Section A Concepts and Skills

Question

A computer is going to choose a letter at random from the text of an English novel.
The table shows the probabilities of the computer choosing the various vowels.

Vowel	**A**	**E**	**I**	**O**	**U**
Probability	**0.06**	**0.13**	**0.07**	**0.08**	**0.03**

(a) What is the probability it will **not** choose a vowel?

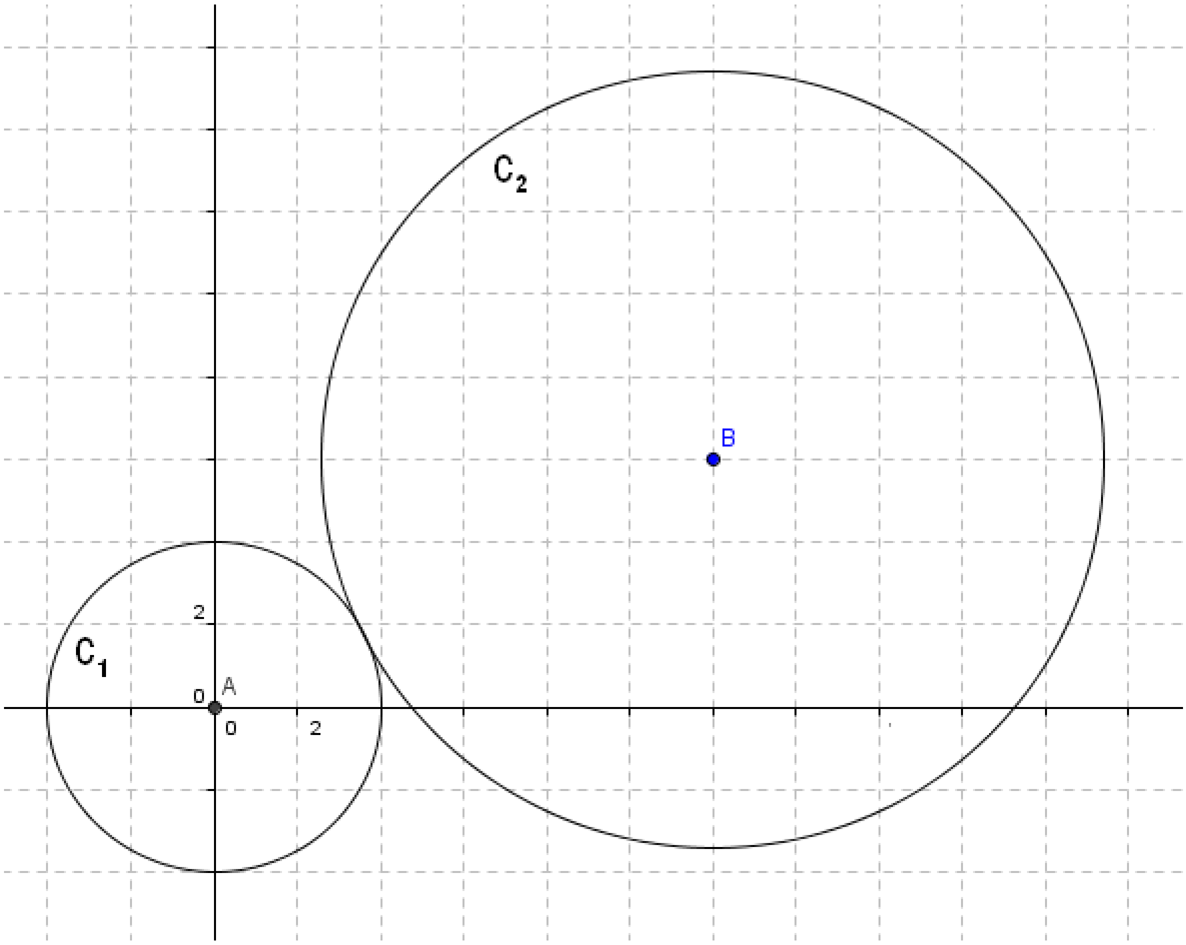
(b) The probability that the computer will choose the letter **T** is **0.09.**

The computer chooses a letter at random, and then a second, and then a third letter.
What is the probability that these letters will be **E, A** and **T** (in that order)?

(c) How many ways can these three letters be arranged? Show each arrangement.

