Ecology part 6 AQA Triple Biology

Name: _____

Class: _____

Date: _____

Time: **85 minutes**

Marks: **78 marks**

Comments:

1. 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.

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.

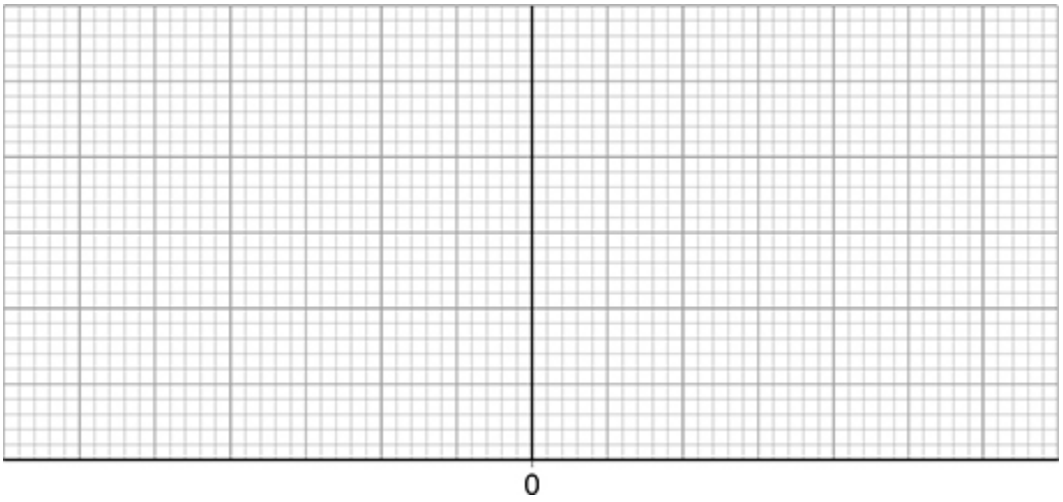
The farmer fed the maize to 1000 chickens.

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.

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.

_____

_____

_____

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?

_____

_____

(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.

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.

_____

_____

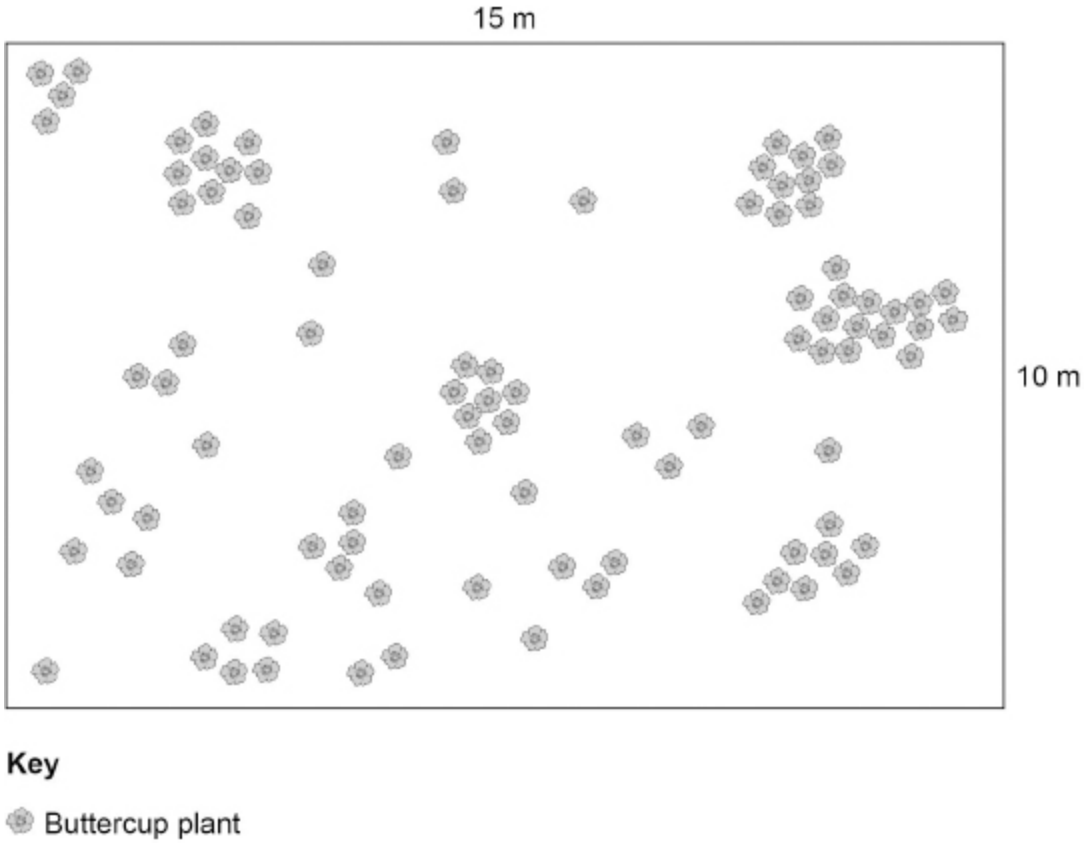
(1)

(Total 13 marks)

2. Students estimated the population of buttercup plants growing on a lawn.

The lawn is a rectangle measuring 15 m × 10 m.

