WESTMINSTER SCHOOL
THE CHALLENGE 2023

BIOLOGY

Thursday 27 April 2023

Time allowed: 30 minutes

Write your answers in the spaces provided.

Calculators are allowed.

Please write in black or blue ink.

For examiner use only

Total Mark	

Questions 1 through 10 are multiple choice questions.

Select one answer for each question.

Carefully and clearly write your answer to each of the ten multiple choice questions in the answer grid below .

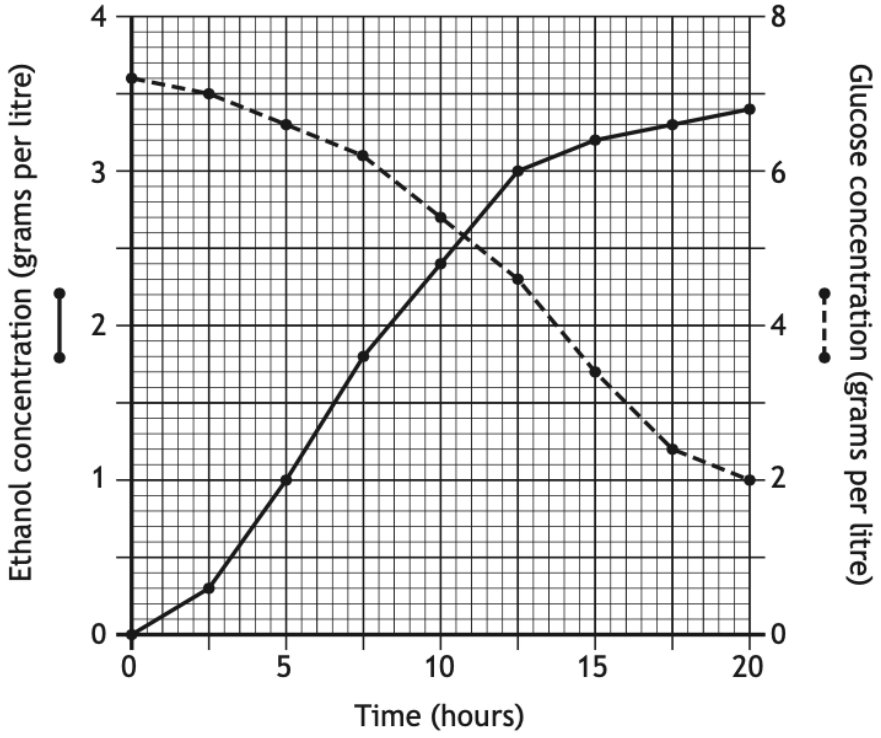
Question	Answer
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Carefully and clearly write your answer to each of the ten multiple choice questions in the answer grid on the previous page .

1.

In an investigation into fermentation, yeast was grown in a flask of glucose solution for 20 hours at 20 °C.

The graph shows the concentrations of ethanol and glucose in the flask over the period of the investigation.



What was the glucose concentration when the ethanol concentration was 3·3 grams per litre?

A 1·2 grams per litre

B 2·2 grams per litre

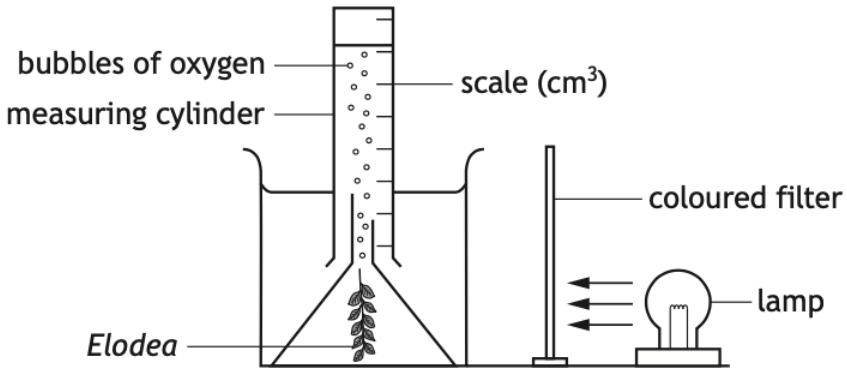
C 2·4 grams per litre

D 6·6 grams per litre

2.

