Q1.

This question is about cell structures.

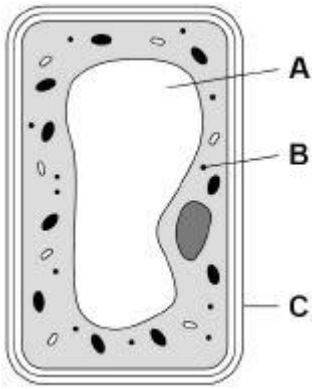
(a) Draw **one** line from each cell structure to the type of cell where the structure is found.

Cell Structure	Type of cell where the structure is found
Nucleus	Prokaryotic cells
Permanent vacuole	Plant cells only
Plasmid	Eukaryotic cells

(2)

(b) **Figure 1** shows a plant cell.

Figure 1



What are the names of structures **A**, **B** and **C**?

Tick **one** box.

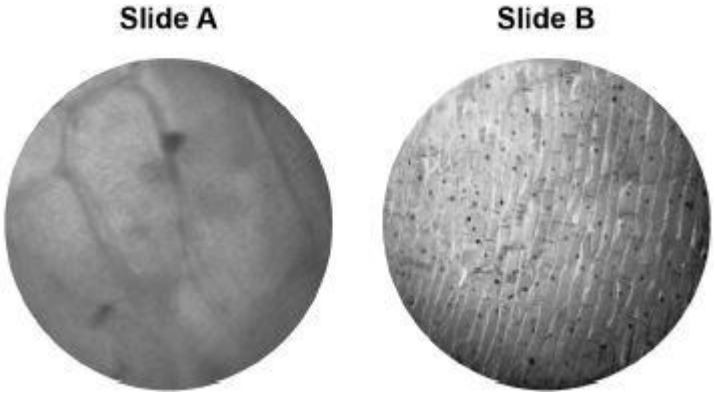
Structure A	Structure B	Structure C	
Chloroplast	Vacuole	Cell wall	☐
Nucleus	Chloroplast	Cell membrane	☐
Vacuole	Mitochondrion	Cell membrane	☐
Vacuole	Ribosome	Cell wall	☐

(1)

A student observed slides of onion cells using a microscope.

Figure 2 shows two of the slides the student observed.

Figure 2



The cells on the slides are **not** clear to see.

(c) Describe how the student should adjust the microscope to see the cells on Slide A more clearly.

_____

_____

(1)

(d) Describe how the student should adjust the microscope to see the cells on Slide B more clearly.

_____

_____

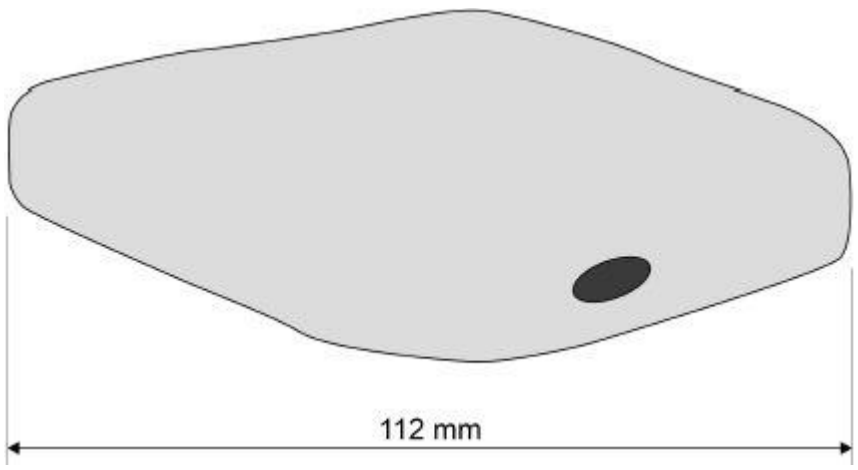
_____

(2)

(e) The student made the necessary adjustments to get a clear image.

Figure 3 shows the student's drawing of one of the cells.

Figure 3



The real length of the cell was 280 micrometres (µm).

Calculate the magnification of the drawing.

Magnification = × _____

(3)

(Total 9 marks)

Q2.

Many biotic and abiotic factors can affect the growth of plants.

(a) Are the factors in **Table 1** biotic or abiotic?

Tick **one** box for each factor.

Table 1

Factor	Biotic	Abiotic
Diseases		
Herbivores		
Temperature		
Water		

(2)

Two students investigated the effect of light intensity on the distribution of small plants.

The plants are growing under a tree in a park.

The students made the following hypothesis:

'As you move outwards from a tree there will be more plant growth.'

(b) Explain why the students thought their hypothesis would be correct.

_____

_____

_____

(3)

(c) The students used two pieces of equipment.

Give the scientific name of each piece of equipment.

