

## Higher Unit 3:

### Sustainability and Interdependence

#### Topic 3.1a Food supply, plant growth and productivity

**1.** Livestock production generates less food per unit area of land than crop production because

**A** energy is gained between trophic levels of the food chain

**B** livestock production degrades natural resources

**C** energy is lost between trophic levels of the food chain

**D** it is easier to grow crops than raise livestock in difficult habitats.

**1**

**2.** In terms of food security, explain why using agricultural land to grow cereal for human consumption rather than to grow cattle food would produce more food for humans per unit area.

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**1**

**Higher Unit 3:**  
**Sustainability and Interdependence**  
**Topic 3.1b Plant growth and Productivity**

- 1.** The table below gives measurements relating to productivity in a field of wheat grown to produce grain for making bread.

<i>Measurement</i>	<i>Productivity</i> (kg dry mass per hectare per year)
plant biomass	11 250
grain yield	4500

What is the harvest index of this wheat crop?

- A** 0.4
- B** 2.5
- C** 6750
- D** 15750

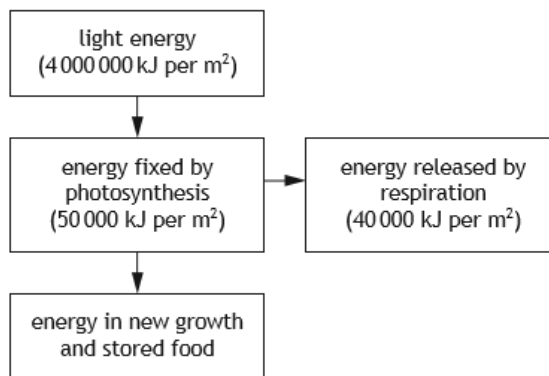
**1**

- 2.** The action spectrum of photosynthesis is a measure of the ability of plants to

- A** absorb all wavelengths of light
- B** absorb light of different intensities
- C** use light to build up food
- D** use light of different wavelengths for photosynthesis.

**1**

3. The flow chart below shows the energy flow in a field of potatoes during one year.

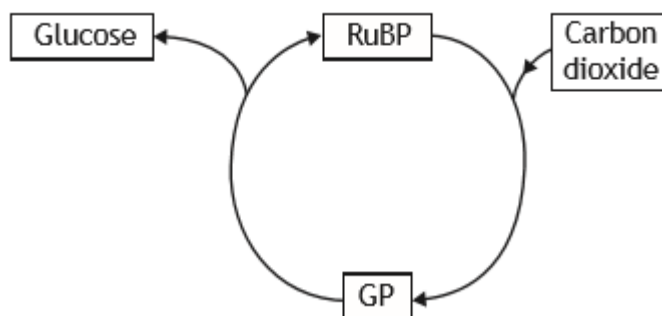


What is the percentage of the available light energy present in new growth and stored food in the potato crop?

- A 2.25
- B 1.25
- C 0.25
- D 1.00

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4. The diagram below represents part of the Calvin cycle within a chloroplast.



Which line in the table below shows the effect of decreasing CO<sup>2</sup> availability on the concentrations of RuBP and GP in the cycle?

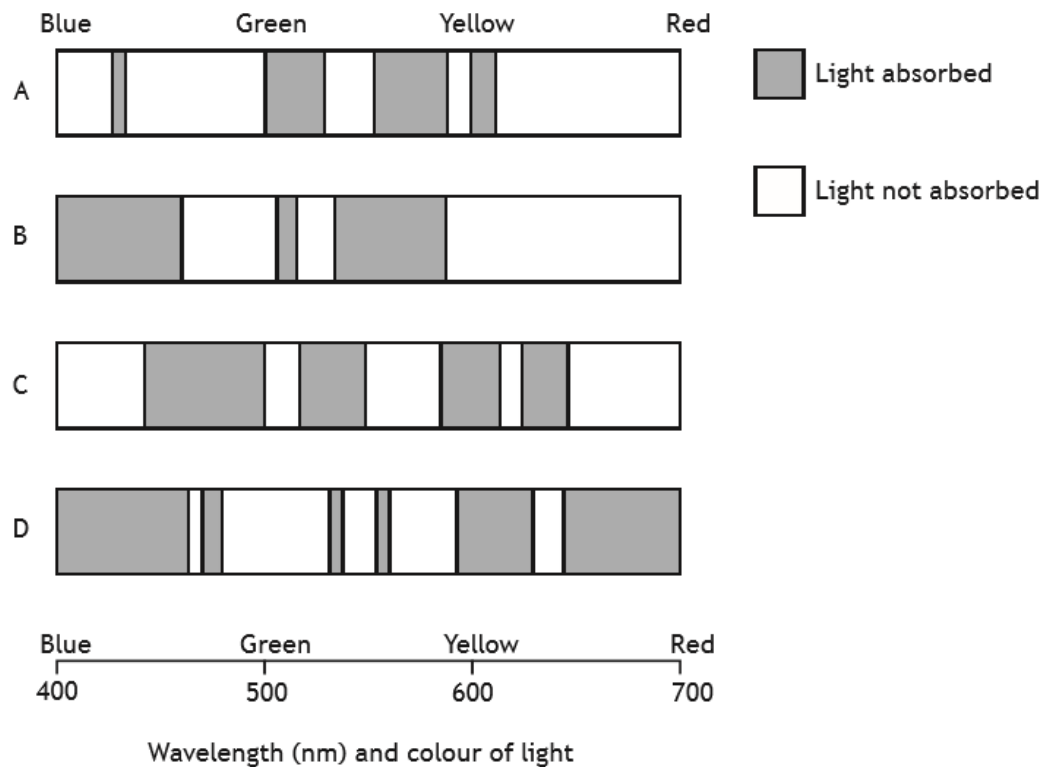
	<i>RuBP concentration</i>	<i>GP concentration</i>
A	decrease	decrease
B	increase	increase
C	decrease	increase
D	increase	decrease

1

- 5.** Which of the following results in a transfer of electrons down the electron transport chains during the light dependent reactions of photosynthesis?
- A** NADP is converted to NADPH
  - B** Water is split by photolysis
  - C** ATP is synthesised
  - D** Pigment molecules absorb energy **1**
- 6.** When quantifying plant productivity, the economic yield is the
- A** total biomass produced
  - B** biomass of desired product
  - C** increase in biomass due to photosynthesis
  - D** rate of biomass production per hectare. **1**
- 7.** Which compound combines with hydrogen during carbon fixation (Calvin cycle)?
- A** Ribulose biphosphate
  - B** NADP
  - C** Oxygen
  - D** 3-phosphoglycerate **1**

8. The following absorption spectra were obtained by testing four different plant extracts.

Which extract contains chlorophyll?