The diagram shows apparatus used in an investigation to measure the rate of photosynthesis in *Elodea* (pondweed) at different wavelengths of light.

Coloured filters were used to change the wavelength of the light. The volume of oxygen collected after 30 minutes was used to measure the rate of photosynthesis.



Suggested improvements to the investigation are shown.

1 Use a measuring cylinder with a narrower diameter.

2 Repeat the experiment several times and take averages.

3 Use a scale with more divisions.

Which of these suggestions would improve the accuracy of the results?

A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

3.

An experiment was carried out to investigate the growth rate of pigs. They were put into five groups of eight pigs, each with the same average initial body mass. Each group was fed a diet which contained either 0, 10%, 20%, 30% or 40% faba beans. The pigs were re-weighed each day for 40 days.

Which aspect of the experimental design increased reliability of the results?

A Five groups of pigs were used.

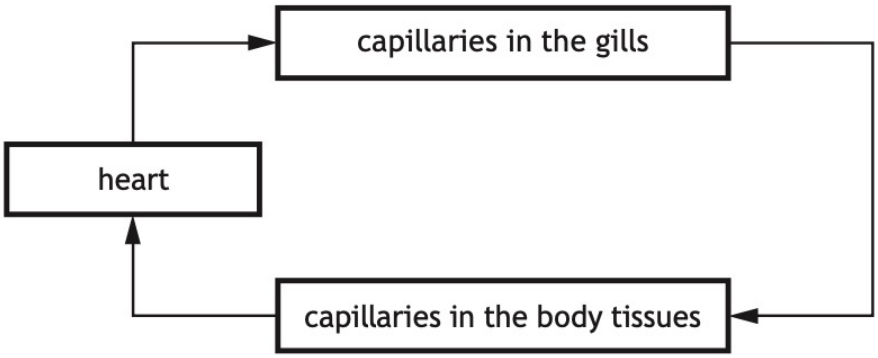
B The pigs were re-weighed each day for 40 days.

C Each group had the same average initial body mass.

D Each group contained eight pigs.

4.

The diagram illustrates the circulatory system of a fish. The arrows indicate the direction of blood flow.



Which row in the table describes the type of circulatory system of a fish and the blood pressure in the capillaries in the gills and body tissues?

	Type of circulatory system	*Blood pressure in the capillaries in the gills*	*Blood pressure in the capillaries in the body tissues*
A	single	lower	higher
B	double	higher	lower
C	single	higher	lower
D	double	lower	higher

5. The table below shows the results of pharmacogenetic tests on a drug designed to treat a liver infection in a group of patients.

		Number of patients	
		beneficial effect on patient	no beneficial effect on patient
Number of patients	toxic side-effects	30	15
	no side-effects	60	45

What percentage of the patients gained benefit from the drug but showed toxic side-effects?

A 20

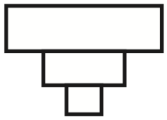
B 25

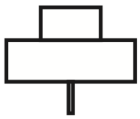
C 30

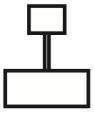
D 90

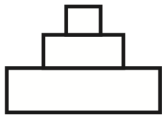
6. Beech tree ⟶ greenfly ⟶ ladybirds

Which of the following diagrams represents the pyramid of numbers for the above food chain?

A 

B 

C 

D 

7. 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.

		Number of beet armyworm larvae	
Sampling date		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?

