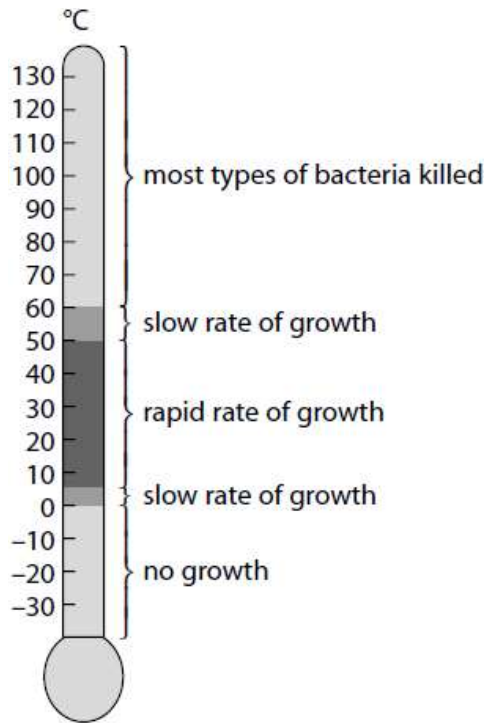


Microbiology, Immunity and Forensics - Questions by Topic

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 $-18\text{ }^{\circ}\text{C}$.

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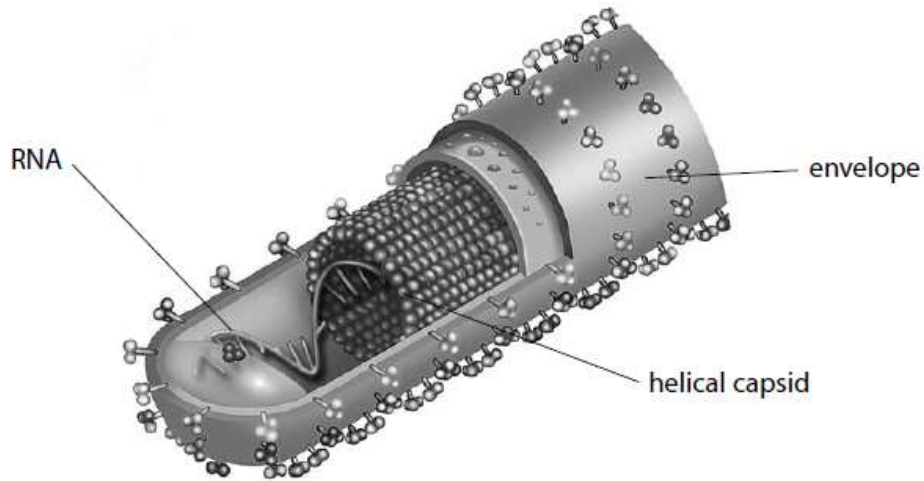
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(Total for question = 13 marks)

Q2.

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



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(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 $7.76 \times 10^4 \text{ nm}^3$.

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)

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(ii) Explain why HIV contains these two enzymes.

(3)

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(Total for question = 9 marks)

Q3.

Antibodies play an important role in the immune response.

(a) Explain the importance of antibodies.