1

9. The table below shows the biological and economic yield of four different crops.

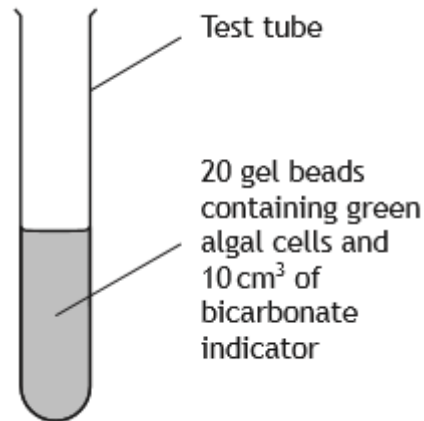
Crop	Biological yield (tonnes of dry mass/hectare)	Economic yield (tonnes of dry mass/hectare)
pea	10	2
rice	15	10
wheat	30	8
potato	30	10

The crop with the highest harvest index is

- A Pea
- B Rice
- C Wheat
- D Potato

1

10. An investigation was carried out to compare the rate of photosynthesis, at different light intensities, of green algal cells immobilised into gel beads.



Seven tubes were set up as shown in the diagram and each positioned at a different distance from a light source to alter the light intensity.

Photosynthesis causes the bicarbonate indicator solution to change colour. After 60 minutes, the bicarbonate indicator solution was transferred from each tube to a colorimeter.

The higher the colorimeter reading, the higher the rate of photosynthesis that has occurred in the tube.

Results are shown in the table.

<i>Tube</i>	<i>Distance of tube from light source (cm)</i>	<i>Colorimeter reading (units)</i>
1	25	92
2	35	92
3	50	83
4	75	32
5	100	14
6	125	6
7	200	0

- a) Identify the dependent variable in this investigation.

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1

- b)** Describe how the apparatus could be improved to ensure that temperature was kept constant.

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**1**

- c)** State an advantage of using algae immobilised into gel beads.

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**1**

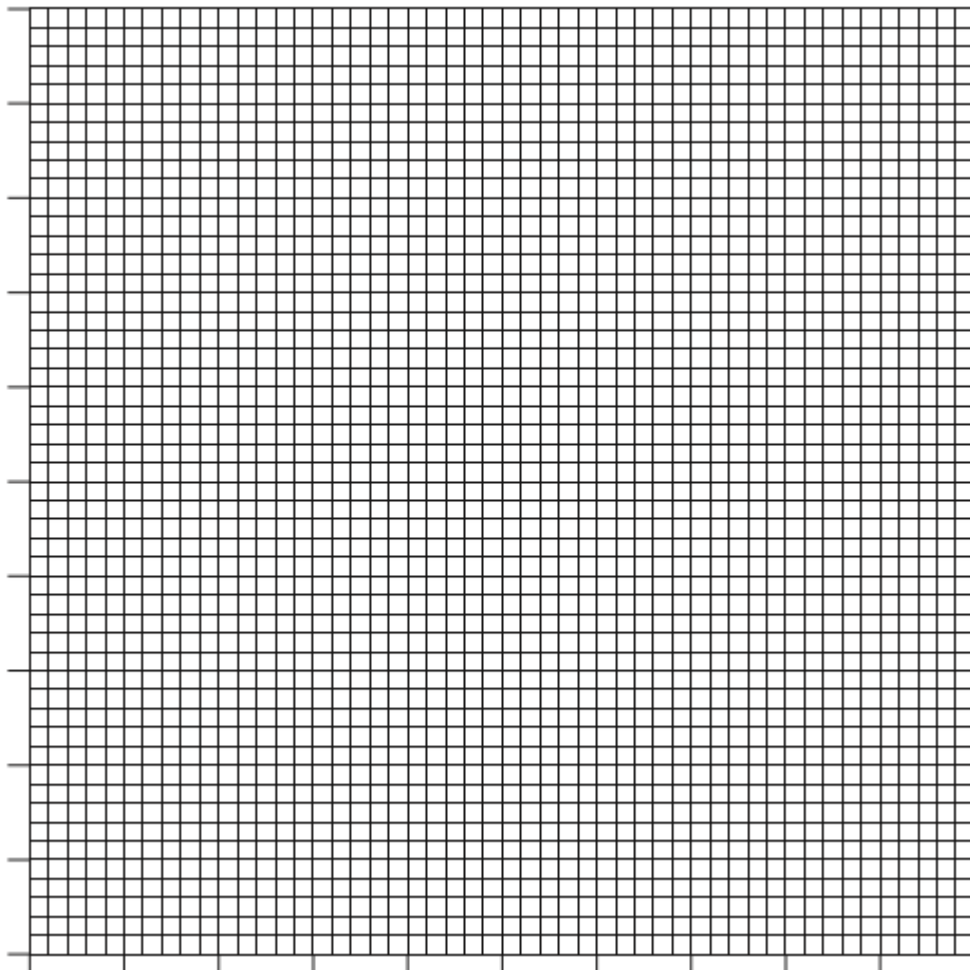
- d)** Describe how the experimental procedure could be improved to increase the reliability of the results.

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**1**

- e)** On the grid below, complete the line graph to show the colorimeter reading against distance of tube from light source.



**2**

- f) From the results of this investigation, draw a conclusion about the effect of light intensity on the rate of photosynthesis.

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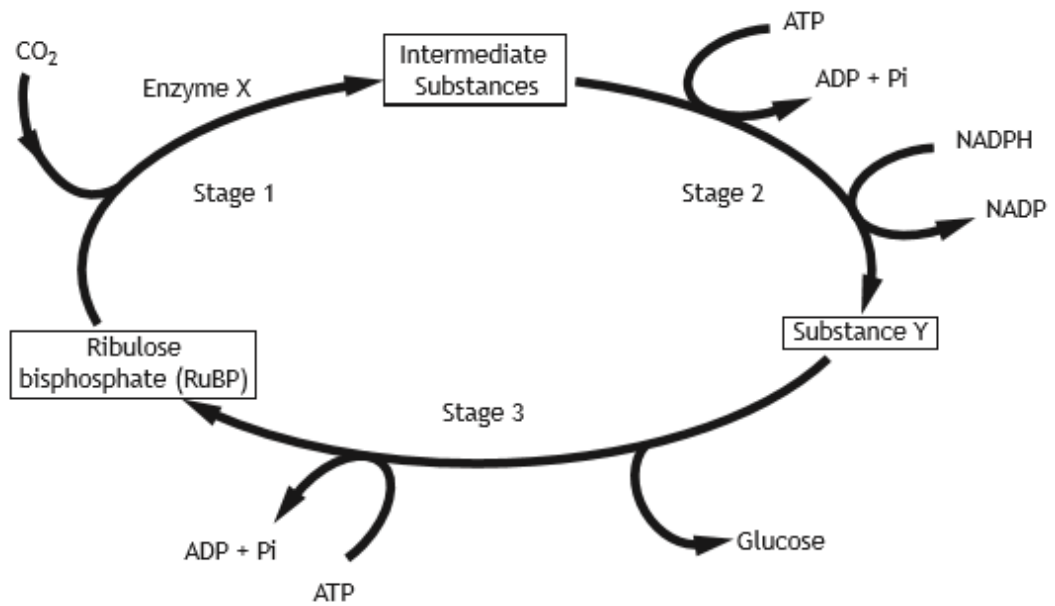
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2

11. The diagram below shows some stages in the Calvin cycle of photosynthesis.



- a) Name Enzyme X and Substance Y.

i) Enzyme X \_\_\_\_\_  
 Substance Y \_\_\_\_\_

2

- ii) Explain the importance of producing glucose and RuBP in Stage 3.

