PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



EXAM QUESTION PACK

TOPIC 2: CELLS, VIRUSES AND REPRODUCTION OF LIVING THINGS

VIRUSES

SCORE	PERCENTAGE
/93	%

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Q1.

An experimental drug called Zmapp was used to treat patients during this outbreak of Ebola virus.

Patients with Ebola virus were randomly split into two groups.

Both groups received standard medical treatment.

One group was also given Zmapp on days 1, 3 and 5.

Some of the patients suffered severe side effects after treatment with Zmapp and required additional medical care.

The results are shown in the table.

Day	Number of patients surviving		Number of patients with severe side effects after treatment with Zmapp on days 1, 3 and 5
	Without Zmapp	With Zmapp	
1	35	36	11
2	32	33	
3	31	31	7
4	30	29	
5	29	28	3
6	26	28	
7	23	28	
8	22	28	
9	22	28	

Analyse the data to assess the effectiveness of Zmapp to treat patients with Ebola virus.

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(Total for question = 4 marks)

Q2.

In 2014, the British nurse Will Pooley contracted Ebola. He was given the experimental drug Zmapp and he recovered.

Zmapp contains three monoclonal antibodies that bind to Ebola glycoprotein.

Changes to viral proteins are essential for fusion of the virus with the host cell membrane.

This process delivers the viral RNA into the cell cytoplasm.

The model shows how the three monoclonal antibodies bind to the Ebola glycoprotein.



(i) Analyse the information to explain the success of Zmapp in treating patients with Ebola.

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(ii) The rate of mutation in the Ebola virus is as fast as that of the influenza virus.

The Ebola genome codes for seven proteins, one of which is the glycoprotein.

Explain what effect a mutation may have on the effectiveness of Zmapp.

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Q3.

Bacteria are the host cells for λ (lambda) phage viruses.

Which is a description of a λ phage?

(1)

☒ **A** DNA virus with a complex protein capsid

☒ **B** DNA virus with a helical protein capsid

☒ **C** RNA virus with a complex protein capsid

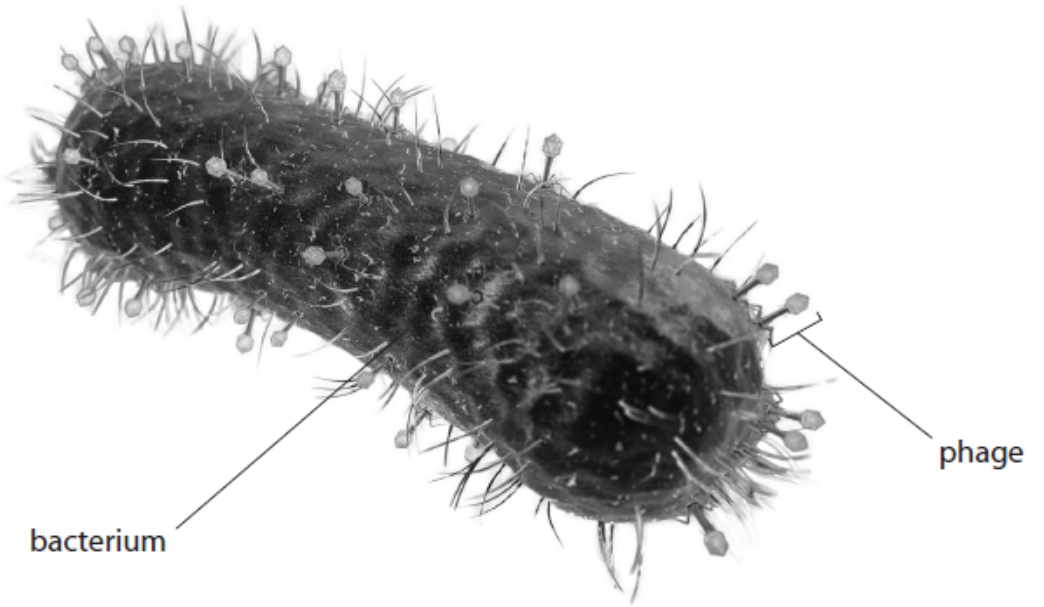
☒ **D** RNA virus with a helical protein capsid

(Total for question = 1 mark)

Q4.

