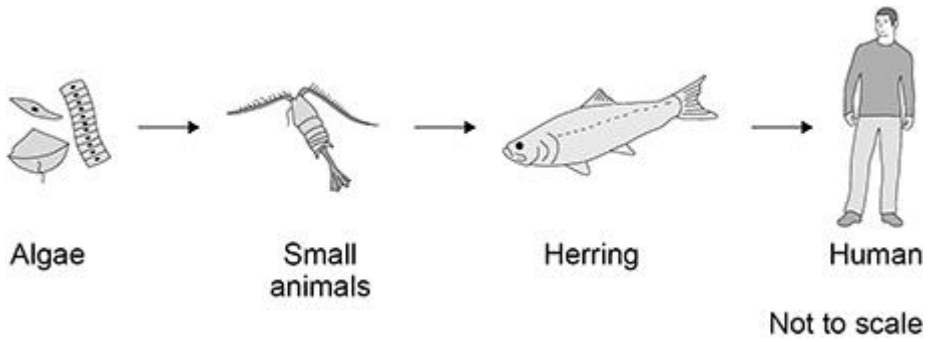
**All questions are for separate science students only**

## Q1.

People eat fish caught in the North Sea.

**Figure 1** shows a food chain.

**Figure 1**




(a) The algae make glucose by photosynthesis.

Which **two** substances do the algae need for photosynthesis?

Tick (✓) **two** boxes.

- Carbon dioxide ☐
- Nitrogen ☐
- Oxygen ☐
- Starch ☐
- Water ☐

**(2)**

(b) What is the source of energy for photosynthesis?

Tick (✓) **one** box.

- Light ☐
- Mineral ions ☐

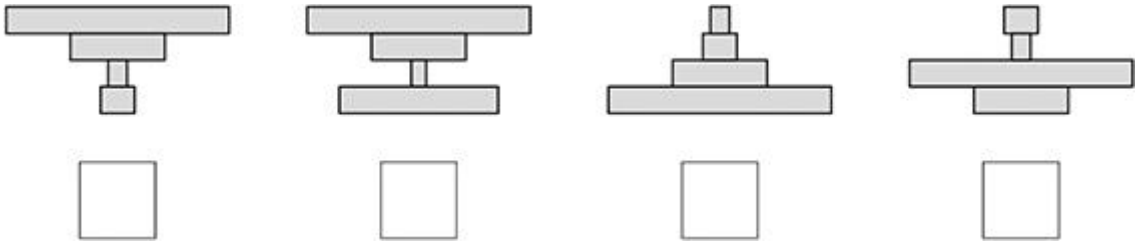
Protein ☐

Water ☐

**(1)**

(c) Which pyramid of biomass is correct for the food chain shown in **Figure 2**?

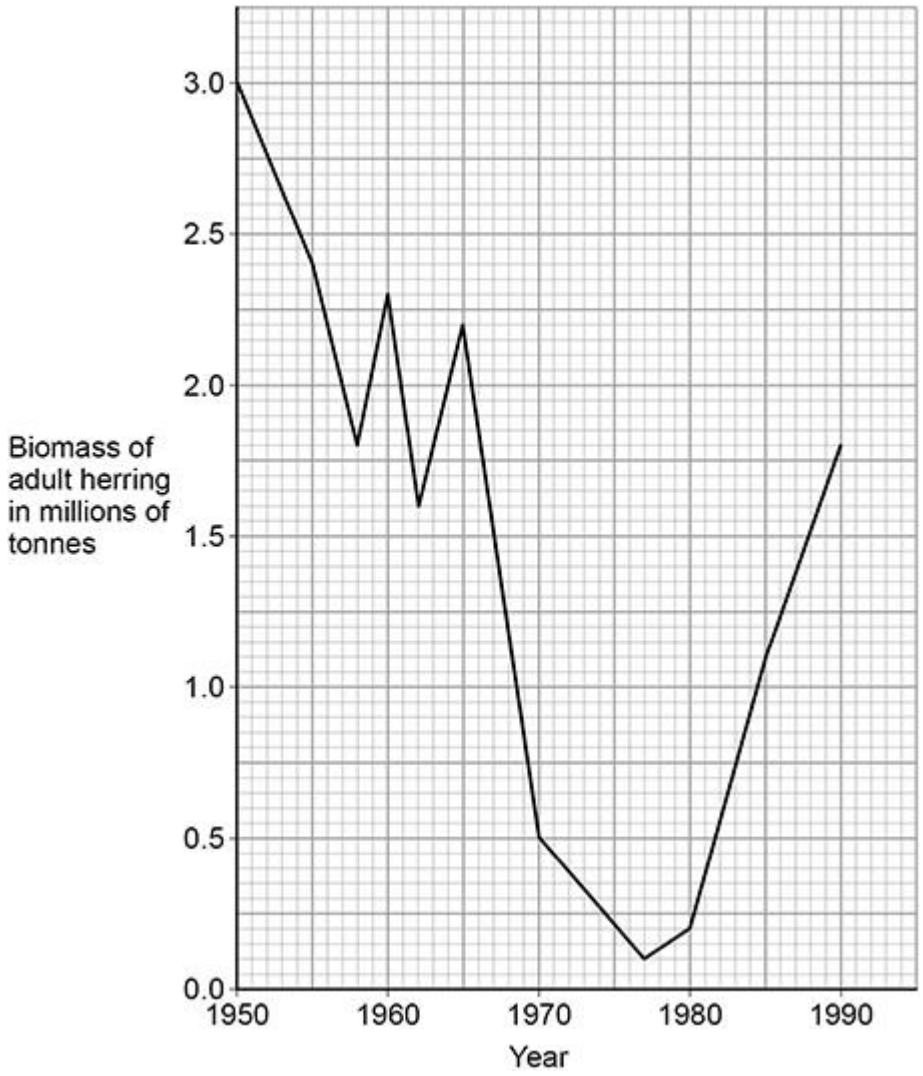
Tick (✓) **one** box.



**(1)**

**Figure 2** shows the biomass of adult herring in the North Sea between 1950 and 1990.

**Figure 2**




(d) Too many herring were caught in the 1960s.

Calculate the percentage decrease in the biomass of adult herring between 1960 and 1970.

