1 A student measures the circumference of a circular pipe.

He wraps a length of string around the pipe five times and marks it with ink, as shown in the photograph.



(a) The student unwraps the string and holds it against a ruler with a centimetre scale. The next photograph shows the first two ink marks on the string.



(i) Estimate the circumference of the pipe, using the photograph of the string and the centimetre scale.

Give your answer to two significant figures.

(2)

estimated circumference = ... cm

(ii) The student finds that the total length of string for 5 turns is 25.6 cm.

Calculate the average (mean) circumference of the pipe using this value.

(1)

average circumference = ... cm

(iii) The student measures the **diameter** of the pipe using a digital calliper.



The calliper shows that the diameter is 15.10 mm.

Calculate the circumference of the pipe using the formula

$$\text{circumference} = \text{diameter} \times \pi$$

(2)

calculated circumference = ... cm

(b) The student uses two methods to find the circumference

- averaging, using a measured length of string
- calculating, using the digital calliper reading

Explain why the two methods are likely to give different results.

(4)

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(Total for Question 1 = 9 marks)

2 A student plans to measure the thickness of a sheet of paper with a ruler.

(a) Explain why it is difficult to measure the thickness of a single piece of paper with a ruler.

(2)

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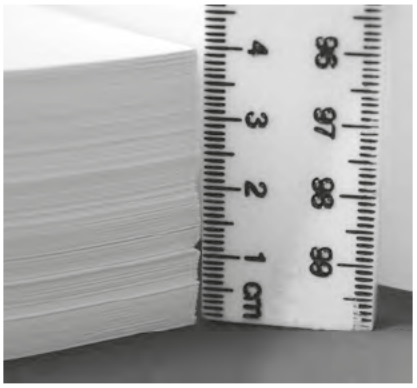
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(b) The student puts a pile of 400 sheets of paper on a table.

He uses a ruler to measure the height of the pile.



The student records the thickness of the pile as 4.1 cm.

(i) This means that the thickness of **one** piece of paper is about

(1)

☒ **A** 1 cm

☒ **B** 1 mm

☒ **C** 0.1 mm

☒ **D** 0.01 mm

(ii) Suggest two reasons why the student's value for the thickness of the pile may be inaccurate.

(2)

1 .....

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2 .....

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(c) The student folds the sheet of paper to make a paper aeroplane.

He throws the paper aeroplane into the air and it flies at a constant velocity.

(i) Explain why the forces on the paper aeroplane must be balanced.

(2)

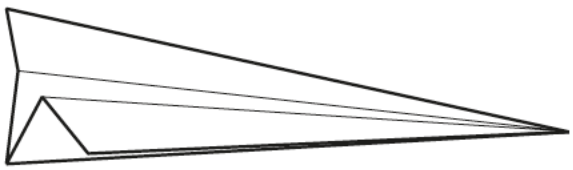
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(ii) The diagram shows the paper aeroplane as it moves at a constant velocity towards the right and slightly downwards.



Add labelled arrows to the diagram to show the directions of the forces of

- weight
- lift
- drag

(3)

(iii) As it flies, the paper aeroplane loses gravitational potential energy.

What happens to this energy?

(1)