A square frame measuring 0.5 m × 0.5 m _____

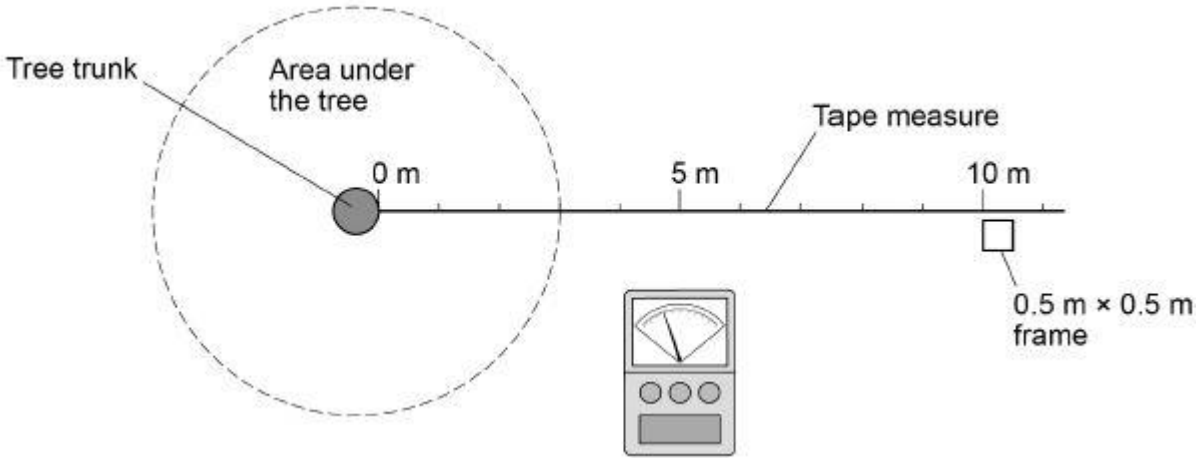
An electronic device to measure light intensity _____

(2)

This is the method used.

1. Fix one end of a tape measure at the base of the tree.
2. Fix the other end of the tape measure 11 metres from the tree.
3. At 0 metres put the square frame on the ground.
4. Identify all the plant species growing inside the frame./p>
5. Estimate and record the percentage cover of each plant species.
6. Measure the light intensity inside the frame.
7. Put the square frame on the ground every 2 metres along the tape to 10 metres.
8. Repeat steps 4 − 6 in every frame.

The diagram below shows the equipment in this investigation.



(d) Calculate the total area sampled.

_____

_____

Total area sampled = _____ m^2

(1)

(e) The whole investigation was done as quickly as possible on the same day.

Suggest **one** reason why.

(1)

(f) Give **one** way the investigation could be improved.

(1)

Table 2 shows the results.

Table 2

	Distance from tree in metres					
	0	**2**	**4**	**6**	**8**	**10**
Percentage cover of grass	15	50	35	16	15	15
Percentage cover of plantain	0	5	10	40	25	30
Percentage cover of daisy	0	0	0	4	20	10
Percentage cover of clover	1	10	25	40	40	45
Total percentage cover of plants	16	65	70	100	100	100
Light intensity in arbitrary units	37	59	150	175	>200	>200

(g) Which plant species in **Table 2** will only grow at high light intensity?

(1)

(h) What conclusion can be made about the relationship between light intensity and the total percentage cover of plants?

Use data from **Table 2** in your answer.

(2)

(i) Light intensity might **not** be the cause of this pattern of plant distribution.

Suggest **one** different factor that may cause these results.

Give **one** reason for your answer.

Factor _____

Reason _____

_____

(2)

(Total 15 marks)

Q3.

Amylase is an enzyme that digests starch.

A student investigated the effect of pH on the activity of amylase.

This is the method used.

1. Mix amylase solution and starch suspension in a boiling tube.
2. Put the boiling tube into a water bath at 25 °C.
3. Remove a drop of the mixture every 30 seconds and test it for the presence of starch.
4. Repeat the investigation at different pH values.

The table below shows the students' results.

pH	Time when no starch was detected in minutes
5.0	7.0
5.5	4.5
6.0	3.0
6.5	2.0
7.0	1.5
7.5	1.5
8.0	2.0

(a) The student concluded pH 7.25 was the optimum pH for the amylase enzyme.

This is **not** a valid conclusion.

Suggest **two** reasons why.