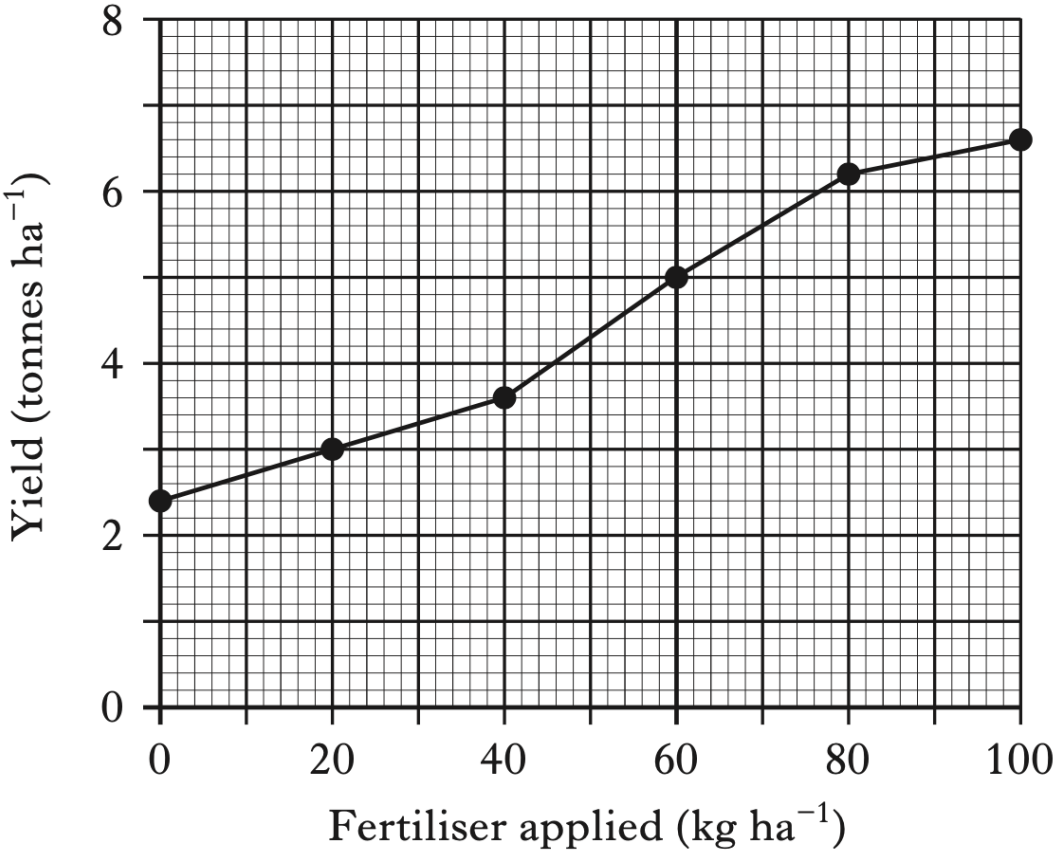
A The insecticide kills a predator of the larvae

B The larvae are resistant to the insecticide

C The beet armyworm breeds in July

D The larvae have a short lifecycle

8. The graph below shows the effect of applying different concentrations of fertiliser on the yield of a crop plant.



The percentage increase in yield obtained when the fertiliser application is increased from 60 to 80 kg ha−1 is

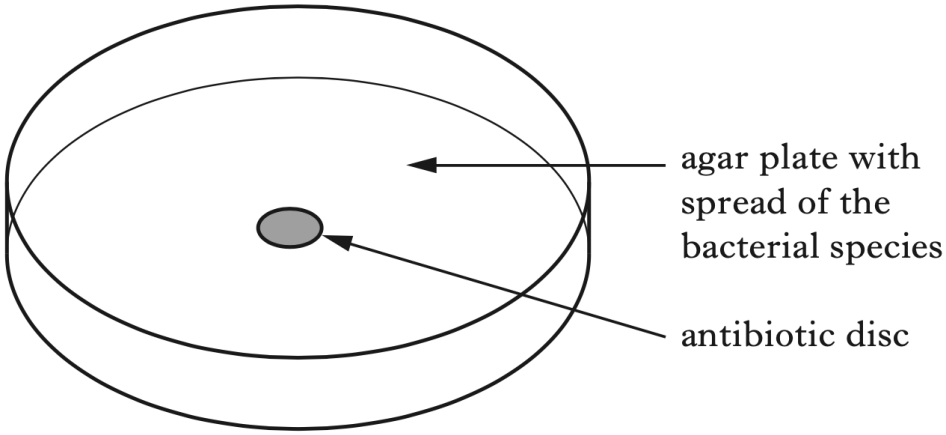
A 1·2%

B 6·2%

C 24%

D 124%.