Use the equation:

$$\text{percentage decrease} = \frac{(\text{biomass in 1960} - \text{biomass in 1970})}{\text{biomass in 1960}} \times 100$$

Give your answer to the nearest whole number.

Percentage decrease = _____ %

**(4)**

From 1977, laws were introduced to help conserve herring.

(e) Describe the change in biomass of adult herring from 1977 to 1990.

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

_____

_____

_____

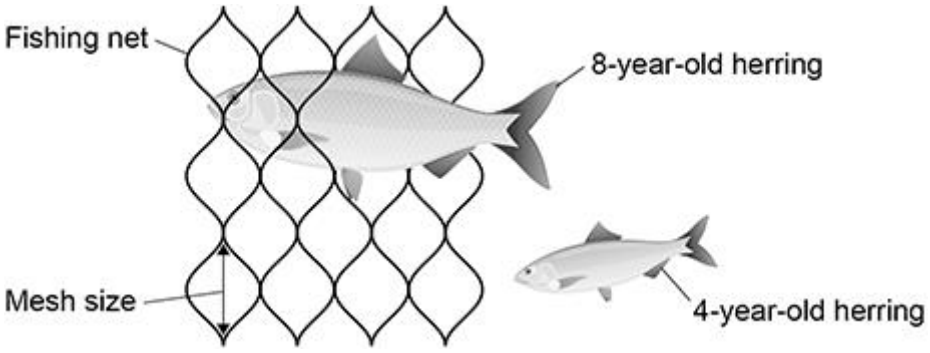
_____

**(2)**

(f) One of the laws was to control mesh size of fishing nets.

**Figure 3** shows a fishing net with a legal mesh size.

**Figure 3**




Herring can live for up to 12 years.

Herring start to reproduce when they are 3 to 4 years old.

Explain how the control of mesh size of fishing nets has helped to conserve stocks of herring.

_____

_____

_____

_____

**(2)**

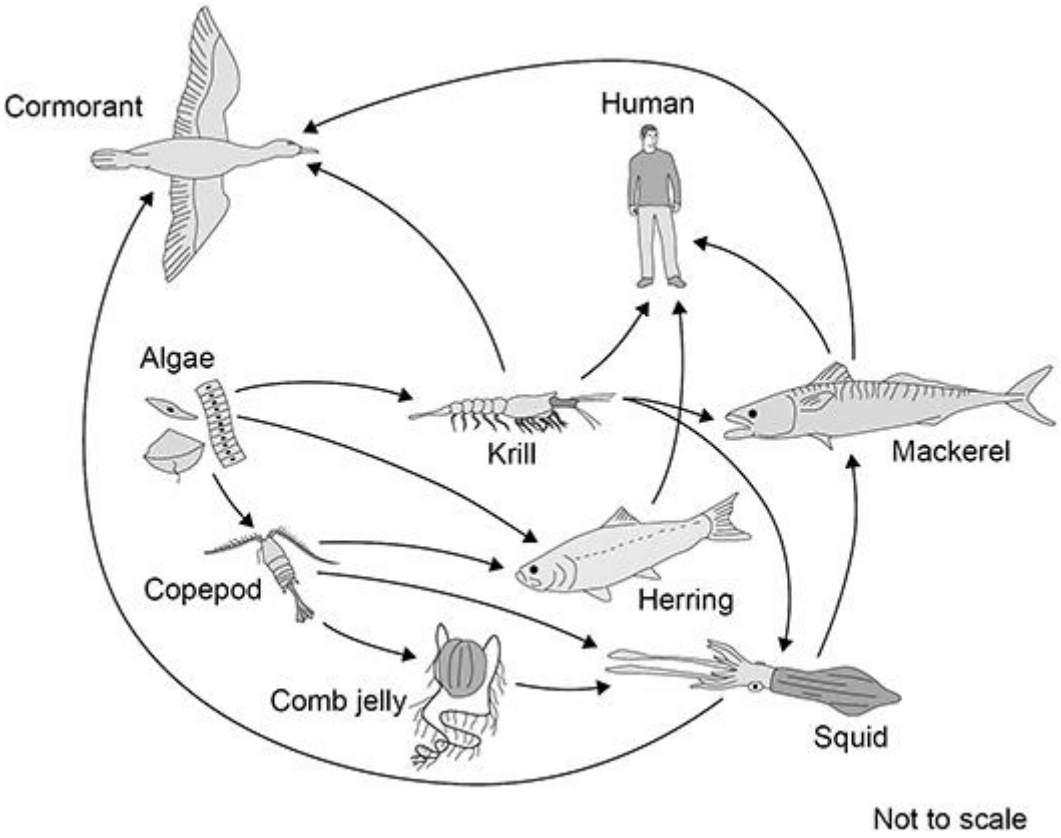
**(Total 12 marks)**

## Q2.

A food web contains several food chains.

**Figure 1** shows a food web.

**Figure 1**




(a) The animals in **Figure 1** get their energy by eating other organisms.

Describe how the algae get energy.

_____

_____

_____

_____

**(2)**

(b) Name **one** primary consumer in **Figure 1**.

_____

**(1)**

(c) Name **one** producer in **Figure 1**.

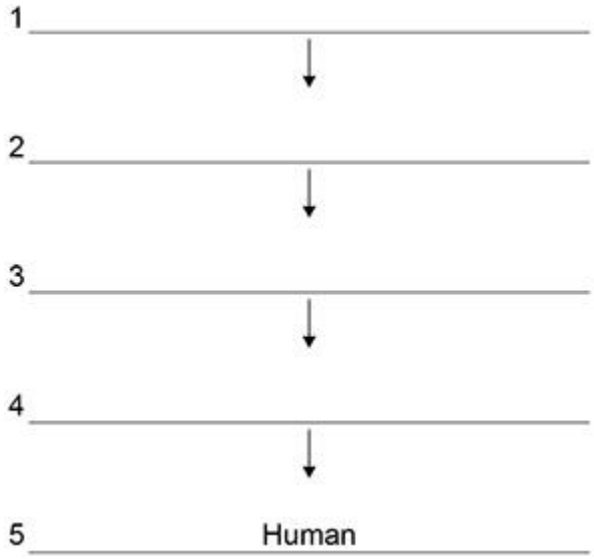
_____

**(1)**

(d) The different food chains in **Figure 1** have different numbers of organisms.