1. _____

_____

2. _____

_____

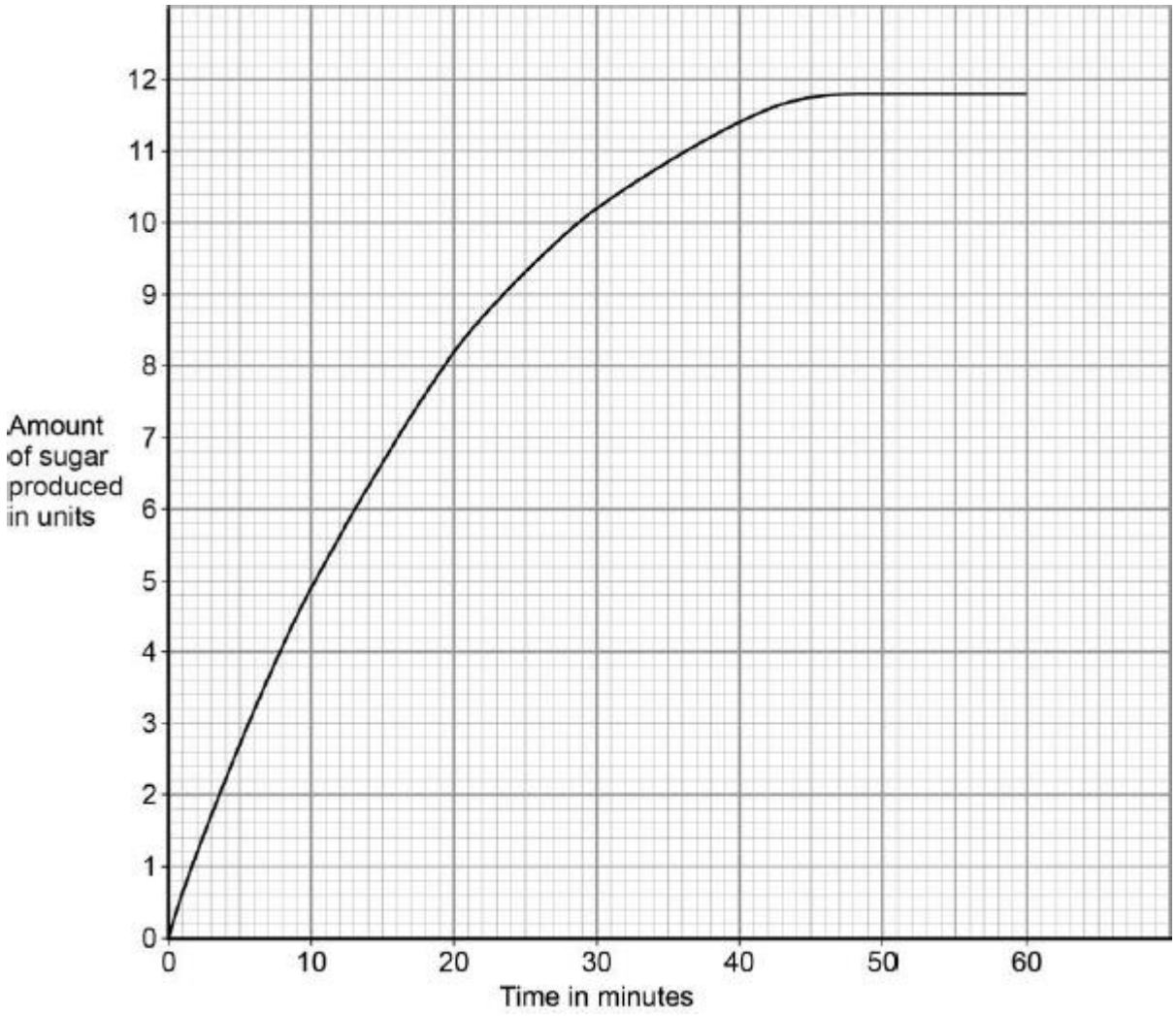
(2)

(b) The student did another investigation.

This is the method used.

1. Put amylase solution and starch suspension into a boiling tube.
2. Make the pH 7.25.
3. Put the boiling tube into a water bath at 25 °C.
4. Measure the amount of sugar produced every 30 seconds.

The results are shown in the figure below.



Calculate the mean rate of sugar produced per minute during the first 5 minutes.

_____

_____

Mean rate = _____ units per minute

(2)

(c) Iodine solution is added to a sample taken from the boiling tube after 10 minutes and 60 minutes.

Suggest what you would see in these samples.

After 10 minutes _____

_____

.After 60 minutes _____

_____

(2)

(d) The scientist repeated the investigation at 37 °C.

Draw a line on the figure above to show the predicted results.

(2)

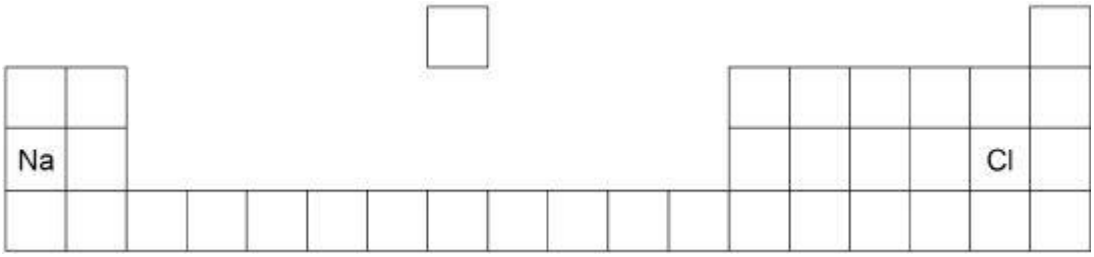
(Total 8 marks)

Q4.

This question is about sodium and chlorine.

Figure 1 shows the positions of sodium and chlorine in the periodic table.

Figure 1



(a) State **one** difference and **one** similarity in the electronic structure of sodium and of chlorine.

Difference _____

_____

Similarity _____

_____

(2)

(b) Sodium atoms react with chlorine atoms to produce sodium chloride (NaCl).

Describe what happens when a sodium atom reacts with a chlorine atom.

Write about electron transfer in your answer.

_____

_____

_____

_____

_____

_____

_____

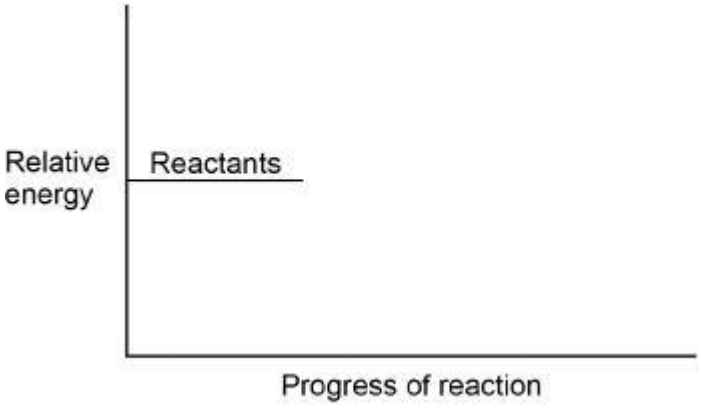
_____

(4)

(c) The reaction between sodium and chlorine is an exothermic reaction.