9. The effect of an antibiotic on a bacterial species was tested by spreading a culture of the bacterial species on an agar plate and adding a disc of absorbent paper soaked in the antibiotic as shown in the diagram below.



The plate was incubated for 24 hours at 30 °C and the growth examined.

Which of the following would be a suitable control for this experiment?

Repeat the experiment exactly but

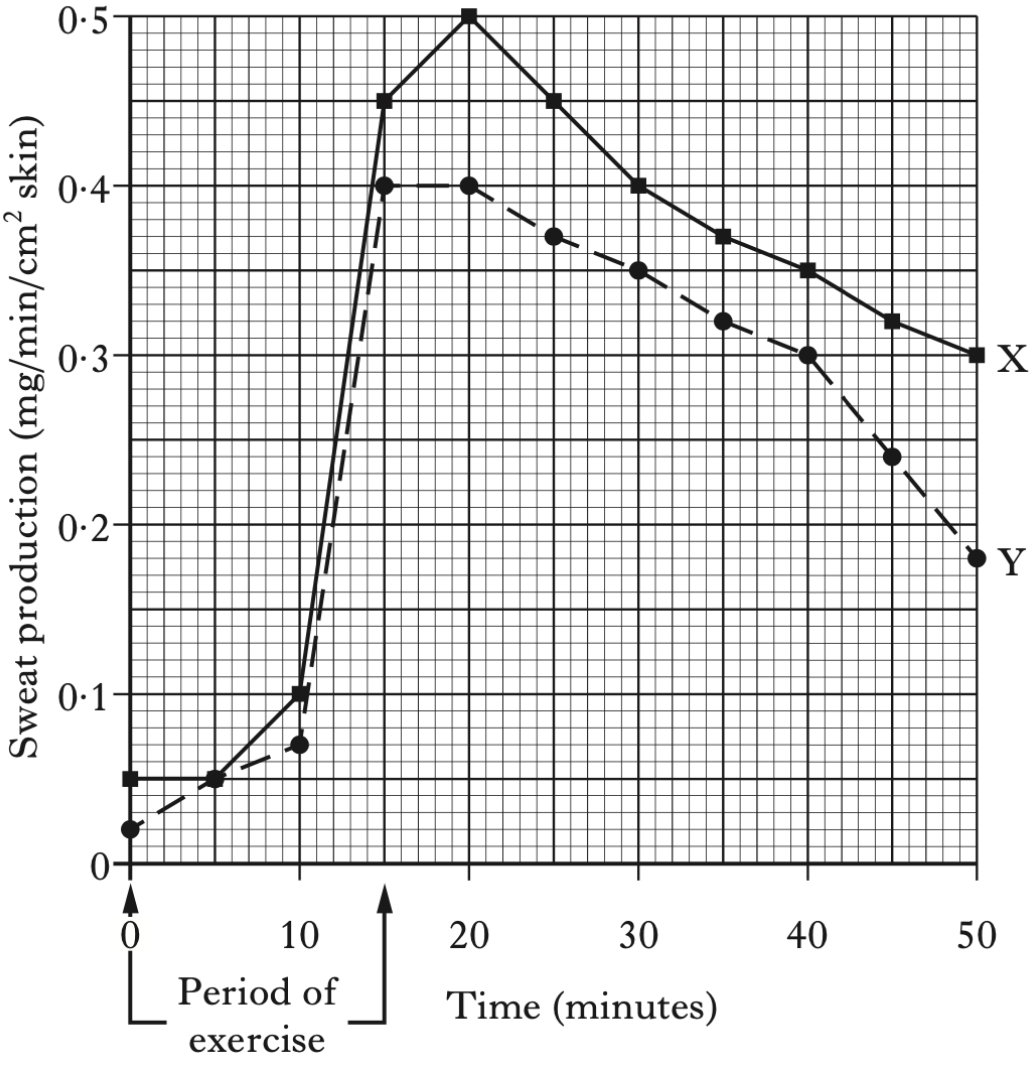
A with no bacteria

B incubate at human body temperature

C use a disc with no antibiotic

D use a disc with a different antibiotic.

