Write your name here

Surname	Other names

Pearson Edexcel
International Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Biology

International Advanced Level

Unit 4: Energy, Environment, Microbiology and Immunity

Sample Assessment Materials for first teaching September 2018

Time: 1 hour 45 minutes

Paper Reference **WBI14/01**

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

- Use **black** ink or **black** ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- **Show all your working in calculations and include units where appropriate.**

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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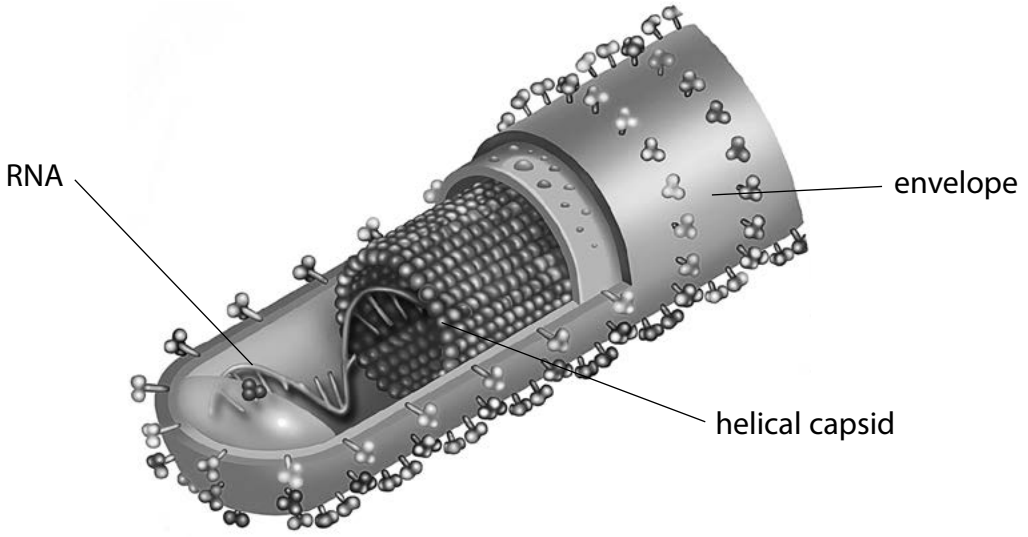
Pearson

Answer ALL questions.

Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 (a) The diagram shows the structure of an Ebola virus.



(i) Which of the following viruses contain the same type of nucleic acid as the Ebola virus?

(1)

☒ **A** human immunodeficiency virus (HIV) only

☒ **B** human immunodeficiency virus (HIV) and tobacco mosaic virus (TMV)

☒ **C** lambda phage (λ phage) only

☒ **D** lambda phage (λ phage) and tobacco mosaic virus (TMV)

(ii) Which of the following viruses have a helical capsid?

(1)

☒ **A** human immunodeficiency virus (HIV) and lambda phage (λ phage)

☒ **B** human immunodeficiency virus (HIV) only

☒ **C** lambda phage (λ phage) and tobacco mosaic virus (TMV)

☒ **D** tobacco mosaic virus (TMV) only

(iii) What type of molecule makes up the capsid of a virus?

(1)

- ☒ **A** carbohydrate
- ☒ **B** lipid
- ☒ **C** nucleic acid
- ☒ **D** protein

(iv) The volume of an Ebola virus is approximately 7.76×10^4 nm^3.

Tobacco mosaic virus (TMV) is approximately 300 nm long and 80 nm in diameter.

Calculate how many times larger Ebola virus is than TMV.

Assume that TMV is a cylinder in shape.

The volume of a cylinder is calculated using the formula

$$V = \pi r^2 l$$

(2)

Answer.....

(b) Human immunodeficiency virus (HIV) contains two enzymes that are **not** found in most other types of virus.

(i) Name these two enzymes.

(1)

(ii) Explain why HIV contains these two enzymes.

