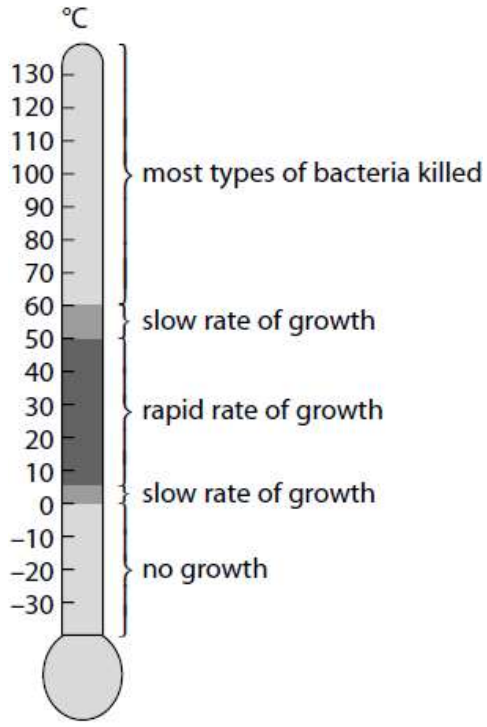
Q1.

Temperature affects the rate of growth of bacteria.

The diagram shows some information about the growth of bacteria in different ranges of temperature.



(a) Explain why most types of bacteria are killed at temperatures above 60 °C, but bacteria can grow slowly in a temperature range of 50 °C to 60 °C.

(4)

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(b) (i) The growth rate constant will be at its highest in the temperature range of 5 °C to 50 °C.

Calculate the growth rate constant (k) of bacteria that have increased from 5×10^3 cells per cm^3 to 1.3×10^5 cells per cm^3 in 4 hours.

(3)

$$k = \frac{\log_{10} N_t - \log_{10} N_0}{0.301 \times t}$$

Answer .....

(ii) The formula used to calculate the growth rate constant can only be applied to one phase of bacterial growth.

To which phase of bacterial growth can the formula be applied?

(1)

☐ **A** death

☐ **B** exponential

☐ **C** lag

☐ **D** stationary

(c) (i) Explain why some foods are kept in refrigerators at a temperature between 0 °C and 5 °C.

(3)

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(ii) Explain why there is no growth of bacteria in a freezer at a temperature of −18 °C.

(2)

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(Total for question = 13 marks)

Q2.

Anthropogenic climate change is considered to be a result of greenhouse gas emissions.

(a) State what is meant by the term **anthropogenic climate change**.

(2)

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(b) (i) Name **two** greenhouse gases.

(1)

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(ii) Explain the role of greenhouse gases in climate change.

(2)

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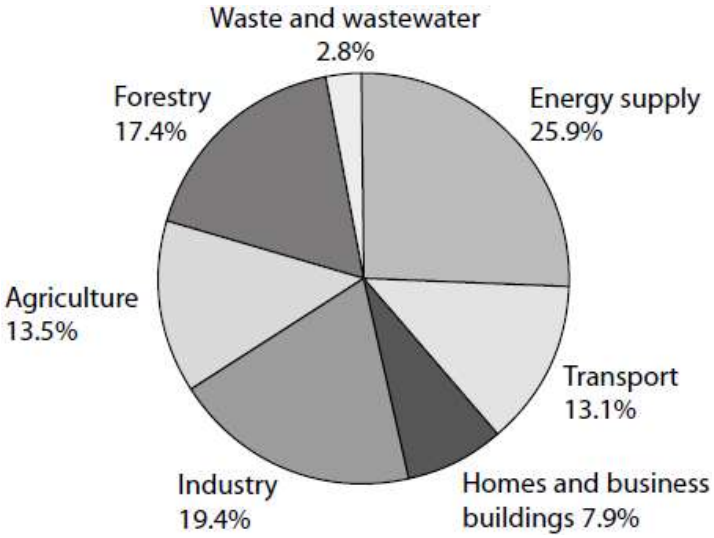
*(c) The pie chart shows the relative contribution of different sources of greenhouse gas emissions.