10. The rate of sweat production of two individuals, X and Y, was measured during and after a period of exercise. The results are shown in the graph below.



Which of the following conclusions can be drawn from the graph?

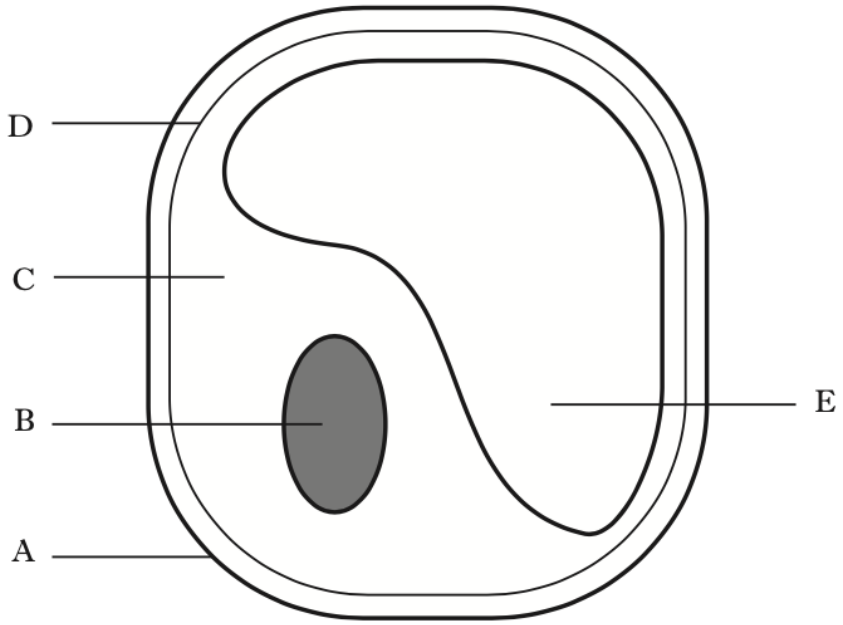
A The rate of sweat production of individual X is always greater than individual Y.

B Individuals X and Y both reach their maximum sweat production at 20 minutes.

C Individual X starts increasing sweat production sooner than individual Y.

D The greatest difference in sweat production by individuals X and Y is at 50 minutes.

11. The diagram below represents a plant cell.



(*a*) Complete the table below to identify the part, the cell structures and the function.

Part	*Cell structure*	*Function*
	cell membrane	controls entry and exit of materials
E		stores cell sap
B		

2

(*b*) Using evidence from the diagram, explain why this cell is more likely to be a root cell than a leaf mesophyll cell.

