Paper Reference(s)

4420/03 4437/09

London Examinations IGCSE

Physics – 4420

Paper 3

Science (Double Award) – 4437

Paper 9

Foundation and Higher Tiers

Wednesday 10 November 2010 – Afternoon

Time: 1 hour 15 minutes

Materials required for examination	**Items included with question papers**
Ruler, protractor, compasses, pencil and calculator	Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.
The paper reference is shown at the top of this page. Write the one for which you have been entered.
Check that you have the correct question paper.
Answer **ALL** the questions. Write your answers in the spaces provided in this question paper.
Some questions must be answered with a cross in a box (☒). If you change your mind about an answer, put a line through the box (☒) and then mark your new answer with a cross (☒).
Show all the steps in any calculations and state the units.
Calculators may be used.

Information for Candidates

The total mark for this paper is 50. The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 16 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

Write your answers neatly and in good English.

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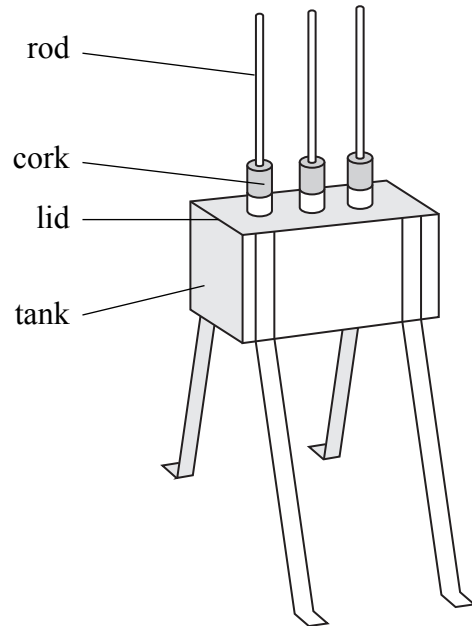*Turn over*

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1. A student knows that some metals are better heat conductors than others.
He investigates rods made of aluminium, brass, copper, iron, lead and zinc.
The diagram shows the equipment which he uses to test three of the rods.

rod

cork

lid

tank

He fits the rods into corks and puts the corks into holes in the lid.
He covers each rod above its cork with wax which is solid at room temperature.
The student pours hot water into the tank and puts the lid on.
After 20 seconds, he measures the length of the melted wax on each rod.

(a) Measure the length of melted wax above the cork in the following diagram.

solid wax

melted wax

cork

Length = ... mm

(1)

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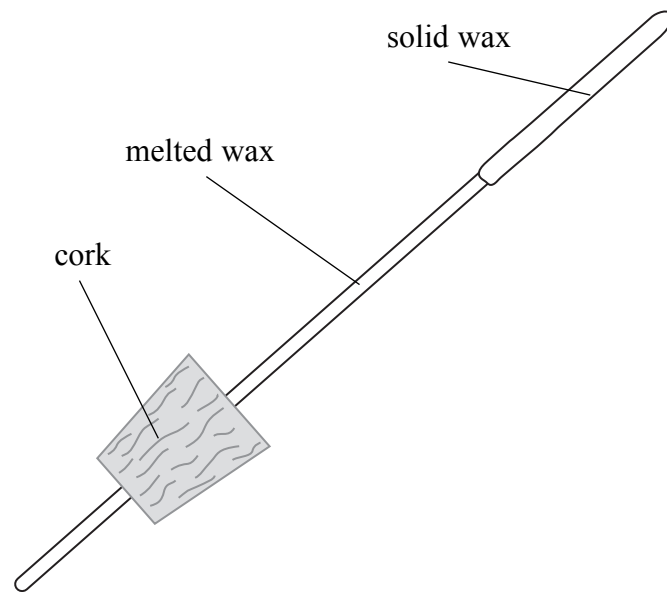
(b) Name the equipment the student needs to measure the time of 20 seconds.

....

(1)

(c) (i) The rods are all the same length.

Give **two** other features of the rods and their arrangement which should be the same to make a fair comparison.

Feature 1 ....

....

Feature 2 ....

....

(2)

(ii) The student repeats the investigation for the other three rods.

Give **two** other features of this second investigation which should be the same as those in the first to make a fair comparison of all six metals.

Do **not** list any feature already referred to in (c)(i).

Feature 1 ....

