



Marine Science

Key skills developed in this work:

- Revision of particle theory and types of bonding (chemistry skills)
- Revision of feeding relationships in food chains and food webs (biology skills)
- Revision of density and properties of water (physics skills)
- Reading and manipulating data from tables and graphs (mathematics skills)
- Carry out fish surveys with Reef.org (observation skills)

Research work:

<https://www.reef.org/programs/volunteer-fish-survey-project>

Join the global fish survey project. This is free and means you can add data every time you go to the beach for a snorkel. Follow the instructions on the weblink above to register and join the global science team.

https://www.youtube.com/watch?v=s4aQgx_Zo00 The Blue Planet I (bbc.co.uk)

<https://www.bbc.co.uk/programmes/p04tjbtx> The Blue Planet II (bbc.co.uk)

Website links:

<https://www.cambridgeinternational.org/programmes-and-qualifications/cambridge-international-as-and-a-level-marine-science-9693/>

<https://www.senecalearning.com/>

<https://www.thestudentroom.co.uk/a-level/>

Appropriate additional reading:

Nature.com

Newscientist.com

Scientificamerican.com

Work through the tasks on the following pages

Q1. Limpets are small animals with shells. Limpets attach to rocks on sea shores.

Figure 1 shows limpets on rocks.

Figure 1



(a) Limpets eat algae.

Limpets are prey for crabs.

Give the food chain for algae, crabs and limpets.

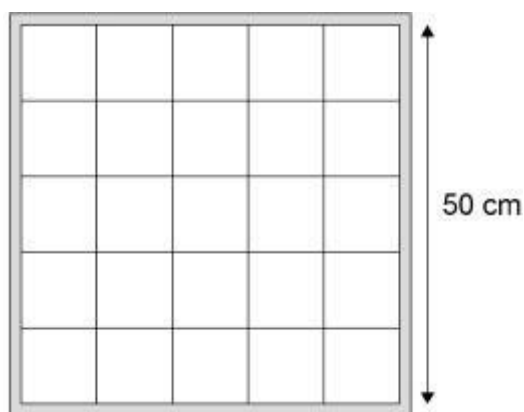
(1)

Students estimated the population of limpets on a sea shore.

The students were given a square quadrat.

Figure 2 shows the quadrat.

Figure 2



(b) Calculate the area of the quadrat in m^2 .

Area of quadrat = _____ m^2

(2)

- (c) The total area of the sea shore was 1800 m².

The students sampled 2% of the total area of the sea shore.

Calculate the number of times the students needed to use the quadrat for the 2% sample.

Use your answer from part (b)

Number of times = _____

(2)

- (d) Explain why throwing a quadrat is **not** a random method to estimate population size.

Do **not** refer to safety in your answer.

(2)

- (e) Describe **one** method the students could use to plan where the quadrat should be randomly placed each time.

(2)

- (f) Suggest **one** hazard the students should be aware of when collecting data on the sea shore.

Do **not** refer to throwing quadrats in your answer.

(1)

- (g) Populations of limpets are monitored to assess the impact of pollution in water.
Suggest **one** type of pollution in water that may affect the population of limpets.

(1)

(Total 11 marks)

Q2. Otters are mammals that live in river ecosystems.

The figure below shows an otter.



- (a) Define the term 'ecosystem'.

(1)

- (b) Otters are an important species for the stability of the river community.

Describe **two** ways animal species may be important for the stability of a whole community.

1 _____

2 _____

(2)

Sewage was accidentally added to a river.

The sewage moved with the river water and affected:

- the number of bacteria in the water
- the concentration of dissolved oxygen in the water.

Samples of river water were analysed at different distances from where the sewage was added.

The table below shows the results.

Distance from where sewage was added in km	Number of bacteria $\times 1000/\text{mm}^3$	Concentration of dissolved oxygen in mg/dm^3
0.0	4	5.4
1.0	75	4.8
2.0	125	4.3
3.0	145	3.8
4.0	160	3.3
5.0	216	2.7

- (c) The number of bacteria at 5.0 km was greater than the number of bacteria where the sewage was added.

Calculate how many times greater.