Complete **Figure 2** to show a food chain in **Figure 1** with **five** organisms, including the human.

**Figure 2**




**(1)**

(e) **Figure 1** shows that mackerel eat krill and squid.

The biomass of mackerel is much less than the combined biomass of krill and squid.

One reason for this is that the mackerel cannot digest all parts of the krill and squid.

Give **two** other reasons.

1 _____

_____

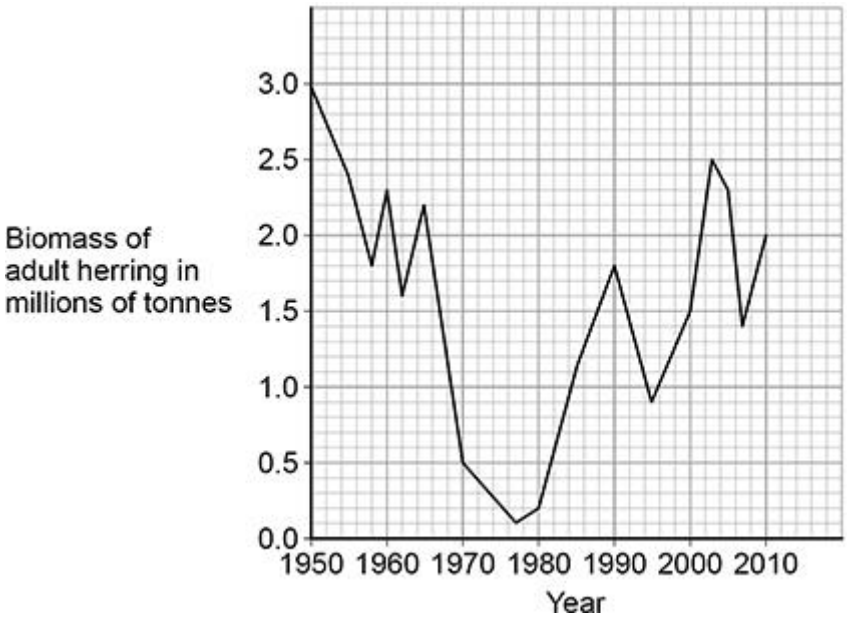
2 _____

_____

**(2)**

**Figure 3** shows how the biomass of adult herring in the North Sea has changed between 1950 and 2010.

**Figure 3**




(f) Calculate the percentage decrease in the biomass of herring between 1960 and 1977.

Give your answer to the nearest whole number.

Percentage decrease = _____ %

**(4)**

(g) Too many herring were caught by fishermen between 1960 and 1977.

Herring can live for up to 12 years and begin to reproduce when 3 to 4 years old.

Laws have been introduced to help conserve herring:

- 1977 to 1981 – herring fishing was banned in the North Sea
- 1984 to present day – control of mesh size of fishing nets
- 1997 to present day – fishing quotas were introduced
- 1998 to present day – herring fishing was banned in breeding grounds during the breeding season.

**Figure 4** shows how a minimum mesh size helps to conserve herring.

**Figure 4**

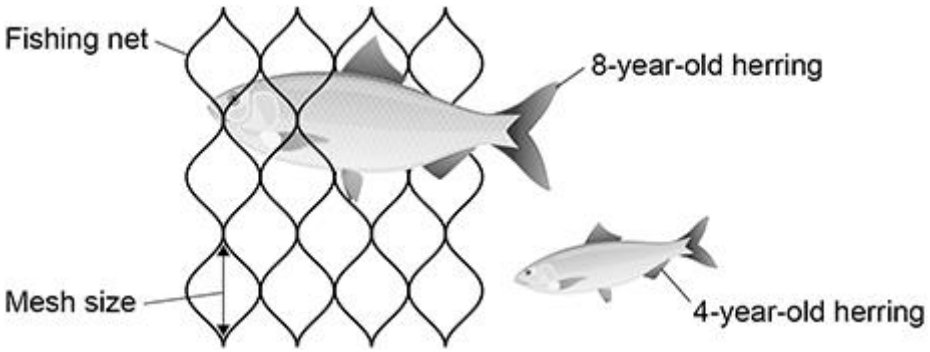
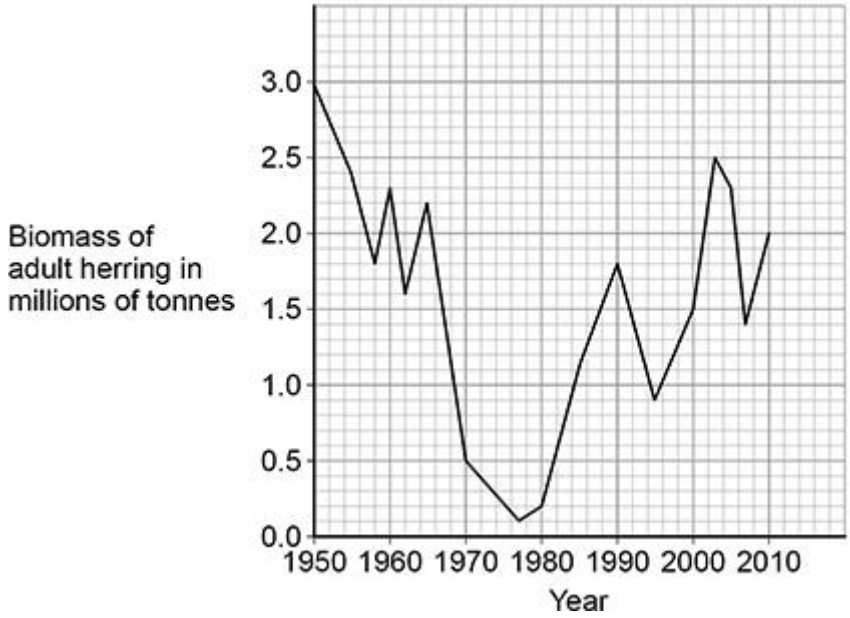



**Figure 3** is repeated below.

**Figure 3**




Evaluate the effect of these laws on the conservation of herring stocks.

Use data from **Figure 3** and information from **Figure 4** in your answer.