The figure below shows the lawn.



This is the method used.

1. Measure the length and width of the lawn.

2. Choose five locations to sample.

3. Place a 1 m × 1 m square frame at each location.

4. Record the number of buttercup plants in each square frame.

(a) Complete the sentences.

Choose answers from the box.

15 cm ruler		**30 m tape measure**
balance	**quadrat**	**transect**

The length and width of the lawn should be measured

using a _____.

The 1 m × 1 m square frame is called a _____.

(2)

(b) How should the students choose the five locations to sample?

Tick (✓) **one** box.

Choose locations at random. ☐

Choose locations at the corners of the lawn. ☐

Choose locations with lots of buttercup plants. ☐

Choose locations with no buttercup plants. ☐

(1)

The table below shows the results.

Sample number	Number of buttercup plants
1	2
2	7
3	0
4	0
5	1

The students used their results to calculate the population of buttercup plants.

(c) Complete the sentences.

Choose answers from the box.

area	mean	median	perimeter	volume

Multiply the length of the lawn by the width of the lawn to give the

lawn's _____.

Add up the total number of buttercup plants and divide by 5 to give

the _____.

(2)

(d) The students calculated that the population of buttercup plants on the lawn was 300.

How did the students use the results in the table above to calculate the population?

_____

_____

(1)

(e) How could the students improve the accuracy of the estimate?

Tick (✓) **one** box.

Count and record more samples. ☐

Select locations in the middle of the lawn. ☐

Use a square frame measuring 0.5 m × 0.5 m. ☐

(1)

(f) One **abiotic** factor that affects the number of buttercup plants on the lawn is soil pH.

Give **one** other **abiotic** factor that could affect the number of buttercup plants on the lawn.

Do **not** refer to soil pH in your answer.

_____

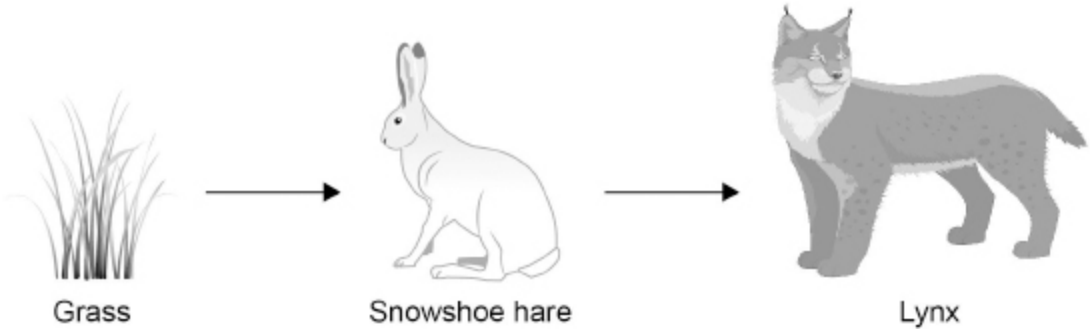
(1)

(Total 8 marks)

3. Different species in a habitat may depend on each other for food.

Figure 1 shows a food chain.

Figure 1



(a) The grass needs energy to grow.

What is the source of energy for the grass?

_____

(1)

(b) The table below lists different types of feeding relationship.

Feeding relationship	**Organism**
Secondary consumer	Lynx
Primary consumer	
Producer	
Herbivore	
Carnivore	
Prey	
Predator	

Write the name of **one** organism from **Figure 1** in each box in the table above.

Each organism may be written in one box or in more than one box.

The first box has been completed for you.

(3)

(c) **Figure 2** shows the appearance of the snowshoe hare in the summer and in the winter.

Figure 2

Snowshoe hare in summer

Snowshoe hare in winter

The snowshoe hare has a different fur colour in the summer than in the winter.

Explain how the different fur colour increases the chance of survival of the snowshoe hare.