Question

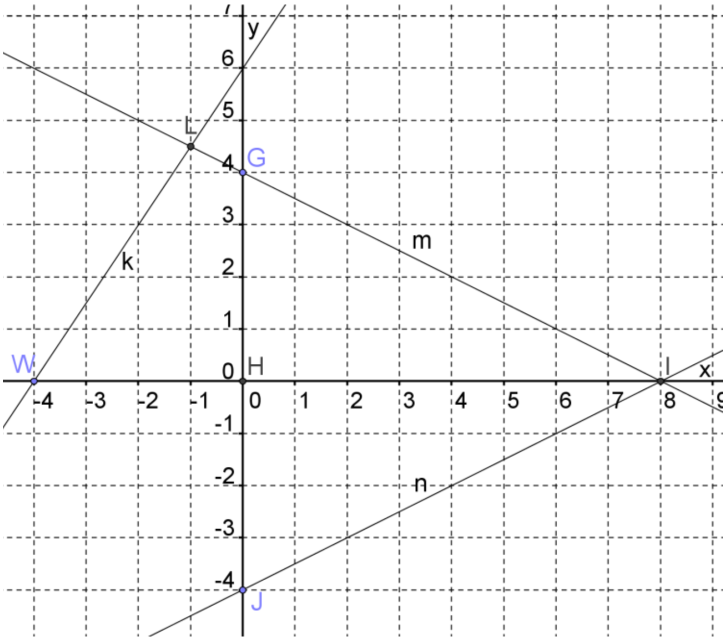
(a) The diagram shows two touching circles; c_1 and c_2. Using the diagram to estimate the centres and radii as accurately as you can, find the equations of the two circles.



(b) It is claimed that the line with equation $x - y + 6 = 0$ is a tangent to both circles.
By performing suitable calculations, decide whether this claim is true or false.
Explain your answer.

Question

In this diagram state whether each of the following statements is true or false (by placing a ✓ in the appropriate box) and in each case give a reason for your answer.



a) $k \perp m$

True	False

b) area ΔGIJ = 32 sq. units

True	False

c) the equation of k is $y = -\frac{2}{3}x + 6$

True	False

d) $m \perp n$

True	False

e) the line $y = -2x + 1$ is perpendicular to n

True	False

f) the line $y = 2x$ is parallel to m

True	False

g) ΔGIJ is an isosceles triangle

True	False

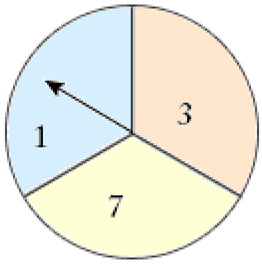
h) the x-axis is the bisector of $\angle GIJ$

True	False

Question

Sophie and Amy were designing a game of chance to raise money for charity in their school. They agreed on the following:

- they would call the game ***Spin and Win***
- they would charge **50 cent** to play
- the rule would be: roll a six-sided die and spin the spinner shown and **add the totals**.



However, they each had different ideas about which outcomes would result in a win, a loss or the player getting their money back.

Sophie's Idea
Money back: Get total of 13

Win €1: Even number total

Lose: Anything else

Amy's Idea
Money back: Even number total

Win €1: Odd total, but not prime

Lose: Anything else

(a) By calculating the expected value of the profit or loss for each idea, write an argument to support **either** Sophie **or** Amy's idea.

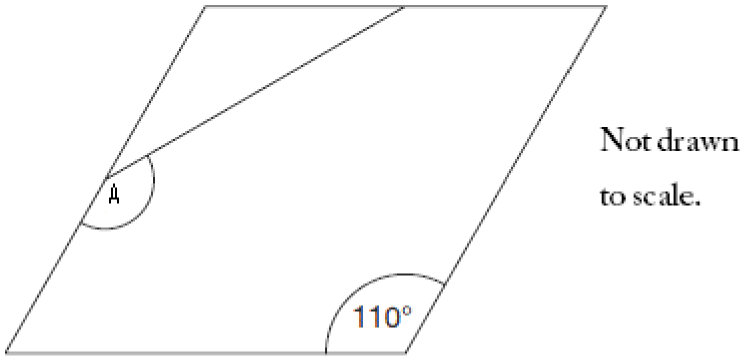
Without changing the rules, give your own idea for ***win***, ***lose*** and ***money back*** that would generate more money for the charity. Justify your idea.

Question

Construct an equilateral triangle. Prove that the inscribed circle and the circumcircle have the same centre.

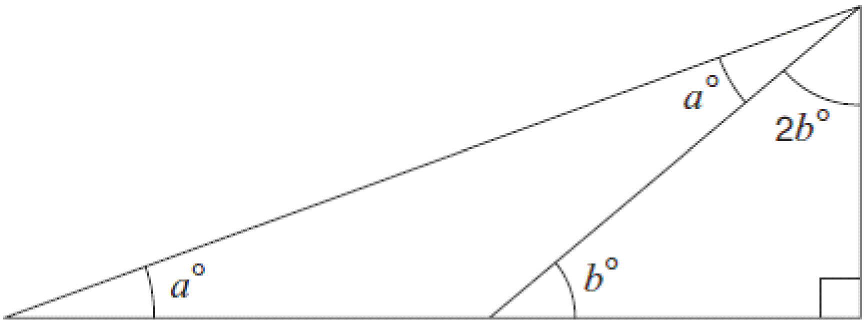
Question

(a) The diagram shows a rhombus (that is, a parallelogram with four sides of equal length). The midpoints of two of its sides are joined with a straight line segment.



Calculate the size of angle *A***.** Show how you found your answer.

(b)



Not drawn to scale.