Bacteria are the host cells for λ (lambda) phage viruses.

The image shows phage viruses attacking a bacterium.



(Source: © nobeastsofierce Science/Alamy Stock Photo)

The length of this bacterium is 1.7 µm.

Calculate the length of the labelled phage.

Give your answer in nanometres (nm).

(2)

Answer ..... nm

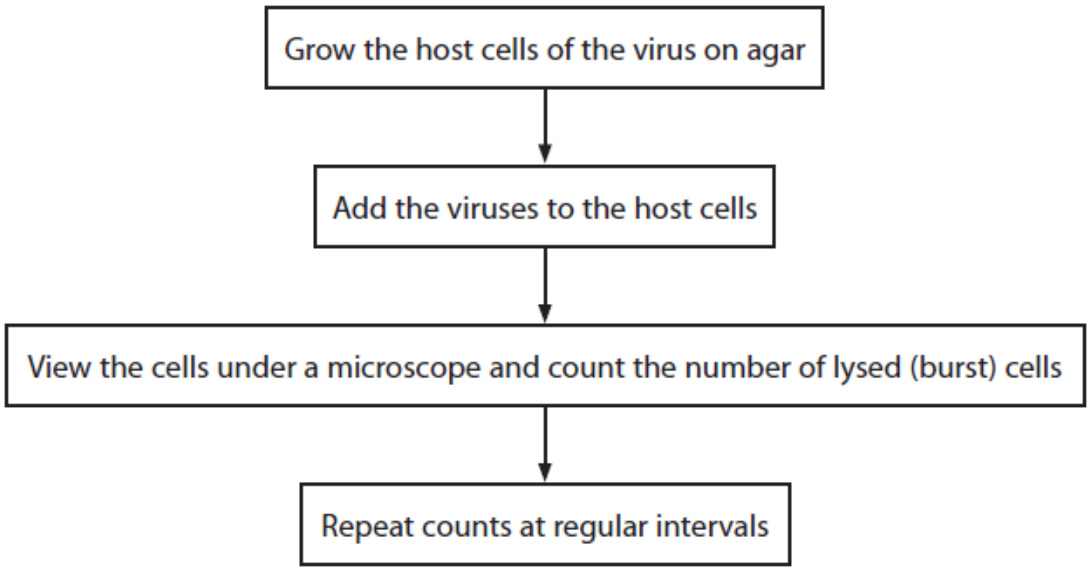
(Total for question = 2 marks)

Q5.