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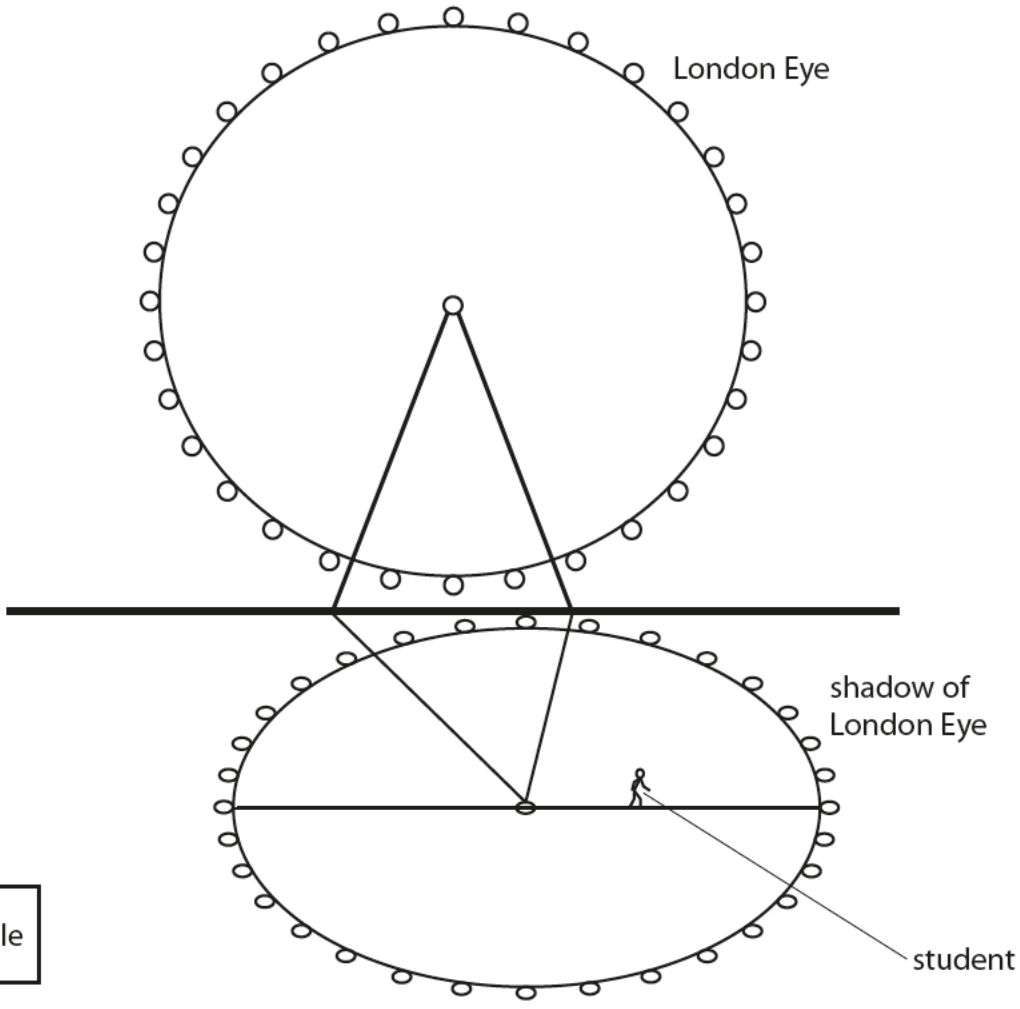
(Total for Question 2 = 11 marks)

3 The London Eye is a large Ferris wheel.



A student measures the diameter of the London Eye using two methods.

(a) Her first method is to walk across the shadow of the wheel and count her steps.



She counts 170 steps across the diameter of the wheel.

She estimates that each of her steps is 0.74 m long.

(i) Calculate the diameter of the wheel using the student's data.

Give your answer to the nearest metre.

(2)

Diameter = ... m

(ii) Suggest **two** reasons why this value may not be accurate.

(2)

1 .....

.....

.....

2 .....

.....

.....

(iii) Suggest **one** way that the student could improve this method to give a more accurate value.

(1)

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(b) Her second method is to use an altimeter. The altimeter can measure height to the nearest 5 m.

The student goes for a ride on the London Eye. She notes her height above the ground every five minutes.