Find the value of ***a*.** Show how you found your answer.

$\angle GIJ$

Question

Sarah is on a TV game show called ***Take the Money and Run***.

She has won €10,000 so far. She now has four options:

Option 1: Leave the show with €10,000 – that is, ***Take the Money and Run***

Option 2: Play on and take a 50% chance of winning €50,000

Option 3: Play on and take a 30% chance of winning €75,000

Option 4: Play on and take a 20% chance of winning €100,000

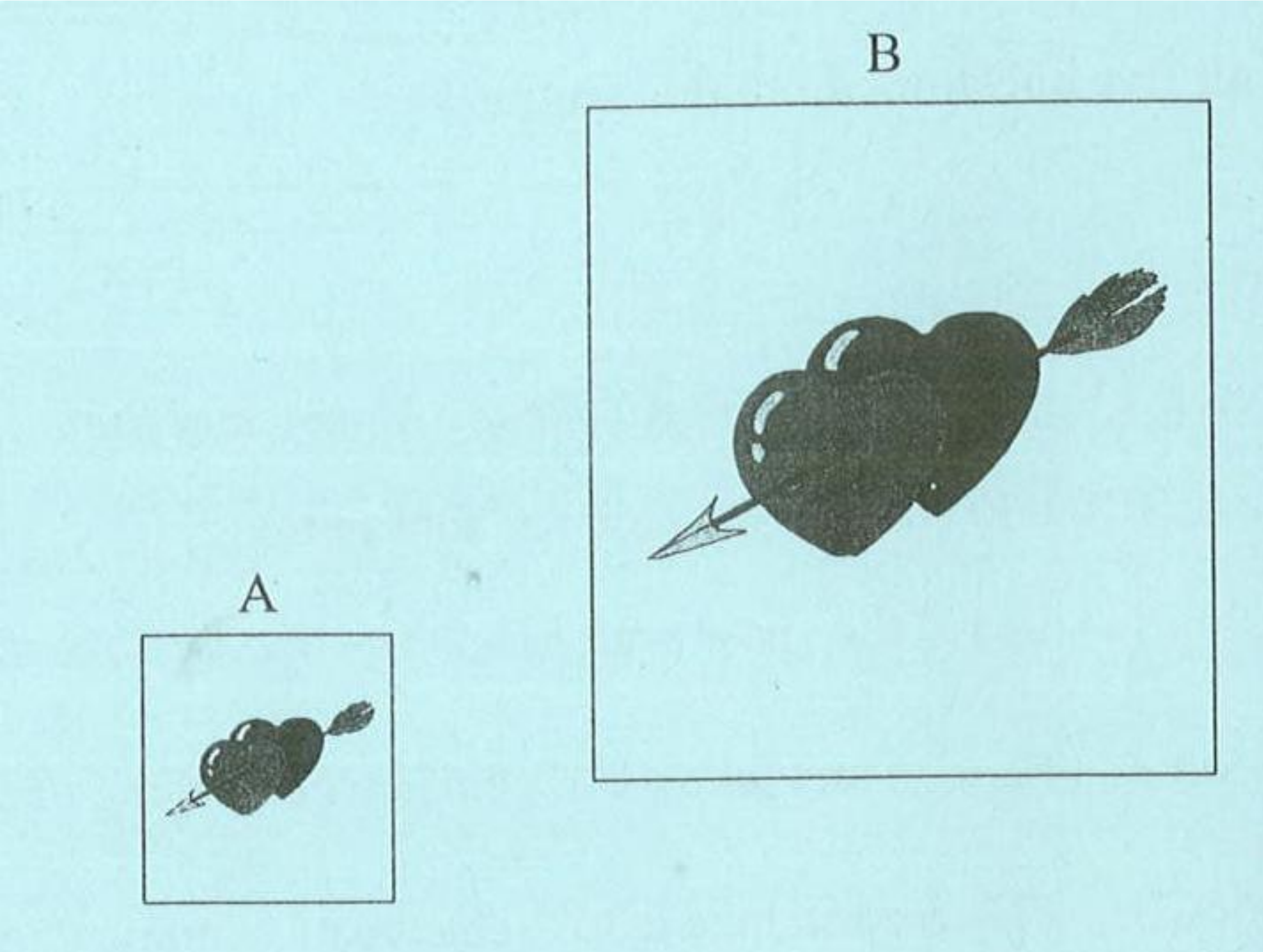
If she plays on, and does not win the higher amount she loses the €10,000.

(a) Calculate the ***Expected Value*** of Sarah's winnings for each of the four options.

(b) What would you advise Sarah to do and why?

Question

The ray method was used to enlarge a design for a Valentine card. The original is labelled A and the image is labelled B.



(a) Find the centre of the enlargement.

(b) Find the scale factor of the enlargement. Show your work.

(c) Calculate the ratio $\frac{Area\ of\ drawing\ B}{Area\ of\ drawing\ A}$. Give your answer correct to one decimal place.

Question

Two spinners, each with four equal segments numbered 1 to 4, are spun.