(3)

(Total for Question 1 = 9 marks)

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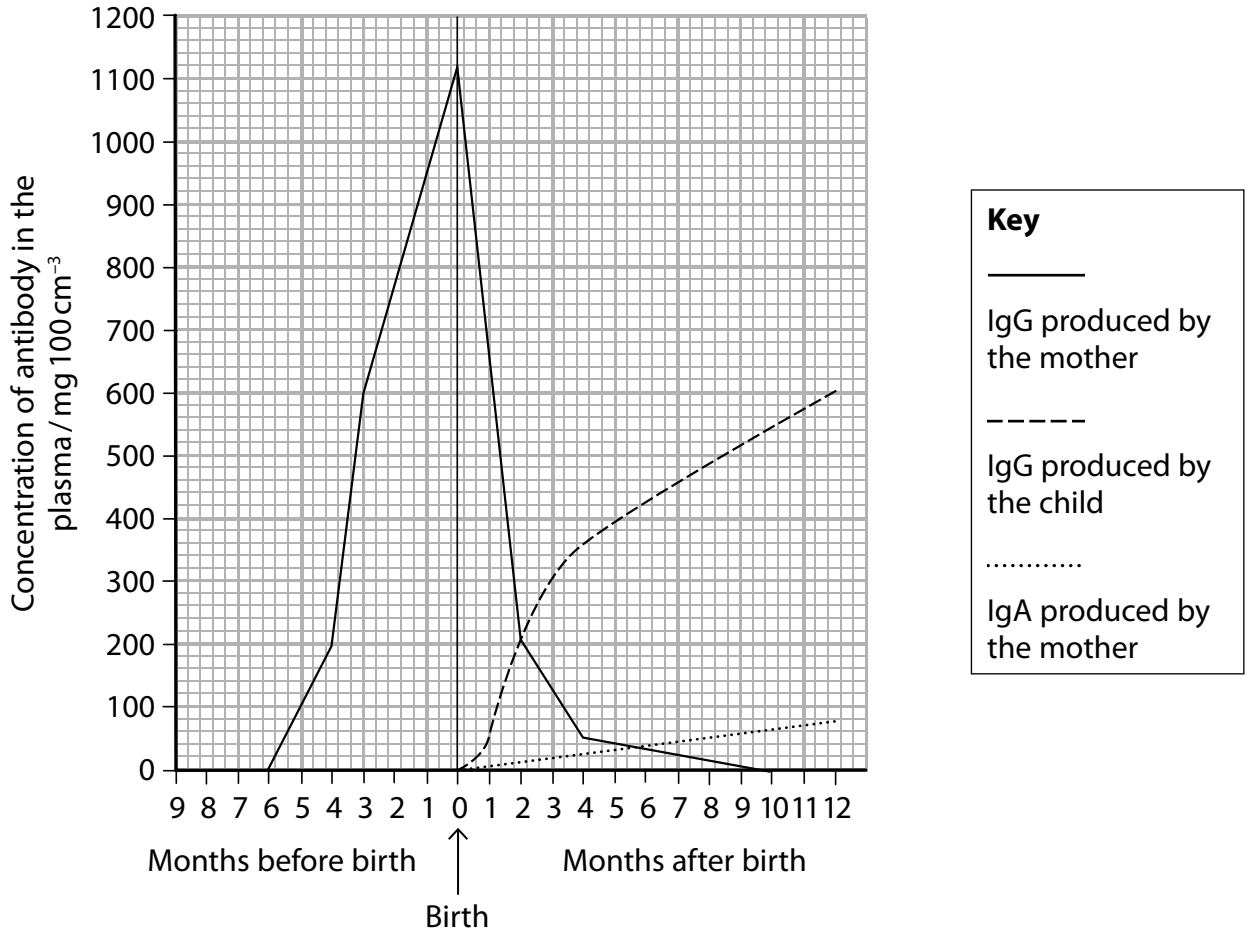
2 Antibodies play an important role in the immune response.