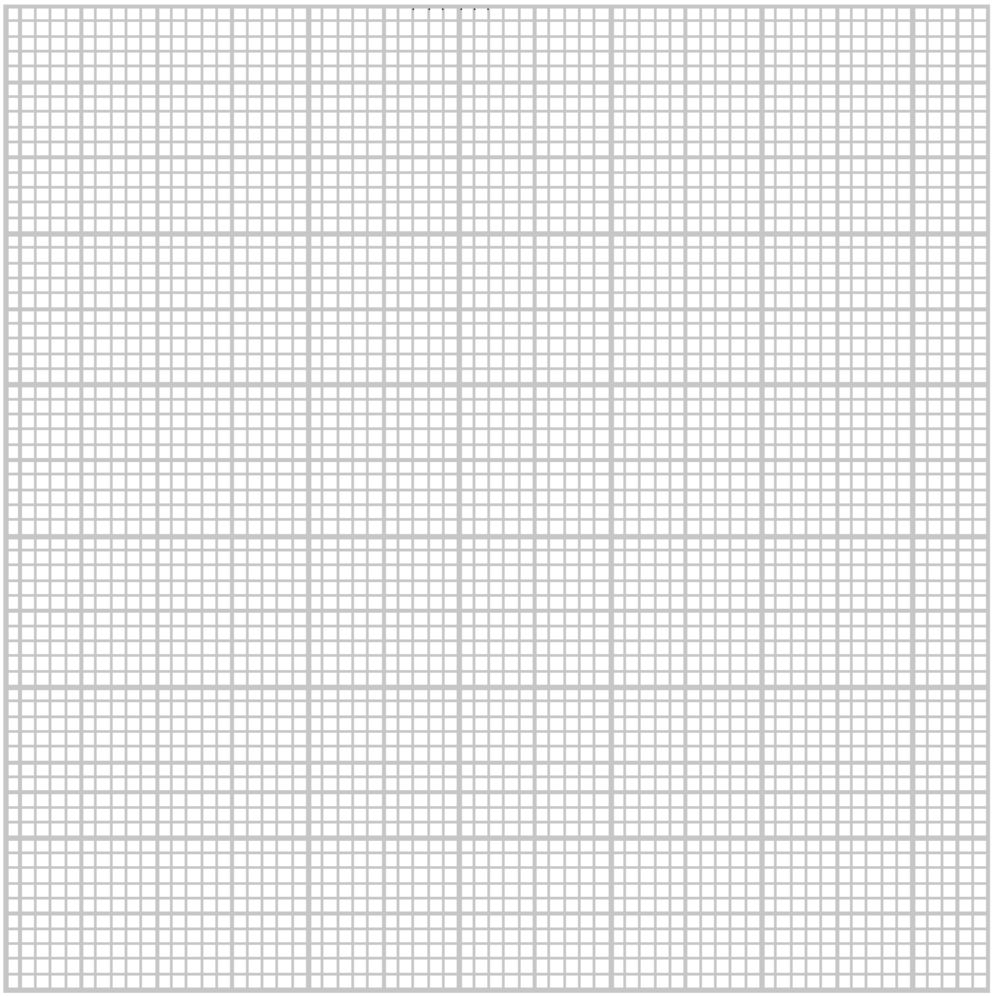
Her results are shown in the table.

Time in minutes	0	5	10	15	20	25	30
Height in m	0	30	90	120	90	30	0

(i) Use the grid to plot a graph of these results.

Draw a curved line of best fit.

(5)



(ii) Use your graph to find the diameter of the wheel according to the altimeter readings.

(1)

Diameter of the wheel according to the altimeter = ... m

(iii) The London Eye website gives the diameter of the wheel as 122 m.

Does the value for the diameter of the wheel from the student's altimeter readings agree with the website value?

Give a reason for your answer.

(1)

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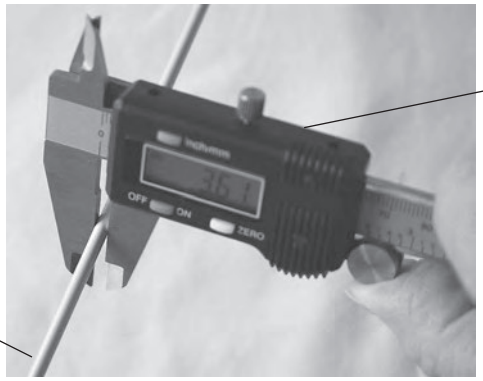
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(Total for Question 3 =12 marks)

4 A student uses a digital calliper to measure the diameter of a knitting needle.



The digital calliper gives readings to the nearest 0.01 mm.

(a) The student measures the diameter of the knitting needle eight times.

These are her readings.



(i) Circle the anomalous reading.

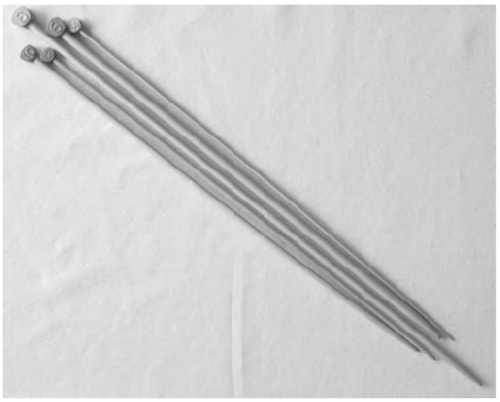
(1)

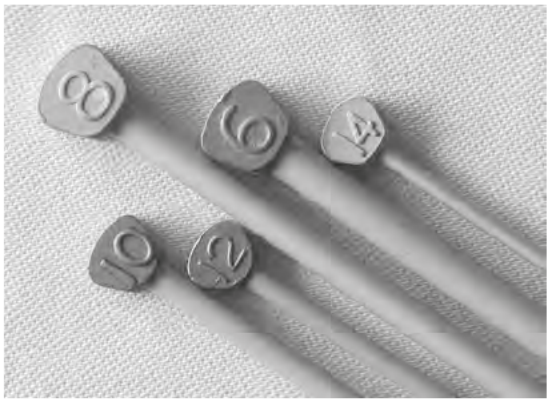
(ii) Calculate the average value for the diameter of the knitting needle.

