	$\cos 25° =$	$\tan 25° =$
$\sin 50° =$	$\cos 50° =$	$\tan 50° =$

$\sin 25° = 0.423$	$\cos 25° = 0.906$	$\tan 25° = 0.466$
$\sin 50° = 0.766$	$\cos 50° = 0.643$	$\tan 50° = 1.192$

(ii) Maria said: "The value from any of these trigonometric functions will always be less than 1." Was Maria correct? Give a reason for your answer.

Maria was **not correct**. For example, the value of $\tan 50$ is greater than 1.

(iii) Sharon said: "If the size of the angle is doubled then the value from any of these trigonometric functions will also double". Was Sharon correct? Give a reason for your answer.

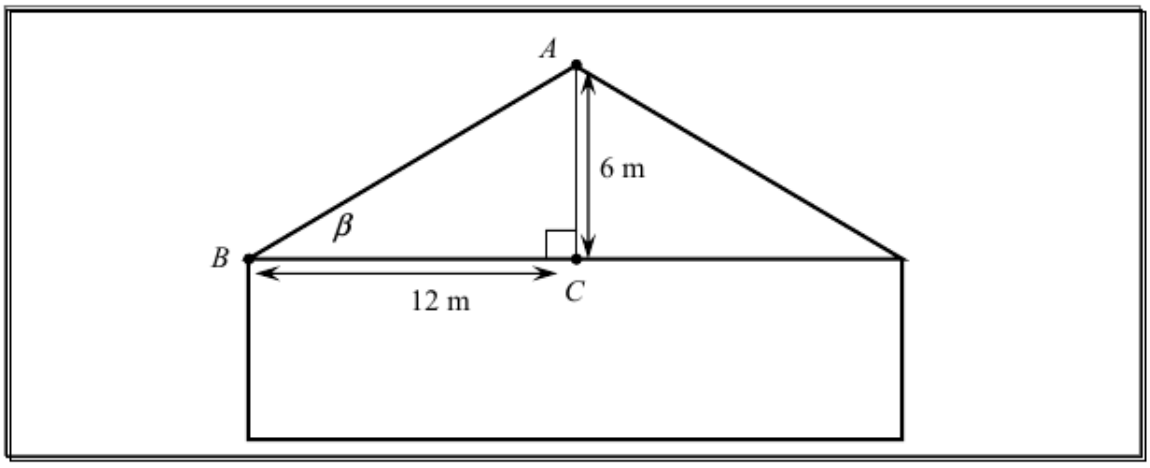
Sharon was **not correct**. None of the values above doubled when the angle was doubled from $25°$ to $50°$.

(iv) James said: "The value from all of these trigonometric functions will increase if the size of the angle is increased". Was James correct? Give a reason for your answer.

James was **not correct**. For example, the value of cos actually decreased when the angle was increased from 25° to 50°.

Question 13 **(Suggested maximum time: 5 minutes)**

Ella is building a house in Montreal. The roof of the house must have a minimum slope (pitch). This is to allow rain and snow to slide off the roof more easily. The pitch of Ella's roof is "6 in 12". She draws the diagram below to show her house, and marks the angle β.



(a) **(i)** Using the right-angled triangle ABC, write down the value of $\tan\beta$ as a fraction.

tan of an angle is equal to the *opposite* side divided by the *adjacent* side so

$$\begin{aligned}\tan\beta &= \frac{opposite}{adjacent} \\ &= \frac{|AC|}{|BC|} \\ &= \frac{6}{12} \\ &= \frac{1}{2}\end{aligned}$$

(ii) Calculate the measure of the angle β. Give your answer correct to the nearest degree.

We know that $\tan\beta = \frac{1}{2} = 0.5$ which means

$$\begin{aligned} \beta &= \tan^{-1}(0.5) \\ &= 26.57^\circ \\ &= 27^\circ \text{ to the nearest degree} \end{aligned}$$

(b) Find the length of the roof from A to B. Give your answer correct to two decimal places.