Number of times greater = _____

(1)

- (d) A student concluded:

‘number of bacteria $\propto$ concentration of dissolved oxygen’

Explain why the student’s conclusion is **not** correct.

Use the table above.

(2)

- (e) Otters:
- live in water and on the land
 - eat mainly fish.

The concentration of dissolved oxygen has decreased in a river where otters live.

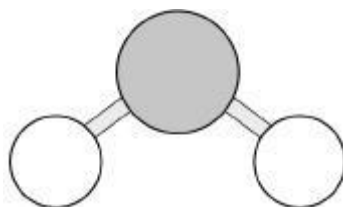
Explain how the decrease in the concentration of dissolved oxygen in the river water will affect the population of otters.

(3)
(Total 9 marks)

Q3.

This question is about substances with covalent bonding.

- (a) The diagram below shows a ball and stick model of a water molecule (H_2O).



Suggest **one** limitation of using a ball and stick model for a water molecule.

(1)

- (b) Ice has a low melting point.

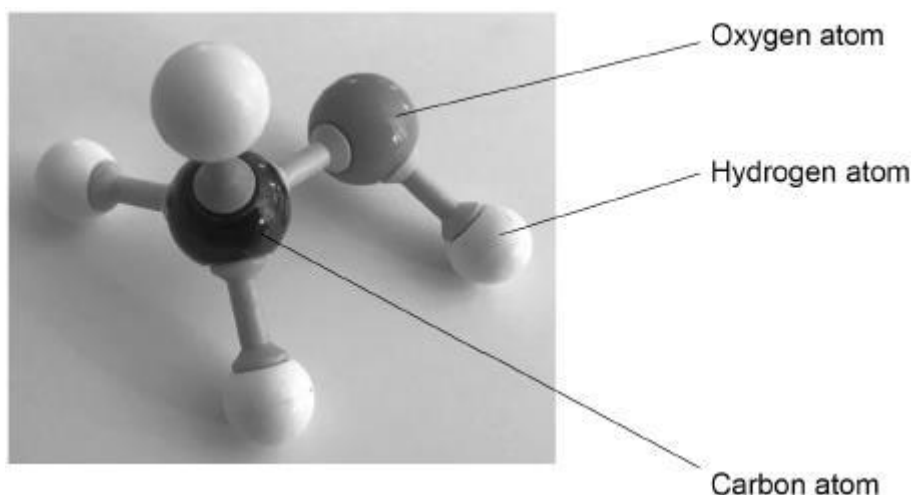
Water molecules in ice are held together by intermolecular forces.

Complete the sentence.

Ice has a low melting point because the intermolecular forces are

(1)

(c) The image below shows the structure of a molecule.



What is the molecular formula of the molecule in the above image?

(1)

(Total 3 marks)

Q4. A student investigated the concentration of salt in solution **Z**.

The student used a method involving osmosis.

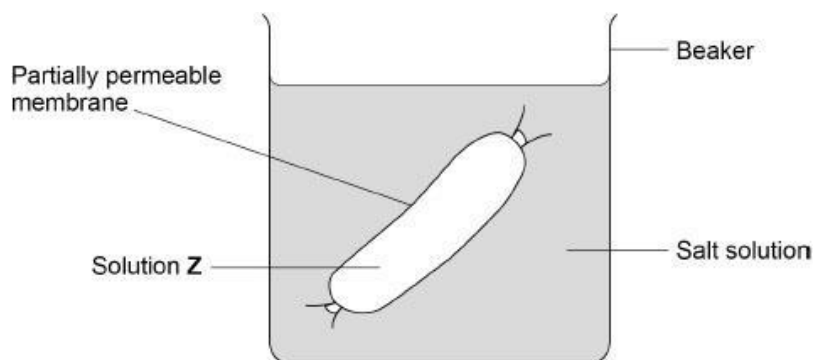
The student used tubing made of partially permeable membrane.

This is the method used.

1. Cut six pieces of tubing to the same length.
2. Tie one end of each piece of tubing.
3. Put the same volume of solution **Z** into each piece of tubing.
4. Tie the other end of each piece of tubing to form a sealed tube.
5. Record the mass of each tube.
6. Place each tube into a different concentration of salt solution.
7. After 2 hours, remove each tube from the salt solutions.
8. Record the mass of each tube.