Glucose \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 RuBP \_\_\_\_\_

2



**b)** Research has been carried out which aims to increase photosynthesis in crop plants by inserting genes for the production of prokaryotic pigments into the cells. These pigments absorb wavelengths of light which are different to those absorbed by the pigments present in the crop plants.

i) Predict what would happen to the concentrations of ATP and NADPH in the crop plant cells.

ATP \_\_\_\_\_

NADPH \_\_\_\_\_

**2**

**12.** During photosynthesis light energy is absorbed by photosynthetic pigments in the chloroplasts.

**a) i)** State one fate of the light which is not absorbed by the photosynthetic pigments.

\_\_\_\_\_ **1**

ii) Describe the effect of absorbed light energy on the pigment molecules.

\_\_\_\_\_  
\_\_\_\_\_ **1**

iii) Plants contain several pigments including chlorophyll a, chlorophyll b and carotenoids.

Explain the advantage to a plant of having more than one type of photosynthetic pigment.

\_\_\_\_\_  
\_\_\_\_\_ **1**

**b)** Following photolysis, hydrogen is transferred to the coenzyme NADP. State the source of this hydrogen.

\_\_\_\_\_ **1**

**c)** Describe the role of the NADPH in the Calvin cycle (carbon fixation).

\_\_\_\_\_  
\_\_\_\_\_ **1**

**Higher Unit 3:**  
**Sustainability and Interdependence**  
**Topic 3.2 Plant and Animal Breeding**

- 1.** A field trial was set up to investigate the effect of phosphate fertiliser on the yield of the potato cultivar Maris Piper. Potatoes were planted in 5 plots, each of which received a different level of phosphate fertiliser. When they were harvested the yield from each plot was recorded.

A list of suggested improvements to this field trial is shown below.

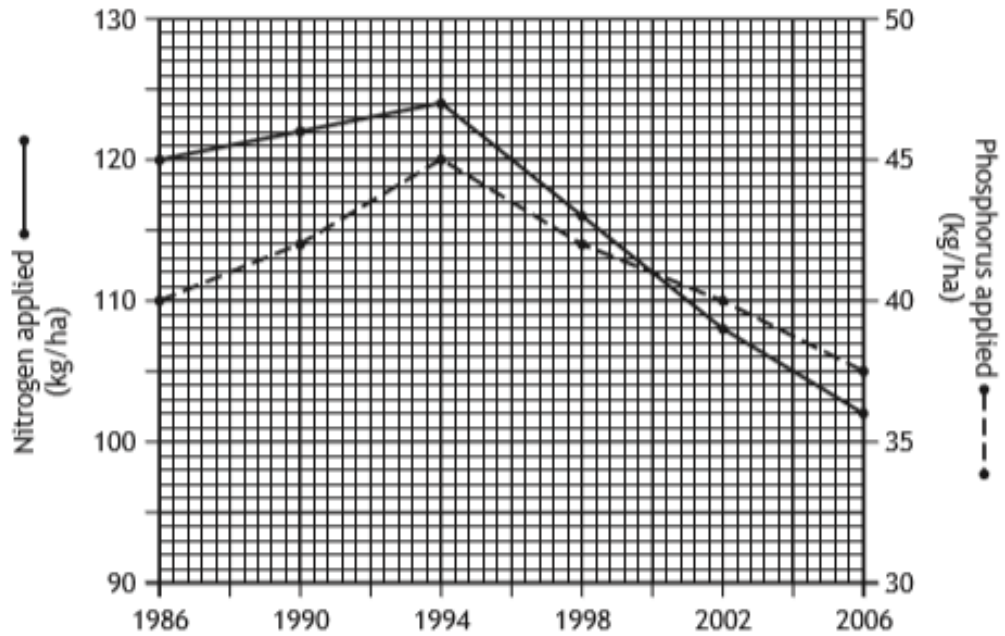
- 1** Apply equal volumes of water to each plot.
- 2** Grow the same number of potato plants in each plot.
- 3** Use 10 plots at each phosphate fertiliser level.
- 4** Plant different potato cultivars in each plot.

Which of the suggestions would improve the validity of the results?

- A** 1 and 2
- B** 1 and 3
- C** 2 and 4
- D** 3 and 4

**1**

2. The graph below shows the levels of nitrogen and phosphorus applied to crops in an area of Scotland between 1986 and 2006.



In which year was there the smallest difference between the levels of nitrogen and phosphorus applied?

- A 1998
- B 2000
- C 2002
- D 2006

**1**

3. Which of the following are features of naturally inbreeding crop plants?

- 1 Susceptible to inbreeding depression
- 2 Deleterious alleles eliminated by natural selection
- 3 Self-pollinating

- A 1 and 2 only
- B 1 and 3 only
- C 2 and 3 only
- D 1, 2 and 3

**1**

4. Inbreeding depression is a result of

- A an increase in heterozygotes
- B a genetically variable population
- C crossbreeding for improved characteristics
- D an accumulation of recessive deleterious alleles.

1

5. The average yield, fat and protein content of the milk from each of three breeds of dairy cattle were determined. The results are shown in the table below.

<i>Breed</i>	<i>Average milk yield per cow</i> (kg per day)	<i>Average fat content of milk</i> (%)	<i>Average protein content of milk</i> (%)
Pure bred Holstein	44.80	4.15	3.25
F <sub>1</sub> hybrid Holstein × Normande	48.64	4.25	3.10
F <sub>1</sub> hybrid Holstein × Scandinavian Red	51.52	4.25	3.15

a) Calculate the percentage increase in average milk yield per cow from the F<sub>1</sub> hybrid Holstein × Scandinavian Red compared to pure bred Holstein cattle.

\_\_\_\_\_ % 1

b) The fat content of milk is important for butter production. Calculate the total fat content in the milk produced in a day from a herd of 200 F<sub>1</sub> hybrid Holstein × Normande cattle.

*Space for calculation*

\_\_\_\_\_ kg per day 1

- c) Select one from: average milk yield per cow; average fat content of milk; or average protein content of milk.

For your choice, draw a conclusion about the effects of crossbreeding.