Complete the reaction profile for the reaction between sodium and chlorine.

Figure 2



(2)

(Total 8 marks)

Q5.

Three substances are all solid at room temperature.

The table describes tests and the result of each test on the three substances.

Substance	**Effect of large force applied**	**Effect of heating gently at first, then strongly**	**Effect of passing electricity through solid**	**Effect of passing electricity through liquid**
A	Breaks into many pieces	Easily melts and then boils	Does not conduct	Does not conduct
B	Breaks into many pieces	No change	Does not conduct	Conducts
C	Becomes thinner	No change	Conducts	Conducts

(a) The covalent bonds in the molecules are not overcome when substance **A** is heated.

What forces are overcome when substance **A** melts?

(1)

(b) What could substance **A** be?

Tick **one** box.

- Graphite ☐
- Iron ☐
- Sodium chloride ☐
- Sulfur ☐

(1)

(c) Suggest why substance **B** conducts electricity as a liquid but does **not** conduct electricity as a solid.

(3)

(d) Suggest why substance **C** becomes thinner when a large force is applied.

(2)

(e) What could substance **C** be?

Tick **one** box.

- Copper ☐
- Diamond ☐
- Iodine ☐

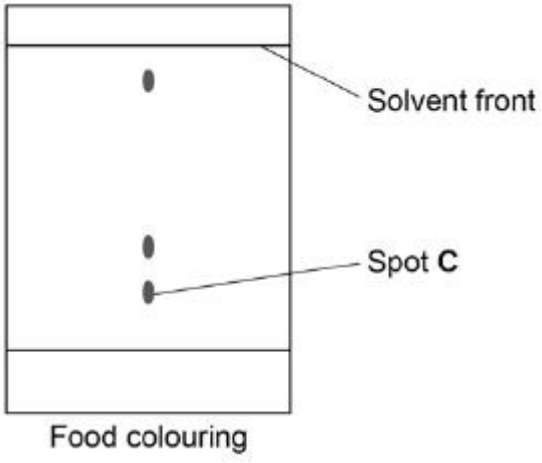
Magnesium oxide ☐

(1)

(Total 8 marks)

Q6.

The diagram shows a chromatogram for a food colouring.



(a) How does the chromatogram show that the food colouring is a mixture?

_____

_____

(1)

(b) A student makes measurements for spot **C**.

The table shows the results.

	Distance in mm
Distance moved by spot **C**	7
Distance moved by solvent	39

Calculate the R_f value for spot **C**.

Give your answer to 2 significant figures.

Use the results in the table.

_____

_____

_____

_____

R_f value = _____

(3)

(c) Plan a chromatography experiment to investigate the colours in an ink.

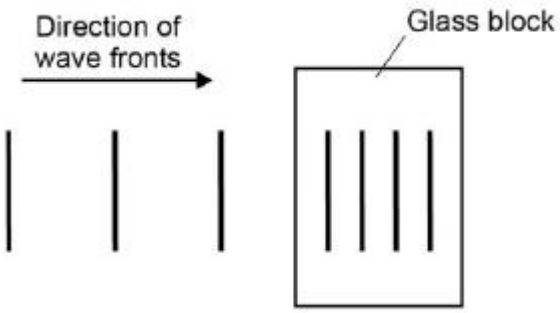
(6)

(Total 10 marks)

Q7.

Figure 1 is a wave front diagram showing light travelling through the air and into a glass block.

Figure 1

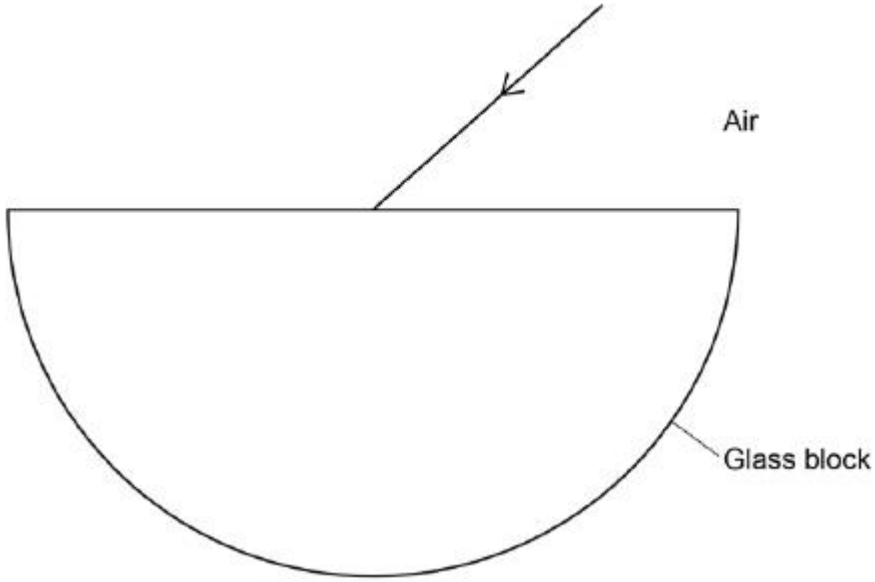


(a) Complete **Figure 1** by drawing wave fronts after they have left the glass block.

(1)

(b) **Figure 2** shows a ray of light incident on a semi-circular glass block.

Figure 2



Complete the ray diagram in **Figure 2**.