_____

_____

_____

_____

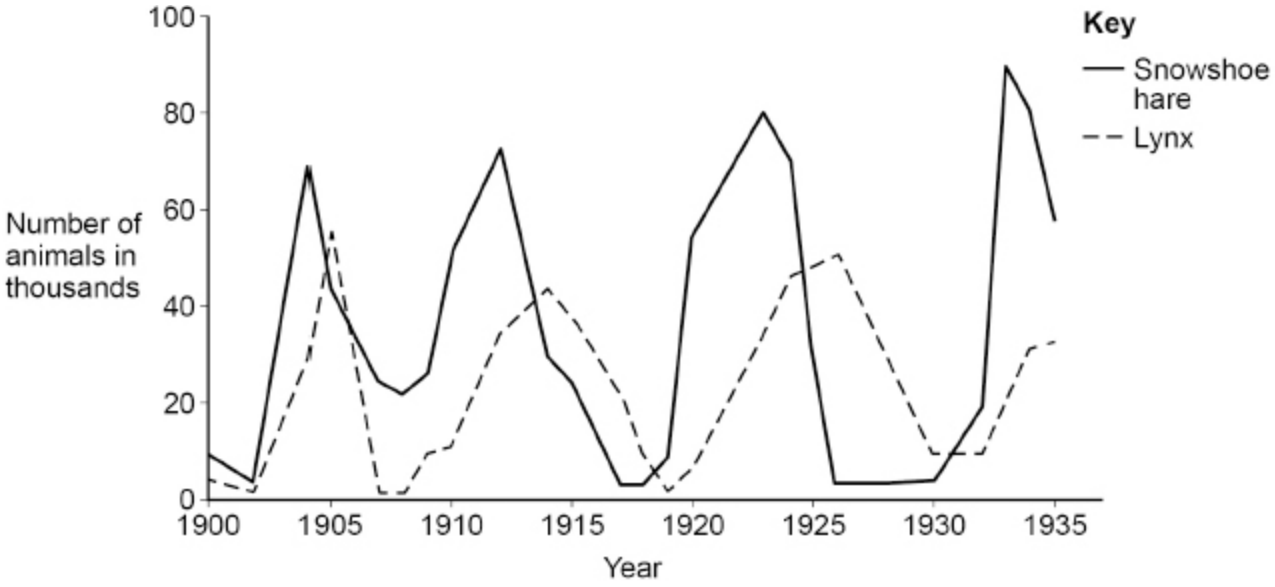
_____

_____

(3)

Figure 3 shows how the number of snowshoe hares and the number of lynx varied in one area between 1900 and 1935.

Figure 3



(d) **Figure 3** shows that the number of snowshoe hares and the number of lynx increase and decrease several times.

Suggest **two** reasons why the number of **snowshoe hares** increases.

1 _____

_____

2 _____

_____

(2)

(e) The number of snowshoe hares increased and decreased four times between 1900 and 1935.

What effect does an **increase** in the number of snowshoe hares have on the number of lynx?

_____

_____

(1)

(f) Suggest **one** reason why the number of lynx decreased from 1915 to 1919.

Use information from **Figure 3**.

_____

_____

(1)

(g) When the snowshoe hare eats grass, about 90% of the biomass of the grass is lost.

Give **two** ways the biomass is lost.

1 _____

_____

2 _____

_____

(2)

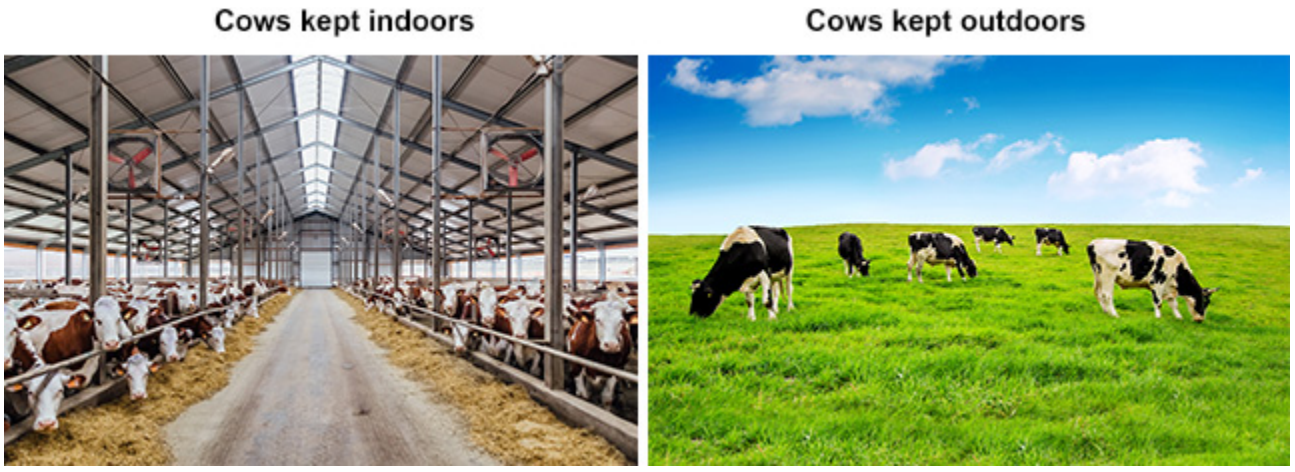
(Total 13 marks)

4. Some farmers keep cows indoors in large sheds.

Other farmers keep cows outdoors in fields of grass.

Figure 1 shows cows being kept indoors and outdoors.

Figure 1



The table below shows the energy inputs and energy outputs for keeping cows.

	Energy in kJ/m^2/year	
	Indoors	**Outdoors**
Input as food	10 000	5 950
Input as fossil fuel	6 000	50
Output as meat and milk	40	2

(a) Calculate the total energy input for keeping cows **outdoors**.

Use data from the table above.

Total energy input = _____ kJ/m^2/year

(1)

(b) The total energy input for keeping cows **indoors** is 16 000 kJ/m^2/year.

Calculate the percentage efficiency of keeping cows **indoors**.

Use the equation:

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

Percentage efficiency = _____ %

(2)

(c) The percentage efficiency of keeping cows outdoors is 0.03%.

Why is it more energy efficient to keep cows indoors than to keep cows outdoors?

Tick (✓) **two** boxes.

Cows are more stressed indoors. ☐

Cows move less indoors. ☐

It is noisier indoors. ☐

It is warmer indoors. ☐

There is less light indoors. ☐

(2)

Diseases in cows can cause problems for farmers.

(d) Suggest why diseases spread more quickly when the cows are kept indoors.