Choice \_\_\_\_\_

Conclusion

\_\_\_\_\_  
\_\_\_\_\_

**1**

- d) The development of pure breeds such as Holsteins has led to an accumulation of deleterious recessive alleles.

State the term that describes this.

\_\_\_\_\_

**1**

- e) Some F2 offspring from crosses of F1 hybrid Holstein × Scandinavian Red cattle will have less desirable milk-producing characteristics than their parents.

- i) Give **one** reason for this.

\_\_\_\_\_  
\_\_\_\_\_

**1**

- ii) Name a process breeders would have to carry out to maintain the milk-producing characteristics of the F1 hybrids in further generations.

\_\_\_\_\_

**1**

- 6.** Genetically modified (GM) crops are evaluated in field trials. Certain experimental procedures are required when setting up field trials to compare GM and non GM crops. Give one such procedure and explain how it allows valid conclusions to be drawn.

Procedure

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Explanation

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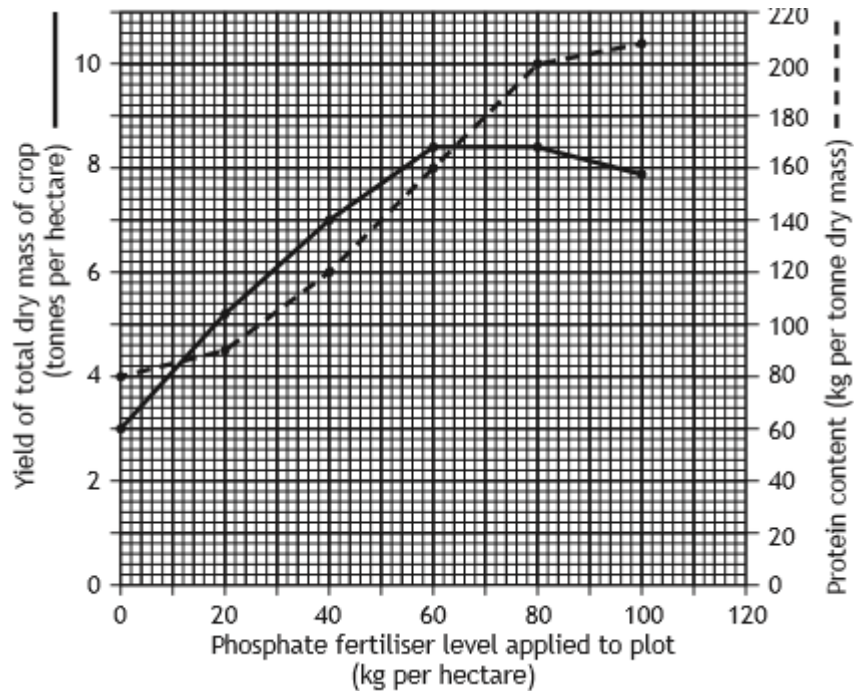
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**2**

7. Alfalfa is a crop plant often grown for cattle food.

In a field trial, alfalfa was grown in six plots each of which had been treated with a different level of phosphate fertiliser. The alfalfa was harvested after 24 weeks of growth and the total dry mass of the crop at each fertiliser level was calculated. The protein content of the alfalfa grown at each fertiliser level was determined.

The results are shown in the graph below.



a) i) **Use values from the graph** to describe the changes in the yield of total dry mass of the crop as the phosphate fertiliser level was increased from 0 to 100 kg per hectare.

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2

ii) Predict the protein content of an alfalfa crop if 120 kg of phosphate fertiliser per hectare had been applied.

\_\_\_\_\_ kg per tonne dry mass 1



- iii) Calculate the total mass of protein produced from one hectare when 40 kg of phosphate fertiliser per hectare was applied.

\_\_\_\_\_ kg

**1**

- b) In a feeding trial, three groups of 10 cattle were fed with alfalfa of different protein contents over a 25-day period. The cattle were weighed at the beginning and end of this period and the average increase in their body mass calculated. The results are shown in the table below.

<i>Cattle group</i>	<i>Protein content of alfalfa fed to cattle (kg per tonne dry mass)</i>	<i>Average increase in body mass of cattle over a 25 day period (kg)</i>
1	80	12
2	90	15
3	120	17

- i) State how the design of the feeding trial ensured the reliability of the results.

**1**

- ii) Using the information from the **table**, calculate the average increase in body mass per day of the cattle in Group 2.

\_\_\_\_\_ kg per day

**1**

- iii) Using information from the **graph and table**;  
**1** suggest the phosphate fertiliser level which was applied in the production of the alfalfa which the cattle in Group 2 were fed;

\_\_\_\_\_ kg per hectare

**1**

2 draw a conclusion about how phosphate fertiliser levels applied to the alfalfa affected the growth of cattle in the feeding trial.

1

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8. Colchicine is a chemical used in plant breeding programmes to induce mutations and produce cultivars with improved characteristics.

Sesame is an important crop plant grown for its edible seeds and leaves.

An investigation was carried out to determine the effects of colchicine concentration on sesame. Sesame seeds were soaked in different concentrations of colchicine solution for 24 hours. Seeds from each concentration were germinated and 50 plants were grown from each concentration. Ninety days later the total leaf area, number of seeds and mass of seeds per plant were recorded.

The average results are shown in the table below.

<i>Colchicine concentration (m mol l<sup>-1</sup>)</i>	<i>Average total leaf area per plant (cm<sup>2</sup>)</i>	<i>Average number of seeds per plant</i>	<i>Average total mass of seeds per plant (g)</i>
0	1500	548	2.8
0.1	2315	532	3.5
0.5	2786	550	4.4
1.0	3500	512	4.7

- a) i) Identify the independent variable in this investigation.

1

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- ii) State an aspect of the investigation which helped to ensure that reliable results were obtained.

1

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**b)** An important characteristic of food crops is the 1000 seed mass which is the total mass of a sample of 1000 seeds.

i) Calculate the 1000 seed mass for the plants grown from seeds soaked in a colchicine concentration of  $0.5 \text{ m mol l}^{-1}$ .

\_\_\_\_\_ g **1**

ii) Express, as the simplest whole number ratio, the average total leaf area per plant from seeds soaked in a colchicine concentration of 0 to that at  $1.0 \text{ m mol l}^{-1}$ .

\_\_\_\_\_ : \_\_\_\_\_  
0                      1.0  
 $\text{m mol l}^{-1}$                $\text{m mol l}^{-1}$

**1**

**c)** Explain the relationship between the total leaf area and total mass of seeds.

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**2**

9. Gluten is a protein found in crops that can cause human health problems. Scientists are breeding barley cultivars to produce ultra low gluten levels.

A commercially produced barley (Sloop) and a low gluten cultivar (LG) were crossed to produce two different cultivars with ultra low gluten levels (ULG 1 and ULG 2).

The gluten content of each cultivar is shown in the table.