_____

_____

_____

_____

_____

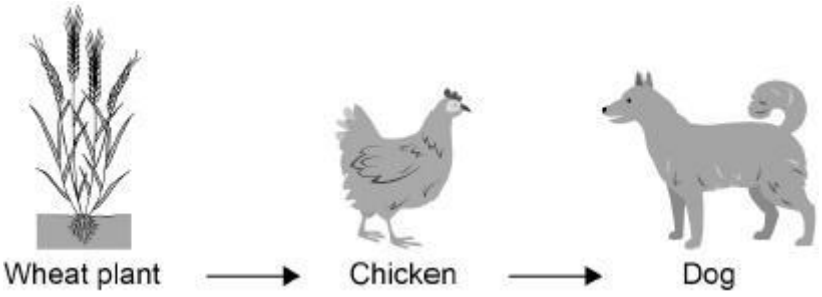
**(6)**

**(Total 17 marks)**

## Q3.

A food for pet dogs contains meat from chickens.

The below diagram shows the food chain.




(a) What is the trophic level of the dog?

Tick (✓) **one** box.

1 ☐ 2 ☐ 3 ☐

**(1)**

(b) Draw **one** line from each organism to the description of the organism's position in the food chain.

| Organism | Description |
|---|---|
| Chicken | Herbivore |
| Dog | Producer |
| Wheat | Secondary consumer |
| | Tertiary consumer |

**(3)**

(c) Name the process wheat plants use to make glucose.

_____

**(1)**

(d) Some of the chicken biomass does **not** become part of the dog's biomass.

What is **one** reason why?

Tick (✓) **one** box.

Some of the chicken is used for the dog to grow ☐

The dog produces waste in faeces ☐

The wheat is eaten by the dog ☐

**(1)**

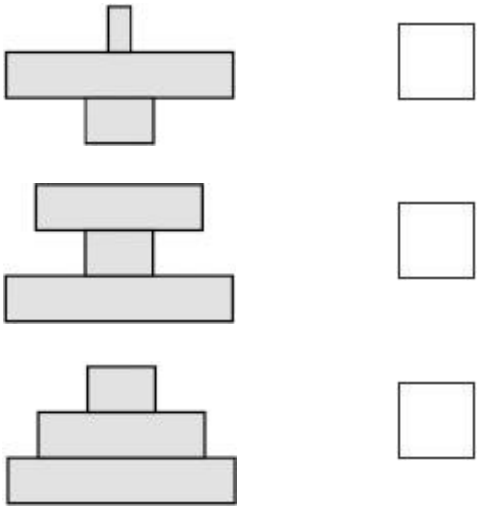
A new dog food has been developed.

The new dog food is made from insects.

The insects in the dog food factory are fed on vegetables.

(e) Which pyramid of biomass represents the vegetables, insects and dogs in this food chain?

Tick (✓) **one** box.



**(1)**

(f) Beef from cows is used to make some dog food.

Cows release methane.

The company that makes dog food from insects made the statement: 'Dog food made from insects is more sustainable than dog food made from beef.'

Which are **two** reasons that support the company's statement?

Tick (✓) **two** boxes.

| | |
|---|---|
| Dogs will eat more insects than cows | ☐ |
| Farming cows needs more land than farming insects | ☐ |
| Fewer cows being farmed will slow down global warming | ☐ |
| Fewer insects than cows are needed to produce dog food | ☐ |
| The food chain for dog food made from insects has more trophic levels | ☐ |

**(2)**

**(Total 9 marks)**

## Q4.

A new dog food has been developed that does **not** contain meat from cows, sheep or chickens.

The new dog food contains insects.

The insects in the dog food factory are fed on waste vegetables.

(a) Sketch the pyramid of biomass for the food chain that produces food for dogs from insects.

Label the pyramid.

**(2)**

(b) Describe **two** reasons why the biomass of the insects eaten by dogs does **not** all become biomass of the dogs.

1 _____

_____

2 _____

_____

**(2)**

(c) Explain how making dog food from insects could improve **human** food security in the future.

_____

_____

_____

_____

_____

_____

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_____

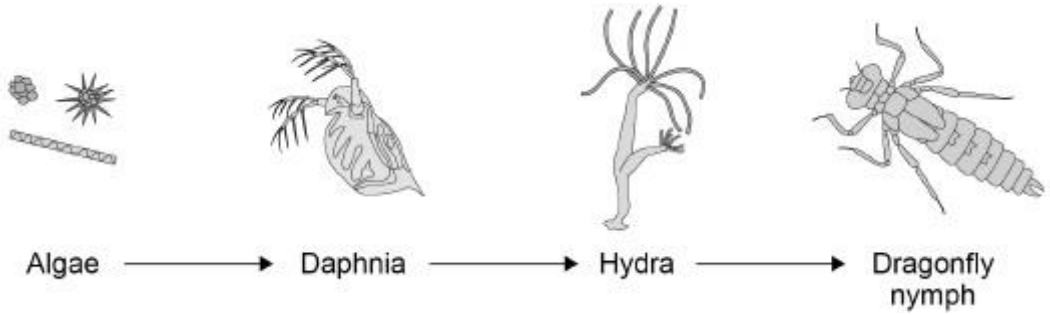
**(4)**

**(Total 8 marks)**

## Q5.

**Figure 1** shows a food chain in a pond.

**Figure 1**




(a) Which term describes the Daphnia in this food chain?

Tick (✓) **one** box.

Apex predator ☐

Primary consumer ☐

Producer ☐

Secondary consumer ☐

**(1)**

(b) Draw a pyramid of biomass for the food chain.

Label each trophic level.

**(2)**

(c) Give **one** reason why the total biomass of the Daphnia in the pond is different from the total biomass of the algae.

_____

_____

**(1)**

Students investigated the size of the population of Daphnia in the pond.

This is the method used.

1. Collect 1 $dm^3$ of pond water from near the edge of the pond.

2. Pour the water through a fine net.

3. Count the number of Daphnia caught in the net.

4. Repeat steps 1–3 four more times.

The table below shows the results.

| **Sample number** | **Number of Daphnia in 1 $dm^3$ water** |
|---|---|
| 1 | 5 |
| 2 | 21 |
| 3 | 0 |
| 4 | 16 |
| 5 | 28 |

(d) Calculate the mean number of Daphnia in 1 $m^3$ of pond water.