(a) Explain the importance of antibodies.

(4)

(b) There are different classes of antibody, including IgA, IgG and IgM.

The graph shows the changes in the concentration of IgA and IgG in the plasma of a fetus before birth and in a child after birth.



(i) Describe the changes in the classes of antibody in a fetus before birth and in a child after birth. Use the information in the graph to support your answer.

(3)

(ii) Which type of immunity explains the presence of IgA?

(1)

- ☒ **A** artificial active
- ☒ **B** artificial passive
- ☒ **C** natural active
- ☒ **D** natural passive

(iii) Suggest why the concentration of antibodies is less in a child 12 months after birth than in an adult.

(2)

(Total for Question 2 = 10 marks)

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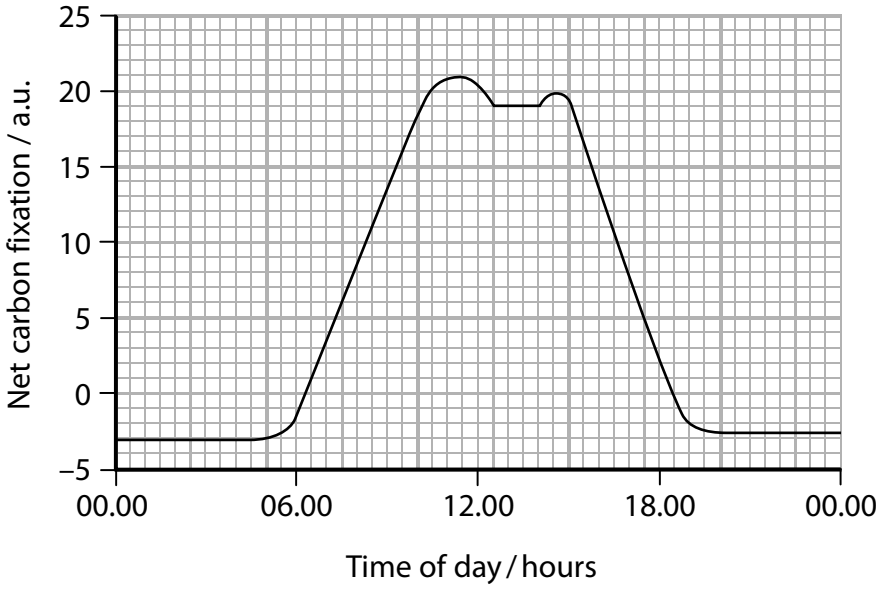
3 (a) Explain the role of the products of the light-dependent reactions of photosynthesis in the Calvin cycle.

(3)

(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.

(3)

(Total for Question 3 = 12 marks)

4 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)

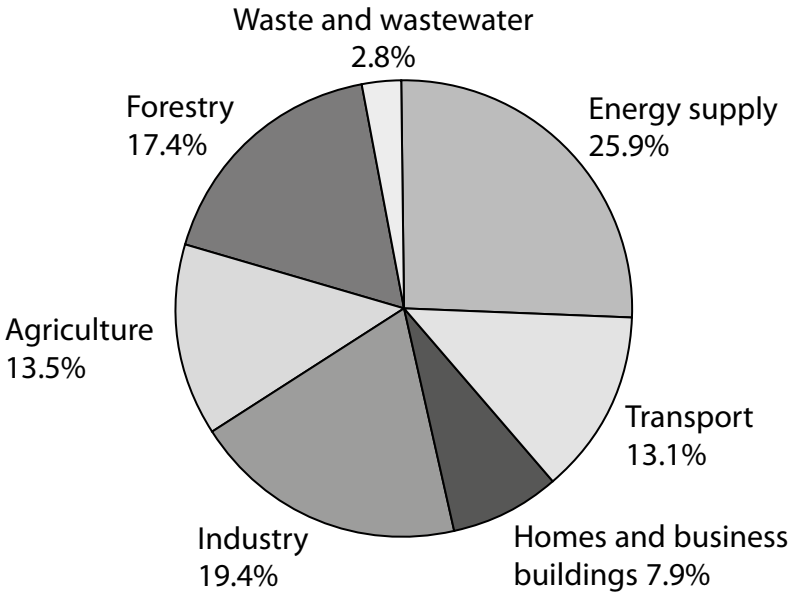
(b) (i) Name **two** greenhouse gases.

