Questions are for separate science science students only

Q1.

Farmers can increase the growth rate of farm animals by controlling the animals' diets.

A farmer has 1000 chickens.

- The farmer feeds the chickens on seeds from maize plants.
- 1 hectare of land produces 16.4 tonnes of maize seeds.
- The maize seeds have an energy content of 16 MJ per kg.
- Chickens can use 80% of the energy in maize seeds.
- Each chicken needs 46 MJ of energy to grow to full size.

(a) Calculate the area of land needed to provide enough energy from maize seeds for 1000 chickens to grow to full size.

Give your answer in m^2. **(biology only)**

Give your answer to 3 significant figures.

1 hectare = 10 000 m^2

1 tonne = 1000 kg

Area of land (3 significant figures) = _____ m^2

(5)

(b) Another farmer produced 4200 kg of maize seeds in a field.

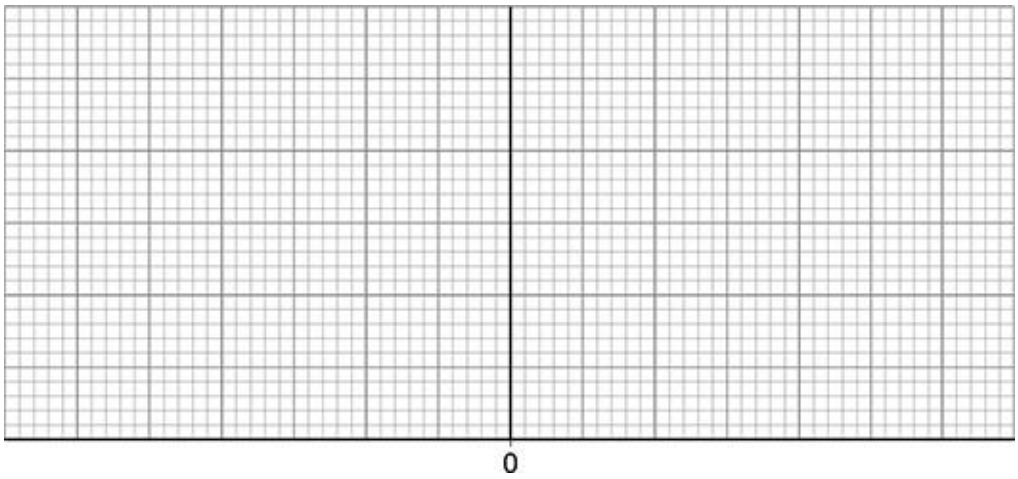
The farmer fed the maize to 1000 chickens.

At full size, the mean mass of one chicken was 2.2 kg.

Complete the figure below to show a pyramid of biomass for the food chain from the maize seeds to 1000 chickens. **(biology only)**

You should:

- label the x-axis
- use a suitable scale.



(3)

(c) Calculate the ratio of chicken biomass to maize seed biomass.

Use data from part (b).

Give your answer in its simplest form. **(biology only)**

_____

_____

Ratio = _____ : _____

(2)

(d) Chickens can use 80% of the biomass from the maize seeds they eat for respiration and growth.

What happens to the remaining 20% of the biomass in the maize seeds? **(biology only)**

_____

_____

(1)

Protein is an important part of a chicken's diet.

- Proteins contain 20 different types of amino acid.
- A chicken can make many of the 20 amino acids from other substances in the diet.
- Essential amino acids are amino acids the chicken **cannot** make.
- Essential amino acids must be included in the diet.

Maize seeds contain protein but the proportion of some essential amino acids is low.

Scientists have produced a type of maize called Quality Protein Maize (QPM).

The table below compares the proportions of seven essential amino acids in normal maize seeds and in QPM seeds.

Amino acid	Mass of amino acid in protein in g/kg	
	Normal maize	Quality protein maize (QPM)
Leucine	122.2	88.1
Lysine	28.9	41.9
Methionine	19.9	18.1
Phenylalanine	49.4	40.9
Threonine	34.5	36.5
Tryptophan	7.3	16.3
Valine	45.9	51.2

(e) Which amino acids are found in significantly higher proportions in the QPM seeds?

Tick (✓) **one** box. **(biology only)**

Lysine and tryptophan ☐

Lysine and valine ☐

Threonine and tryptophan ☐

Threonine and valine ☐

(1)

(f) The table above shows that 1 kg of QPM contains less leucine than 1 kg of normal maize.