....

Feature 2 ....

....

(2)

(d) The student's friend says that it is more reliable to take several readings rather than just one.

This is correct because any anomalous (or unexpected) readings are then easier to identify.

(i) State how you can recognise an anomalous reading.

....

....

(1)

(ii) State what you should do with an anomalous reading.

....

....

(1)

(e) In a similar investigation a student collects the following data.

Metal	Length of melted wax in mm
aluminium	62
brass	28
copper	96
iron	25
lead	22
zinc	35

The teacher says that the student's data should be drawn as a bar chart (histogram).

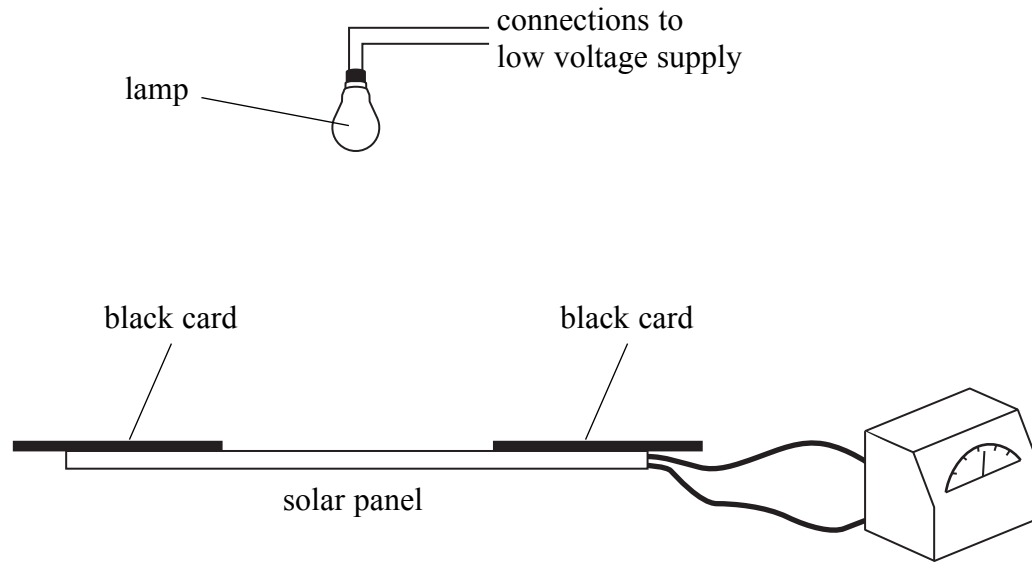(i) Use the student's data to draw a bar chart.
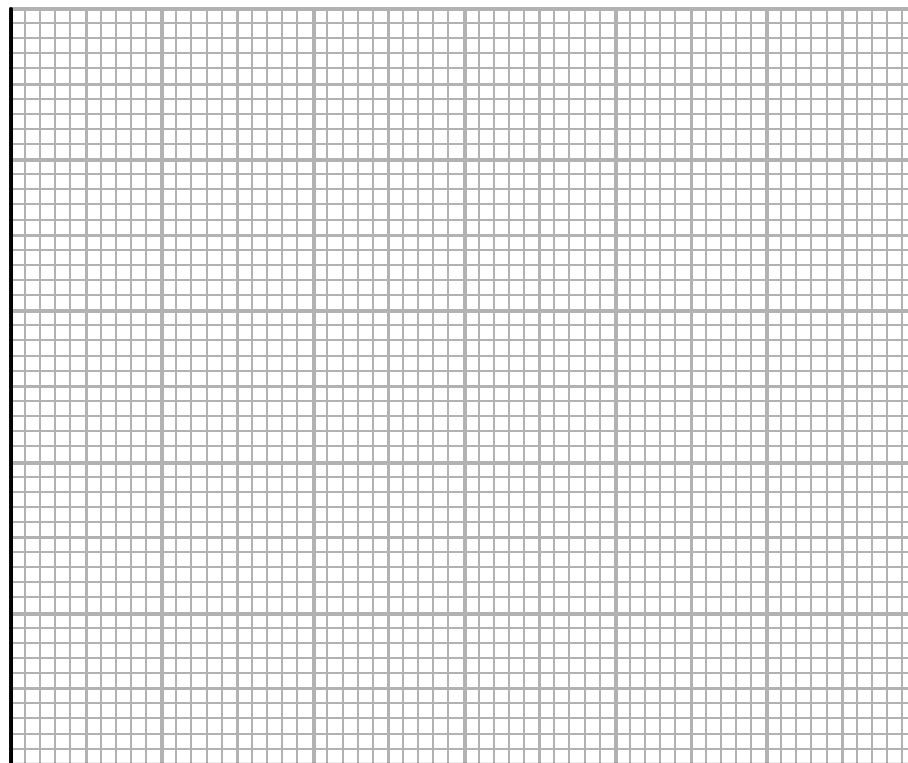
(3)