(1)

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

(2)

*(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.

(6)

(Total for Question 4 = 11 marks)

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5 Some disorders are caused by mutations in the mitochondrial DNA and can be inherited.

Three-parent embryos have been developed to prevent the inheritance of these disorders.

Diagram 1 shows how three-parent embryos are made.

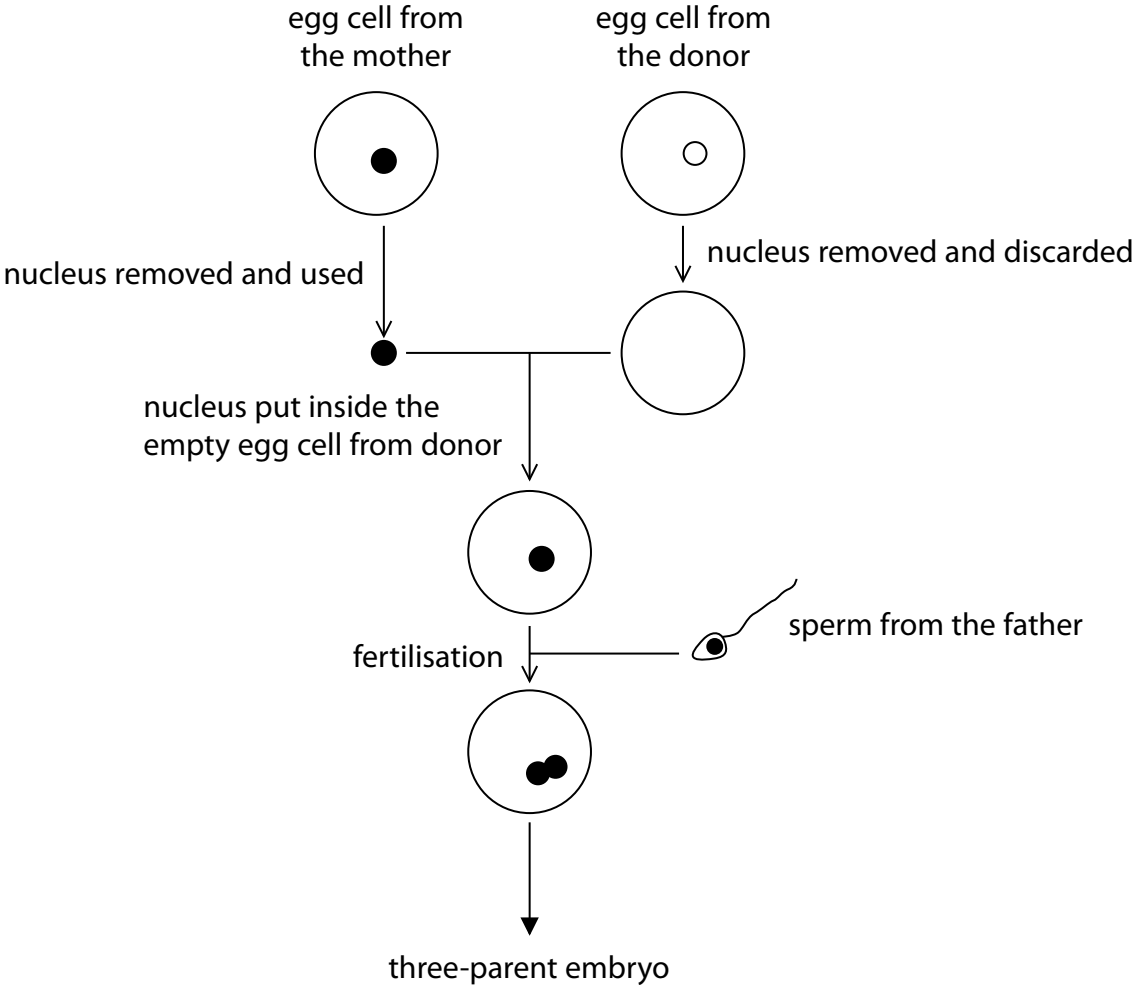


Diagram 1

(a) The cells in the three-parent embryo are totipotent stem cells.

State what is meant by the term **totipotent stem cells**.

(2)

(b) Diagram 2 shows the results of separating the DNA from the three-parent embryo, the mother and the father, using gel electrophoresis.