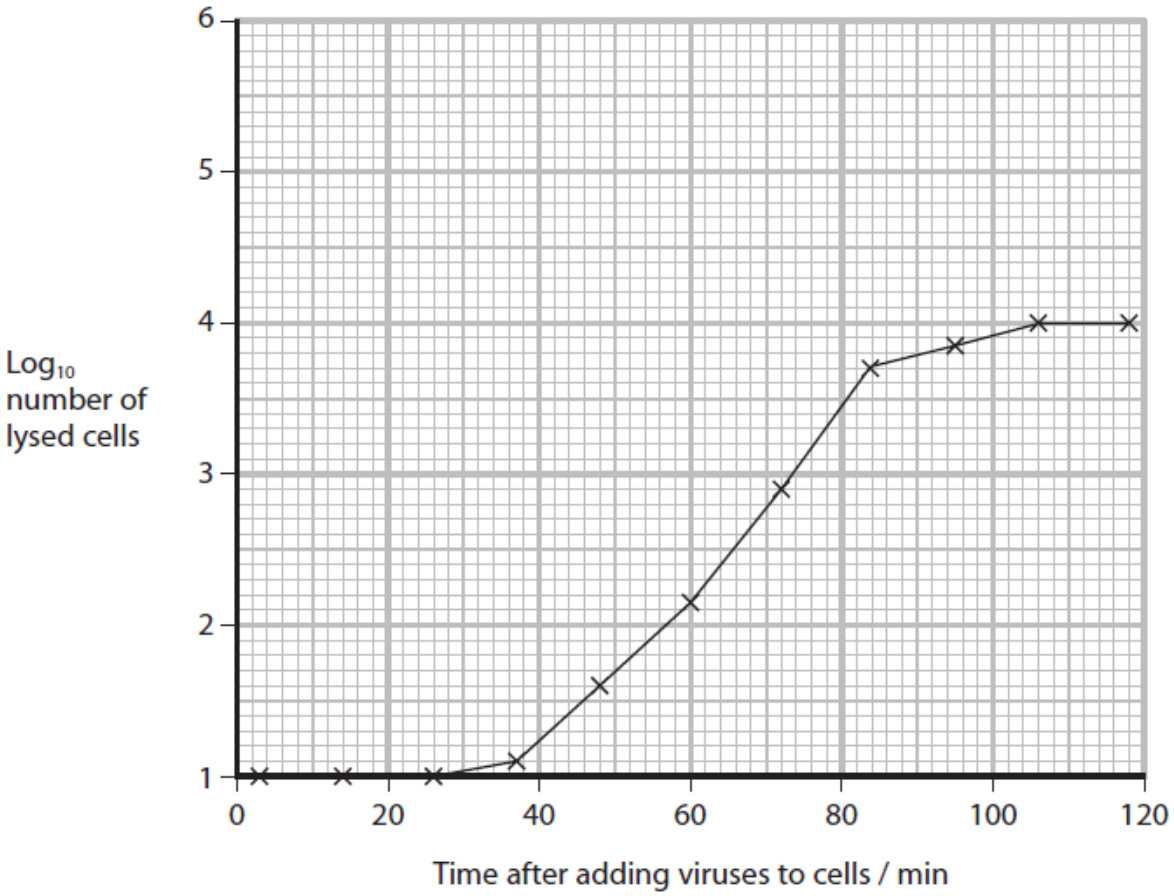
Bacteria are the host cells for λ (lambda) phage viruses.

Viruses can be cultured and a growth curve can be produced.

The flow chart shows how this can be done.



The graph shows a growth curve for viruses.



(i) Explain why there was a delay before the number of lysed cells started to increase.

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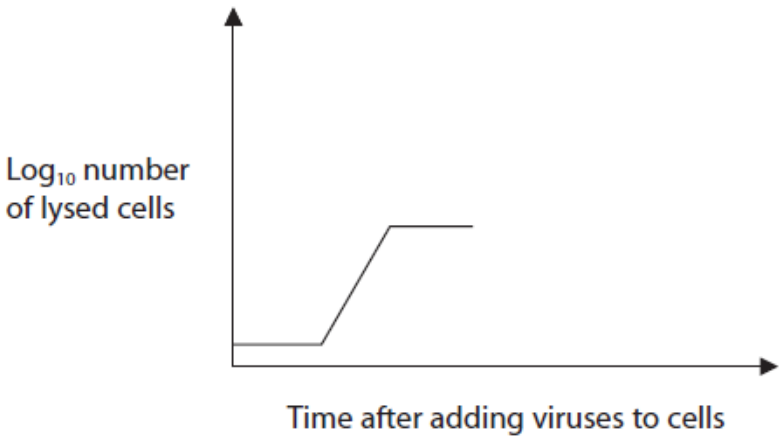
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(ii) Calculate the mean rate of increase in the actual number of lysed cells between 50 minutes and 90 minutes.

(2)

Answer ..... cells min $^{-1}$

(iii) A sketch has been made of this growth curve.