_____

_____

(1)

One species of bacterium causes a disease in cows.

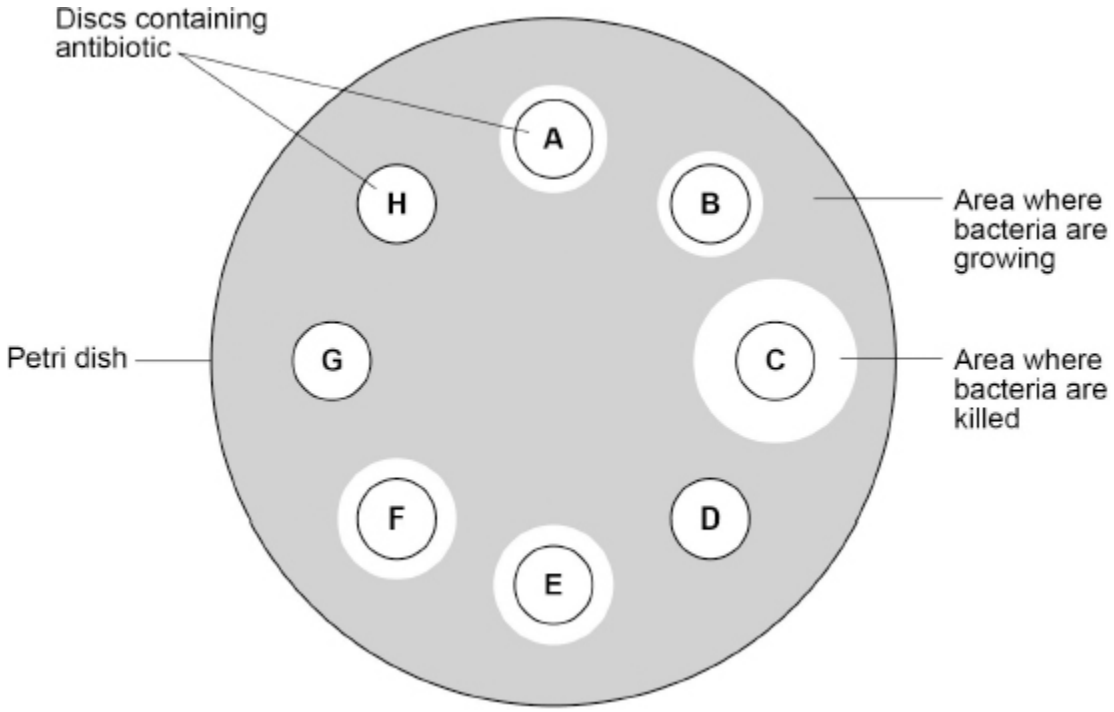
Scientists investigated the effect of eight different antibiotics on the growth of this species of bacterium.

The scientists put discs containing the different antibiotics onto a Petri dish containing the bacteria.

Antibiotics **A** to **H** were used in the investigation.

Figure 2 shows what the Petri dish looked like after 2 days.

Figure 2



(e) This species of bacterium is resistant to some of the antibiotics.

Give the letter of **one** antibiotic the bacterium is resistant to.

_____

(1)

(f) Complete the sentence.

Choose the answer from the box.

carbohydrate	**DNA**	**lipid**

Antibiotic resistance in a single bacterium is caused by a change in the bacterium's _____.

(1)

(g) Complete the sentence.

Choose the answer from the box.

excretion	feeding	reproduction

A change in one bacterium can cause millions of bacteria to become resistant to the antibiotic.

This is because bacteria have a high rate of _____.

(1)

(h) Suggest why the production of millions of antibiotic-resistant bacteria is a problem for farmers.

_____

_____

_____

_____

(2)

(Total 11 marks)

5. Bacteria are one type of organism that cause decay.

(a) Which other type of organism causes decay?

Tick (✓) **one** box.

Fungi ☐

Plants ☐

Viruses ☐

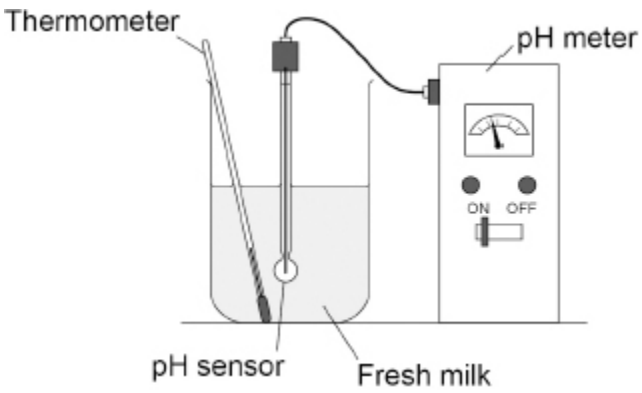
(1)

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

The decay was caused by bacteria in the milk.

Figure 1 shows the apparatus used.

Figure 1



This is the method used.

1. Set up the apparatus as shown in **Figure 1** with the milk at 20 °C.

2. Record the pH each day for 7 days.

3. Repeat with more samples of milk at 5 °C and at 30 °C.

(b) What was the dependent variable in the investigation?

Tick (✓) **one** box.