1 $m^3$ = 1000 $dm^3$

_____

_____

_____

_____

_____

Mean number of Daphnia in 1 $m^3$ of pond water = _____

**(2)**

(e) The pond was a rectangular shape, measuring:

- length = 2.5 metres
- width = 1.5 metres

- depth = 0.5 metres.

Calculate the estimated number of Daphnia in the pond.

Use your answer from part **(d)**.

Give your answer in standard form.

_____

_____

_____

_____

_____

_____

_____

_____

Number of Daphnia in the pond = _____

**(4)**

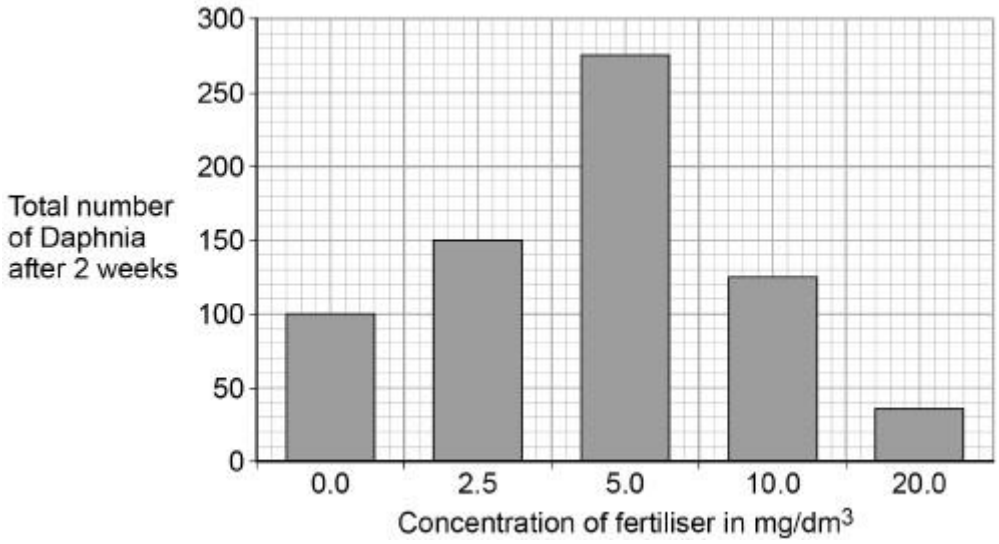
Rainfall can cause fertiliser to be washed from farmland into a pond.

The students investigated the effect of fertiliser on the population of Daphnia in water from the pond.

- The students put 20 Daphnia in each of five different concentrations of fertiliser.
- The students counted the total number of Daphnia in each concentration of fertiliser after 2 weeks.

**Figure 2** shows the results.

**Figure 2**




(f) A concentration of 5.0 mg/dm$^3$ of fertiliser caused a large increase in the population of Daphnia.

Explain why.

_____

_____

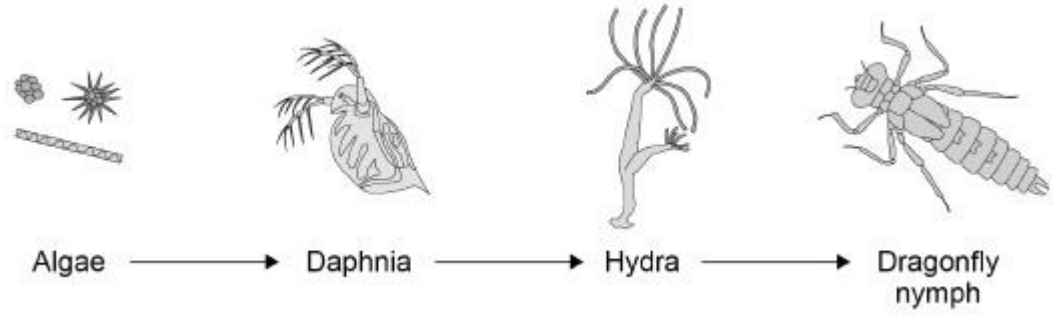
_____

_____

**(2)**

(g) **Figure 1** is repeated below.

**Figure 1**




The population of **Hydra** will decrease when 20 mg/dm$^3$ of fertiliser is added to the pond.

Explain why.

_____

_____

_____

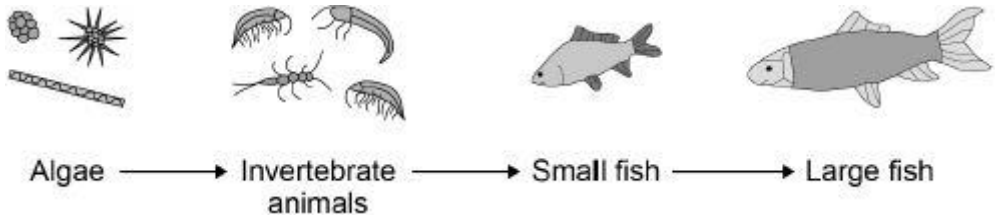
_____

**(2)**

**(Total 14 marks)**

## Q6.

The diagram below shows a food chain in a river.




(a) Draw **one** line from each scientific term to the correct organism in the food chain.

| Scientific term | Organism in the food chain |
|---|---|
| | Algae |
| Apex predator | |
| | Invertebrate animals |
| Primary consumer | |
| | Large fish |
| Producer | |
| | Small fish |

**(3)**

(b) The table below shows the biomass of the organisms at each stage in the food chain.

| Organism | Biomass in arbitrary units |
|---|---|
| Algae | 840 |
| Invertebrate animals | 200 |
| Small fish | 40 |
| Large fish | 10 |

Calculate the percentage of the biomass of the invertebrate animals that is transferred to the large fish.

Use the equation:

$$\text{percentage} = \frac{\text{biomass of large fish}}{\text{biomass of invertebrate animals}} \times 100$$

_____

_____

_____

_____

Percentage = _____

**(2)**

(c) A large amount of biomass is lost from the food chain.

Complete the sentences.

Choose answers from the box.

| | | |
|---|---|---|
| **coordination** | **digestion** | **excretion** |
| **filtration** | **ingestion** | **respiration** |

When the small fish eat the invertebrate animals, not all of this material is broken down during _____ .

Materials absorbed from the gut may enter the body cells of the small fish.