Suggest why a diet containing less leucine does **not** slow down the growth of chickens. **(biology only)**

_____

_____

(1)

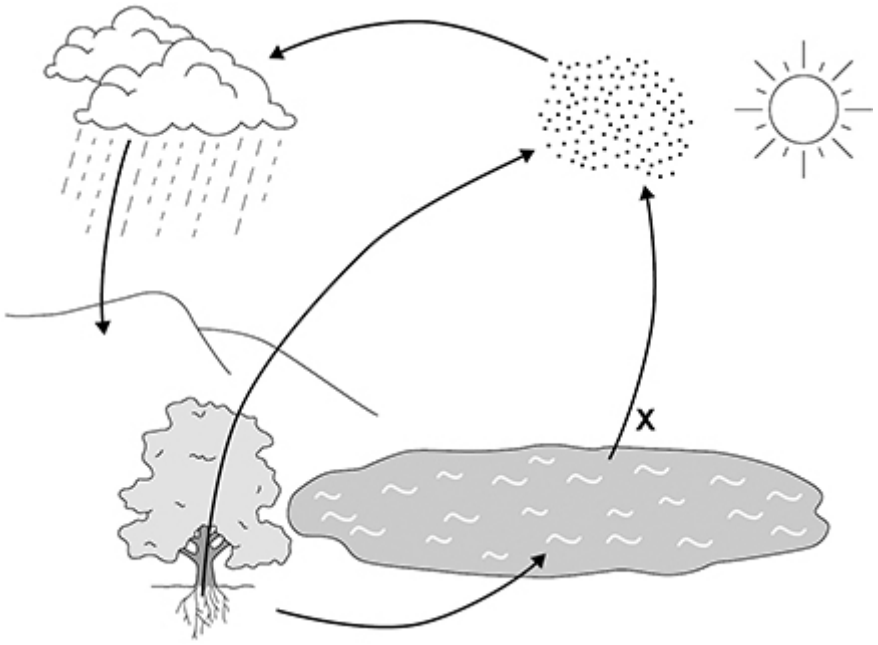
(Total 13 marks)

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 _____

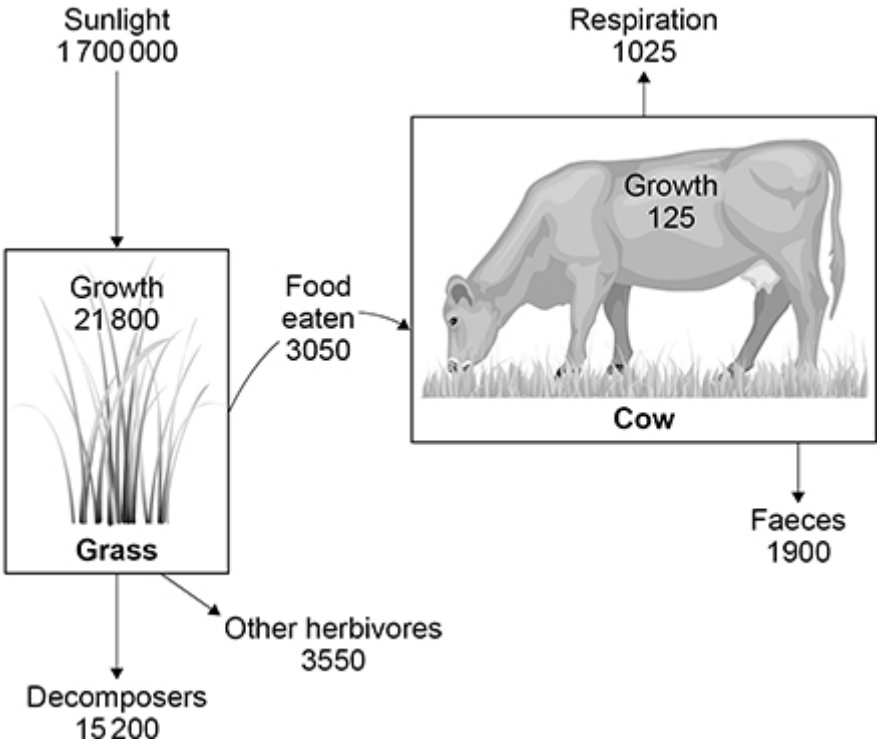
_____

(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)**

_____

_____

_____

_____

_____

_____

_____

_____

_____

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 _____

_____

(2)

(Total 13 marks)