The pH of the milk ☐

The type of milk ☐

The volume of the milk ☐

(1)

(c) How could the students keep the milk at 30 °C for 7 days?

Tick (✓) **one** box.

Put a lid on the beaker. ☐

Put the beaker in a water bath. ☐

Stir the milk continuously. ☐

Wrap cloth around the beaker. ☐

(1)

(d) As the milk decays, the bacteria digest fats in the milk.

What type of acid is produced by digestion of fats in the milk?

Tick (✓) **one** box.

Amino acid ☐

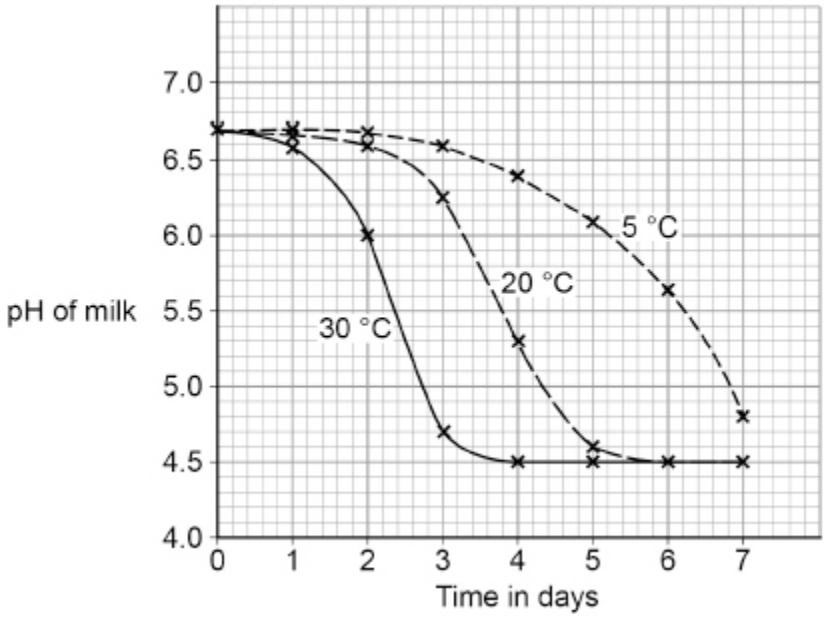
Fatty acid ☐

Hydrochloric acid ☐

(1)

Figure 2 shows the results.

Figure 2



(e) Why did the pH **not** fall below pH 4.5 at 20 °C?

Tick (✓) **one** box.

All the fat had been digested. ☐

The reaction was too fast. ☐

The temperature was too low. ☐

(1)

The digestion of fat was fastest at 30 °C and slowest at 5 °C.

(f) Give **one** reason why the rate of digestion was faster at 30 °C than at 5 °C.

_____

_____

(1)

(g) Calculate the rate of digestion at 30 °C from day 2 to day 3.

Complete the following calculation.

Use data from **Figure 2**.

At 30 °C, the pH at day 2 = _____

At 30 °C, the pH at day 3 = _____

Therefore the fall in pH at 30 °C from day 2 to day 3 = _____ pH units/day

(2)

(h) The rate of digestion at 5°C from day 2 to day 3 is 0.1 pH units/day.

How many times faster is the rate of digestion at 30°C than the rate of digestion at 5°C from day 2 to day 3?

Use your answer to part (g).

_____

_____

_____

Rate at 30 °C is _____ times faster

(2)

(Total 10 marks)

6. Many different species can live together in the same habitat.

(a) What name is given to all of the organisms living in the same habitat?

Tick (✓) **one** box.

A community ☐

A food chain ☐

A population ☐

An ecosystem ☐

(1)

Figure 1 shows four species of bird from the same habitat in the UK.

Figure 1

Brambling (*Fringilla montifringilla*)

Bullfinch (*Pyrrhula pyrrhula*)

Chaffinch (*Fringilla coelebs*)

Goldfinch (*Carduelis carduelis*)

(b) Which species of bird in **Figure 1** do scientists think are most closely related?

Tick (✓) **one** box.

Brambling and chaffinch ☐

Brambling and goldfinch ☐

Bullfinch and chaffinch ☐

Bullfinch and goldfinch ☐

(1)

(c) Scientists think the brambling and the bullfinch belong to different species.

What evidence is used by scientists to classify the brambling and the bullfinch as different species?

Tick (✓) **one** box.

The brambling and the bullfinch are different sizes. ☐

The brambling and the bullfinch cannot breed together to give fertile offspring. ☐