The bands from the DNA of the embryo are labelled from 1 to 12.

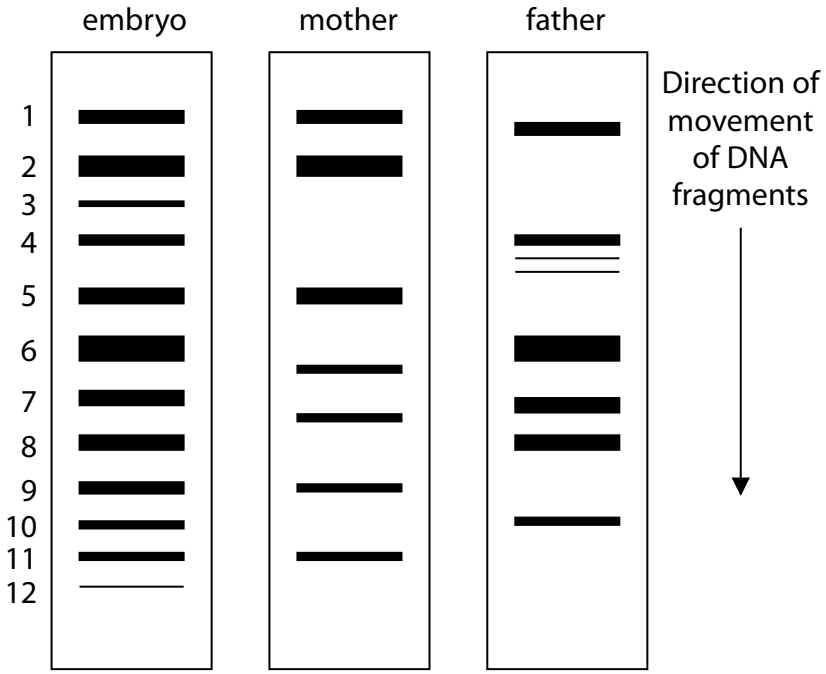


Diagram 2

(i) Which of the following is the reason for the movement of the DNA fragments?

(1)

- ☒ **A** negatively-charged fragments move towards the negative end of the gel
- ☒ **B** negatively-charged fragments move towards the positive end of the gel
- ☒ **C** positively-charged fragments move towards the negative end of the gel
- ☒ **D** positively-charged fragments move towards the positive end of the gel

(ii) Which band on the gel contains the heaviest DNA fragments?

(1)

- ☒ **A** 1
- ☒ **B** 3
- ☒ **C** 6
- ☒ **D** 9

*(iii) Explain the banding pattern of this three-parent embryo. Use information in Diagram 1 and Diagram 2 to support your answer.