_____

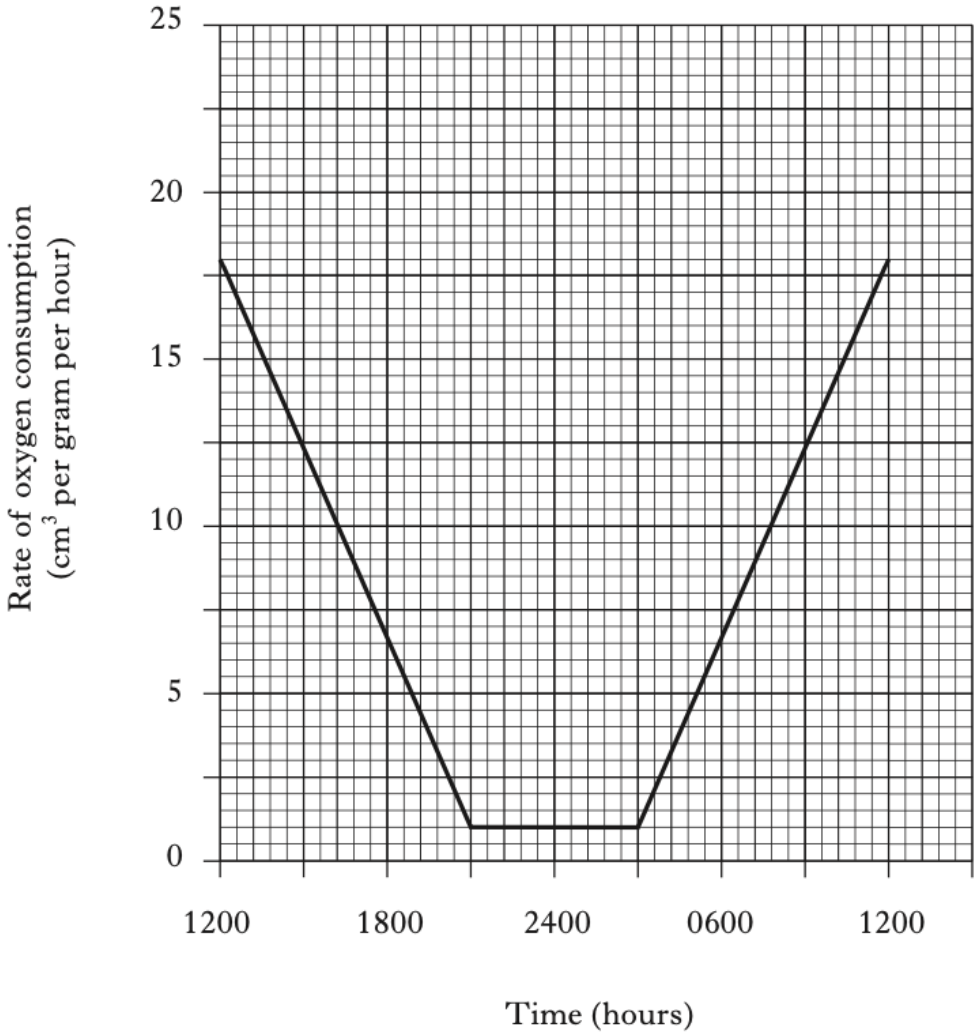
_____ **1**

(*c*) Name the structural carbohydrate that is found in cell walls.

_____ **1**

12. Hummingbirds use a lot of energy to get their food from flowers during the day.

The graph below shows the rate of oxygen consumption of a hummingbird from 12 noon (1200) one day to 12 noon the next day.



(*a*) Name the cell process which uses the oxygen taken in by the hummingbird.

_____ **1**

(*b*) (i) State the times that the rate of oxygen consumption was lowest.

Between _____ and _____ hours. **1**

(ii) Explain the relationship between the rate of oxygen consumption and the activity of the hummingbird.

_____

_____

_____ **1**

(*c*) Predict the effect of colder weather on the rate of oxygen consumption by the hummingbird.

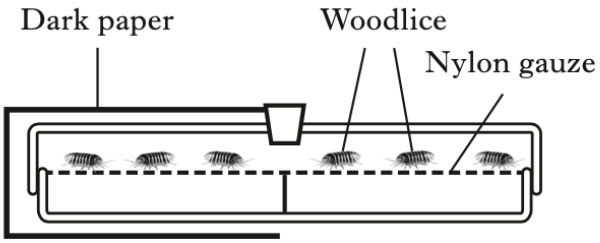
Give a reason for your answer.

Prediction _____ **1**

Reason _____

_____ **1**

13. A student set up the choice chamber below to investigate the response of woodlice to light.



(*a*) Describe how the student would alter the set up of the choice chamber to investigate the response of woodlice to humidity.

_____

_____

_____ **2**

(*b*) Describe what the student could do to make the results more reliable.

_____

_____ **1**

(*c*) Explain how the response of woodlice to humidity increases their chances of survival.

_____

_____ **1**

14. The Scottish wildcat (*Felis sylvestris grampia*) is under threat of extinction with only around 400 pure-bred cats in the wild.

Wildcats live in conifer forests, dense woodland or rocky areas. They are carnivores that feed on herbivores such as rabbits, mice and voles. Although their young are eaten by pine martens and foxes, the main threat to their existence is interbreeding with the domestic cat.

(*a*) (i) Using information from the passage, complete the boxes below to show a food chain.

1

(ii) Complete the table below using named examples from the passage.

Term	*Named example*
habitat	
carnivore	
prey	

2

(iii) State what further evidence would be needed to support the hypothesis that wildcats and domestic cats are the same species.