- Draw the ray of light passing through and leaving the glass block.
- Label the angle of refraction.

(4)

(c) Explain why the light is refracted.

_____

_____

_____

_____

(2)

(d) A student investigated how different coloured light was refracted by glass.

The student aimed rays of different coloured light at a glass block.

She measured the angle of refraction for each colour.

Give **two** variables that the student should control.

1. _____

2. _____

(2)

The table shows the student's results.

Colour of light	**Angle of refraction in degrees**
Red	27.94

Orange	27.90
Yellow	27.82
Green	27.78
Blue	27.70

(e) Explain why these results could **not** have been obtained with a normal protractor.

_____

_____

_____

_____

(2)

(f) What conclusion can be made about the relationship between the wavelength of light and the angle of refraction?

_____

_____

(1)

(g) Glass does **not** transmit ultraviolet radiation.

Suggest what happens to ultraviolet radiation when it is incident on glass.

_____

_____

(1)

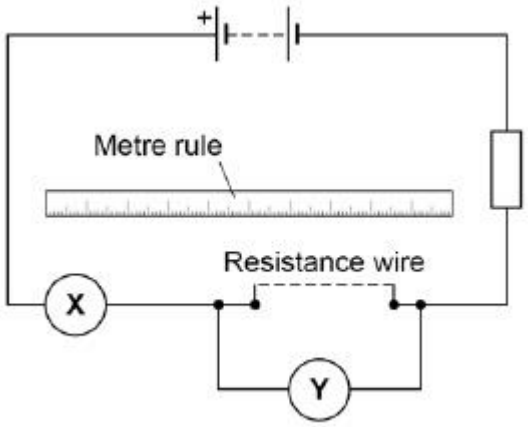
(Total 13 marks)

Q8.

A student investigated how length affects resistance of a wire.

Figure 1 shows the circuit the student used.

Figure 1



(a) The student took measurements using the meters **X** and **Y**.

Name meters **X** and **Y**.

Meter **X** _____

Meter **Y** _____

(2)

The table shows the results.

	Resistance in Ω			
Length in m	**Test 1**	**Test 2**	**Test 3**	**Mean**
0.100	0.66	0.67	0.74	0.69
0.200	1.36	1.40	1.34	1.37
0.300	2.02	2.02	2.03	2.02
0.400	2.77	2.72	2.68	2.72
0.500	3.37	3.35	3.40	3.37
0.600	4.03	4.02	3.96	4.00

(b) For which length of wire are the readings of resistance the most precise?

Give the reason for your answer.

Length = _____ m

Reason _____

_____

(2)

(c) Why did the student do three tests and calculate a mean?

_____

_____

(1)

(d) Write the equation that links current, potential difference, and resistance.

_____

(1)

(e) The potential difference across a piece of wire is 2.1 V

The current in the wire is 0.30 A

Calculate the resistance of the wire.

Write any equation that you use.

_____

_____

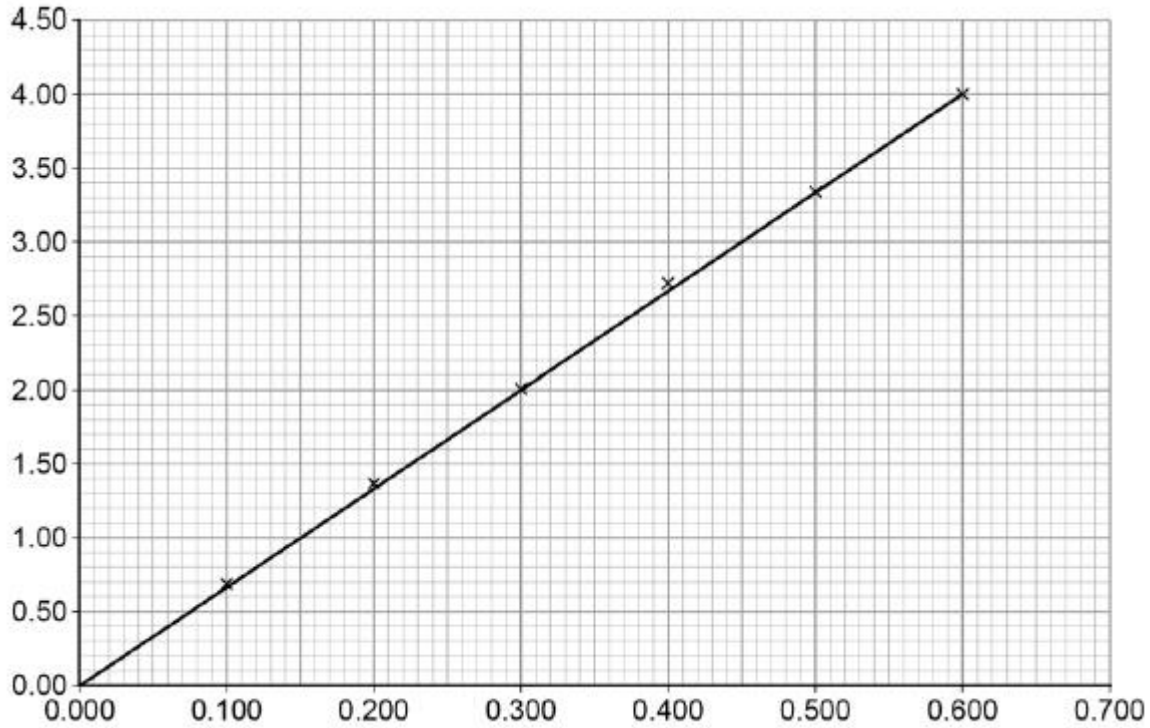
_____

Resistance = _____ Ω

(3)

Figure 2 shows a graph of the results.