(6)

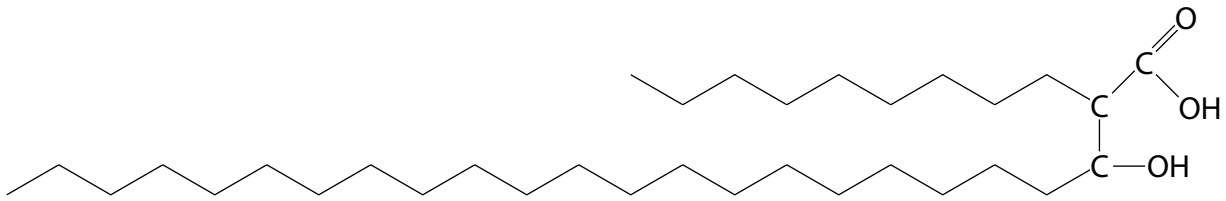
(Total for Question 5 = 10 marks)

6 Tuberculosis is a disease caused by infection with *Mycobacterium tuberculosis*.

The cell wall of *M. tuberculosis* is different from most other types of bacteria as it contains different types of mycolic acid.

Mycolic acid protects the bacteria from lysozyme action, dehydration and polar (hydrophilic) antibiotics.

The diagram shows part of one type of mycolic acid.



(a) What type of molecule is mycolic acid?

(1)

☒ **A** carbohydrate

☒ **B** fatty acid

☒ **C** nucleic acid

☒ **D** polypeptide

(b) Treatment for tuberculosis involves the use of different types of antibiotic, taken over several months.

The table gives details of four antibiotics used to treat tuberculosis.

Antibiotic	Mode of action
E	disrupts the formation of the cell wall
J	inhibits the synthesis of mycolic acids
P	activates an enzyme that inhibits the synthesis of fatty acids
R	binds to the active site of RNA polymerase

(i) Suggest why antibiotic E is effective only when *M. tuberculosis* bacteria are dividing.

(1)

(ii) Explain why antibiotic J could result in an increase in antigen presentation by macrophages.

(2)

(iii) Explain how antibiotic P could affect *M. tuberculosis*.

(3)

(iv) Explain how antibiotic R could affect *M. tuberculosis*.

(3)

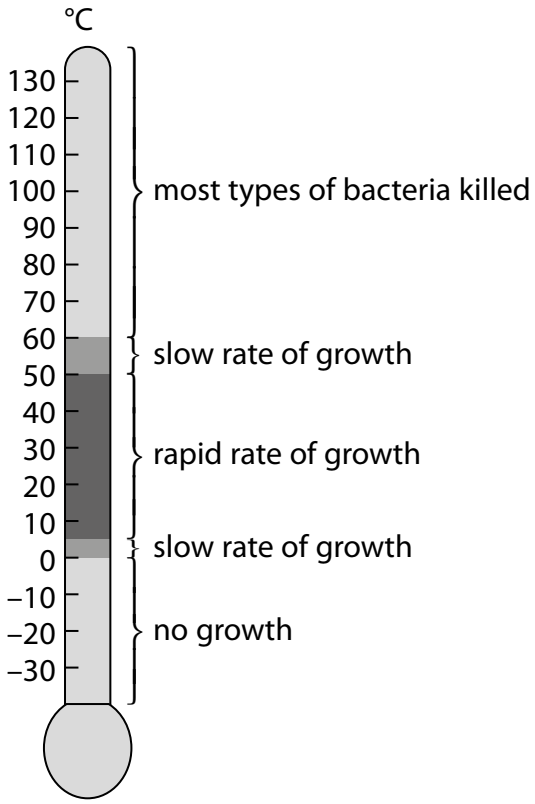
(v) Explain why taking a combination of antibiotics for several months could increase the resistance of *M. tuberculosis* to these antibiotics.