(ii) Explain why a line graph is wrong for the student's data.

....

....

....

....

(1)

(Total 12 marks)

Q1

2. A student investigates the relationship between the voltage across a solar panel and the area that is exposed to light.

   He uses the arrangement shown in the diagram.

The student uses a 30 cm rule to measure the sides of the part of the panel that is exposed to light.

(a) Suggest and explain the purpose of the black card.

   ....

   ....

   ....

   ....

   (2)

(b) State why the student carries out the investigation in a blacked-out room.

   ....

   ....

   ....

   (1)

(c) During the investigation the student uses the same panel and the same lamp.

List **two** other variables which the student needs to keep constant.

1 ....

2 ....

(2)

(d) The diagram shows the voltage reading across the solar panel when a square area of side 8 cm is exposed to light.
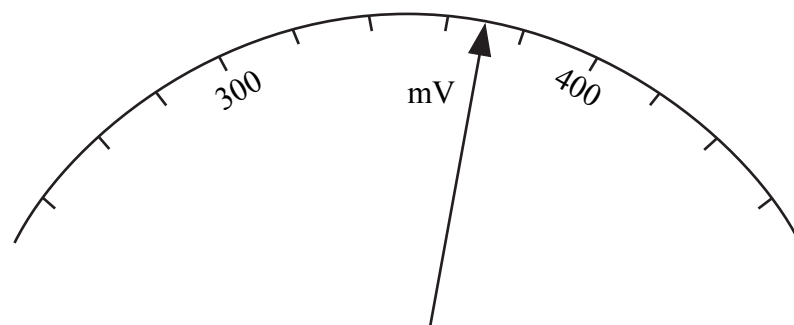
(i) Complete the sentence.

The meter is a .... and the reading is .... mV.

(2)

(ii) Calculate the area, in cm^2, of a square of side 8 cm.

....

Area = ... cm^2

(1)
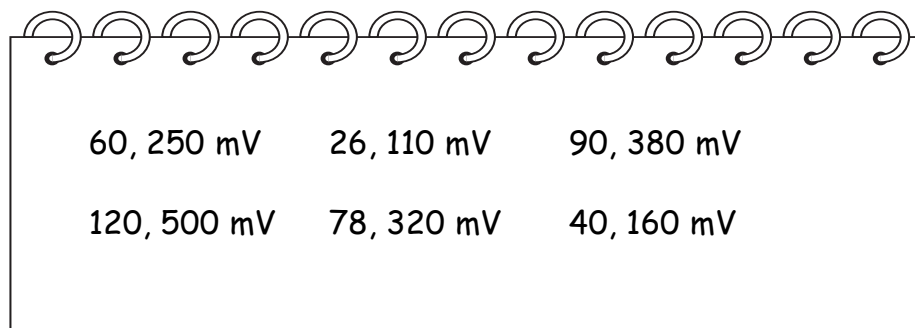
(e) Another student carries out a similar investigation.
   Her results for exposed area and voltage are shown.

| 60, 250 mV | 26, 110 mV | 90, 380 mV |
| 120, 500 mV | 78, 320 mV | 40, 160 mV |

(i) Put these results into a suitable table with column headings and units.

(3)

(ii) On the grid below, plot a graph of voltage against exposed area.
Label both axes and add a suitable scale to the vertical axis.
Decide whether a straight line of best fit or a curved line of best fit is appropriate and draw it on your graph.

....

....