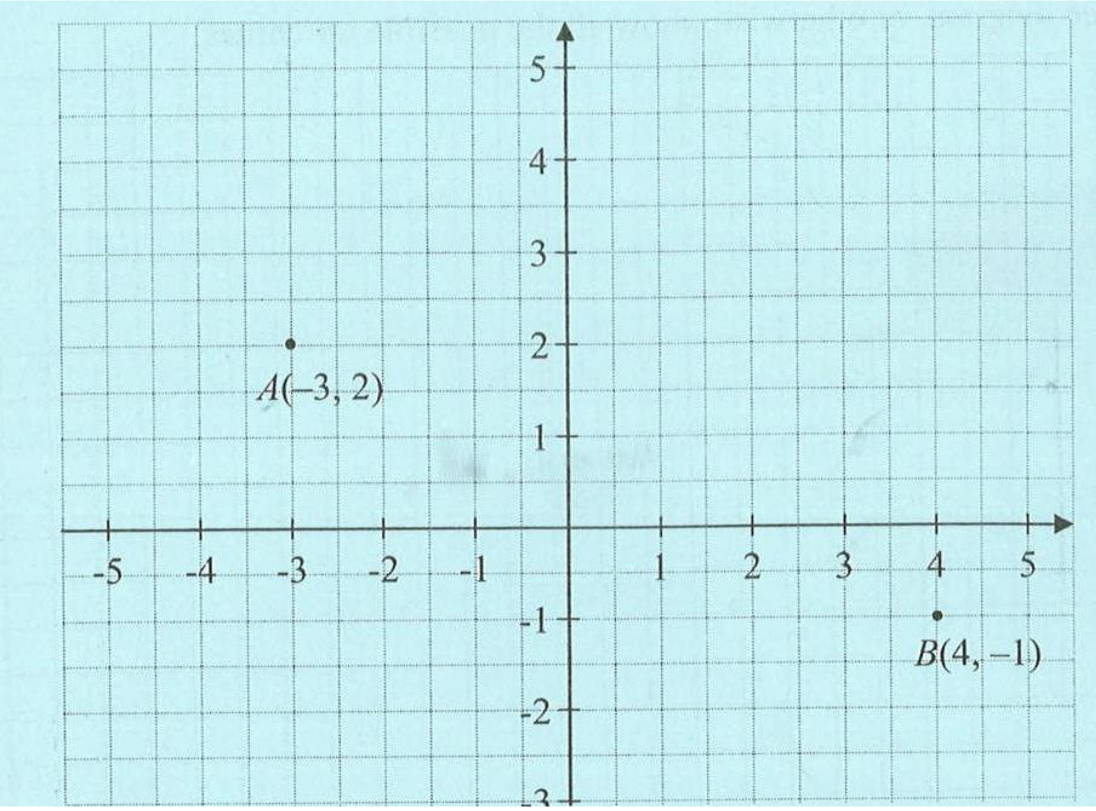
(a) Using a list, table, tree diagram, or otherwise, show all the **possible outcomes.**

(b) If the spinners are fair, what is the probability of getting two fours?

(c) Jason thinks that one of the spinners is not fair.

Describe an experiment that he could do to find out whether the spinner is fair.

Question
Two points *A*(- 3, 2) and *B*(4, - 1) are shown on the diagram below. Plot two suitable points *C* and *D* so that *ABCD* is a parallelogram. Label the points and write down their coordinates.