Figure 2



(f) What is the label for each axis of the graph?

x-axis _____

y-axis _____

(2)

(g) What conclusion can be made from the graph in **Figure 2**?

_____

_____

(1)

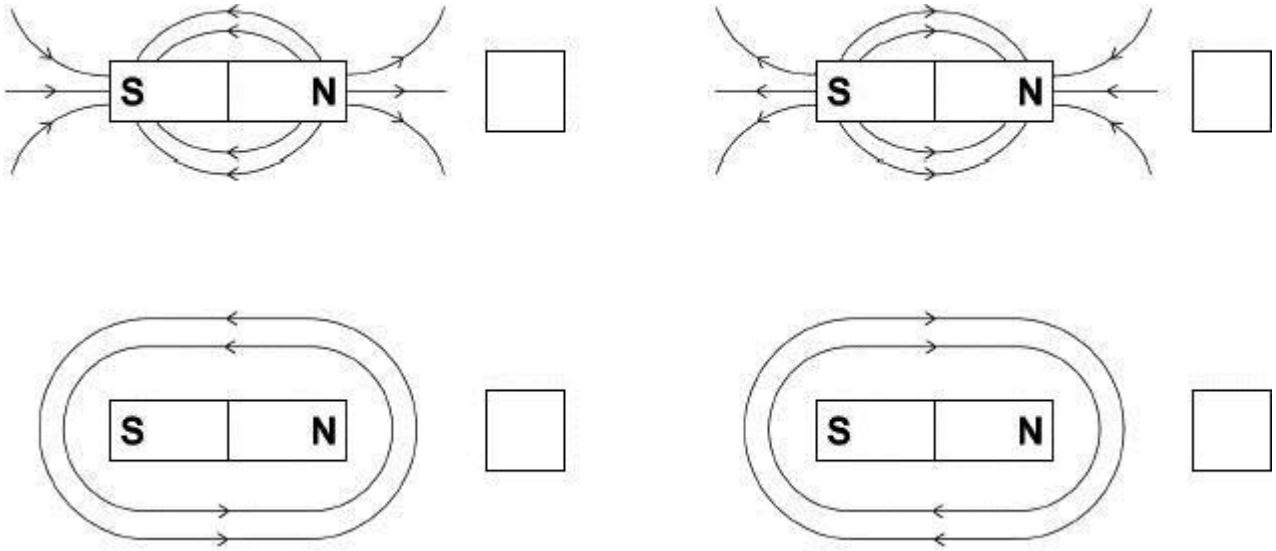
(Total 12 marks)

Q9.

A magnet produces a magnetic field.

(a) Which diagram shows the magnetic field pattern around a bar magnet?

Tick **one** box.



(1)

(b) **Figure 1** shows three metal blocks.

The blocks are not labelled.

One block is a permanent magnet, one is iron and one is aluminium.

Figure 1

Describe how another permanent magnet can be used to identify the blocks.

_____

_____

_____

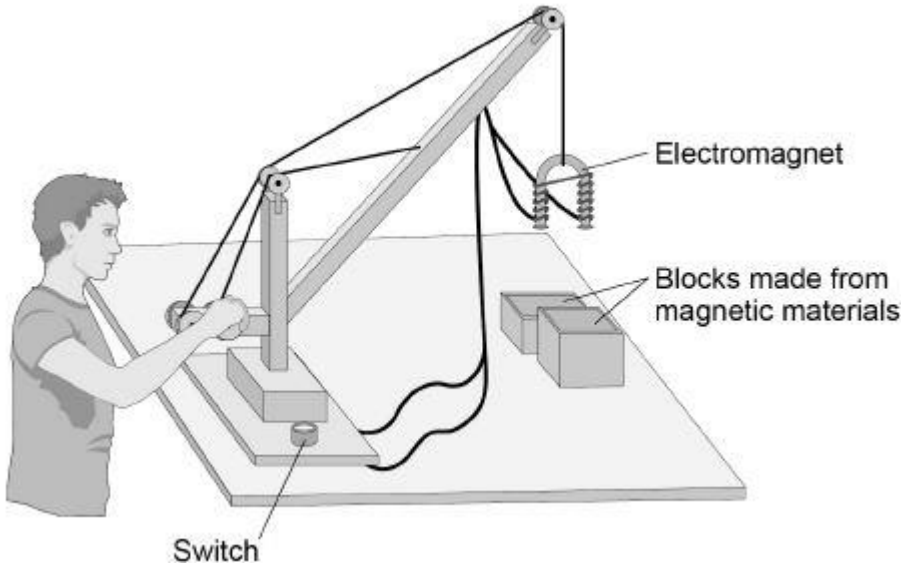
_____

_____

(3)

(c) **Figure 2** shows a toy crane.

Figure 2



The toy crane uses an electromagnet to pick up and move the blocks.