Figure 1 shows one of the sealed tubes in a salt solution.

Figure 1



(a) What was the independent variable for the investigation?

Tick (✓) **one** box.

Change in mass of tube

☐

Concentration of salt solution

☐

Time in salt solution

☐

Volume of solution **Z**

☐

(1)

(b) The student dried the outside of each tube with a paper towel before recording the mass.

Why was it important to dry the tubes?

(1)

The table below shows the results.

Concentration of salt solution in mol/dm ³	Mass of tube in grams			Percentage (%) change in mass
	At start	After 2 hours	Change	
0.0	15.54	16.50	0.96	X
0.2	15.16	15.78	0.62	4.1
0.4	15.00	15.35	0.35	2.3
0.6	15.29	15.37	0.08	0.5
0.8	14.95	14.75	-0.20	-1.3
1.0	14.77	14.40	-0.37	-2.5

(c) Calculate value **X** in the table above.

Give your answer to 1 decimal place.

Value **X** (1 decimal place) = _____ %

(3)

(d) Complete **Figure 2**.

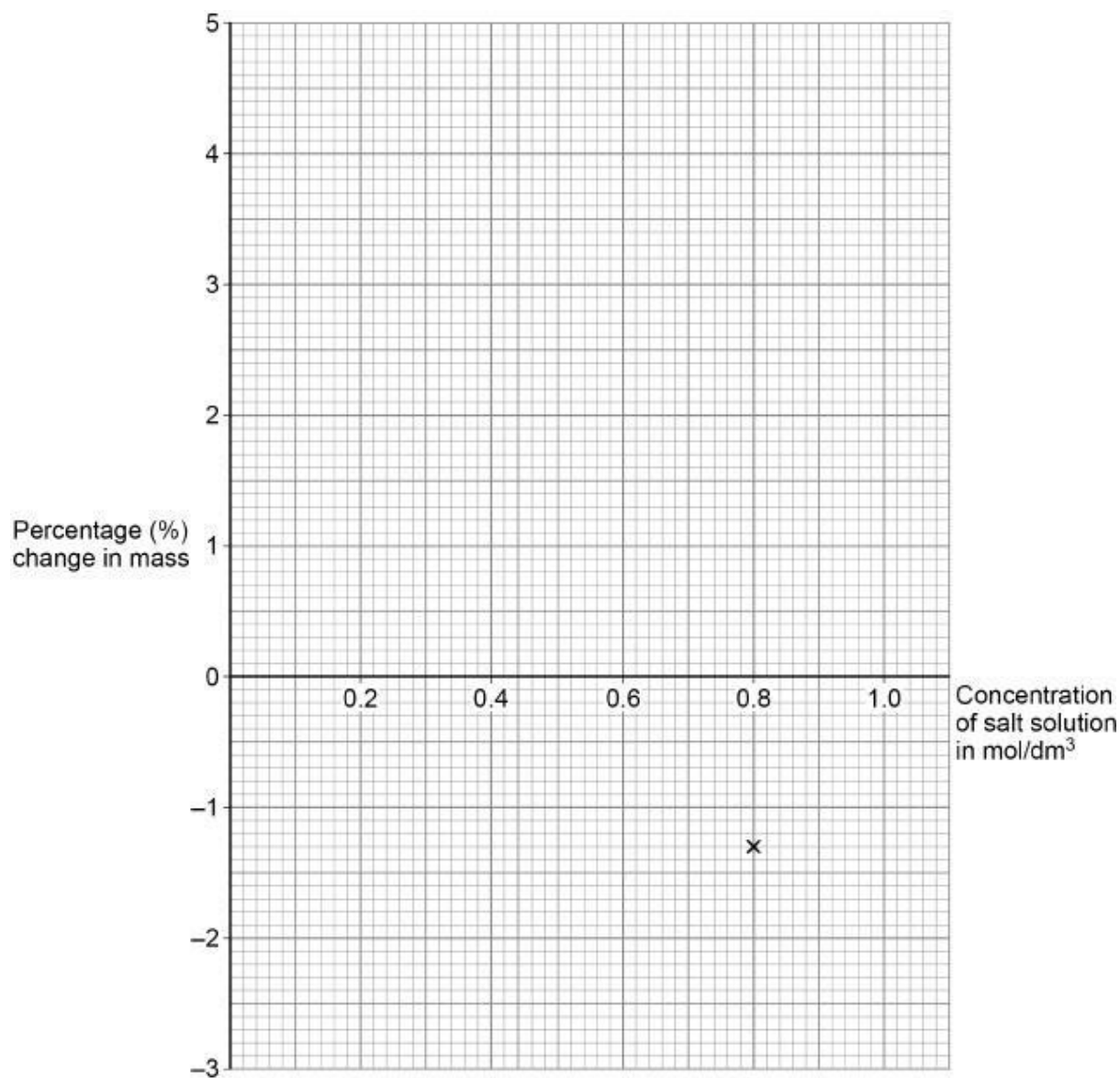
You should:

- plot the percentage change in mass from the table above for salt concentrations of **only** 0.2 mol/dm^3 to 1.0 mol/dm^3
- draw a line of best fit.

One of the results has been plotted for you.

(3)

Figure 2



(e) Determine the concentration of salt in solution **Z**.

Use **Figure 2**.

Concentration = _____ mol/dm^3

(1)

(Total 9 marks)

Q5.

Water exists as ice, water or steam.

- (a) Complete the sentences.

Choose the answers from the box.

ice	steam	water
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The particles are arranged in a regular pattern in _____.

The particles are close together but not in a pattern in _____.

The particles move quickly in all directions in _____.

(2)

- (b) Which will have the most internal energy?

Tick **one** box.

1 kg of ice

☐

1 kg of steam

☐

1 kg of water

☐

(1)

- (c) Which will have the lowest density?

Tick **one** box.

Ice

☐

Steam

☐

Water

☐

(1)

The image shows an iceberg floating in the sea.



- (d) The iceberg has a mass of 11 200 kg

The volume of the iceberg is 12.0 m³

Calculate the density of the iceberg.

Use the equation:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

Density = _____ kg/m³

(2)

- (e) Explain why the iceberg will melt.

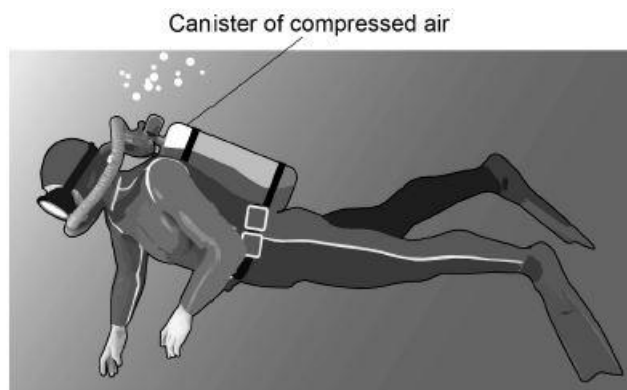
(2)

(Total 8 marks)

Q6.

Figure 1 shows a diver.

Figure 1



- (a) Which two sentences describe the movement of the air particles in the canister?

Tick **two** boxes.

They vibrate about a fixed position.

☐

They move in random directions.

☐

The motion of all the particles is predictable.

☐

They move with a range of different speeds.

☐

They move in circular paths.

☐

(2)

- (b) The temperature of the air inside the canister increases.

What happens to the movement of the air particles?

(1)

- (c) It could be dangerous if the temperature of the air inside the canister increased by a large amount.

Explain why.