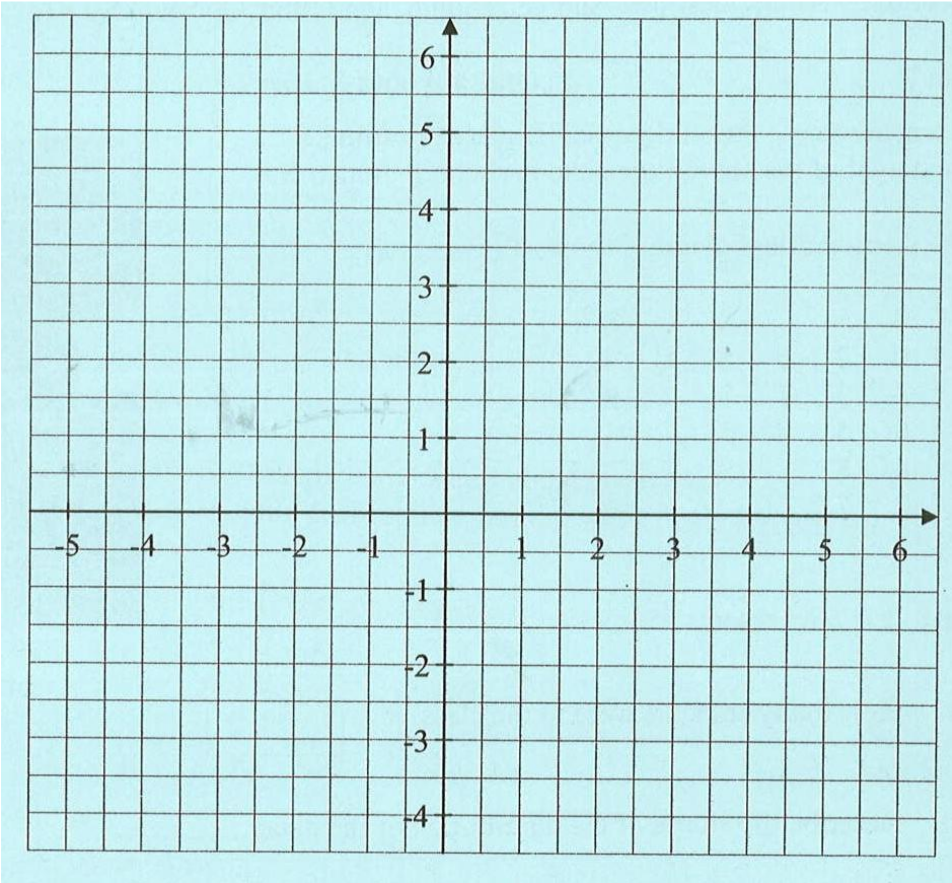


(b) By performing suitable calculations, show that the figure you have drawn is indeed a parallelogram.

(c) Verify that the diagonals of the parallelogram bisect each other.

Question

(a)On the diagram below, show the triangle *ABC*, where *A* is (-4, 1) *B* is (-2, 5) and *C* is (6, 1)



(b) Find D, the midpoint of [AC], and label this point on the diagram.

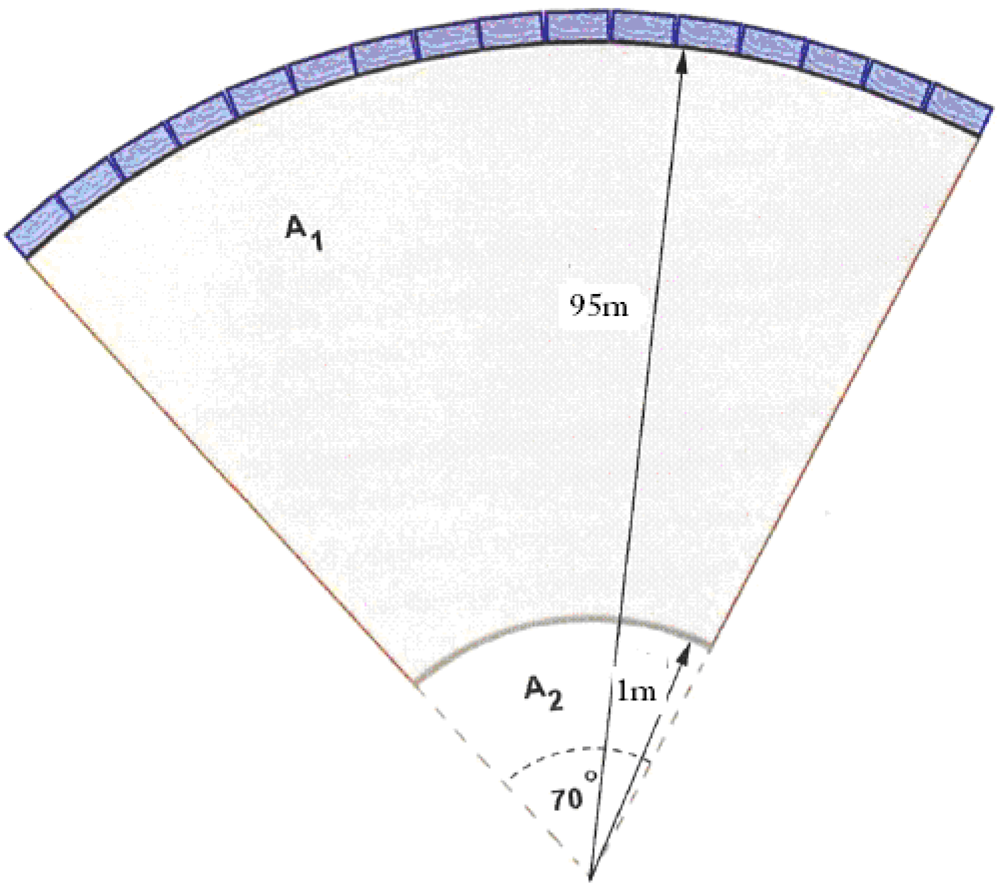
(c)Hence, construct on the diagram the circle with diameter [AC].

(d) Show that the angle $\angle ABC$ is a right angle.

Section B	Contexts and Applications

Question

(a) The modern or Olympic *hammer throw* is an athletic throwing event where the object is to throw a heavy metal ball attached to a wire and handle. In the diagram below A_2 represents a portion of the *throwing circle* and A_1 represents the area in which the hammer should land. The diagram is not drawn to scale.



(i) A net is to be erected at the end of the landing area. The foundation consists of a single row of bricks; each brick is 41cm long. How many bricks will be needed to lay the foundations?