<i>Barley cultivar</i>	<i>Gluten content (mg/g)</i>
Sloop	57.0
LG	5.1
ULG 1	1.7
ULG 2	0.004

- a) Calculate how many times greater the gluten content of Sloop is compared to that of ULG 2.

\_\_\_\_\_ times greater **1**

- b) The allele for ultra low gluten is recessive. To investigate if the cultivar LG was heterozygous for gluten, it was crossed with the cultivar ULG1 which was homozygous for this recessive allele.



- i) Name this type of cross.

\_\_\_\_\_

**1**

- ii) Describe the expected phenotypes of the offspring if LG was heterozygous.

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**1**

- c) Barley is a naturally inbreeding plant.

Explain why inbreeding depression would be unlikely to be a problem when a barley cultivar self-pollinates for many generations.

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**1**

- d) Barley grains contain the enzyme amylase which breaks down starch in the grain to sugar used in brewing beer.

Average grain mass, starch content and amylase activity for three barley cultivars are shown in the table.

<i>Barley cultivar</i>	<i>Average mass of a single grain (mg)</i>	<i>Starch content of grains (%)</i>	<i>Amylase activity (units/mg)</i>
Sloop	53.6	70	0.6
ULG1	33.5	65	1.0
ULG2	39.2	64	1.4

- i) As well as total mass of all the grains, state the information required in order to calculate the average mass of a single grain.

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**1**

- ii) Select a cultivar from the table that would be best to use in beer production and justify your selection.

Cultivar \_\_\_\_\_

Justification \_\_\_\_\_

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**1**

**Higher Unit 3:  
Sustainability and Interdependence  
Topic 3.3 Crop protection**

**1.** The list below gives some adaptations of weed plants.

- 1 high seed output
- 2 possession of storage organs
- 3 vegetative reproduction
- 4 long term seed viability

Which of these are competitive adaptations of annual weeds?

- A** 1 and 2 only
- B** 1 and 4 only
- C** 2 and 3 only
- D** 2 and 4 only

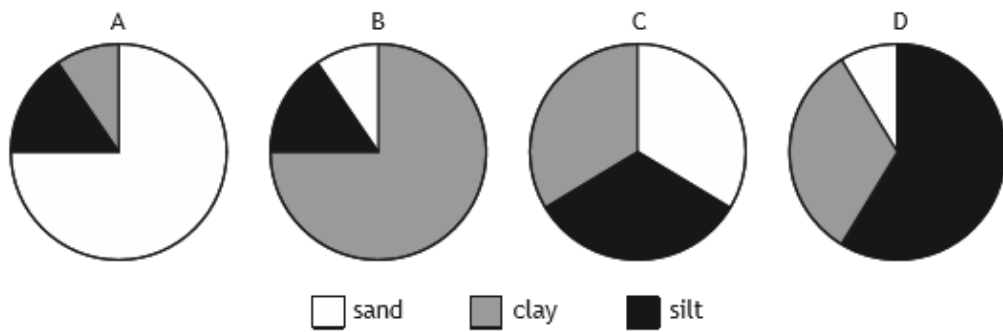
**1**

2. Soil type is dependent on the composition of its components which in turn affects the productivity of plants growing in it.

The table below shows the percentage of each component present in four different soils.

Soil type	Component (%)		
	clay	silt	sand
sandy clay loam	20-30	0-30	50-80
clay loam	20-35	20-60	20-50
sandy silt loam	0-20	40-80	20-50
silty clay loam	20-35	45-80	0-20

Which of the following charts represents a clay loam?



1

3. The table below shows the number of beet armyworm larvae found in plots of cotton plants.

Some plots were treated with insecticide on 27 June and 1 August and other plots left untreated.

<i>Sampling date</i>		<i>Number of beet armyworm larvae</i>	
		Treated plots	Untreated plots
July	8	3	3
	15	33	2
	22	22	17
	29	42	10
August	5	120	8
	12	160	10

Which of the following is the most likely explanation for the differences between the treated and untreated plots?

- A The insecticide kills a predator of the larvae
- B The larvae are resistant to the insecticide
- C The beet armyworm breeds in July
- D The larvae have a short lifecycle

1



4. The table shows optimum, maximum and minimum temperatures for the growth of some crop plants.

<i>Crop</i>	<i>Temperature (°C)</i>		
	<i>Optimum</i>	<i>Maximum</i>	<i>Minimum</i>
Maize	22–26	32–34	20–22
Wheat	20–25	36–38	5–7
Rice	30–33	37–40	18–22
Potato	15–20	28–34	12–14
Soyabean	25–28	37–40	10–14

Which of the following predictions is supported by the evidence in the table?

- A Maize will grow at lower temperatures than soyabean.
- B Rice will grow at higher temperatures than soyabean.
- C Rice will grow in a narrower range of temperatures than maize.
- D Wheat will grow in a wider range of temperatures than potato.

**1**

- 5.** Harlequin ladybirds, *Harmonia axyridis*, were introduced to the UK from their native habitat in Eastern Asia in order to reduce the population of aphids, which feed on crop plants.

Since their introduction, harlequin ladybirds have spread rapidly and their population has dramatically increased. As a result the populations of some ladybird species have dramatically decreased, although the population of native seven-spot ladybirds has remained relatively stable.

- a)** Name this control method used to manage the population of aphids.

**1**

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- b)** Using the information given, explain why the harlequin ladybird can be described as an invasive species.

**1**

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- c)** Suggest one reason why the population size of the seven-spot ladybird has remained relatively stable.

**1**

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- d)** Give a reason why the population of harlequin ladybirds has increased more quickly in the UK than in their native habitat.

**1**

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**6.** Potato plants are attacked by leaf eating caterpillars. *Bacillus thuringiensis* is a bacterium which can be used to control these pests. The bacteria produce a protein (Bt toxin) which kills these caterpillars.

**a) i)** Explain how an attack by leaf eating caterpillars causes a reduction in crop yield.

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**2**

ii) State an advantage of using this type of biological control rather than using chemicals.

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**1**

**b)** Bt toxin does not kill all caterpillars. A study was carried out to investigate the effectiveness of the Bt toxin compared with a modified Bt toxin by exposing different groups of caterpillars to them. The results are shown in the table.

<i>Toxin tested</i>	<i>Number of caterpillars tested</i>	<i>Number of caterpillars surviving</i>	<i>Caterpillars killed (%)</i>
Bt toxin alone	240	204	
Modified Bt toxin alone	300	105	65
Bt toxin and modified Bt toxin used together	210	42	80

i) Complete the table to show the percentage of caterpillars killed by the Bt toxin alone.

**1**

- ii) The Bt toxin and modified Bt toxin work by different mechanisms. Use information from the table to justify this statement.