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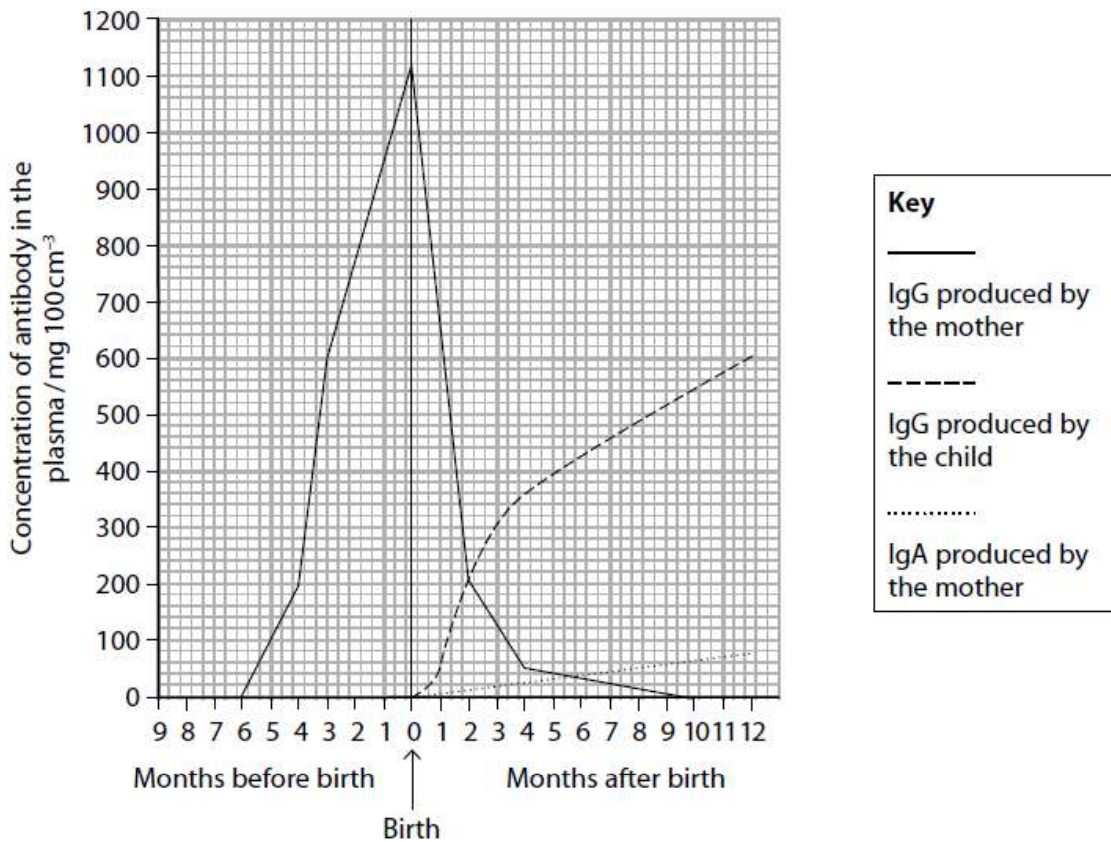
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(b) There are different classes of antibody, including IgA, IgG and IgM.

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)

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(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)

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(Total for question = 10 marks)

Q4.

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.