(ii) The area A_1 will be planted with grass. A *10kg* bag of lawn seed covers approximately $220m^2$. How many bags of grass seed must be bought?

Show all your work and state any assumptions you make.

Question

The lengths of the ring fingers of 30 Irish students chosen randomly from amongst those who completed the *censusatschool* phase 9 questionnaire are displayed below. The measurements are in cm.

7.5	8	7	6	7.5
8.3	6.5	8	5	9
7.3	8.5	7	7	9
7.2	6.5	7	10	9
3	4	6.6	6	8
7	8	7	7.5	8.4

(a) Use the data to investigate whether ring finger lengths are normally distributed. Explain your answer.

(b) Sharon measured the length of her ring finger and found it to be 11.3cm. Her boyfriend says her finger length is most unusual; Sharon disagrees. By calculating the mean and standard deviation of the distribution above, present evidence to support either Sharon's argument, or that of her boyfriend.

Question

(a) A teacher asked the students in her class to estimate the height of the church opposite the school in metres.

The stem-and-leaf diagram shows all the results

Key: 3|5 represents 35m

3	5 9
4	0 2 6 8 8
5	3 3 5 7 7 9
6	0 5 5 5
7	4 8
8	2 7

(i) How many students are in the class?____________

(ii) Describe the **shape** of the distribution of the data

(iii) What was the median estimate? _____________

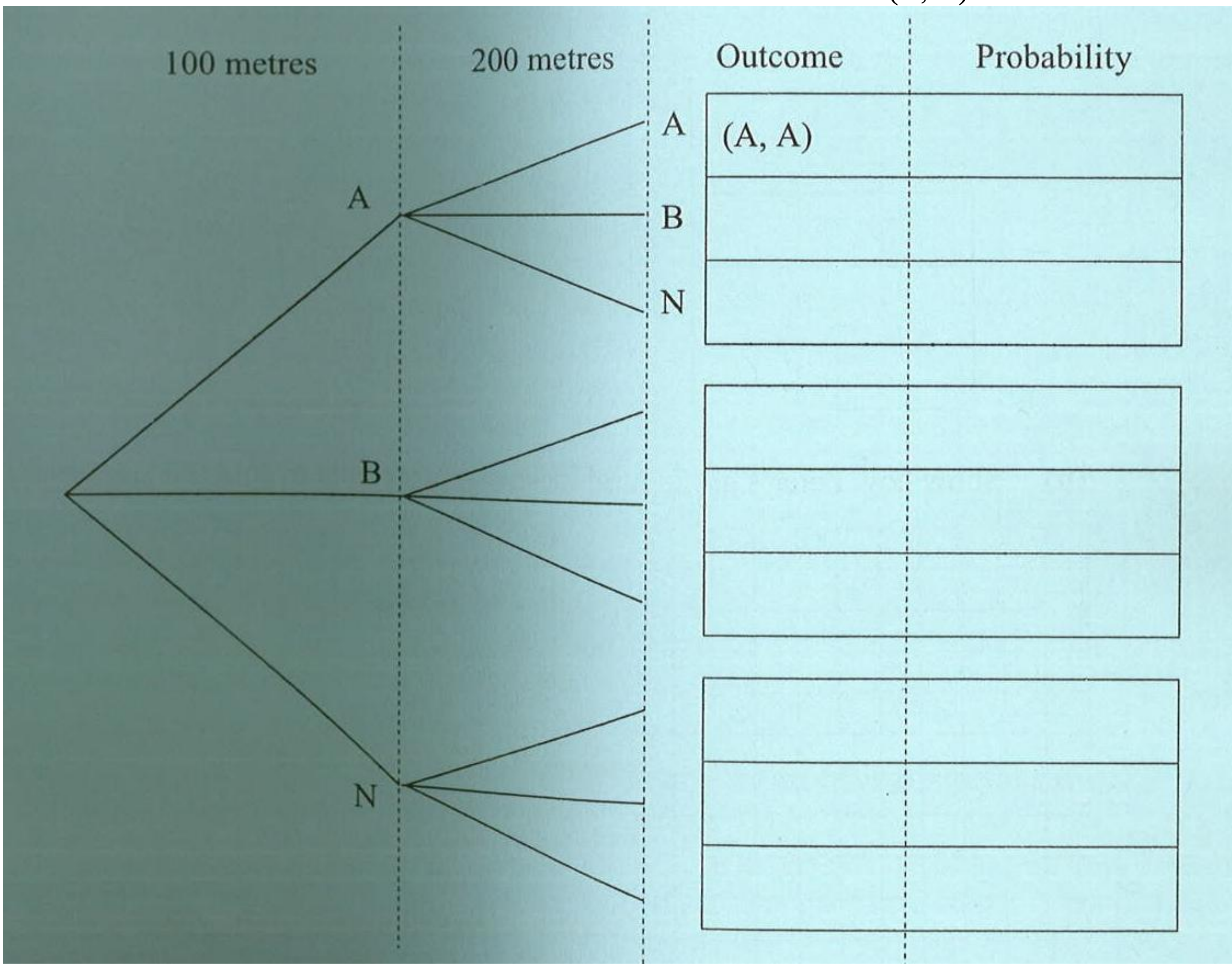
(iv) Explain the answer to part (iii) to someone who does not know what the word "median" means.