These materials are broken down into carbon dioxide and water by _____ .

The carbon dioxide and other waste materials from the body cells are removed from the small fish by _____ .

**(3)**

(d) A disease kills many of the small fish.

Why does the number of invertebrate animals increase?

_____

_____

**(1)**

**(Total 9 marks)**

## Q7.

**Figure 1** shows:

- a food chain for organisms in a river
- the biomass of the organisms at each trophic level.

**Figure 1**

Algae → Invertebrate animals → Small fish → Large fish

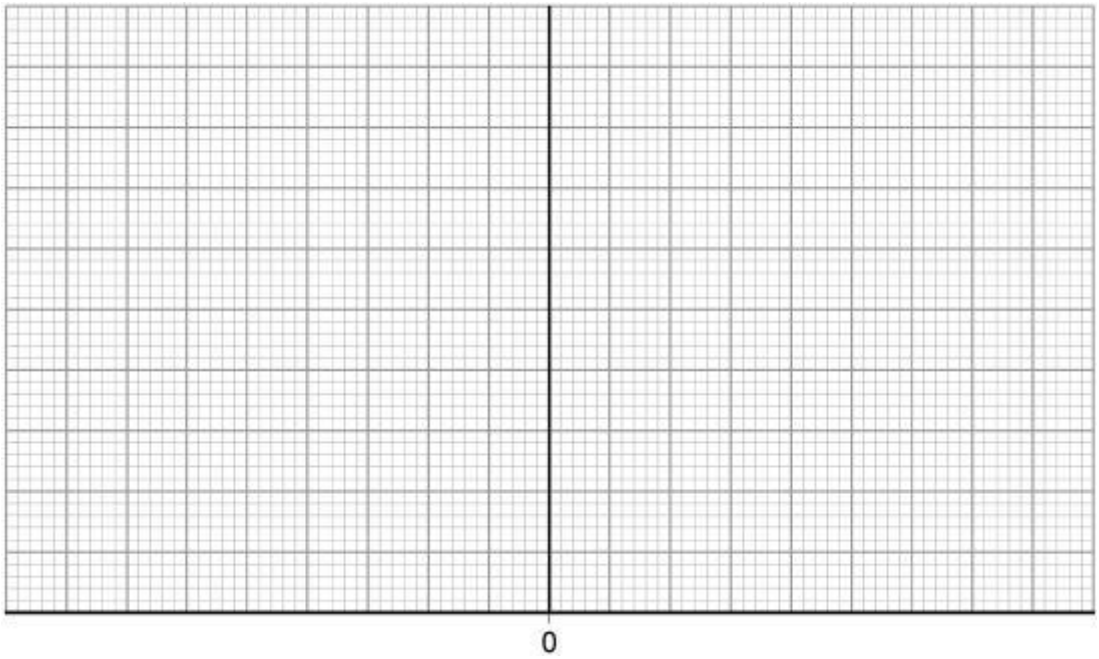
| | | | | |
|---|---|---|---|---|
| Biomass in g/m$^2$: | 840 | 200 | 40 | 10 |

(a) Draw a pyramid of biomass for the food chain in **Figure 1** on **Figure 2**.

You should:

- use a suitable scale
- label the x-axis
- label each trophic level.

**Figure 2**




**(4)**

(b) Calculate the percentage of the biomass lost between the algae and the large fish.

Give your answer to 2 significant figures.

Percentage loss = _____

**(3)**

(c) Give **one** way that biomass is lost between trophic levels.

**(1)**

(d) A large amount of untreated sewage entered the river. Many fish died.

Untreated sewage contains organic matter and bacteria.

Explain why many fish died.

_____

_____

_____

**(5)**

**(Total 13 marks)**

## Q8.

Cows are reared for meat production.

The cows can be reared indoors in heated barns, or outdoors in grassy fields.

The table shows energy inputs and energy outputs for both methods of rearing cows.

| | **kJ / m² / year** | | |
|---|---|---|---|
| | **Energy input** | | **Energy output** |
| | **Food** | **Fossil fuels** | **Meat production** |
| **Indoors** | 10 000 | 6 000 | 40 |
| **Outdoors** | 5 950 | 50 | **X** |

(a) The percentage efficiency for rearing cows **outdoors** is 0.03%

Calculate the energy output value **X**.

Use the equation:

$$\text{percentage efficiency} = \frac{\text{energy output}}{\text{total energy input}} \times 100$$

_____

_____

_____

_____

_____

_____

_____

Energy output value **X** = _____ kJ / m² / year

**(3)**

(b) The percentage efficiency for rearing cows **outdoors** is 0.03%

Calculate how many times more efficient it is to rear cows indoors than to rear cows outdoors.

Use the equation from (a).

_____

_____

_____

_____

_____

Answer = _____ times

**(3)**

(c) A large amount of energy is wasted in both methods of rearing cows.

Give **two** ways in which the energy is wasted.

1.

_____

_____

2.

_____

_____

**(2)**

(d) Suggest **two** reasons why it is more efficient to rear cows indoors than to rear cows outdoors.

1.

_____

_____

2.

_____

_____

**(2)**

**(Total 10 marks)**

## Q9.

The diagram below shows a food chain in a garden.




(a) Name **one consumer** shown in the diagram above.

_____

**(1)**

(b) Name **one carnivore** shown in the diagram above.

_____

**(1)**

(c) A disease kills most of the shrews in the garden.

Suggest why the number of snails in the garden may then increase.

_____

_____

**(1)**

(d) What is the name given to all the snails in the garden shown in the diagram above?

Tick **one** box.

Community ☐

Ecosystem ☐

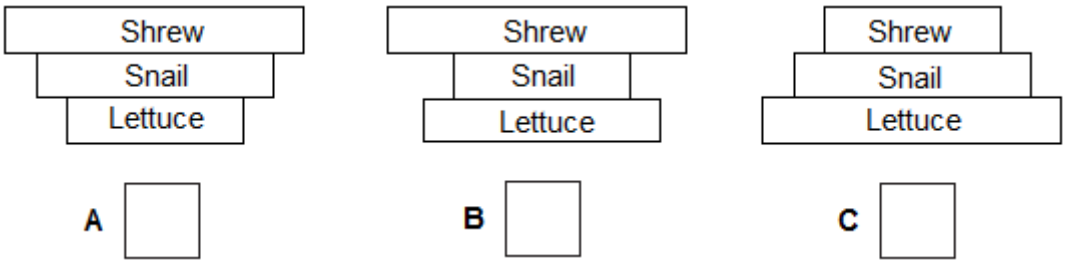
Population ☐

Territory ☐

**(1)**

(e) Which pyramid of biomass is correct for the food chain shown in the diagram above?