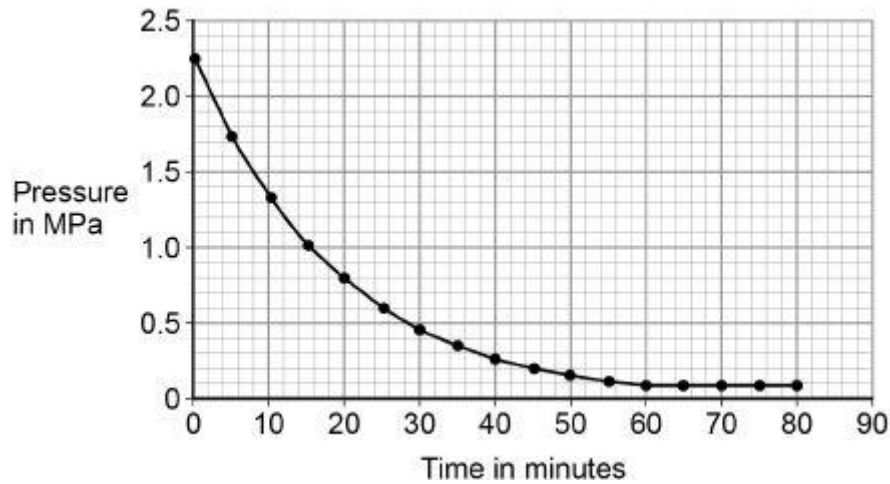
(2)

A canister of air was tested to find out how the pressure changed when it was used by a diver.

- Air was allowed to escape from the canister.
- The pressure of the air in the canister was recorded every 5 minutes for 80 minutes.

Figure 2 shows the results.

Figure 2



- (d) Estimate the atmospheric pressure.

Use **Figure 2**

Atmospheric pressure = _____ MPa

(1)

- (e) Divers can safely stay underwater until the pressure of the air in the canister has reduced to 25% of its original value.

Determine the maximum time the diver can safely stay underwater.

Use **Figure 2**

Time = _____ minutes

(3)

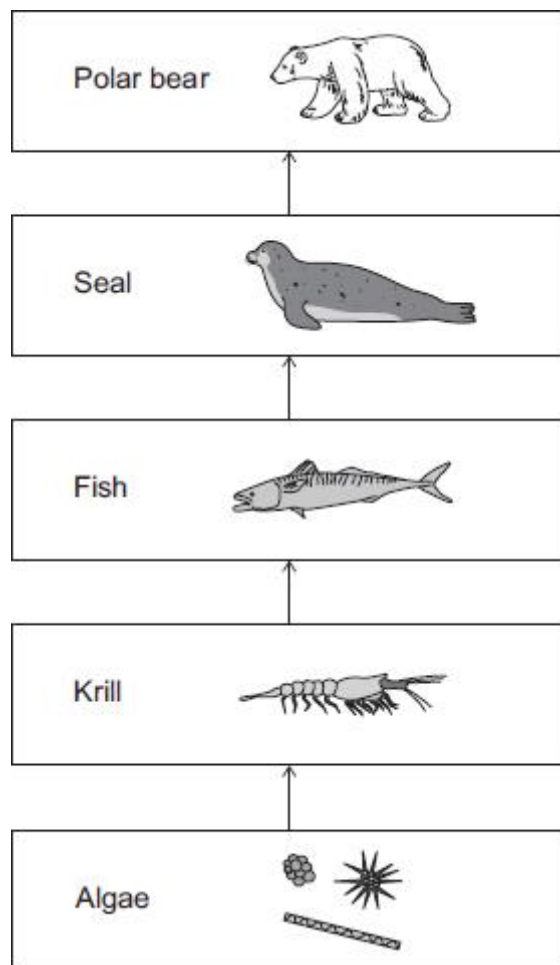
- (f) What happens to the volume of the air when it is released from the canister?

(1)

(Total 10 marks)

Q7.

The figure below shows a food chain.



not to scale

(a) Which of the organisms in the figure above is the primary consumer?

(1)

(b) Name the predator of the fish in the figure above.

(1)

- (c) Draw **one** line from each term to the definition of the term.

Term	Definition
Ecosystem	All the living organisms and non-living parts of an environment.
Interdependence	The effect of species on each other.
Population	The limited resources that animals compete for.
	The number of individuals of one species in a habitat.

(3)

- (d) Complete the sentence.

Choose the answer from the box.

decrease	stay the same	increase
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A decrease in the number of polar bears would cause the number of seals to _____.

(1)

- (e) Food chains and food webs can be used to predict the effect of a decreasing number of polar bears.

Why is a food web more useful than a food chain?

Tick (✓) **one** box.

Food webs show where energy is wasted.

☐

Most animals eat more than one type of prey.

☐

Producers are at the start of all food webs.

☐

(1)

- (f) Krill eat algae.