(b) Alex and Bobby are running in the final of a 100m race and a 200m race.
The probabilities of each of them winning each race are given in the table below.
The probability that neither of them wins the 100m race is also given.

	Alex	**Bobby**	**Neither**
100 metre race	$\frac{1}{6}$	$\frac{1}{4}$	$\frac{7}{12}$
200 metre race	$\frac{1}{4}$	$\frac{3}{8}$	

(i) Complete the table above, by inserting the probability that someone other than Alex or Bobby wins the 200 metre race.

(ii) Using the tree diagram or otherwise, complete the list of outcomes below. For example, the outcome that Alex wins the first race and the second race is recorded as (A, A) as shown.

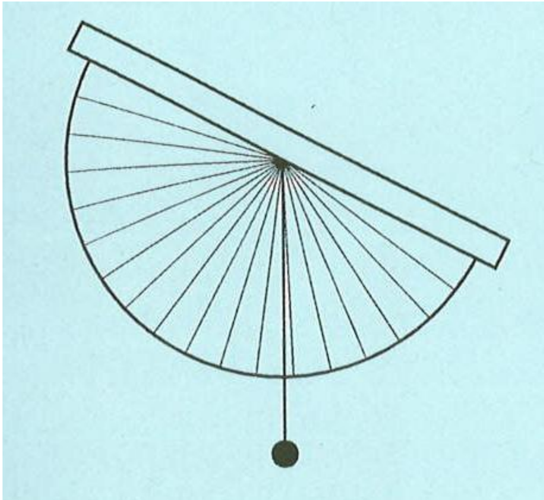


(c) What is the probability that Alex and Bobby win a race each?

Question

The students mentioned in **(a)** above went to measure the height of the church.

(a) Peter explained his group’s method:
“We made a clinometer from a protractor, a pen tube, some thread and a weight.
We measured the distance from here to the church and it was 92 metres.
We made sure the ground was flat,then we used the clinometer to look up at the top of the spire of the church. The weight had moved from 90° to 65°, so we knew the angle up was 25°. We worked out the height from that. But we had to remember to add on my height of 1.8 metres at the end.”



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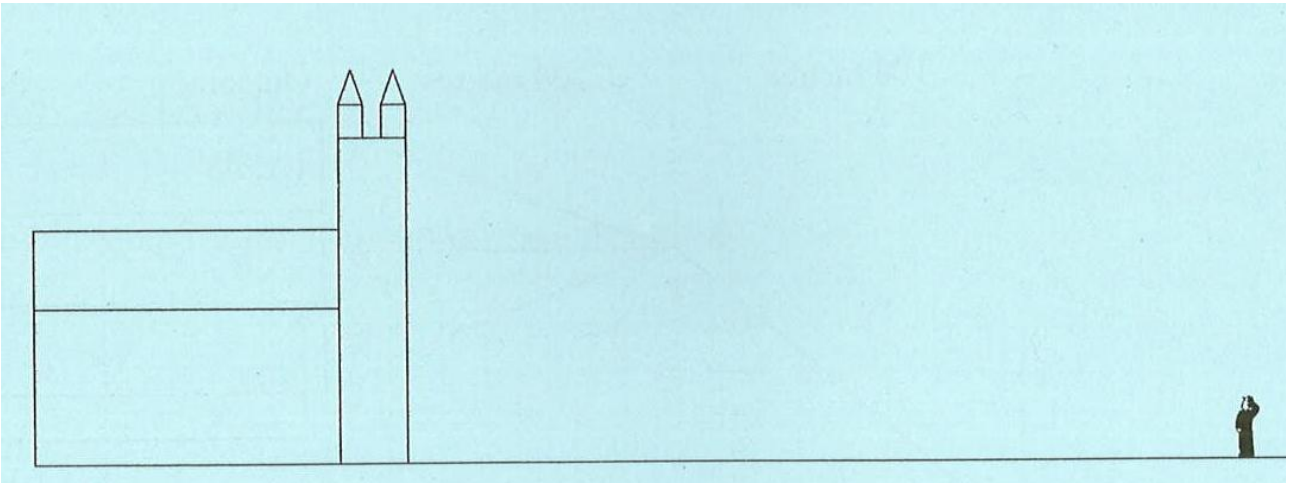
(i) On the diagram below, show the measurements that Peter’s group made.



(ii) Show how Peter’s group used these measurements to find the height of the church.

b) Hannah was in a different group from Peter. She explained her group's method for finding the height of the church:

"It was really sunny and we used the shadows cast by the sun.
Amy stood with her back to the sun and we used a tape measure to measure Amy's shadow along the ground from the tips of her toes to the top of her shadow's head. We also measured Amy's height and recorded the results in the table.