0   20   40   60   80   100   120

....
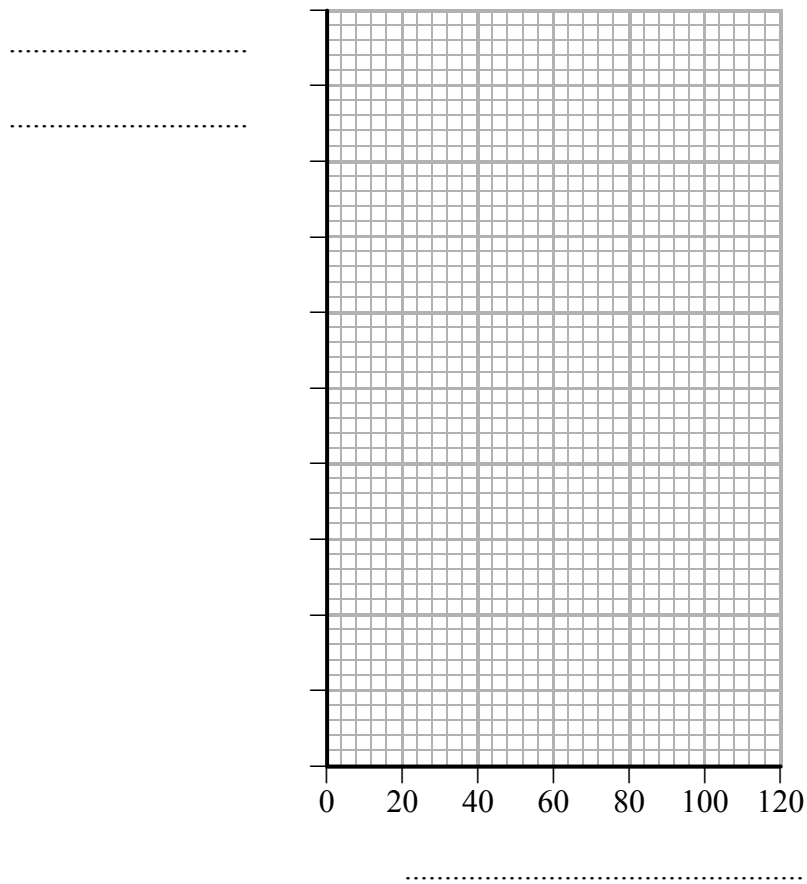
(6)

(iii) Use your graph to find the voltage, in millivolts, across the solar panel when the exposed area is 100 cm².