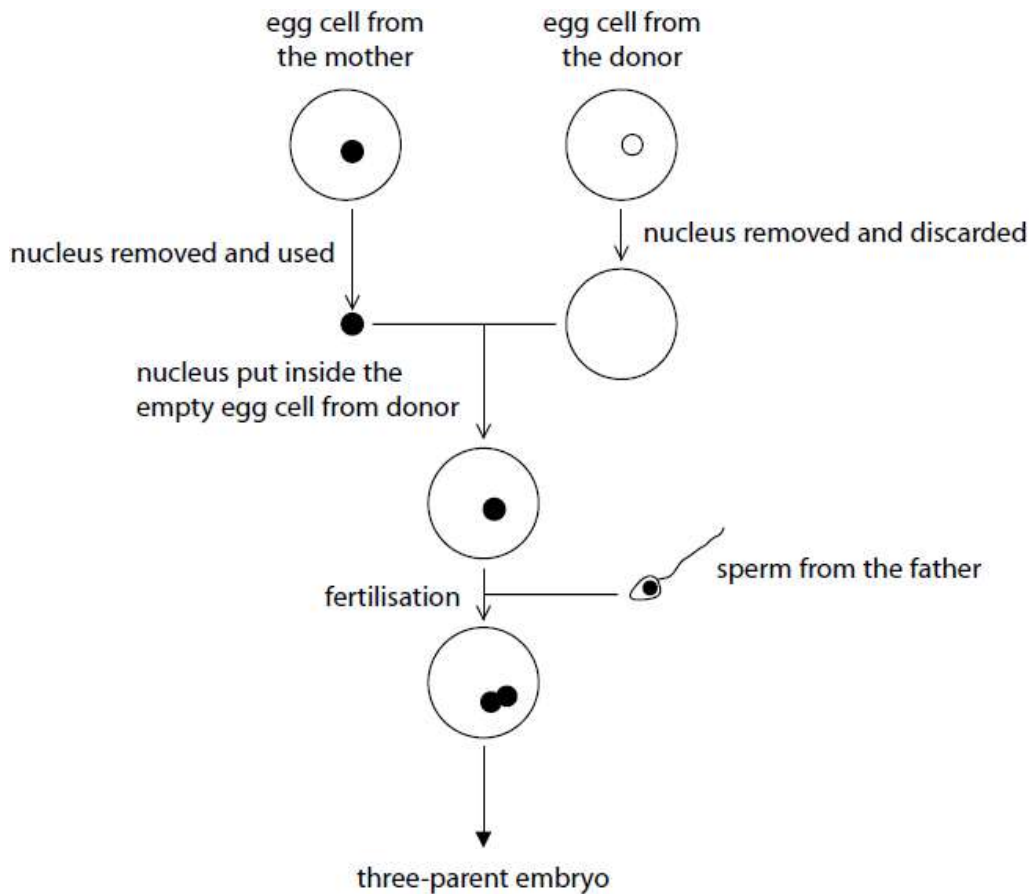


Diagram 1

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

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

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(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.

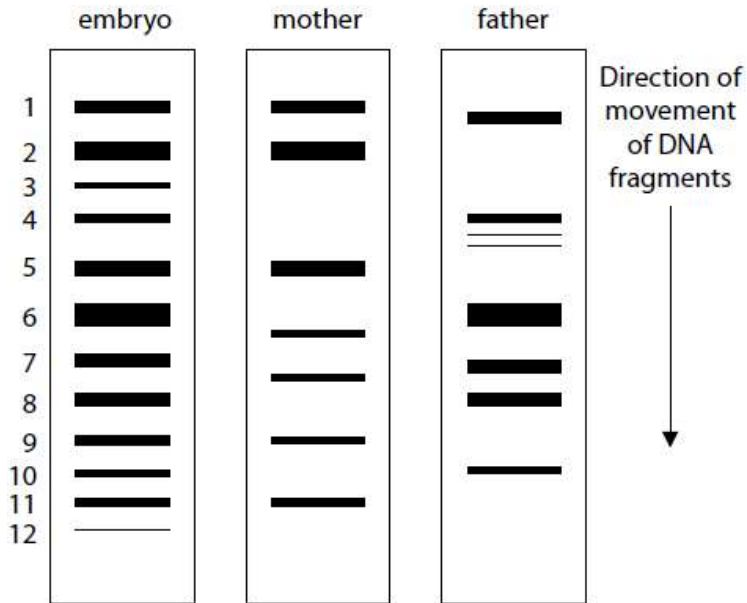


Diagram 2

(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

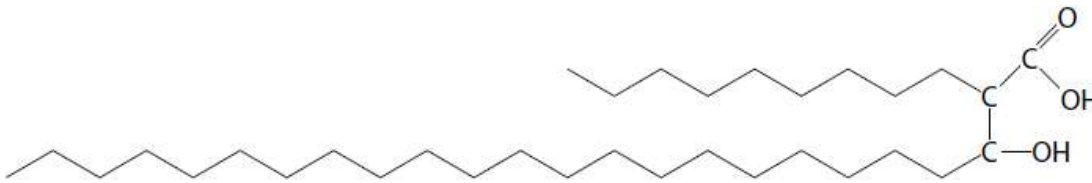
Q5.

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)

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

(2)

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

(3)

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

(3)

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

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(Total for question = 12 marks)