Tick **one** box.




A ☐ B ☐ C ☐

**(1)**

(f) Some snails ate some lettuces.

The lettuces contained 11 000 kJ of energy.

Only 10% of this energy was transferred to the snails.

Calculate the energy transferred to the snails from the lettuces.

_____

Energy = _____ kJ

**(1)**

(g) Give **one** reason why only 10% of the energy in the lettuces is transferred to the snails.

Tick **one** box.

The lettuces carry out photosynthesis ☐

The snails do not eat the roots of the lettuces ☐

Not all parts of a snail can be eaten ☐

**(1)**

(h) **Abiotic** factors can affect the food chain.

Wind direction is one abiotic factor.

Name **one other** abiotic factor.

_____

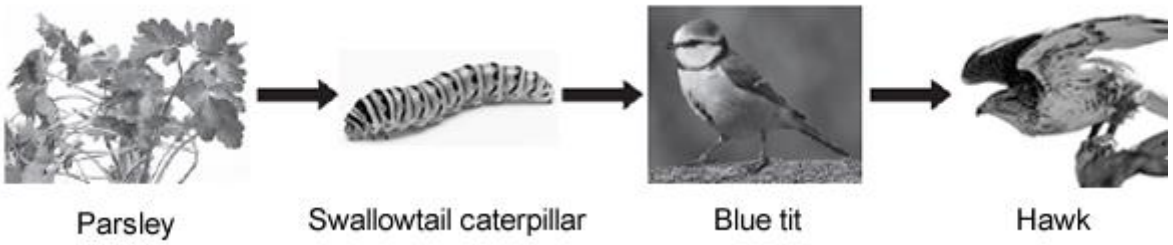
**(1)**

**(Total 8 marks)**

## Q10.

**Figure 1** shows how energy and biomass pass along a food chain.

**Figure 1**




(a) The parsley shown in **Figure 1** carries out photosynthesis.

_____

_____

_____

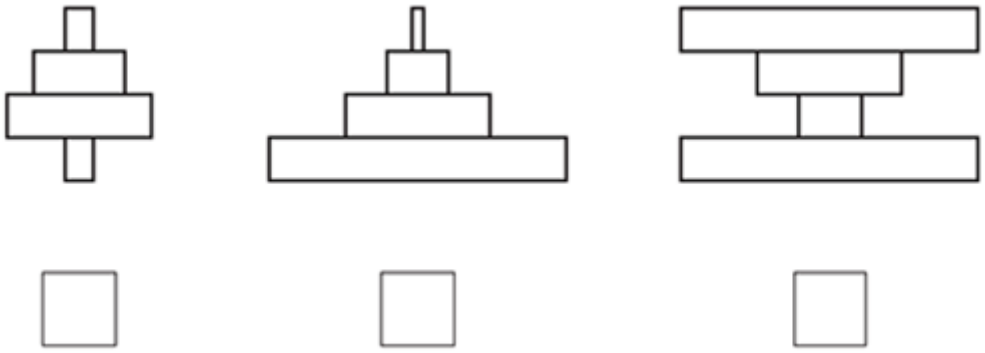
_____

**(2)**

(b) Which diagram shows the pyramid of biomass for the food chain in **Figure 1**?

Why is photosynthesis important in the food chain?

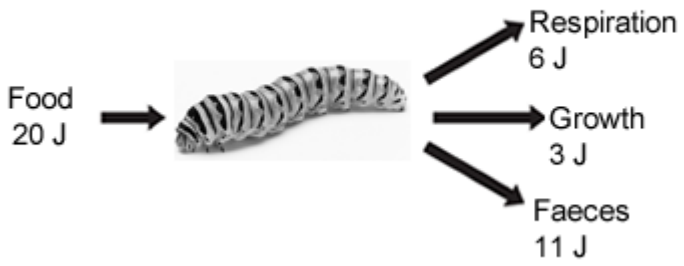
Tick (✓) **one** box.



**(1)**

(c) **Figure 2** shows the ways a swallowtail caterpillar transfers 20 J of energy from food.

**Figure 2**




What percentage of the energy in the caterpillar's food is used for growth?

_____

_____

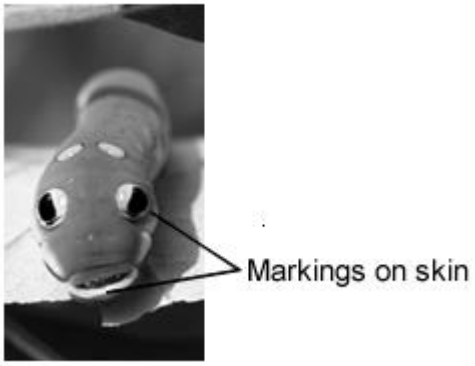
Percentage = _____

**(2)**

(d) The organisms in the food chain are adapted for survival.

(i) **Figure 3** shows a swallowtail caterpillar seen from the back.

**Figure 3**




Suggest how the swallowtail caterpillar shown in **Figure 3** is adapted to reduce the chance of being eaten by blue tits.

_____

_____

_____

_____

**(2)**

(ii) **Figure 4** shows a hawk.

Figure 4

Suggest **two** ways that the hawk is adapted to catch and kill blue tits.

1. _____

_____

2. _____

_____

**(2)**

**(Total 9 marks)**



## Q11.

Students investigated a food chain in a garden.

**lettuce → snail → thrush (bird)**

The students:
- estimated the number of lettuce plants in the garden
- estimated the number of snails feeding on the lettuces
- counted two thrushes in the garden in 5 hours.

The table below shows the students' results and calculations.

| Organism | Population size | Mean mass of each organism in g | Biomass of population in g | Biomass from previous organism that is lost in | Percentage of biomass lost |
|---|---|---|---|---|---|

| | | | | **g** | |
|---|---|---|---|---|---|
| Lettuce | 50 | 120.0 | 6000 | | |
| Snail | 200 | 2.5 | 500 | 5500 | 91 |
| Thrush | 2 | 85.0 | 170 | 330 | 66 |

(a) (i) Give **two** ways that biomass is lost along a food chain.