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**1**

**Higher Unit 3:  
Sustainability and Interdependence  
Topic 3.4 Animal Welfare**

**1.** The list below describes observed behaviour of pigs on a farm.

- 1 Stereotypic flicking of the head
- 2 Repeated wounding of other pigs by biting
- 3 Lying in a position which does not allow suckling

Which of these behaviours indicate poor animal welfare?

- A** 1 and 2 only
- B** 1 and 3 only
- C** 2 and 3 only
- D** 1, 2 and 3

**1**

**2.** The statements below refer to behaviour sometimes displayed by lions kept in captivity.

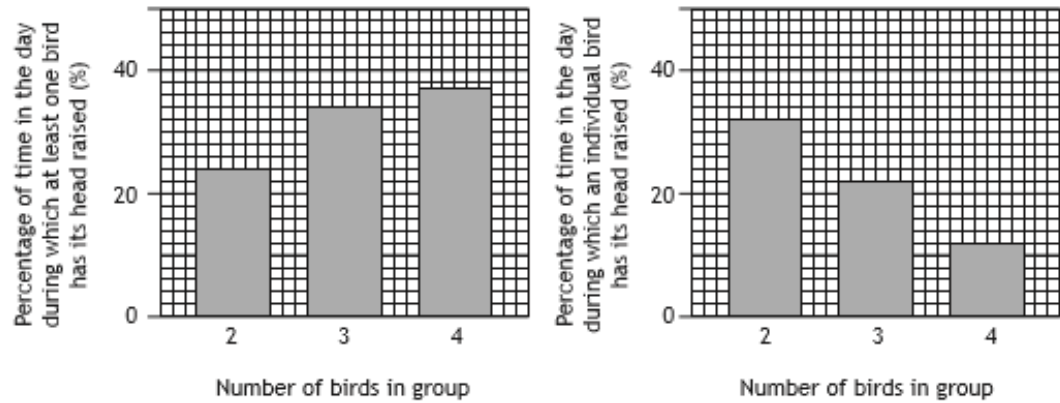
- 1 Repetitive chewing on cage bars
- 2 Excessive licking of body
- 3 Continually pacing backwards and forward

Which are examples of stereotypy?

- A** 1 only
- B** 1 and 2 only
- C** 2 and 3 only
- D** 1, 2 and 3

**1**

3. Ostriches are large birds that live on open plains in Africa. They divide their time between feeding on vegetation and raising their heads to look for predators. The graphs below show the results of a study on the effect of group size in ostriches on their behaviour.

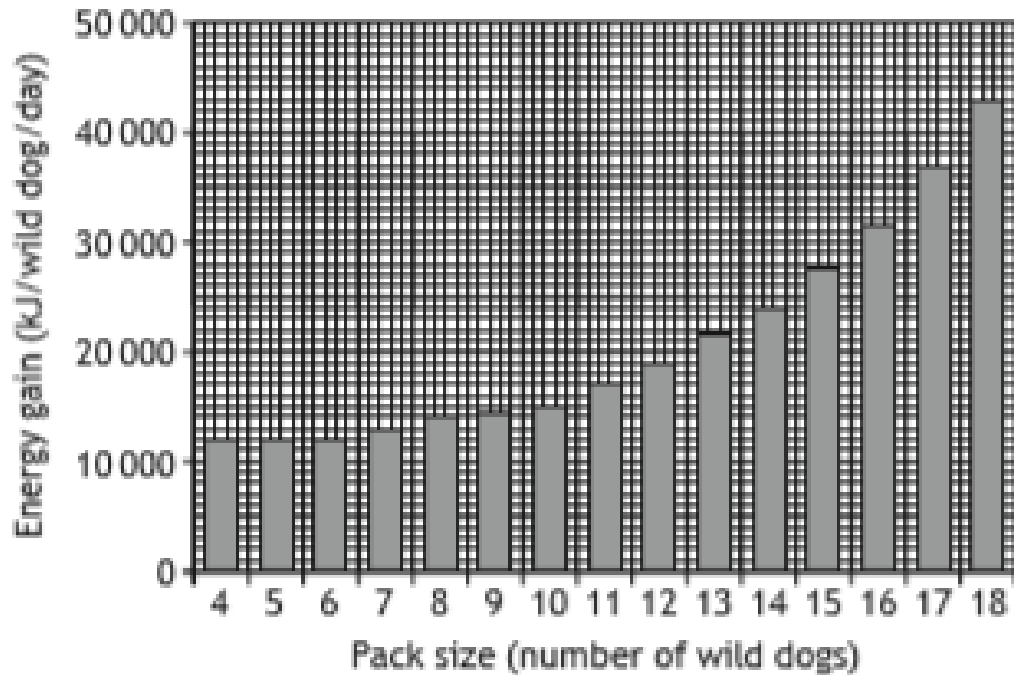


Which of the following is a valid conclusion from these results? In larger groups, an individual ostrich spends

- A less time with its head raised so the group is less likely to see predators
- B less time with its head raised but the group is more likely to see predators
- C more time with its head raised so the group is more likely to see predators
- D more time with its head raised but the group is less likely to see predators. **1**

4. African wild dogs are carnivores which live in packs and use cooperative hunting. Each wild dog requires an average of 30 000 kJ of energy per day for the pack to survive.

The bar chart shows the relationship between pack size and energy gain per wild dog per day.



- a) Using information from the bar chart, state the minimum pack size

- i) at which cooperative hunting becomes an advantage;

\_\_\_\_\_ wild dogs

**1**

- ii) for survival of the pack.

\_\_\_\_\_ wild dogs

**1**

- b) Suggest why wild dogs in larger packs gain more energy per individual from hunting even though there are more animals to be fed.

\_\_\_\_\_  
\_\_\_\_\_

**1**

- c) Most of the wild dogs in a pack are related. Usually only one dominant female has offspring which other members of the pack will feed.

Explain why pack members feed offspring which are not their own.

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**1**



**Higher Unit 3:**  
**Sustainability and Interdependence**  
**Topic 3.5 Symbiosis**

- 1.** Adult beef tapeworms live in the intestine of humans. Segments of the adult worm are released in the faeces. Embryos that develop from them remain viable for five months. The embryos may be eaten by cattle and develop in their muscle tissue.

Which row in the table below identifies the roles of the human, tapeworm embryo and cattle?

	<i>Role</i>		
	<i>human</i>	<i>tapeworm embryo</i>	<i>cattle</i>
A	host	resistant stage	secondary host
B	host	vector	secondary host
C	secondary host	vector	host
D	secondary host	resistant stage	vector

**1**

- 2.** The following statements describe symbiotic relationships between organisms.
- 1 Mistletoe plants absorb nutrients from apple trees on which they grow.
  - 2 Egyptian Plover birds clean the teeth of Nile crocodiles and feed on the debris they remove.
  - 3 Tapeworms live in the small intestine of pigs and absorb some of their nutrients. Which of these relationships can be described as parasitic?