(2)

(Total for Question 6 = 12 marks)

7 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)

(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)

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

(2)

(Total for Question 7 = 13 marks)

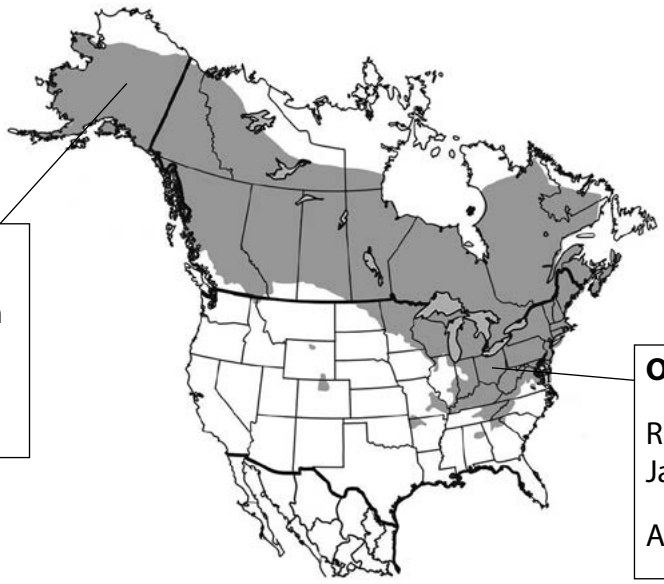
8 The photograph shows a wood frog.

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.



Alaska

Range of temperatures in January: −28 °C to −19 °C

Annual snow fall: 174 cm

Ohio

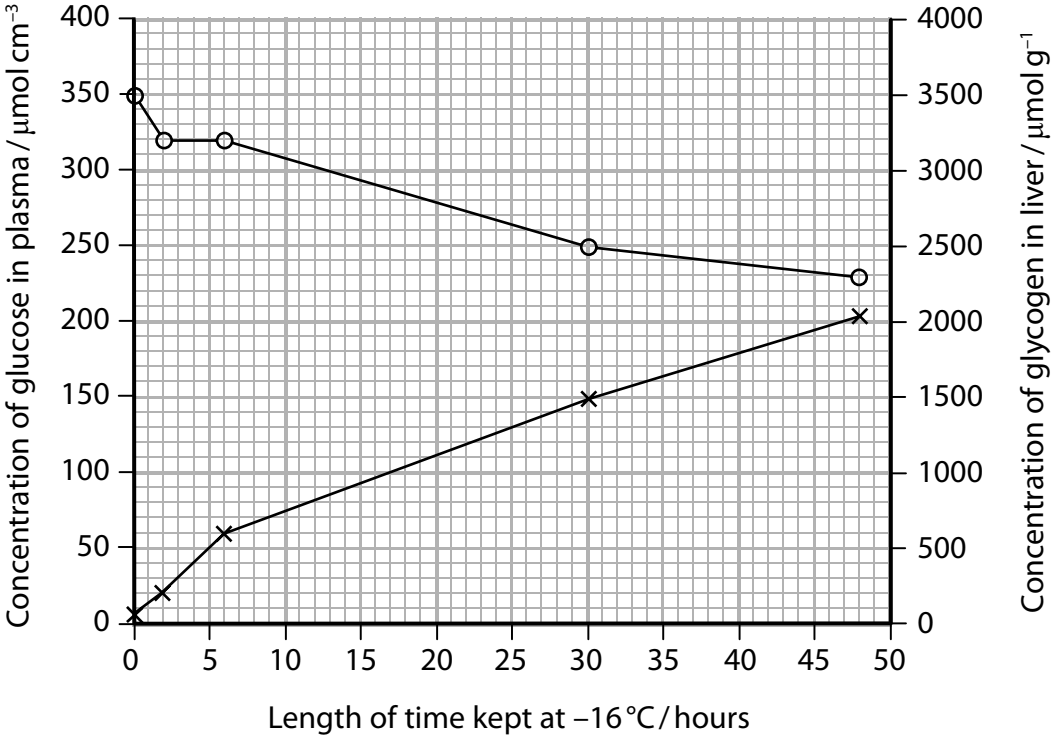
Range of temperatures in January: −5 °C to 4 °C

Annual snow fall: 35 cm

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)

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

☒ **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)

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

(2)

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

(5)

(Total for Question 8 = 13 marks)

TOTAL FOR PAPER = 90 MARKS

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