Then we recorded the length of the shadow cast by the church. We measured along the ground from the base of the church out to the end of its shadow and recorded this measurement."

Amy's Shadow	2 m
Church's Shadow	69.4 m
Amy's Height	1.7 m

Show how Hannah's group used their results to calculate the height of the church.

(c)The church is actually 50 metres high. Calculate the percentage error in each groups result.

Question

Oxygen levels in a polluted river were measured at randomly selected locations before and after a clean-up. These results were given in the table:

Before (mg/l)				After (mg/l)			
20 23 2	25 23 10	20 10 11	9 11 5 11	26 11 3	10 15 8	10 11 11	9 11 4 13

(a) Construct a back-to-back stem-and-leaf plot of the above data.

(b) State **one difference** and **one similarity** between the distributions of the measurements before and after cleanup.

Difference:

Similarity:

Question

Noel and Sarah were taking part in a mathematics competition with other students from the *ProjectMaths* schools. They were finding the area of the face of the triangular sculpture shown below.

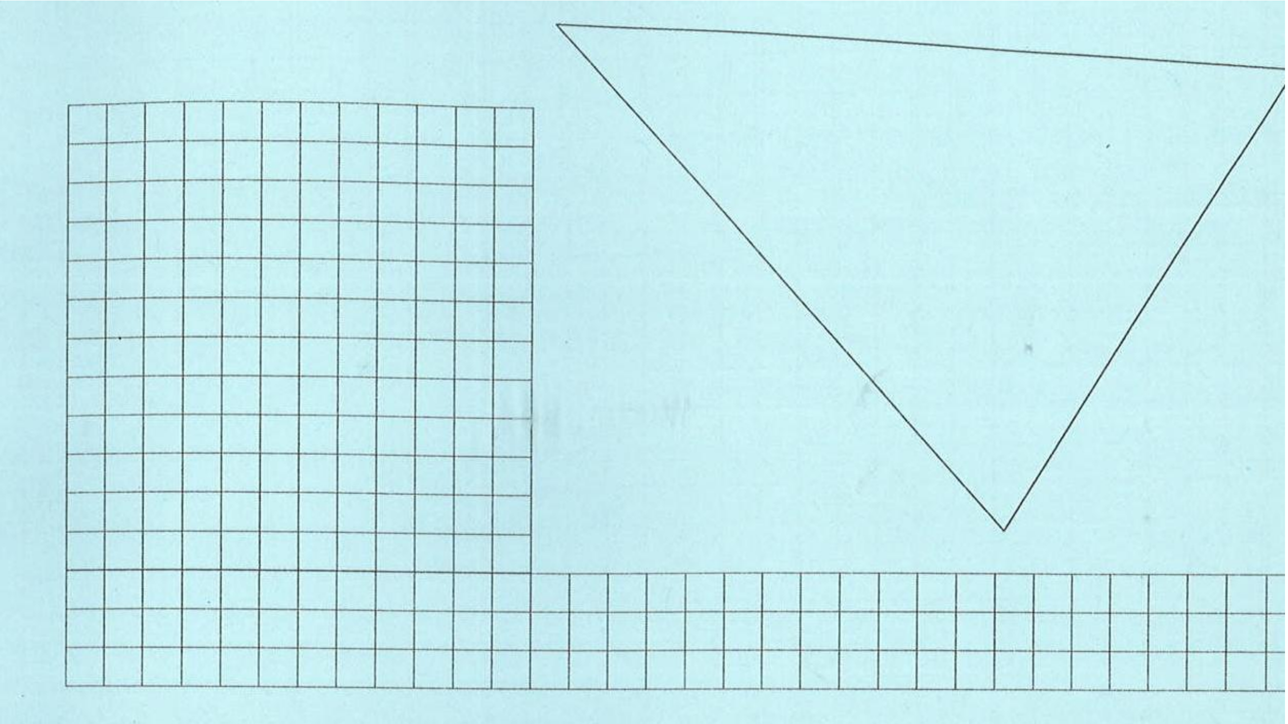
Noel said: "We should measure the height and base of the triangle. Then use the formula that says the area is half the base by the height."

Sarah said: "Okay. How do we know which side is the base?"

Noel said: "it doesn't matter, because of the theorem we did."

(i) State the theorem that Noel is talking about.

(ii) Noel and Sarah trace the triangle on the photograph onto a page to find it’s area. Their drawing is shown here. By making suitable measurements on the drawing, verify the theorem you stated in part (a).



(c) Suppose that the drawing was a true representation of the face of the sculpture. If each centimetre in the drawing represents 70cm in reality find the area of the face of the sculpture.

(d) The true shape of the face of the sculpture is shown below. The people who made it have changed their mind and now want a parallelogram instead!
Show how the triangle could be turned into a parallelogram by making one cut and moving one of the two pieces. You should make it clear exactly where the cut is to be made, and show the new position of the piece moved.