(6)

Q1.

Organic substances decay into simpler substances.

(a)   The leaves fall off many trees in autumn.

The dead leaves contain carbon compounds and nitrogen compounds.

Describe how carbon **and** nitrogen in compounds in the leaves are
recycled and used by living trees. **(biology only)**

You should include a description of:

•   how the leaves are broken down
•   how substances are taken in and used by the trees.

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(6)

Students investigated the effect of temperature on the decay of milk.

This is the method used.

1. Place 25 cm³ of fresh milk into each of three beakers.

2. Keep one beaker of milk at 5 °C.

3. Keep one beaker of milk at 15 °C.

4. Keep one beaker of milk at 25 °C.

5. Record the pH of the milk in each beaker every day for 4 days.
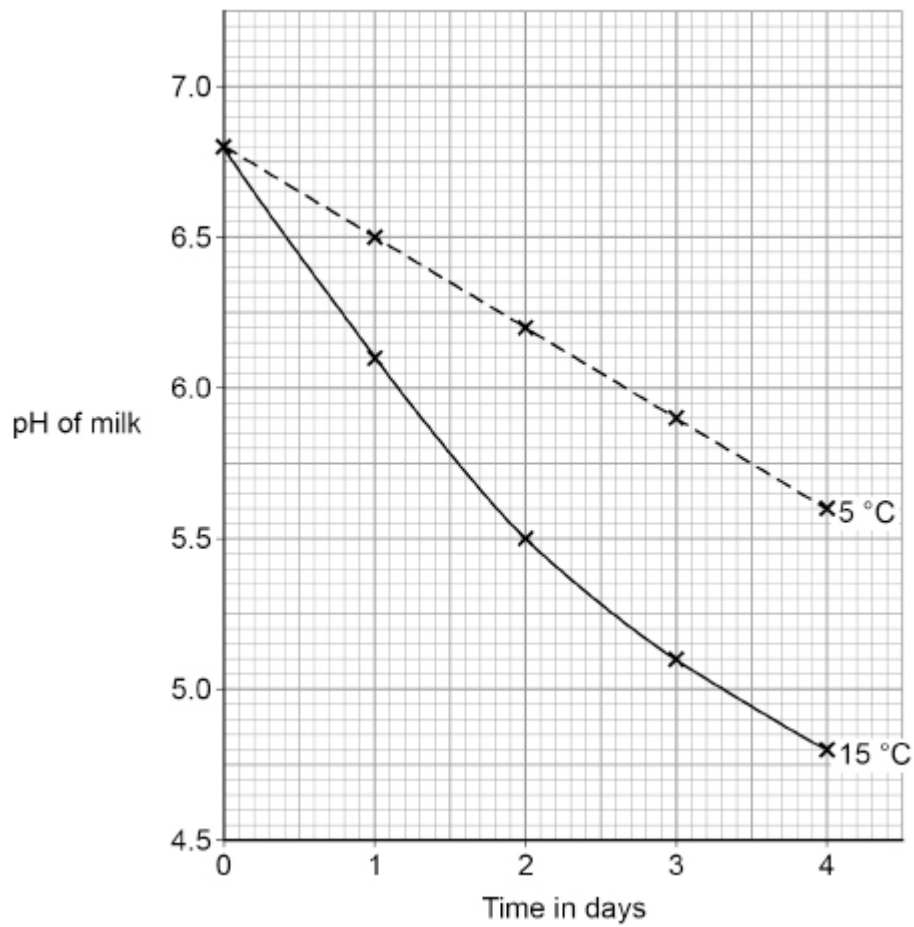
The table below shows the results.

Time in days	pH of milk		
	5°C	**15°C**	**25°C**
0	6.8	6.8	6.8
1	6.5	6.1	5.3
2	6.2	5.5	4.9
3	5.9	5.1	4.8
4	5.6	4.8	4.8

(b) Suggest **one** improvement the students could have made to the method. **(biology only)**

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_____

(1)

Figure 1 shows the results at 5 °C and at 15 °C.