The brambling and the bullfinch live in different parts of the habitat. ☐

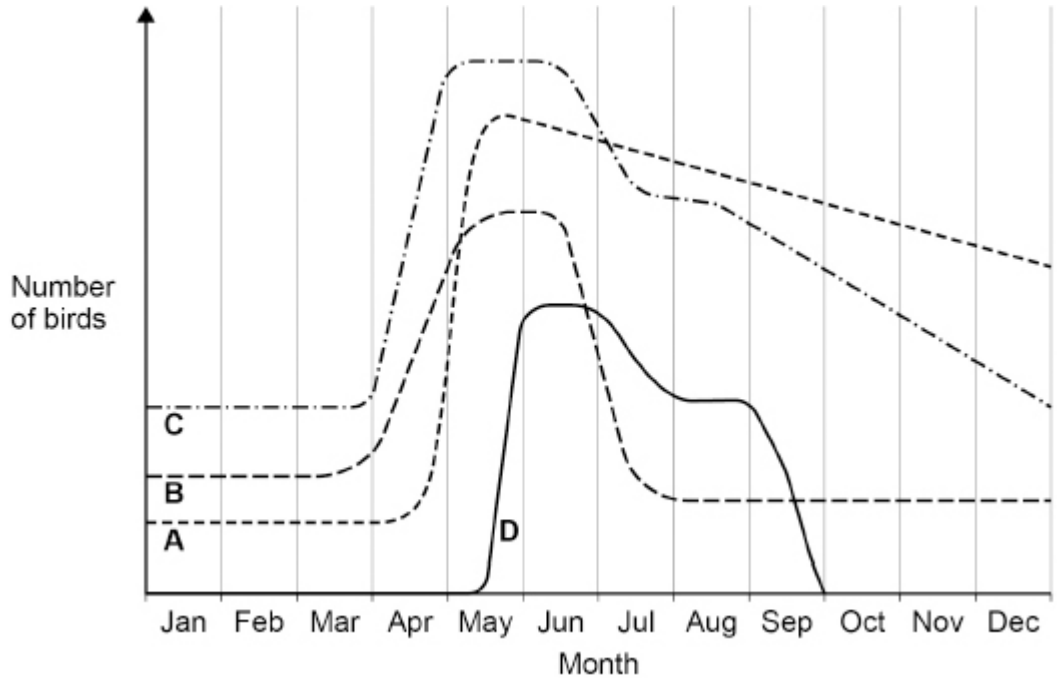
The brambling eats mainly seeds and the bullfinch eats mainly insects. ☐

(1)

Four other species of bird (**A**, **B**, **C** and **D**) live in a habitat in the UK.

Figure 2 shows how the numbers of each species of bird varied during one year.

Figure 2



Use information from **Figure 2** to answer parts (d) to (f)

(d) Describe what happens to the number of birds of species **A** during the year.

_____

_____

_____

_____

_____

_____

(3)

(e) In June and July, a disease affected the populations of some of the species.

Which species had the **lowest** resistance to the disease?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(f) One species migrates between the UK and other countries.

Which species migrates between the UK and other countries?

Give a reason for your answer.

Species _____

Reason _____

_____

_____

(1)

(Total 8 marks)

7. Reproduction can produce offspring which are:

- genetically different

  or

- genetically identical.

Farmers grow tomato plants in greenhouses.

The tomatoes are sold in supermarkets.

(a) Suggest **one** advantage of growing tomato plants that are genetically different.

_____

_____

(1)

(b) Suggest **one** advantage of growing tomato plants that are genetically identical.

_____

_____

(1)

(c) Scientists can grow genetically identical tomato plants using tissue culture.

What is tissue culture?

_____

_____

(1)

(d) Genetically identical tomato plants growing in the same garden do **not** all grow to the same height.

Give **one** reason why.

_____

_____

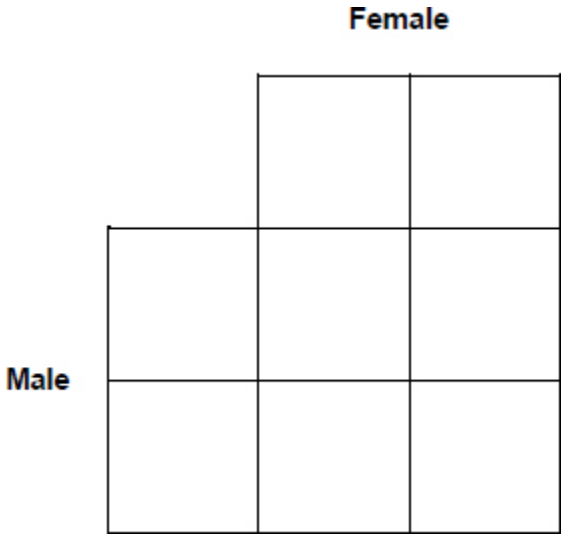
(1)

The sex of dogs is determined by **X** and **Y** chromosomes in the same way as in humans.

(e) Complete the Punnett square diagram in **Figure 1** to show the inheritance of sex in dogs.

Use the symbols **X** and **Y**.

Figure 1



(3)

(f) A female dog gave birth to six offspring.

Why would you expect there to be three male offspring and three female offspring?

Use your answer to part (e).

_____

_____

(1)

Farmers keep chickens for:

- meat production
- egg production.

Some varieties of chicken grow more quickly and are more suitable for meat production.