Using Pythagoras theorem on the triangle ABC we get

$$\begin{aligned} |AB|^2 &= |AC|^2 + |BC|^2 \\ |AB|^2 &= 6^2 + 12^2 \\ |AB|^2 &= 36 + 144 \\ |AB|^2 &= 180 \end{aligned}$$

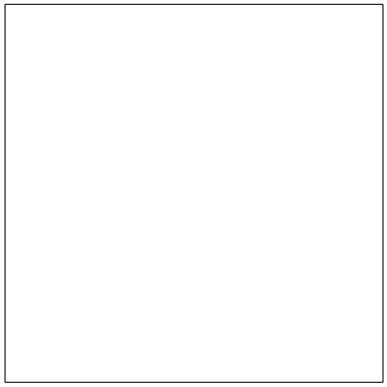
which means

$$\begin{aligned} |AB| &= \sqrt{180} \\ |AB| &= 13.42 \text{ m} \end{aligned}$$

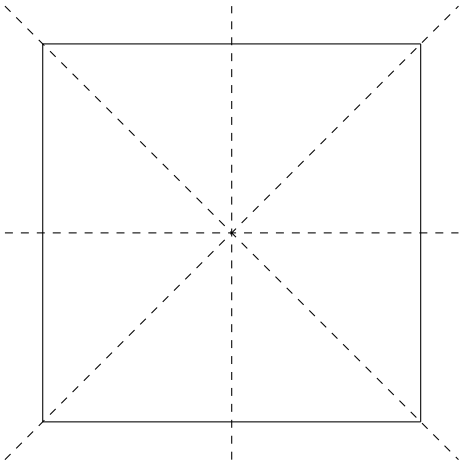
correct to two decimal places.

Question 14 **(Suggested maximum time: 2 minutes)**

The following diagram shows a square. Draw in all its axes of symmetry.



There are 4 axes of symmetry in total, as shown.



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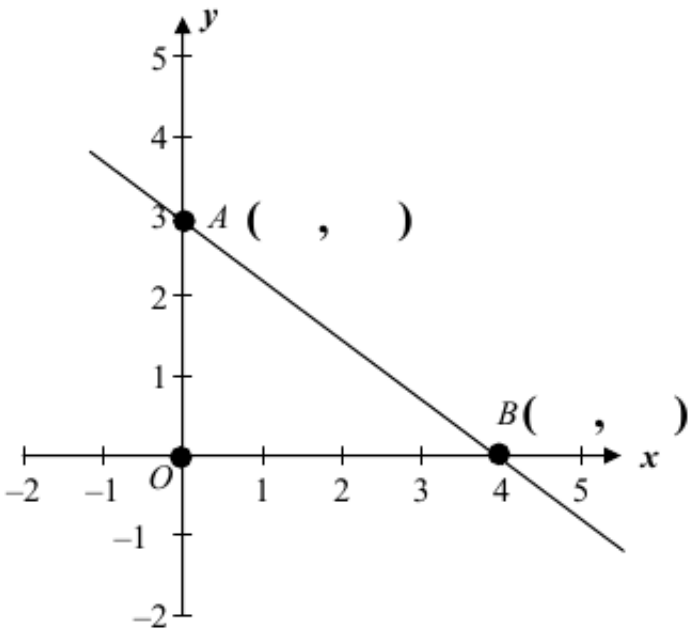
Question 15 **(Suggested maximum time: 5 minutes)**



(i) Write down the co-ordinates of the point A and the point B on the diagram.

A is on the y-axis which is the line $x = 0$ so its x coordinate is 0. The y-coordinate is 3. So

$$A = (0,3)$$

Similarly, since B is on the x-axis ($y = 0$) the coordinates are

$$B = (4,0)$$

(ii) Use the distance formula to find $|AB|$.

The distance formula says that the distance between two points (x_1, y_1) and (x_2, y_2) is:

$$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Here we have $(x_1, y_1) = (0, 3)$ and $(x_2, y_2) = (4, 0)$ so the distance between A and B is

$$\begin{aligned} |AB| &= \sqrt{(4-0)^2 + (0-3)^2} \\ &= \sqrt{16+9} \\ &= \sqrt{25} \\ &= 5 \end{aligned}$$

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(iii) Write down the distance from O to A and the distance from O to B.

Since these points lie on the axes the distances are

$$\begin{aligned} |OA| &= 3 \\ |OB| &= 4 \end{aligned}$$

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(iv) Use the Theorem of Pythagoras to find the length of the hypotenuse of the triangle OBA.