Voltage = ... mV

(1)   **Q2**

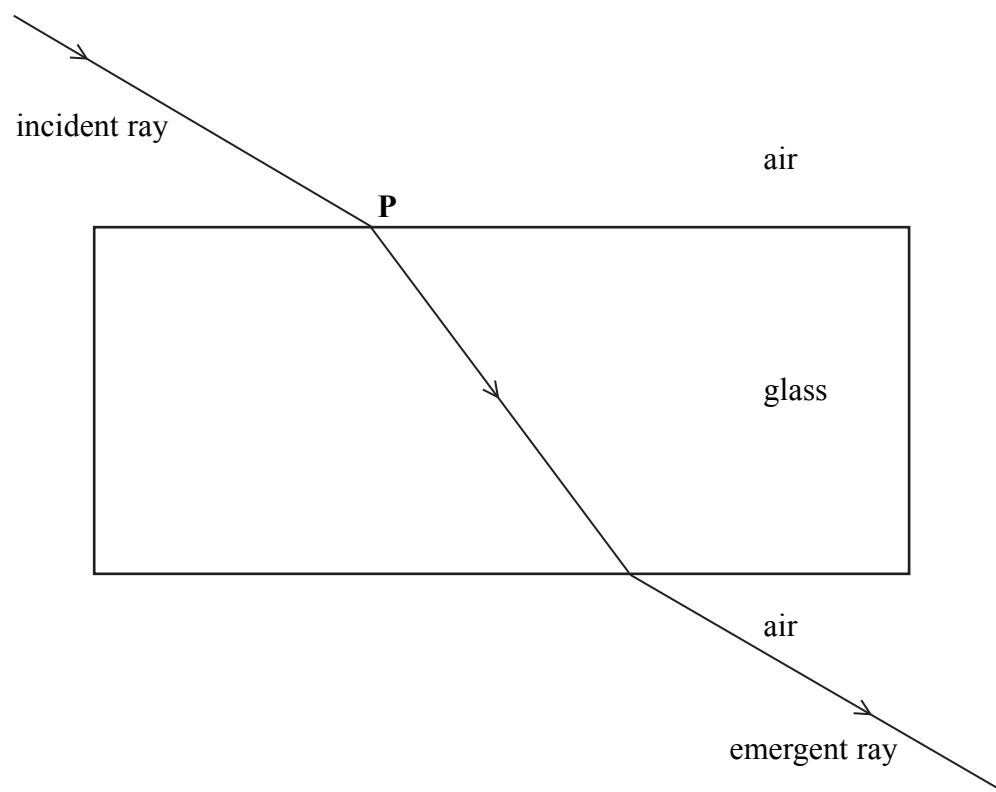**(Total 18 marks)**

3. A student investigates the refraction of light through a rectangular block of glass.
The diagram shows part of his investigation.

incident ray

air

P

glass

air

emergent ray

(a) What can the student use to produce the incident ray?

....

(1)

(b) How can the student mark the position of the emergent ray?

....

....

....

(2)

(c) On the diagram:

(i) Draw a line which is perpendicular to the surface of the glass block at point **P**.
This line should go upwards and downwards.
Label this line **normal**.

(1)

(ii) Label the angle between the incident ray and the normal as *i* and the angle between the normal and the ray in the glass as *r*.
Use a protractor to measure angle *i* and angle *r* to the nearest degree in each case.

angle *i* = ... °   angle *r* = ... °

(2)

(iii) The student uses his measurements correctly to calculate the refractive index of the glass. He gives 1.509869215 as his answer.

Refractive index is a ratio and so has no units.

Explain what is wrong with his answer.

....

....

....

....

....

....

(3)

(d) Another student investigates a rectangular block of transparent plastic.
She records six pairs of measurements, calculates the refractive index for each pair and then calculates the average refractive index.

Explain why this is an improvement on using one pair of measurements.

....

....

....

....

....

....

(3)   **Q3**

(Total 12 marks)

4. A student reads an article in a science magazine about dinosaurs' footprints.
The footprints became fossilised after the dinosaur had walked on mud or wet sand.

(a) Two factors which will affect the depth of the footprints are the weight of the dinosaur and the area of its feet.
The greater the weight of the dinosaur and the smaller the area of its feet the deeper the footprints will be.

Suggest another factor and explain how it will affect the depth of the footprints.

....

....

....

....

(2)

(b) The student uses the equipment shown as part of her investigation.
She carefully places the wooden block on the mud and then puts a weight on the wooden block.

large glass
container

wooden block

mud
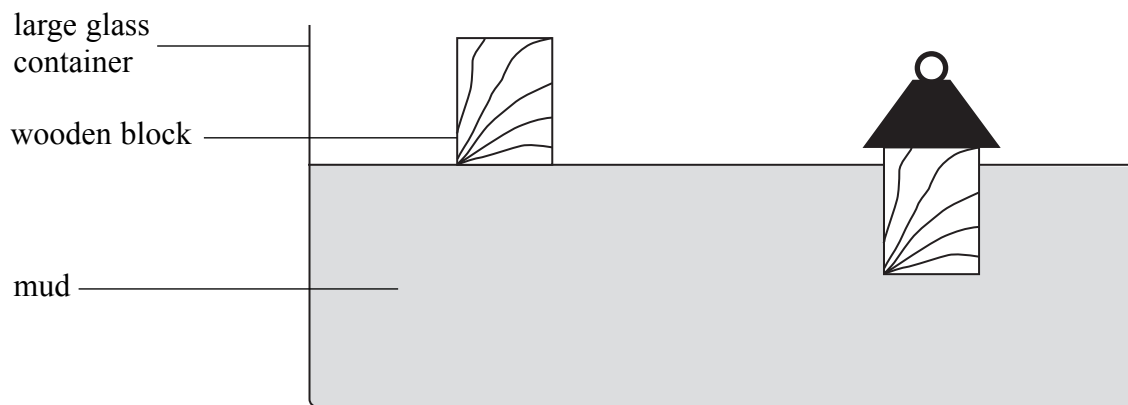
(i) Show on the diagram the depth by which the wooden block has sunk into the mud.

(1)

(ii) Use a ruler to measure this depth, in millimetres.