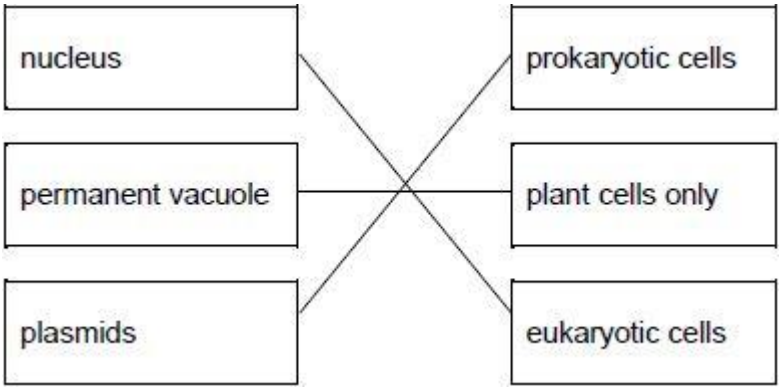
Explain how this electromagnet is able to pick up and move the blocks.

(6)

(Total 10 marks)

Q1.

(a)



*allow **1** mark for one or two correct links*

2

(b)

vacuole	ribosome	cell wall

tick box takes precedence
if no tick is given, look at both the figure and the circling of words in the table
if writing is seen on the figure and in the table both must be correct

1

(c) turn the (fine focusing) knob until the cells are in focus

allow focus it

*do **not** accept increase magnification*

ignore decrease magnification
ignore clear
ignore references to resolution / illumination
ignore zoom in / out

1

(d) (rotate the) nosepiece / objective lens

allow change the (objective / eyepiece) lens

1

to a higher power (lens)

allow (to) increase the magnification

a comparator is required

ignore change / adjust the magnification

allow stronger or more powerful lens

ignore references to resolution / illumination unqualified

ignore zoom in / out

ignore references to an electron microscope

1

(e) conversion of units:

(112 mm ⟶) 112 000 (µm)
or
(280 µm ⟶) 0.28 (mm)

1

$$(\text{magnification} =) \frac{112}{0.28}$$

or

$$(\text{magnification} =) \frac{112000}{280}$$

*allow **1** mark for no conversion of units 112 / 280*
or
incorrect value from step 1 correctly substituted

1

400 (×)

*do **not** accept if units are given*
*if no other mark scored allow **1** mark for:*

$$\text{magnification} = \frac{\text{size of image}}{\text{size of real object}}$$

a triangle with words or letters in is insufficient, as the correct rearrangement is needed

1

*an answer of 400 (×) scores **3** marks*

[9]

Q2.

(a)

Factor	Biotic	Abiotic
Diseases	✓	
Herbivores	✓	
Temp		✓
Water		✓

*allow **1** mark for 2 or 3 correct*

2

(b) (leaves block light near tree so) more light (as you move outwards)

allow low light intensity under tree
ignore Sun

1

for photosynthesis

allow less photosynthesis under the tree

1

(which) produces (more) glucose / proteins (for growth)

ignore growth
ignore food

allow molecules, cell components or other correct substances instead of proteins

if no other mark awarded allow less water / ions / minerals / nutrients under the tree

1

(c) quadrat

correct spelling only

1

light meter

allow lux meter
allow light intensity meter
allow light data logger

1

in this order

(d) 1.5(0) (m^2)

allow 15 000 cm^2

1

(e) to keep light (intensity) as similar as possible

allow the light (intensity) might change

ignore references to temperature
ignore weather
ignore Sun

1

(f) any **one** from:

- repeat (investigation) around the tree

allow repeat in different directions

- repeat (investigation) for other trees / areas
- sample every one metre
- count the number of each species present (rather than percentage cover)

ignore repeats unqualified
ignore repeat at different times / days / seasons
ignore different size quadrat
ignore random sampling

1

(g) daisy

1

(h) as light (intensity) increased so did the percentage / cover of plants

ignore directly proportional
ignore positive correlation unqualified

1

up to 100% / maximum at 175 (arbitrary units)

ignore distance

1

(i) any pair from:

- (lack of) water / rain (1)

because the leaves are stopping the rain
or
because the roots of the tree are absorbing it (1)

allow soil moisture

- (lack of) minerals / ions (1)

  allow magnesium / nitrate / nutrients

because the tree (roots) have absorbed them (1)

- temperature (1)

  allow too cold / cooler

because less thermal energy from the sun is reaching under the tree canopy (1)

allow 'heat' for thermal energy

allow pH / acidity (1)
because (some) fallen leaves are acidic (1)

2

ignore carbon dioxide
*do **not** accept oxygen*

[15]

Q3.

(a) any **two** from:

- same result at pH 7 and 7.5
  or
  could be any pH between 7 and 7.5
  or
  not tested at pH 7.25
  or
  need to test at smaller pH intervals (between 7 and 7.5)
- accuracy of result only to nearest 0.5 minutes
- no repeats
- difficult to determine end point (colour)

2

(b) 2.7 / 5

1

0.54 (units per minute)

*allow 0.52 with no working shown for **2** marks*

1

*allow **1** mark for 0.52 **or** 0.56*

(c) (after 10 minutes) solution goes black

1

(after 60 minutes) solution stays the same
or
does not go black
or
goes slightly orange

1

(d) steeper curve

1

levels off at 11.8 units **and** before 45 minutes

1

[8]

Q4.