The hypotenuse is the line AB. By Pythagoras' theorem

$$\begin{aligned} |AB|^2 &= |OA|^2 + |OB|^2 \\ |AB|^2 &= 3^2 + 4^2 \\ |AB|^2 &= 9 + 16 \\ |AB|^2 &= 25 \end{aligned}$$

which means

$$\begin{aligned} |AB| &= \sqrt{25} \\ &= 5 \end{aligned}$$

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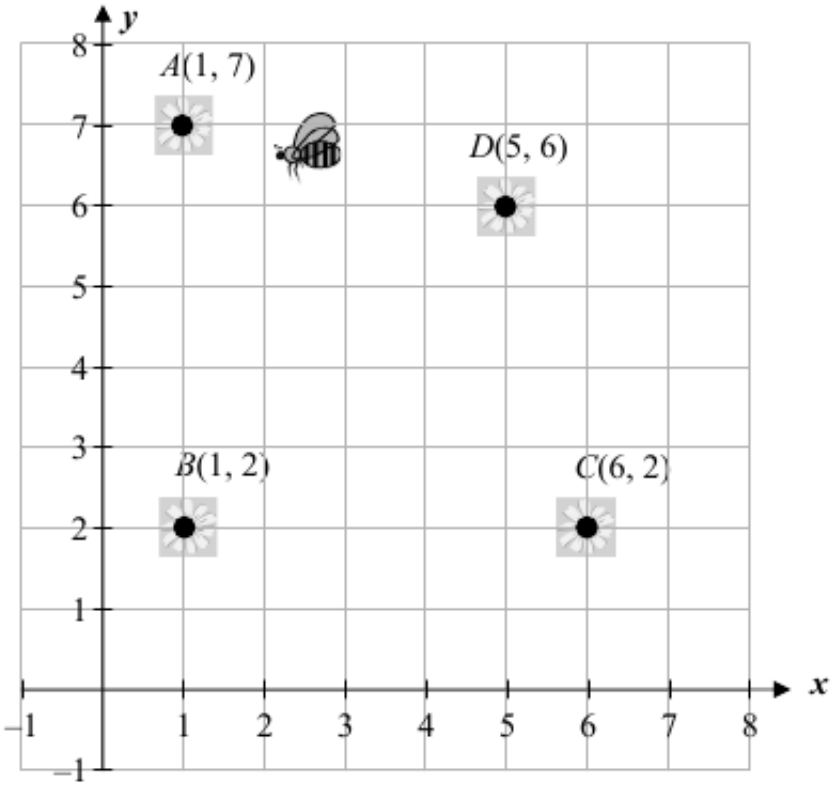
Question 16 **(Suggested maximum time: 5 minutes)**

A computer game shows the location of four flowers $A(1,7), B(1,2), C(6,2)$, and $D(5,6)$ on a grid. The object of the game is to collect all the nectar from the flowers in the shortest time.



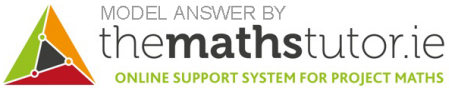
(i) A bee found a hidden flower halfway between flower B and flower D.
Find the co-ordinates of this hidden flower.

The point halfway between B and D is called the midpoint. Given two points (x_1, y_1) and (x_2, y_2), the midpoint is the point

$$\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$$

So the midpoint of $B = (1,2) = (x_1, y_1)$ and $D = (5,6) = (x_2, y_2)$ is

$$\begin{aligned}\left(\frac{1+5}{2}, \frac{2+6}{2}\right) &= \left(\frac{6}{2}, \frac{8}{2}\right) \\ &= (3,4)\end{aligned}$$

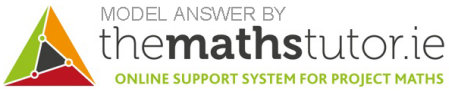


(ii) Another flower E can be located by completing the square $ABCE$. Write down the coordinates of the point E.

A is 5 squares directly up from B and C is 5 squares horizontally to the right of B. If we continue 5 squares to the right of A we get

$$E = (6,7)$$

This can also be done by moving 5 squares directly upwards from C.



(iii) Bee 1 and Bee 2 are on flower A. Bee 1 flies directly from flower A to B and then on to C. Bee 2 flies from flower A directly to D and then on to C. Write down which bee has travelled the shortest total distance. Give a reason for your answer.

Answer: Bee 2
Reason: From the diagram, we can see that Bee 1 travelled a total distance of 10 units. Bee 2 travelled a total distance of $\sqrt{1^2+4^2}+\sqrt{4^2+12} = 8.25$ units correct to 2 decimal places. So Bee 2 travelled the shorter total distance.