Depth = ... mm

(1)

(c) The diagram, with centimetre squares, shows a footprint made by a small dinosaur.
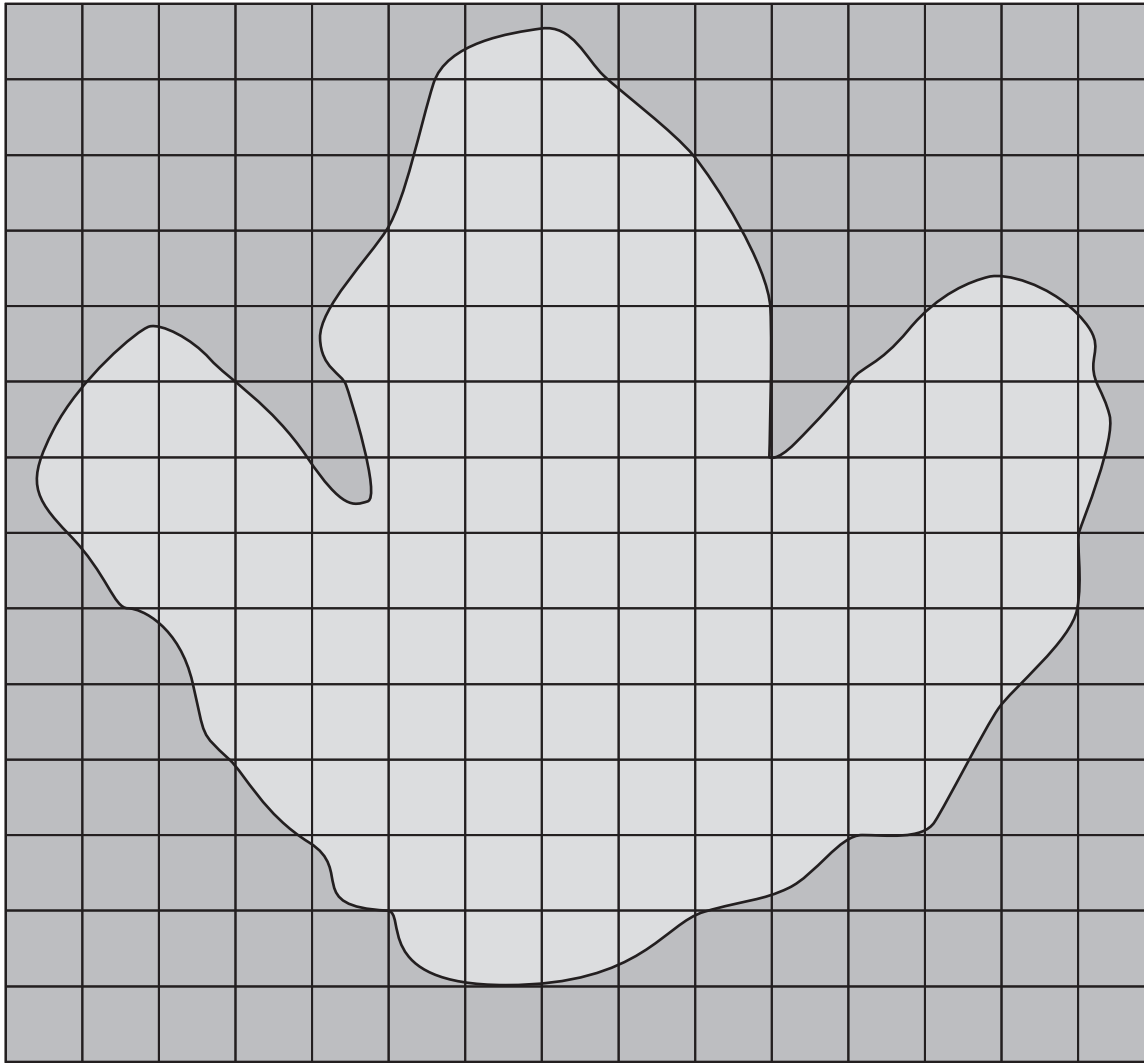
(i) Add information to the diagram to show how you could use it to find the area of the footprint.

Explain how you would use this information to find the area.

....

....

....

....

....

(3)

(ii) Find the area of the footprint.
Put a cross (☒) next to the area which is nearest to your result.

100 cm² ☒

110 cm² ☒

120 cm² ☒

130 cm² ☒

(1)

Q4

(Total 8 marks)

TOTAL FOR PAPER: 50 MARKS

END