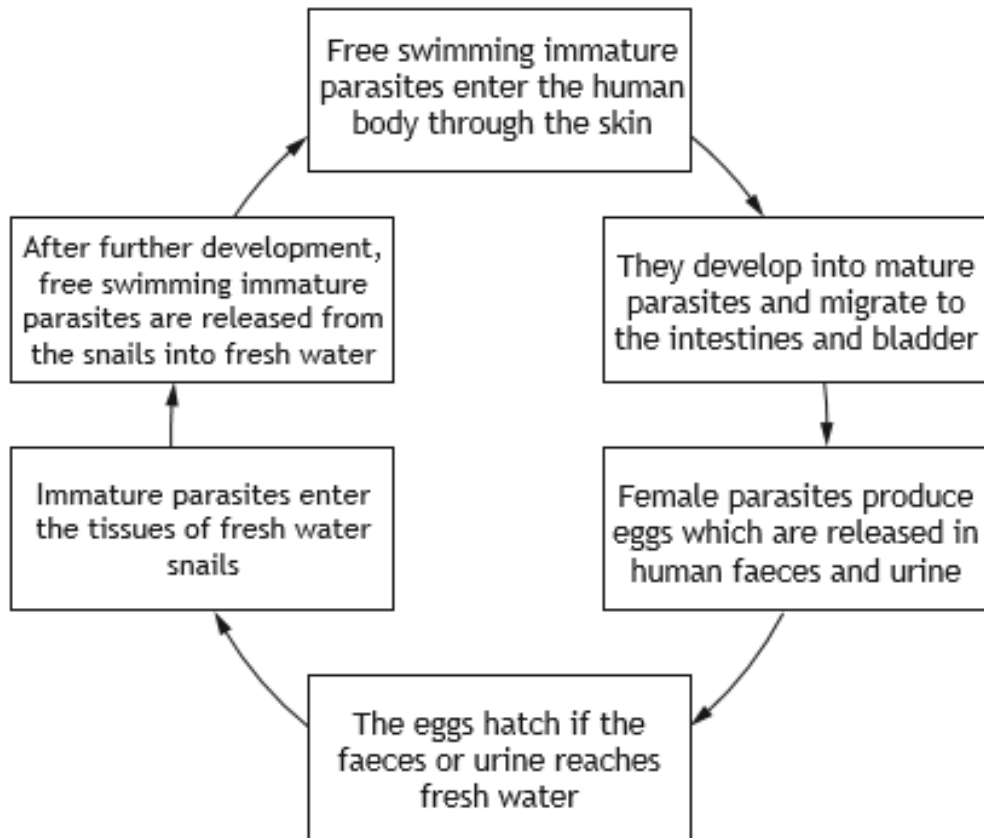
- A** 2 only  
**B** 3 only  
**C** 1 and 2 only  
**D** 1 and 3 only

**1**

3. The parasite *Schistosoma mansoni* causes the condition schistosomiasis in humans.

The condition is common in tropical regions where the parasite is often present in fresh water. Humans can be infected if they enter water containing the parasite.

The life cycle of *Schistosoma mansoni* is shown below.



- a) Explain why *Schistosoma mansoni* is described as a parasite.

\_\_\_\_\_

**1**

- b) Identify the secondary host and suggest a benefit to *Schistosoma mansoni* of including a secondary host in its life cycle.

Secondary host \_\_\_\_\_

Benefit \_\_\_\_\_

\_\_\_\_\_

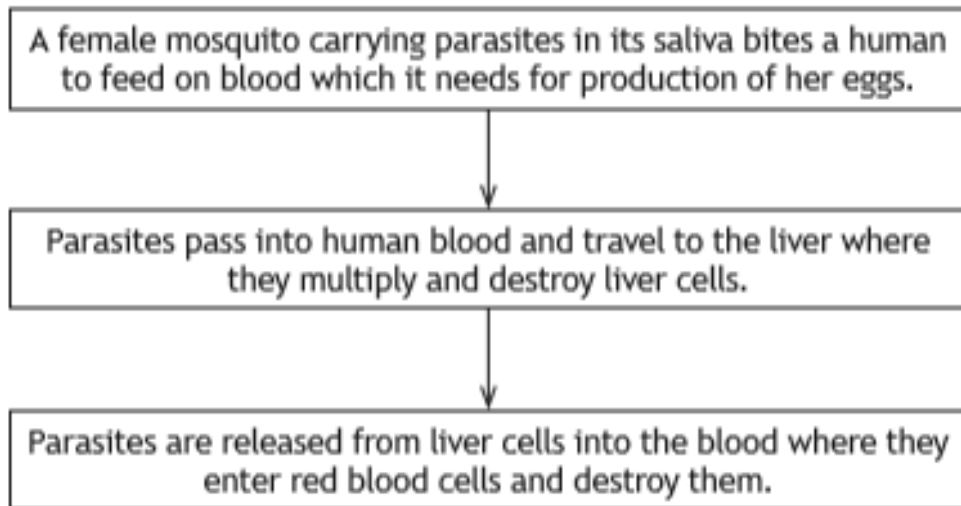
**2**

- c) Describe **one** measure which could be adopted to reduce the number of cases of schistosomiasis.

1

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4. Malaria is a disease in humans caused by a parasite which is transmitted from human to human by mosquitoes. The stages of infection in humans are shown in the flow diagram below.



- a) i) Identify the vector in this parasitic relationship.

1

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- ii) Give a reason why only female mosquitoes transmit the malaria parasite.

1

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- b) Explain the effect of a parasitic relationship on the host.

1

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c) Two methods used to control the spread of malaria are described below.

Method 1 – mosquito repellent applied to the skin.

Method 2 – anti-malarial drugs that kill the parasite.

Choose one of these methods and explain how it can reduce the number of cases of malaria.

Method \_\_\_\_\_

Explanation \_\_\_\_\_

\_\_\_\_\_

**1**

**Higher Unit 3:**  
**Sustainability and Interdependence**  
**Topic 3.6 Animal Behaviour**

- 1.** In primates such as chimpanzees, parental care
- A** occurs over a short time period
  - B** provides time for learning complex social behaviour
  - C** increases the parent's social status within their group
  - D** involves appeasement behaviour within a group. **1**
- 2.** Altruistic behaviour between closely related animals
- A** reduces competition between individuals in the population
  - B** increases the survival chances of the donor animal
  - C** increases the frequency of shared genes in the next generation
  - D** reduces unnecessary aggression and conflict in social groups. **1**
- 3.** A species that plays a role vital for the survival of many other species in an ecosystem is called
- A** a keystone species
  - B** a native species
  - C** an invasive species
  - D** a dominant species. **1**

4. On returning to their roost after feeding, vampire bats may regurgitate blood to feed an unrelated individual in the same social group.

This is an example of

- A mutualism
- B altruism
- C social hierarchy
- D kin selection.