Figure 1

(c)   Complete **Figure 1**. **(biology only)**
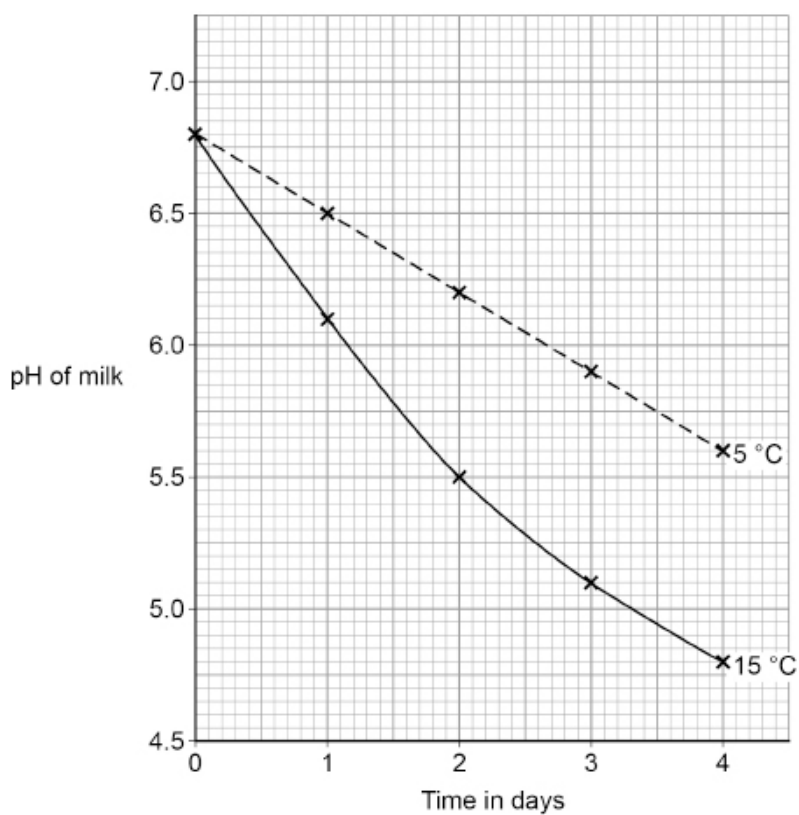
You should:

•   plot the data for 25 °C from the table above

•   draw a line of best fit.

(3)

Figure 2 shows the results for 5 °C and at 15 °C again.

Figure 2

(d)   The rate of pH change increases with an increase in temperature.

The rate of pH change at 5 °C is 0.3 pH units per day.

Calculate how many times faster the rate of pH change is at 15 °C than the rate of pH change at 5 °C, at **day 2**.

You should draw a tangent on **Figure 2**. **(biology only)**

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Rate at 15 °C is _____ times faster.

(4)

(e)   Milk contains lipids.

The lipids are broken down when the milk decays.

Explain why the pH changes more quickly when the temperature is higher.
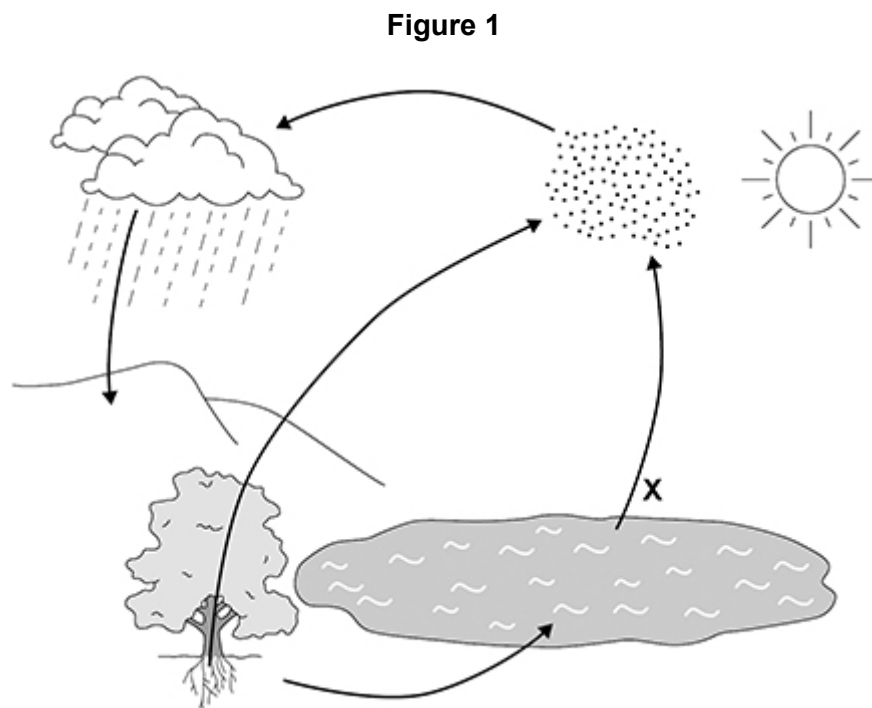**(biology only)**