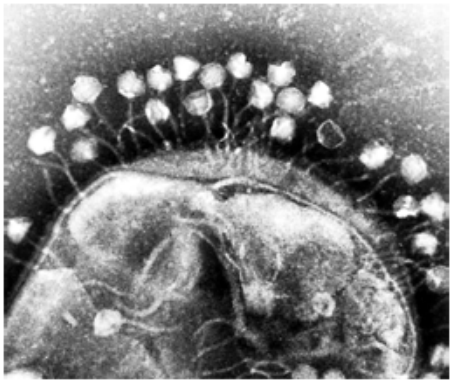
Complete this sketch to predict the shape of the growth curve after 120 minutes, assuming there is an excess of host cells.

(2)

(Total for question = 7 marks)

Q6.

The photograph shows part of a bacterial cell surrounded by viruses, as seen using an electron microscope.



(i) Which of these structures would be present in a bacterial cell but absent in a palisade mesophyll cell?

(1)

☒ **A** cellulose cell wall and nucleoid

☒ **B** cellulose cell wall and nucleolus

☒ **C** peptidoglycan cell wall and nucleoid

☒ **D** peptidoglycan cell wall and nucleolus

(ii) Which virus contains DNA?

(1)

☒ **A** Ebola

☒ **B** HIV

☒ **C** λ (lambda) phage

☒ **D** tobacco mosaic

(iii) Explain why an electron microscope, rather than a light microscope, was used to produce this photograph.

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(Total for question = 4 marks)

Q7. Human diseases can be caused by many different types of organism, such as bacteria and viruses.

(a) Give **two** differences between the genetic material of bacteria and viruses.

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(b) Tuberculosis (TB) is caused when droplets, containing the bacterium *Mycobacterium tuberculosis*, are inhaled into the lungs.

In the lungs, large numbers of the bacterium are formed rapidly. These can be ingested by macrophages. Eventually, tubercles (tissue masses), containing dormant bacteria inside macrophages, may form.

(i) Describe how macrophages ingest the bacteria.

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(ii) Suggest why treatment with antibiotics may not be effective against the dormant bacteria in the tubercles.

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(iii) TB can be prevented by vaccination. Explain how a person can develop artificial active immunity following vaccination.

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(c) In a person with TB, the dormant bacteria in tubercles may be activated after several years. The bacteria multiply rapidly, resulting in severe lung damage.

The bacteria are released from the tubercles. These bacteria can inhibit the activity of T cells and infect other organs.

Explain why the activity of these bacteria and the inhibition of T cells means that a person may quickly develop severe symptoms leading to death.

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(Total for Question = 13 marks)

Q8.

In 2014 there was an Ebola virus outbreak in West Africa.

Ebola virus begins its lytic cycle soon after the infection of body cells.

(i) Describe the lytic cycle of a virus.

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(ii) Some doctors believe that the Ebola virus may undergo latency within body cells.

State what is meant by the term latency.

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(Total for question = 4 marks)

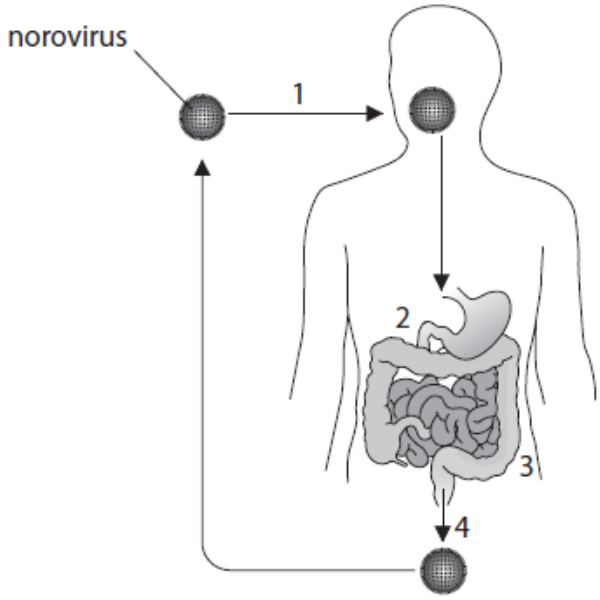
Q9.

Norovirus is a single-stranded RNA, non-enveloped virus.

Norovirus is the most common cause of gastroenteritis.