Explain the relative contribution of each source of greenhouse gas. Use the information in the pie chart and your own knowledge to support your answer.

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(Total for question = 11 marks)

Q3.

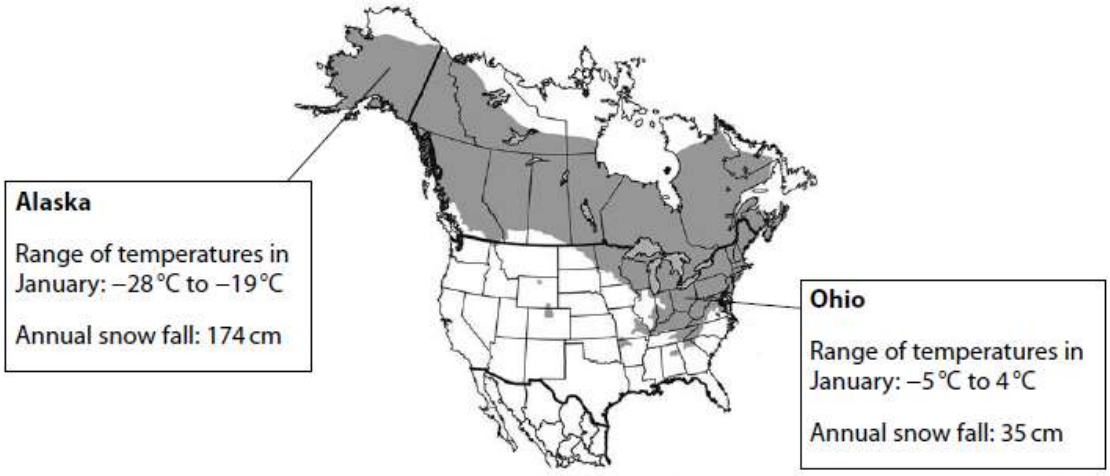
The photograph shows a wood frog.

Source: http://www.borealforest.org/reptiles/wood_frog.htm

Wood frogs are found throughout North America.

The shaded areas on the map shows the distribution of wood frogs in North America.

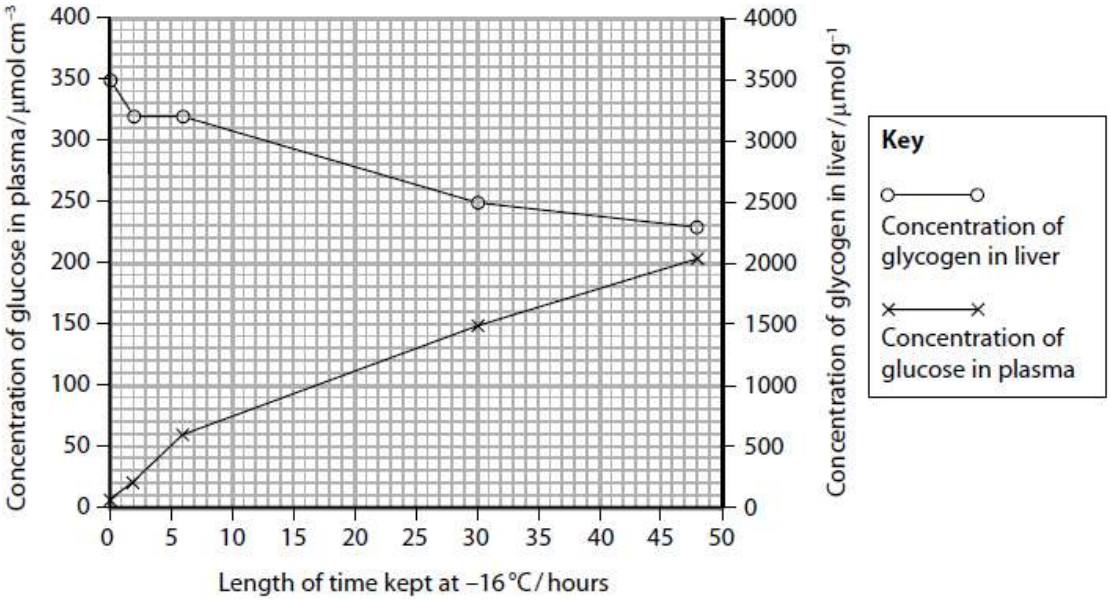
Information is also given about the climate in two areas, Alaska and Ohio.