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(3)
(Total 17 marks)

Q2.

Energy flows through an ecosystem and materials are recycled.

Figure 1 shows the water cycle.

Figure 1

(a)   Name process **X**.

_____

(1)

(b)   Name the process by which water is absorbed into plant roots.

_____

(1)

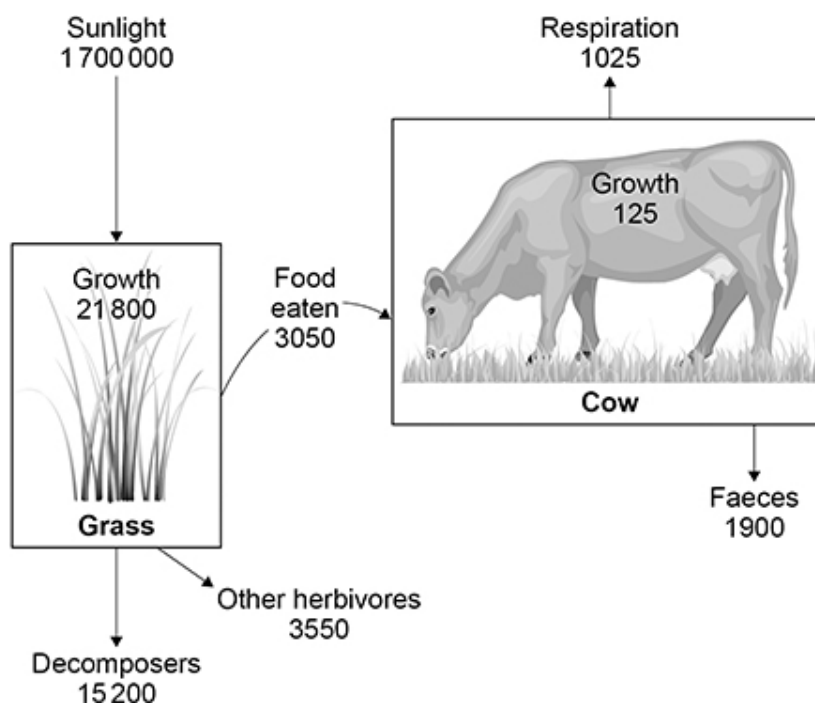(c)   Give **two** uses of water in plants.

1   _____

_____

2   _____

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(2)

Figure 2 shows the flow of energy through a food chain.

The numbers are in kilojoules/m^2/year.

Figure 2

(d)   The cow is more efficient than the grass at converting energy.

The energy conversion efficiency of the cow is 4.098%.

Calculate how many times more efficient the cow is at converting energy than the grass.

The equation for energy conversion efficiency is:

$$\text{energy conversion efficiency} = \frac{\text{energy used for growth}}{\text{energy input}} \times 100$$

Give your answer to 3 significant figures. **(biology only)**

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Number of times (3 significant figures) = _____

(5)

(e)   It is more energy-efficient to rear cows indoors than to rear cows outdoors.

Give **two** reasons why. **(biology only)**

1   _____

_____

2   _____

_____

(2)

(f)   Suggest **two** possible disadvantages of rearing cows indoors. **(biology only)**

1   _____

_____

2   _____

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(2)

(Total 13 marks)

Q3.