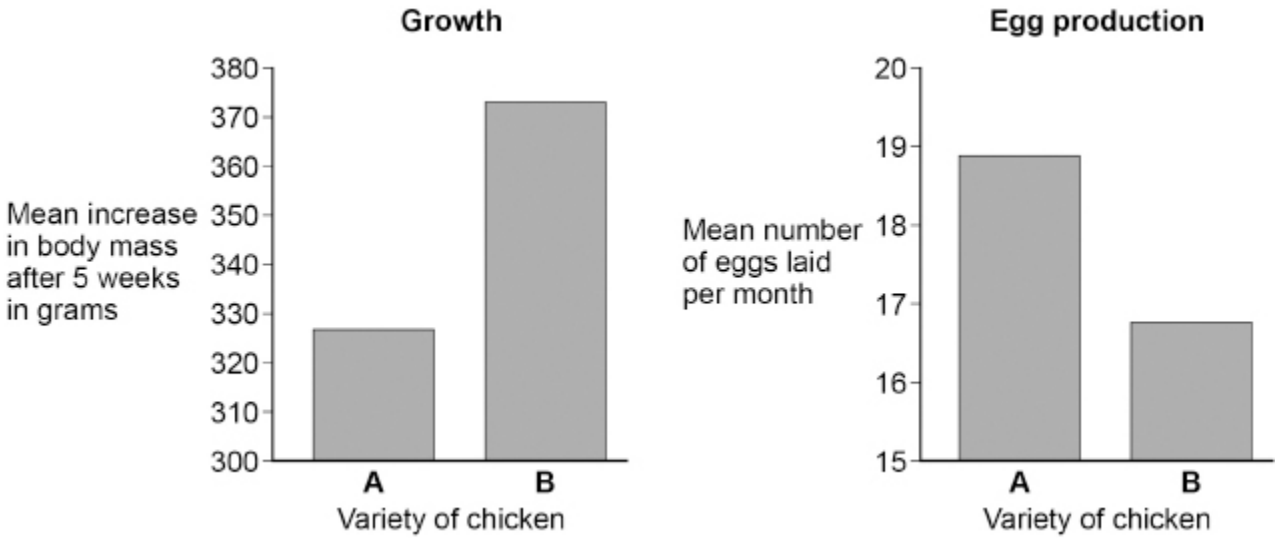
Other varieties of chicken produce more eggs.

A farmer keeps two varieties of chicken, **A** and **B**.

The farmer investigated the growth rates and egg-production rates of both varieties.

Figure 2 shows the results.

Figure 2



(g) Suggest **two** control variables the farmer should have used in this investigation.

1 _____

_____

2 _____

_____

(2)

(h) **Figure 2** shows mean values from 500 chickens of each variety.

Give the reason the farmer used a large number of chickens.

_____

_____

(1)

(i) The farmer wants to produce a new variety of chicken that is good for **both** meat production **and** egg production.

Describe how selective breeding of chicken varieties **A** and **B** can produce the new variety of chicken.

(4)

(Total 15 marks)

1. (a) 46 000 **or** 16 400 **or** 12.8 **or** 0.8

1

46 000 **and** 16 400
or
262 400

1

46 000 **and** 209 920
or
3593.75

1

2191.3
or

$$\frac{46\,000 \times 10\,000}{209\,920}$$

or

$$\frac{3593.75 \times 10\,000}{16\,400}$$

1

2190

1

(b) suitable scale, symmetrical around 0

1

labels for *x*-axis
and for bars
(biomass in) kg
(bars) maize and chickens

1

correct values plotted:
chickens 2200
maize 4200
allow a tolerance of ±½ small square
ignore height of bars

1

(c) $\frac{2200}{4200}$

1

= 0.5238… : 1
or
11 : 21
or
1 : 1.9

allow rounded value

1

(d) lost via egestion / faeces

ignore urine / excretion / waste
ignore not digested
*do **not** accept respiration*
*do **not** accept not eaten*
*do **not** accept movement **or** as heat **or** for keeping warm*

1

(e) lysine and tryptophan

1

(f) any **one** from:

- chickens need low amounts of leucine (for growth)
  *do **not** accept leucine is not needed (for growth)*
- (chicken) proteins contain low amount / proportion of leucine

1

[13]

2. (a) (30 m) tape measure

1

quadrat

1

must be in this order

(b) choose locations at random

1

(c) area

1

mean

1

must be in this order

(d) multiply mean by area

allow multiply 2 by 150

allow multiply total (of five quadrats) by a fifth of the area

allow multiply 10 by 30

1

(e) count and record more samples

1

(f) any **one** from:

- water / moisture

  allow humidity

  allow rain

  allow drought

- light

  ignore sun unqualified

  allow shade (by eg building)

- temperature
- oxygen in the soil

  ignore oxygen unqualified

- wind
- minerals / ions

  allow named ions

  allow fertiliser / salts

  ignore carbon dioxide

  ignore nutrients

  ignore (soil) pH

1

[8]

3. (a) any **one** from:

- sun
- light

  ignore photosynthesis

1

(b)

Feeding relationship	Organism	
Secondary consumer	lynx	
Primary consumer	(snowshoe) hare	1
Producer	grass	
Herbivore	(snowshoe) hare	1
Carnivore	lynx	
Prey	(snowshoe) hare	1
Predator	lynx	

*if no other mark awarded allow **1** mark for 3 correct answers*

Up to 3

(c) camouflaged / hidden **or** not (easily) seen

allow description eg blends in with surroundings

1

from lynx / predator / carnivore

1

not killed / eaten

allow less likely to be killed / eaten

1

(d) any **two** from:

- fewer lynx (to eat them)

  *allow not many predators / lynx do **not** accept no lynx / predators*

- more food / grass (available)

  allow a lot of food / grass

- hares reproduce / breed / multiply

2

(e) (number of lynx) increases

1

(f) less food **or** fewer (snowshoe) hares (to eat) **or** fewer prey

ignore the lynx were hunted

*do **not** accept no food*

1

(g) any **two** from:

- (lost in) respiration (of snowshoe hare)

  allow as carbon dioxide
- egestion / faeces

  allow not all digested
- excretion / urea / urine
- not all eaten

  allow not all (named) parts eaten

2

*if no other mark awarded, allow **1** mark for waste*

[13]

4. (a) 6000 (kJ/m^2/year)

1

(b) $\frac{40}{16\,000} \times 100$

1

0.25 (%)

1

(c) cows move less indoors

1

it is warmer indoors

1

(d) cows are close(r) together

allow cows are in an enclosed space

1

(e) any **one** from:

- D
- G
- H

1

(f) DNA

1

(g) reproduction

1

(h) any **two** from:

ignore reference to crops

- many animals will become ill

  allow many animals may die

- resistant bacteria passed from animal to animal

  *allow disease passed from animal to animal **or** other animals infected*

- animals cannot be cured (by the antibiotic)

  allow antibiotic will not work

- animals may be less productive / efficient

  allow less meat / milk produced

  allow less growth

- farmer may lose profit / money

  allow cannot sell infected produce / animals

2

[11]

5. (a) fungi

1

(b) the pH of the milk

1

(c) put the beaker in a water bath

1

(d) fatty acid

1

(e) all the fat had been digested

1

(f) any **one** from:

allow converse if clearly describing 5 °C

- (there is) more (kinetic) energy

  allow particles move faster

  allow more collisions between particles

- enzyme activity is higher

  allow enzymes work faster

  ignore enzymes work better

- bacteria / microorganisms are dividing / reproducing faster

  allow number of bacteria / microorganisms increasing faster

  allow more bacteria / microorganisms

  ignore bacteria / microorganisms grow faster

  ignore it is warmer

1

(g) (30 °C, 2 days) 6(.0)
and
(30 °C, 3 days) 4.7

allow a tolerance of ±½ small square

1

(fall) 1.3 (pH units/day)

allow −1.3 (pH units/day)

allow correct answer using student's incorrect readings in the range of 5.95 to 6.05 and / or 4.65 to 4.75

1

(h) $\frac{1.3}{0.1}$

*allow ecf from answer in part **(g)***

1

13

*do **not** accept if a unit is given*

1

[10]

6. (a) a community

1

(b) brambling and chaffinch

1

(c) the brambling and the bullfinch cannot breed together to give fertile offspring

1

(d) constant (from Jan) to Mar / (mid-)Apr

ignore straight

1

increases (from mid-)Apr to / and May

1

decreases from May / Jun to Dec

1

allow answers in terms of month numbers

ignore seasons

*if no other marks awarded allow for **1** mark constant, **then** increase **then** decrease*

(e) B

1

(f) D (because) present only May to Sep

allow D (because) present only May to Oct

*allow D (because) **not** present Oct to Apr / May*

allow D (because) present only in summer

*allow D (because) **not** present in winter*

allow D (because) not present for all the year

allow D (because) only present for some of the year

1

[8]

7. (a) any **one** from:

- variation of a named / described (desirable) characteristic

  allow eg different flavour / colour
- not all susceptible to the same disease / pathogen
- maintain / increase gene pool

  allow different customer preferences

1

(b) any **one** from:

- they have the same named /(desirable) characteristic(s)

  *allow eg all high yield **or** all disease-resistant **or** same (desirable) flavour*
- they grow at the same rate
- they ready to harvest at same time

1

(c) (a group of) cells are grown (into a new organism)

ignore clones

1

(d) any **one** from:

different

- water

  allow rain
- minerals / ions

  allow named example

  ignore nutrients
- light

  ignore sun unqualified
- herbivores

  allow named example
- disease

  allow named example
- plant density
- soil pH

1

allow different temperature

allow different environmental conditions

(e) male gametes = **X** + **Y**

1

female gametes = **X** + **X**

1

*if neither mark awarded, allow **1** mark for*

*male = **X** + **X and** female = **X** + **Y***

offspring genotypes correctly derived from gametes

allow correct for chromosome assignment in mp1 & mp2

1

(f) any **one** from:

- half are XX and half are XY
- equal probability of X or Y sperm fertilising an egg
- (the Punnett square shows) 50% (chance of) male / female

1

(g) any **two** from:

- temperature
- type / amount of food

allow (volume / amount of) water

- light
- whether chickens are kept indoors or outdoors
- amount of movement / space (allowed)

allow same stocking density

allow same number of each type

ignore same number unqualified

- time of year

allow mass at start

allow age of chicken(s)

*allow same medication **or** all healthy*

2

(h) any **one** from:

- (more) valid / representative

or

reduce the effect of anomalies

allow can calculate a valid mean

- (more) accurate mean

allow (more) accurate results

allow (more) reliable mean / results

1

(i) breed best of **A** and **B** (together)

*allow cross / mate best of **A** and **B***

1

select offspring with highest egg numbers **and** heaviest / fastest growing

allow select the best offspring for both desired characteristics

1

breed (these) offspring together

1

repeat over many / several generations

*do **not** accept reference to repeated breeding of the original parents*

1

[15]