Algae store a mass of 68 arbitrary units of carbon in 1 year.

8% of the carbon stored in algae becomes part of the carbon stored in krill.

Calculate the mass of carbon that becomes stored in krill.

Use the equation:

$$\text{mass of carbon stored in krill} = \text{mass of carbon stored in algae} \times \frac{8}{100}$$

Mass of carbon stored in krill = _____ arbitrary units

(2)

- (g) Algae and plants need magnesium ions to grow.

Complete the sentence.

Choose the answer from the box.

chlorophyll	glucose	urea
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In algae and plants, magnesium ions become part of _____.

(1)

- (h) The minerals in sea water are one abiotic factor that affects algae.

Which are **two** other **abiotic** factors that affect algae?

Tick (✓) **two** boxes.

Food availability

☐

Light intensity

☐

Pathogens

☐

Prey

☐

Temperature

☐

(2)

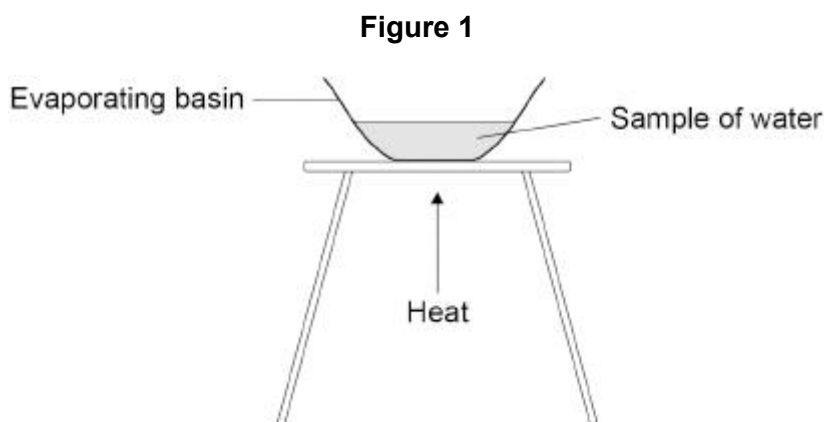
(Total 12 marks)

Q8.

Some types of water contain dissolved substances.

A student investigated the mass of dissolved solids in distilled water and in sea water.

Figure 1 shows the apparatus.



This is the method used.

1. Weigh an evaporating basin.
2. Add a sample of distilled water to the evaporating basin.
3. Weigh the evaporating basin and the water sample.
4. Heat the water sample.
5. Weigh the evaporating basin and contents.
6. Repeat steps 1 to 5 two more times.
7. Repeat steps 1 to 6 with sea water.

(a) Give **one** safety precaution the student should take.

(1)

(b) The method used did **not** give valid results.

Which **two** improvements could the student make to give valid results?

Tick (✓) **two** boxes.

Heat until the mass of the evaporating basin and contents does not change.

☐

Leave some water in the evaporating basin after heating.

☐

Record the results in a table and plot a bar graph.

☐

Use 25 cm³ of water for each experiment.

☐

Use a beaker instead of an evaporating basin.

☐

(2)

- (c) A different student used a method which gave valid results.

The table below shows the results.

Type of water	Mass of dissolved solids in grams		
	Test 1	Test 2	Test 3
Distilled water	0.00	0.00	0.00
Sea water	0.31	0.32	0.27

The student concludes that distilled water is pure.

Suggest **one** reason why.

(1)

Tap water is potable.

One step in producing potable water is sterilisation.

- (d) Why is potable water sterilised?

Tick (✓) **one** box.

To improve the taste

☐

To kill bacteria

☐

To remove dissolved solids

☐

(1)

- (e) Chlorine is used to sterilise water.

The reaction between chlorine and water is reversible.

Complete the sentence.

Equilibrium is reached when the forward and reverse reactions

occur at the same _____.

(1)

- (f) The test for chlorine uses damp litmus paper.

Complete the sentence.