A scientist found a polluted pond which had a new type of blue algae in the water.

The blue colour of the algae was caused by a mutation.

(a)   What is a mutation?

_____

_____

(1)

The scientist measured the number of blue algal cells in a sample of the pond water.

The scientist used a special slide which has a counting grid.

This is the method used.
1.   Dilute 2.5 cm³ of pond water to a volume of 10 cm³ with distilled water.
2.   Place a drop of the diluted pond water on the special slide, as shown in **Figure 1**.
3.   Place a thick coverslip over the diluted pond water to give a depth of 0.1 mm of pond water.
4.   Use a microscope to count the number of algal cells in a 0.2 mm × 0.2 mm square on the counting grid.

Figure 1 shows a side view of the special slide.

Figure 1

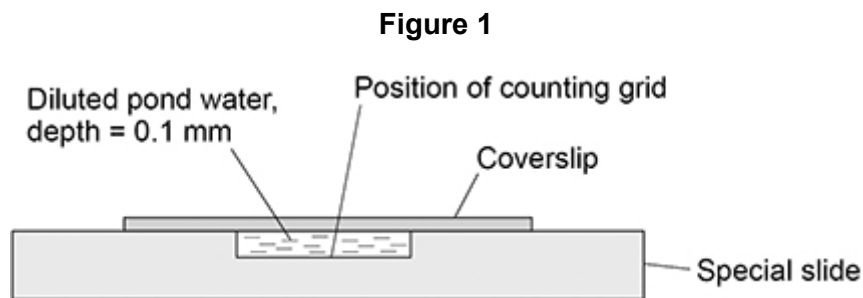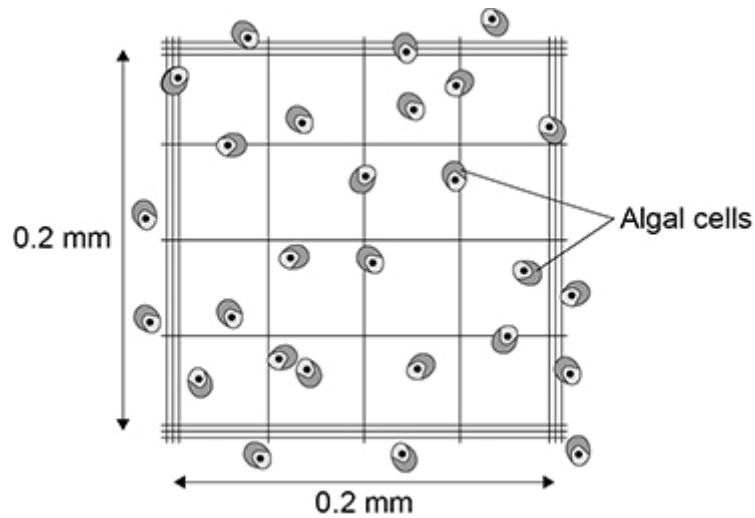**Figure 2** shows the view of the counting grid through a microscope.

Figure 2

(b)   How many algal cells are in the 0.2 mm × 0.2 mm square in **Figure 2**?

Use the following procedure:

- Count all cells that are completely within the 0.2 mm × 0.2 mm square in the counting grid.

- Count cells that are touching the left side or the lower side of the square.

- Do **not** count cells that are touching the right side or the top side of the square.

Number of algal cells in the 0.2 mm × 0.2 mm square = _____

(1)

(c)   One week later the scientist repeated the test and counted 14 cells on the 0.2 mm × 0.2 mm counting grid.

Calculate the number of algal cells in 1.0 mm^3 of **undiluted** pond water.

Use the scientist's second count of 14 cells. **(biology only)**

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Number of algal cells in 1.0 mm^3 of undiluted pond water = _____

(6)

(d)   Suggest why the scientist diluted the pond water before placing it on the special slide.

_____

_____

(1)

(e)   A student repeated the scientist's method.

The student used a thin coverslip over the diluted pond water instead of the thick coverslip.

The liquid pulled the thin coverslip downwards slightly.