Source: https://answersingenesis.org/natural-selection/adaptation/the-secret-lives-of-frozen-frogs/

(a) Scientists kept a wood frog from Alaska at −16 °C. The scientists measured the concentration of glycogen in the liver and the concentration of glucose in the plasma over a period of 48 hours.

The graph shows the results.



(i) How many of the following statements describe glycogen?

1. The monomer is *β* glucose
2. It is made from two different types of polymer
3. There are 1,4 and 1,6 glycosidic bonds
4. It is insoluble

(1)

☐ **A** 1

☐ **B** 2

☐ **C** 3

☐ **D** 4

(ii) Explain the changes in the concentration of glycogen and glucose.

Use the information in the graph to support your answer.

(2)

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(b) The scientists found that wood frogs from Alaska had higher concentrations of glucose in their plasma than wood frogs from Ohio.

The scientists also found that the wood frogs from Alaska had higher concentrations of other solutes, such as urea, in their plasma.

The table shows the mean concentration of urea in the plasma of these frogs. The table also shows the standard deviations.

Type of wood frogs	Mean concentration of urea in plasma / μmol cm^{-3}	Standard deviation
from Alaska	106	10
from Ohio	28	5

(i) Calculate the percentage difference in the mean concentration of urea in the plasma of the wood frogs from Alaska compared with the wood frogs from Ohio.

(1)

Answer ..... %

(ii) Explain why the data for the wood frogs from Alaska are more reliable than the data for the wood frogs from Ohio.

(2)

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(iii) Explain why a high concentration of solutes in the plasma could protect the wood frogs from Alaska in very cold temperatures.

(2)

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(c) Explain how these wood frogs evolved to occupy different niches in North America.

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(Total for question = 13 marks)

Q4.

(a) Explain the role of the products of the light-dependent reactions of photosynthesis in the Calvin cycle.

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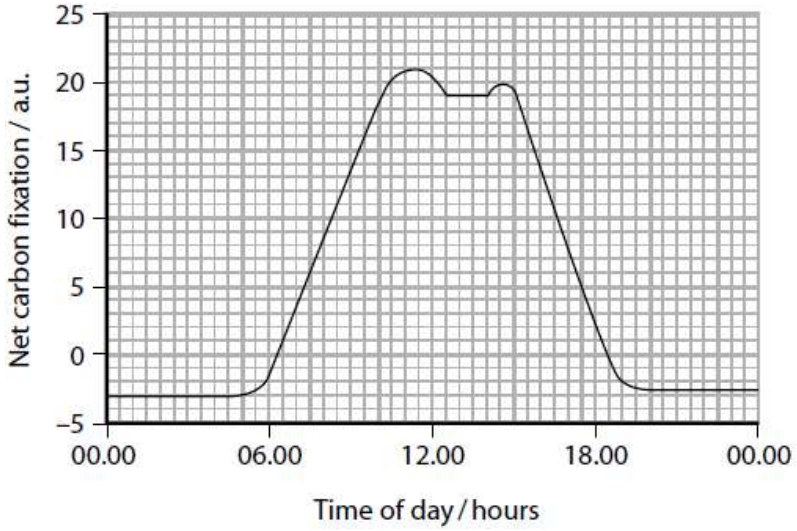
(b) The graph shows the net carbon fixation in a plant over a period of 24 hours.



(i) Calculate the rate of decrease of net carbon fixation at 12 00 hours.

Include units in your answer.

(3)

Answer .....

(ii) Suggest an explanation for the decrease in net carbon fixation between 12 00 hours and 13 00 hours.

(3)

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(iii) Suggest why the net carbon fixation was negative before 05 00 hours and after 19 00 hours.

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(Total for question = 12 marks)