Choose the answer from the box.

blue	green	white
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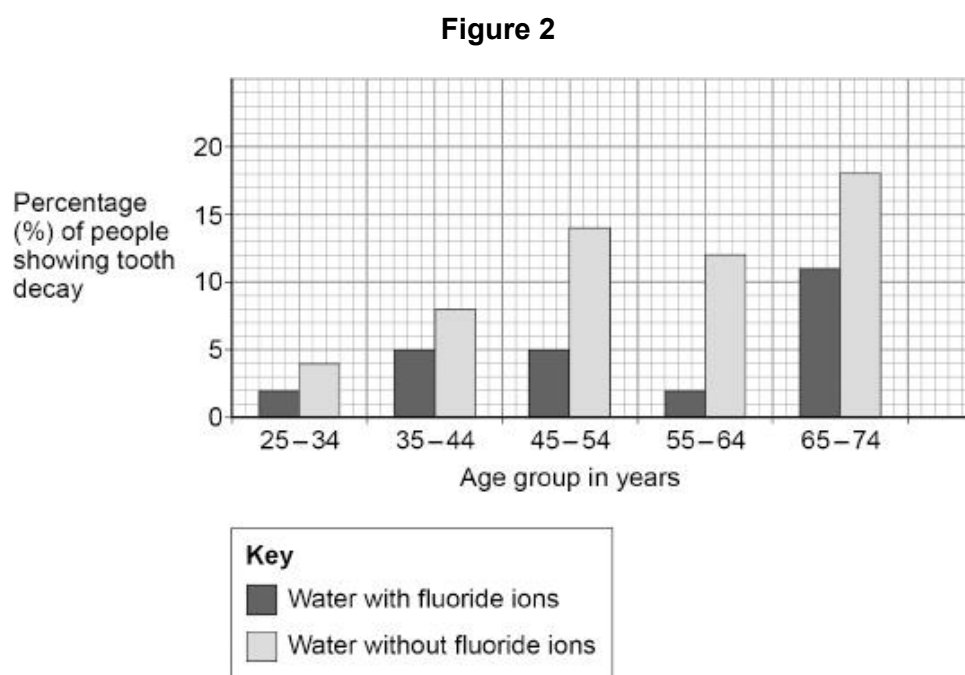
When damp litmus paper is put into chlorine gas

the litmus paper turns _____.

(1)

There is evidence that adding fluoride ions to drinking water reduces tooth decay.

Figure 2 shows the percentage of people showing tooth decay.



- (g) Compare the effects of adding fluoride ions to drinking water on tooth decay in people between the ages of 25 and 74.

Use data from **Figure 2**.

(4)

- (h) Student **A** says that water companies should add fluoride ions to all drinking water.

Student **B** disagrees.

Suggest **one** reason why Student **B** may think that fluoride ions should **not** be added to all drinking water.

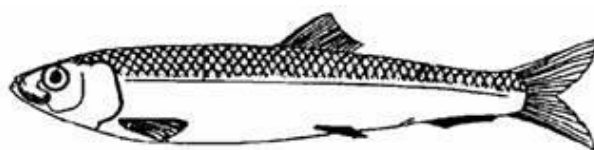
(1)

(Total 12 marks)

Q9. Copepods are tiny animals which live in the sea.



Copepods



Herring

(not to scale)

During the day they live deep down near the sea bed.
At night they move up to the surface where they feed on tiny plants.
When the sun rises they move down to the bottom again.

- (a) Suggest why the tiny **plants** live near the surface of the sea.

(2)

- (b) Herring feed on copepods.

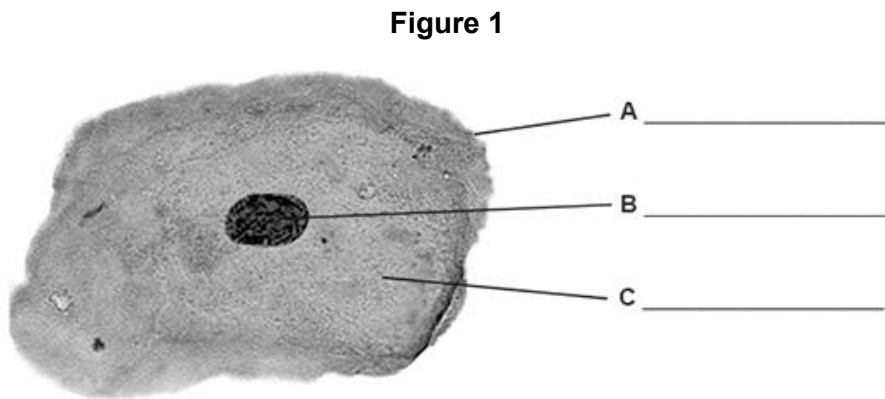
Where will herring be found during the day? Give a reason for your answer.