_____

_____ **1**

(*b*) (i) Conifer plantations can show low biodiversity. The tall trees growing close together block the light to any ground-living plants and there is limited animal life.

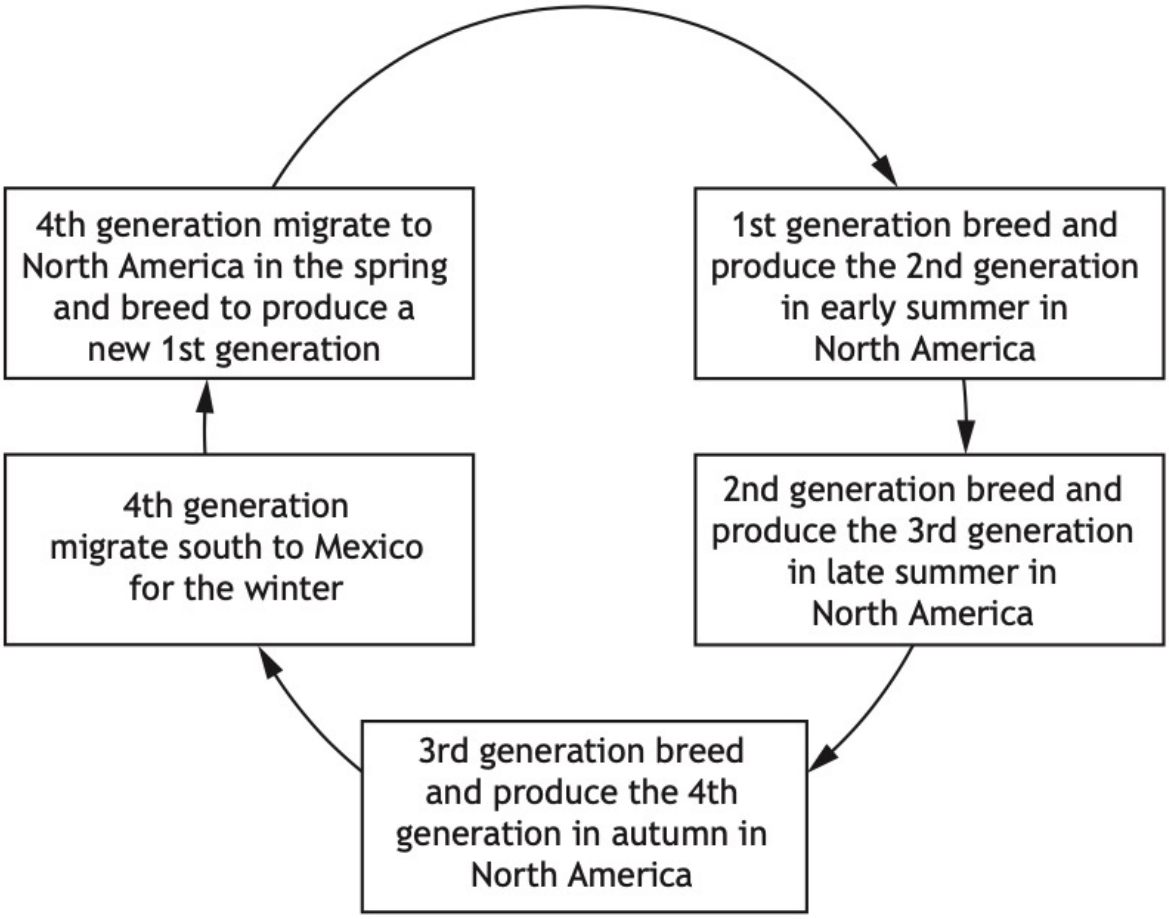
State what is meant by the term biodiversity.

_____

_____ **1**

15.

The diagram shows information on the breeding and migration of Monarch butterflies (*Danaus plexippus*). Each generation dies after laying eggs.



State one advantage and one disadvantage to the Monarch butterfly of migration to Mexico. **2**

Advantage _____

_____

Disadvantage _____

_____

END OF QUESTIONS