_____

_____

_____

_____

**(2)**

(ii) Scientists estimate that about 90% of the biomass in food is lost at each step in a food chain.

Suggest **one** reason why the students' value for the percentage of biomass lost between the snails and the thrushes is only 66%.

_____

_____

**(1)**

(b) European banded snails have shells with different colours (light or dark) and with stripes or with no stripes.

**Figure 1** shows two examples of European banded snails.

**Figure 1**

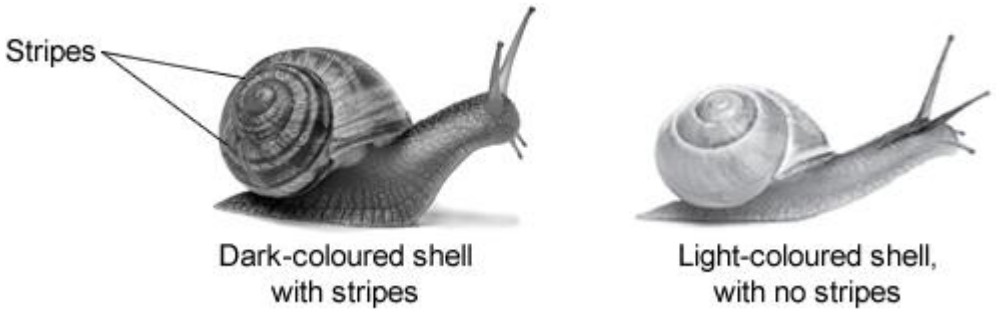
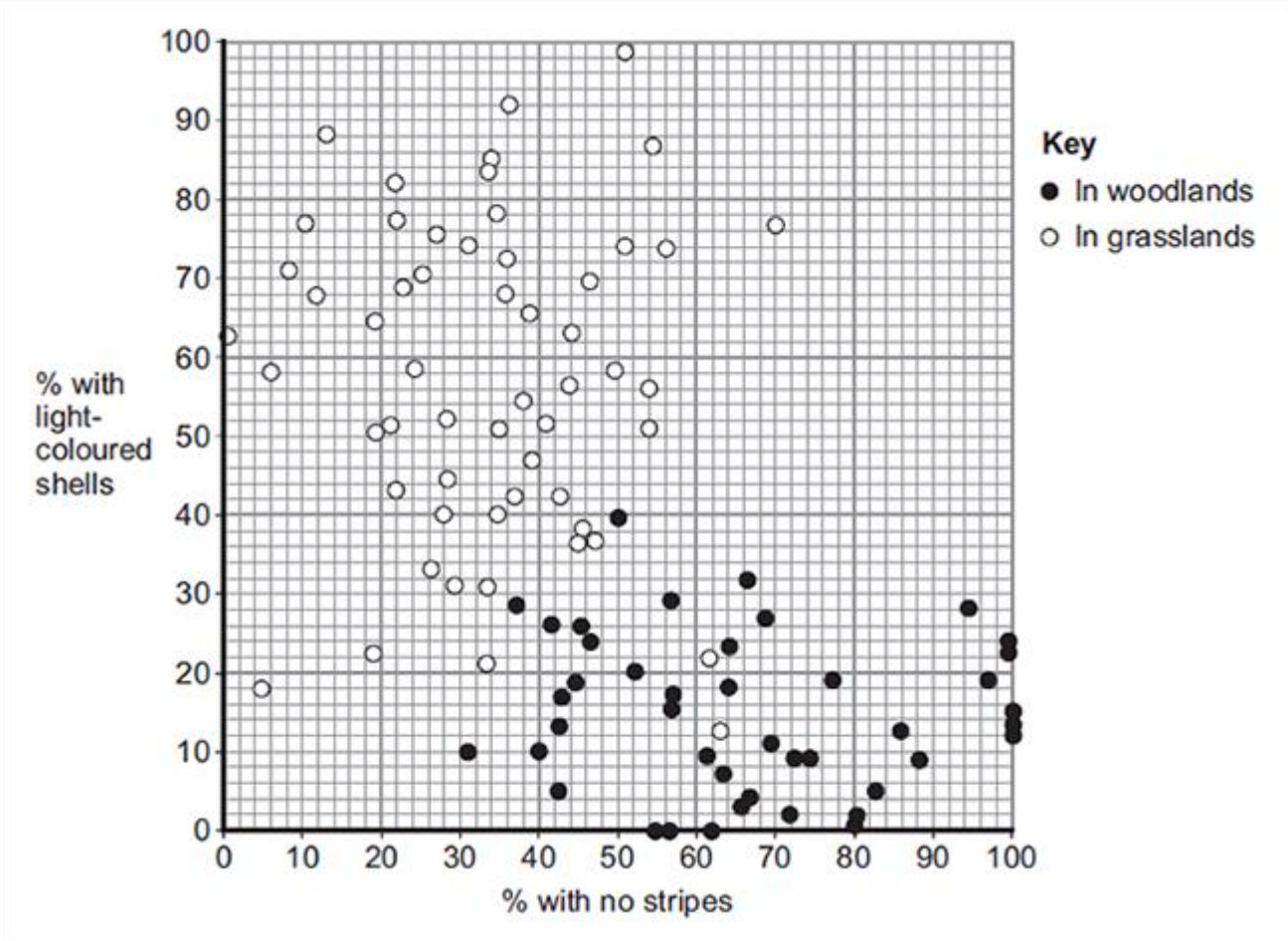





**Figure 2** shows results from surveys in woodlands and in grasslands of the percentage of snails with light-coloured shells and the percentage of snails with no stripes.

Each point on the graph represents the results of one survey in one habitat.

**Figure 2**




(i) **Figure 2** is a scatter graph.

Why is a scatter graph used for this data?

_____

_____

**(1)**

(ii) Compare the general appearance of snails that live in woodlands with the general appearance of snails that live in grasslands.

_____

_____

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**(2)**

(iii) Suggest a reason for the general appearance of snails that live in woodlands.

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**(1)**

**(Total 7 marks)**