(2)

(Total 4 marks)

Q10. This question is about cells.

Figure 1 shows an animal cell.



(a) Label parts **A**, **B** and **C** on **Figure 1**.

Choose answers from the box.

cell membrane	cell wall	chloroplast
cytoplasm	nucleus	

(3)

(b) What is the function of the nucleus in a cell?

Tick (✓) **one** box.

- To contain a solution called cell sap ☐
- To control the activities of the whole cell ☐
- To control the movement of substances into the cell ☐

(1)

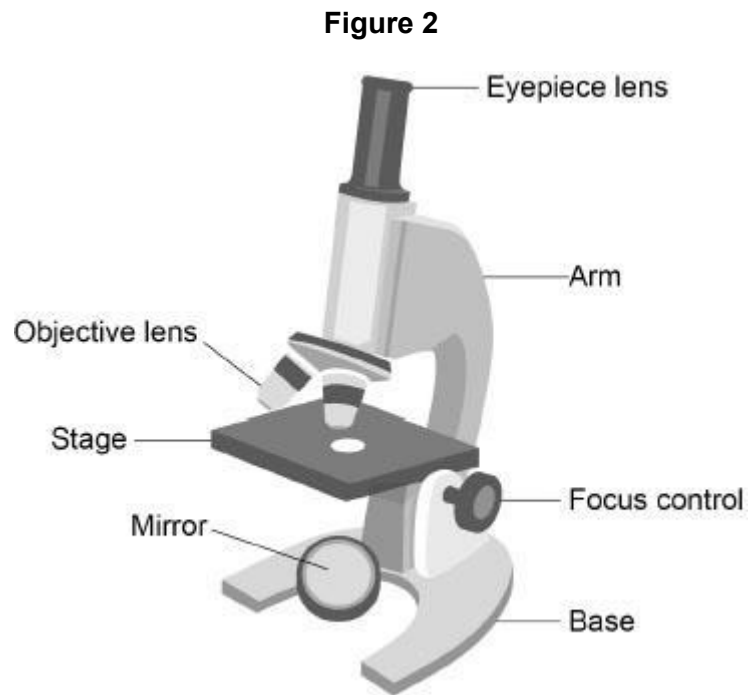
(c) What is the function of the mitochondria in a cell?

Tick (✓) **one** box.

- To produce glucose during photosynthesis ☐
- To produce proteins for the cell ☐
- To release energy in respiration ☐

(1)

(d) **Figure 2** shows a light microscope.



A student is given a prepared slide of animal cells to view using the microscope.

Complete the sentences.

Use labels from **Figure 2**.

Place the slide on the _____.

Use the objective lens that has low power.

Look through the _____.

Direct the light by moving the _____.

Make the image larger by using the high power _____.

(e) **Figure 3** shows a different animal cell.

Figure 3



Calculate the magnification of the image in **Figure 3**.

Complete the following steps.

Measure the width of the image from **Y** to **Z**, in millimetres (mm).

Width of image = _____ mm

Give the width of the image in micrometres (μm).

1 mm = 1000 μm

Width of image = _____ μm

The cell in **Figure 3** has a real width of 40 micrometres (μm).

Use the equation to calculate the magnification.

$$\text{magnification} = \frac{\text{width of image in } \mu\text{m}}{\text{real width of cell in } \mu\text{m}}$$

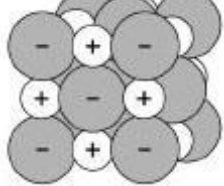
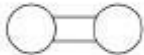
Magnification = $\times$ _____

(4)

(Total 13 marks)

Q11.

The table below shows diagrams which represent the structures of two substances.

Substance	Structure
Sodium chloride NaCl	
Oxygen O ₂	

Compare the structure and bonding of sodium chloride and oxygen.

[illegible]

(Total 6 marks)