**1**

5. Some species of social insect are of economic importance to humans by providing ecosystem services.

Which of the following are examples of ecosystem services?

- 1 Braconid wasps parasitising hornworms which are a pest of tomatoes.
- 2 Bumblebees pollinating an orchard of apple trees.
- 3 Worker termites caring for the queen and her offspring.

- A 1 and 2 only
- B 1 and 3 only
- C 2 and 3 only
- D 1, 2 and 3

**1**

6. The honey bee (*Apis mellifera*) is a social insect that lives in colonies.

The queen is the only female in a colony that reproduces. Other females are workers that collect food, maintain the colony and care for the developing offspring.

a) Explain the advantage to the worker bees of caring for the offspring of the queen.

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2

b) The graph below shows the changes in the number of honey bee hives kept by bee-keepers in the USA from 1945 to 2005.



i) **Using values from the graph**, describe changes in the number of bee hives from 1980 to 1995.

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1

- ii) Calculate the simplest whole number ratio of the number of bee hives in 1965 and 2005.

\_\_\_\_\_ hives in 1965 : \_\_\_\_\_ hives in 2005

**1**



### Higher Unit 3:

### Sustainability and Interdependence

### Topic 3.7/8 Mass Extinction and Threats to Biodiversity

1. Which row in the table identifies how the bottleneck effect and habitat corridors may change genetic diversity of a population?

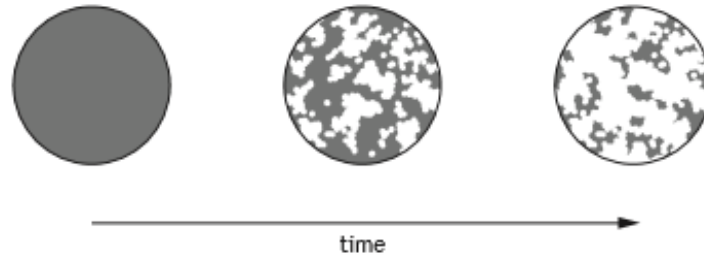
		<i>Change in genetic diversity</i>	
		<i>Bottleneck effect</i>	<i>Habitat corridors</i>
A		decrease	decrease
B		decrease	increase
C		increase	decrease
D		increase	increase

1

2. The biodiversity and the genetic diversity of individual species are affected when fragments of woodland become isolated.

The diagram below illustrates habitat fragmentation of an area of woodland over time.

The shaded areas represent woodland.



- a) i) Name **one** component of genetic diversity.

\_\_\_\_\_ **1**

- ii) Suggest a reason why a decrease in genetic diversity of an individual species can lead to local extinctions within habitat fragments.

\_\_\_\_\_  
\_\_\_\_\_ **1**

- b) Suggest how habitat edge species might affect interior species as the habitat fragments become smaller.

\_\_\_\_\_  
\_\_\_\_\_ **1**

- c) Habitat corridors can be created to remedy habitat fragmentation.

- i) State what is meant by the term "habitat corridor".

\_\_\_\_\_  
\_\_\_\_\_ **1**

- ii) Explain how a habitat corridor can increase biodiversity after local extinction.

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**1**

- 3.** Japanese knotweed (*Fallopia japonica*) was introduced to Britain as an ornamental plant. It grows to 3 metres in height and has large leaves. It has become naturalised and has colonised many parts of the country where it out-competes native plants.

- a)** Give the term used for a naturalised species that eliminates native species.

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**1**

- b)** Name one resource for which Japanese knotweed may outcompete the native plants.

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**1**

- c)** An insect from Japan, which feeds on Japanese knotweed, has been proposed as a biological control agent.

- i) Describe one possible risk of introducing this insect into Britain.

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**1**

- ii) Describe a procedure that should be carried out to assess the risk of introducing this insect.

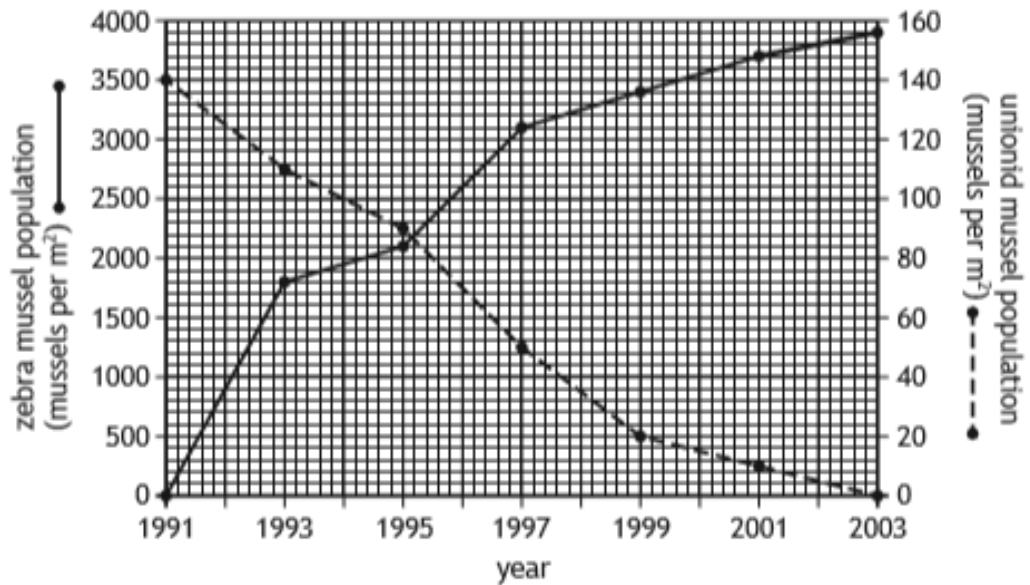
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**1**

4. Freshwater mussels are small animals which live on the beds of lakes and rivers. Zebra mussels are a species of freshwater mussel native to lakes in Russia. They were accidentally introduced by humans into a river in North America in 1991. The populations of zebra mussels and the native unionid mussels were measured over a 12 year period.

The results are shown in the graph below.



- a) i) State the unionid mussel population in 1993.

\_\_\_\_\_ mussels per m<sup>2</sup> **1**

- ii) State the zebra mussel population when the unionid mussel population was 50 mussels per m<sup>2</sup>.

\_\_\_\_\_ mussels per m<sup>2</sup> **1**

- iii) Calculate the average increase per year in the zebra mussel population between 1991 and 2003.

\_\_\_\_\_ mussels per m<sup>2</sup> per year **1**

- b)** Explain how the graph confirms that zebra mussels are more successful competitors than unionid mussels.

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**1**

- c)** **Using evidence from the graph,** explain why zebra mussels are an invasive species.

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**1**

- d)** Suggest a reason why the population of zebra mussels may have increased faster in the North American river than in its native habitat.

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**1**

- e)** Invasive species have a negative impact on genetic diversity of an ecosystem.

State what is meant by genetic diversity.

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**1**