(3)

average diameter = ... mm

(b) The student finds more knitting needles, some of which are shown in the photographs.



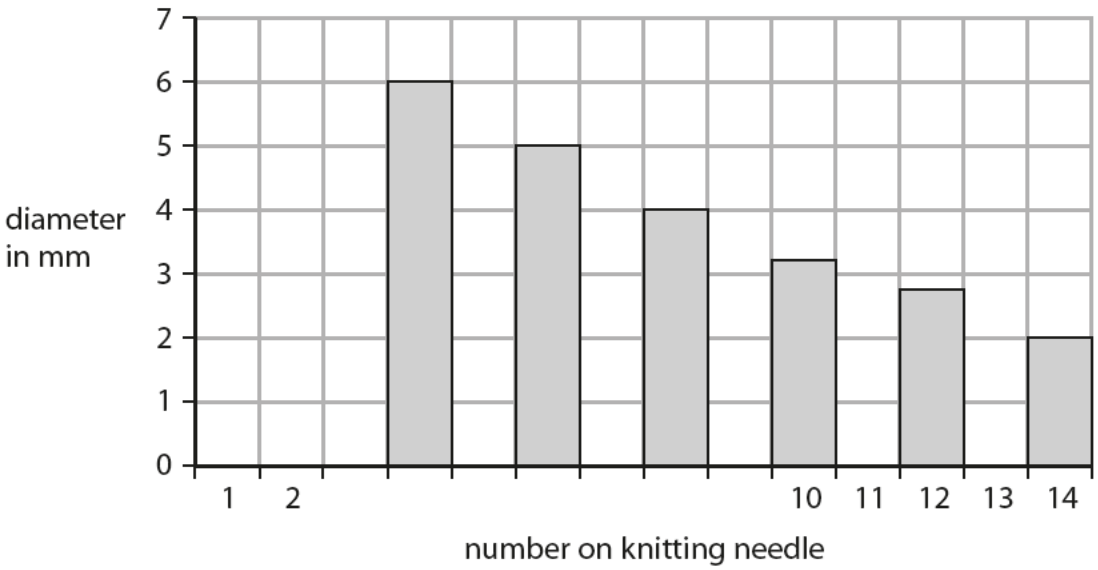


Each knitting needle is marked with a number that indicates its size.

Each number corresponds to a set diameter, as shown in the table.

Number on knitting needle	Diameter in mm
14	2.00
12	2.75
10	3.25
8	4.00
6	5.00
4	6.00

The student displays this data as a chart.



(i) Name the type of chart used by the student.

(1)

(ii) Explain why the data is best displayed using this chart rather than another type of graph.

(2)

(iii) Describe the relationship between the number on a knitting needle and its diameter.

(2)

(c) The knitting needles are not uniform in shape.

Describe how the student could measure the volume of a non-uniform shape.

(4)

(Total for Question 4 = 13 marks)

5 (a) Some units can be written in different ways.

(i) A power of 1 watt is the same as

(1)

☒ **A** 1 joule per coulomb (1 J/C)

☒ **B** 1 joule per second (1 J/s)

☒ **C** 1 newton per square metre (1 N/m^2)

☒ **D** 1 newton per kilogram (1 N/kg)

(ii) A pressure of 1 pascal is the same as

(1)

☒ **A** 1 joule per coulomb (1 J/C)

☒ **B** 1 joule per second (1 J/s)

☒ **C** 1 newton per square metre (1 N/m^2)

☒ **D** 1 newton per kilogram (1 N/kg)

(b) Magnetic fields can be indicated using lines.

(i) The arrow on a magnetic field line shows

(1)

☒ **A** the direction of a magnetic field

☒ **B** the electrostatic attraction

☒ **C** the presence of an electric current

☒ **D** the strength of a magnetic field

(ii) Equal spaces between magnetic field lines show that the magnetic field

(1)

☒ **A** has uniform strength

☒ **B** goes from a S-pole to a N-pole

☒ **C** must be caused by a current

☒ **D** must be caused by a bar magnet

(Total for Question 5 = 4 marks)