(a) (difference)
sodium has one and chlorine has seven electrons in outer level / shell
or
number of electrons

number of electrons must be correct if quoted

1

(similarity)
both have three / same number of levels / shells
or
have electrons in third level / shell
or
both have incomplete (outer) levels / shells

allow both have 2 electrons in inner shell
or
both have 8 electrons in second shell
or
both are one electron away from full outer level / shell

1

(b) sodium (atom) loses

allow moves / transfers for loses

*do **not** accept sodium ion loses*

1

one (outer shell electron)

1

chlorine (atom) gains

*do **not** accept chloride*

1

one (electron)

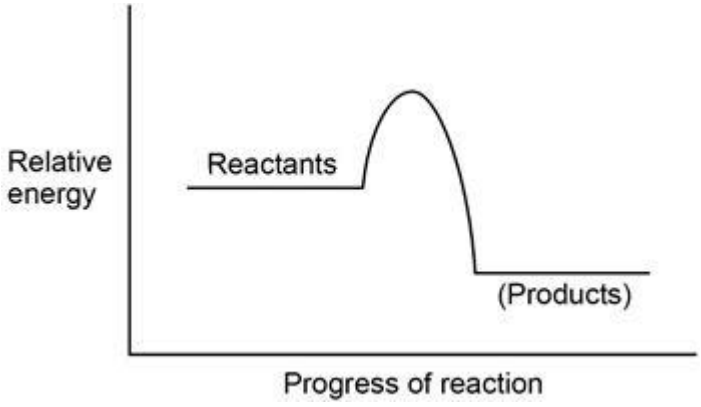
1

transfer of 1 electron from chlorine to sodium ***max 2*** *marks*

reference to sharing or covalent bonding ***max 3*** *marks*

allow marks from suitable diagram(s)

(c)



ignore labels

any curve / line going up and then down

products <u>line</u> below reactants

allow curve to start / finish anywhere along reactant / product lines

1
1

[8]

Q5.

(a) intermolecular

1

(b) sulfur

1

(c) ions

1

fixed in solid

1

mobile in liquid

1

(d) layers of atoms

allow ions

1

slide over each other

1

(e) copper

1

[8]

Q6.

(a) more than 1 dot in a vertical line

1

(b) correct equation and substitution 7/39

accept R_f = distance moved by spot C / distance moved by solvent

1

calculation and answer 0.1795

1

answer to 2 significant figures 0.18

1

(c)

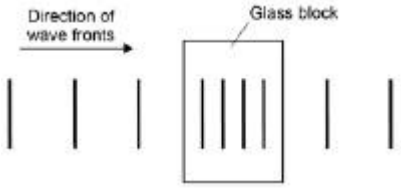
Level 3: The plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5-6
Level 2: The plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3-4
Level 1: The plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1-2
No relevant content	0
Indicative content • put dots of known colours, and a dot of the ink on a pencil line on the chromatography paper. • place the bottom of the paper in water, making sure the start line is above the water • leave for solvent to rise up through paper. • when solvent near top of paper, remove and leave to dry. • compare positions of dots for known colours with those from ink	

6

[10]

Q7.

(a) at least two wave fronts drawn to the right of the glass block, parallel to the other wave fronts and with equal spacing compared with the wave fronts to the left of the glass block



1

(b) ray of light refracts towards the normal where it is incident on the glass block

1

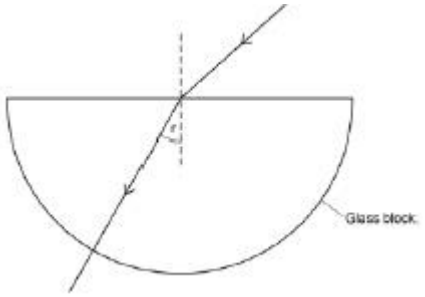
ray of light does not refract when it exits the glass block

1

a normal is drawn on where the ray is incident on the glass block

1

the angle of refraction is labelled



lines should be drawn with a ruler

1

(c) light travels more slowly (in the glass block than in the air)

1

so it changes direction

allow so it bends towards the normal

1

(d) the angle of incidence

1

the type of glass used

allow the glass block

1

(e) the <u>resolution</u> of a normal protractor is too big

1

so it could not measure the difference between results

allow so it could not read angles to 2 decimal places

1

(f) a longer wavelength gives a greater angle of refraction

1

(g) absorbed / reflected

1

[13]

Q8.

(a) ammeter

1

voltmeter

must be in the correct order

1

(b) 0.300 (m)

1

there is the smallest spread about the mean

1

(c) to reduce the effect of random errors

1

(d) potential difference = current × resistance

allow $V = I \times R$

1

(e) R = V / I

1

R = 2.1 / 0.30

1

R = 7.0 Ω

*an answer of 7.0 Ω scores **3** marks*

1

(f) length in m

1

resistance in Ω

must be in the correct order
allow other correct labelling eg
length / m
length (m)
allow 1 mark if units are omitted

1

(g) resistance is directly proportional to length

1

[12]

Q9.

(a) 1st box ticked

1

(b) (permanent magnet) has no effect on the aluminium

1

iron is attracted (to the permanent magnet)

1

(only) the (permanent) magnet can be repelled (by the permanent magnet)

1

(c) **Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to give a clear account.

5–6

Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logically linking. The resulting account is not fully clear.

3–4

Level 1: Points are identified and stated simply, but their relevance is not clear

and there is no attempt at logical linking.

1–2

No relevant content

0

Indicative content

- completing the circuit
- turns the electromagnet on

- there is a current in the coil
- a magnetic field is produced around the coil
- the iron core becomes magnetised

- move electromagnet towards the blocks
- the block is attracted to the electromagnet
- moving the crane moves the block

- switching off the current switches off the electromagnet
- releasing the block

[10]