Explain how the use of the thin coverslip would affect the results for the cell count.
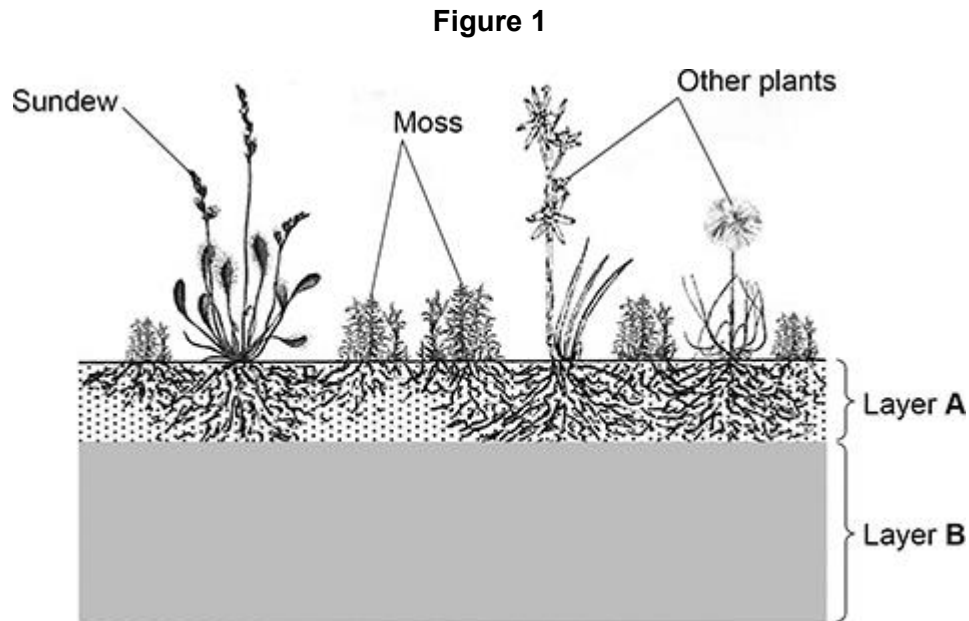
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(2)

(Total 11 marks)

Q4.

Peat bogs are estimated to contain twice as much carbon as all the world's forests.

Figure 1 shows a section through part of a peat bog.

Figure 1

Layer **A** contains a lot of air.

Layer **B**:

• contains the dead remains of plants

• has a low pH

• contains very little oxygen

• contains carbon dioxide and methane.

(a) Explain why most of the dead remains of plants in layer **B** do **not** decay.
(biology only)

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(3)

(b)   The peat bog in **Figure 1** is a stable community.

The moss produces biomass at a rate of 340 g/m^2/year.

What is the approximate biomass of the moss that becomes biomass in primary consumers? **(biology only)**

Tick (✓) **one** box.

0.34 g/m^2/year ☐

3.4 g/m^2/year ☐

34 g/m^2/year ☐

340 g/m^2/year ☐

(1)

The sundew plant shown in **Figure 1** has leaves with sticky hairs that trap and digest insects.

Digestion of the insects releases phosphates and simple compounds of nitrogen that are used by the sundew plant.

(c)   What substance can the sundew plant make using the **phosphates**? **(biology only)**

Tick (✓) **one** box.

Cellulose ☐

DNA ☐

Glycerol ☐

Starch ☐

(1)

(d)   What substance can the sundew plant make using the **nitrogen**? **(biology only)**

Tick (✓) **one** box.

Fatty acid	☐
Glucose	☐
Lactic acid	☐
Protein	☐

(1)

(e)   Humans have destroyed large areas of peat bog to collect peat.

The peat provides fuel and provides compost for gardeners to use.

The peat comes from layer **B** in **Figure 1**.

Layer **B**:
- contains the dead remains of plants
- has a low pH
- contains very little oxygen
- contains carbon dioxide and methane.

Figure 2 shows the removal of peat from a peat bog.

Figure 2

Peat is dug out and cut into 'bricks' that are left to dry

Explain how the destruction of peat bogs and the use of peat affects the temperature of the Earth's atmosphere. **(biology only) (HT only)**

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(4)
(Total 10 marks)