Norovirus is usually spread through the faecal-oral route.

The diagram shows the pathway that norovirus takes through the body.



1 The norovirus is transmitted in contaminated food or water.

2 The norovirus passes through the stomach and into the small intestine.

3 Some noroviruses are taken up by the cells of the small intestine.

4 Some noroviruses pass out of the body in the faeces.

This process only takes a few hours.

Describe what happens inside the cells of the small intestine that have taken up the norovirus.

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(Total for question = 3 marks)

Q10.

In 2014, the British nurse Will Pooley contracted Ebola. He was given the experimental drug Zmapp and he recovered.

Zmapp contains three monoclonal antibodies that bind to Ebola glycoprotein.

Changes to viral proteins are essential for fusion of the virus with the host cell membrane.

This process delivers the viral RNA into the cell cytoplasm.

The model shows how the three monoclonal antibodies bind to the Ebola glycoprotein.



Zmapp is an experimental drug. Although it has not undergone clinical trials, animal testing has shown it to be effective.

Explain why the use of Zmapp to treat Will Pooley had ethical implications.

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Q11.

Infections caused by *Chlamydia* and human papillomavirus (HPV) are sexually transmitted.

The HPV is a non-enveloped DNA virus.

Chlamydia infection is caused by the bacterium, *Chlamydia trachomatis*.

Compare and contrast the structure of a bacterial cell with the structure of HPV.

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(Total for question = 3 marks)

Q12.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

In 2014 there was an Ebola virus outbreak in West Africa.

Which of the following viruses contains RNA and the enzyme reverse transcriptase?

(1)

☒ **A** Ebola virus

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

☒ **C** λ (lambda) phage

☒ **D** tobacco mosaic virus

(Total for question = 1 mark)

Q13. Bacteria and viruses can cause human diseases.

(a) Distinguish between the structure of bacteria and viruses

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(b) Infection with a bacterium can result in the development of active immunity to that bacterium. This results in the production of antibodies by plasma cells.

(i) Describe how infection with a bacterium results in the production of plasma cells.

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(ii) Explain how antibodies help a person to recover from an infection.

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(iii) A person who has had an organ transplant has to take immunosuppressive drugs. This prevents the immune system from destroying the organ transplant. Some of these drugs work by inhibiting the production of cytokines.

Suggest what effect these drugs could have on a person infected with a bacterium or a virus.

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(Total for Question = 13 marks)

Q14.

The classification of viruses is based on their structure and the type of nucleic acid that they contain.

(a) Which of the following is a reason why the influenza virus is classified as a retrovirus?

(1)

☒ **A** it has a capsid

☒ **B** it has an envelope

☒ **C** it contains RNA

☒ **D** it contains DNA

(b) Which of the following methods would be best for preventing the transmission of influenza through a population?

(1)

☒ **A** take paracetamol

☒ **B** wear a face mask

☒ **C** use insect repellent

☒ **D** take antibiotics

(c) Explain how the influenza virus has a pathogenic effect.

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(Total for question = 6 marks)

Q15.

Food poisoning can be caused by food that is contaminated with pathogenic microorganisms.

A number of different viruses can cause food poisoning.

One virus that can cause food poisoning is the Norovirus.

Noroviruses are RNA viruses.

(i) The following four statements are features of viruses:

1. have envelopes

2. contain reverse transcriptase

3. surrounded by a protein coat

4. have a helical structure

Which of the following is correct for all RNA viruses?

(1)

☒ **A** statement 1, statement 2 and statement 3

☒ **B** statement 2 only

☒ **C** statement 3 only

☒ **D** statement 1 and statement 4

(ii) Which of the following groups of viruses are also RNA viruses?

(1)

☒ **A** Ebola virus, human immunodeficiency virus and tobacco mosaic virus

☒ **B** Ebola virus, λ phage and tobacco mosaic virus

☒ **C** Human immunodeficiency virus, λ phage and tobacco mosaic virus

☒ **D** λ phage and tobacco mosaic virus

(Total for question = 2 marks)

Q16.

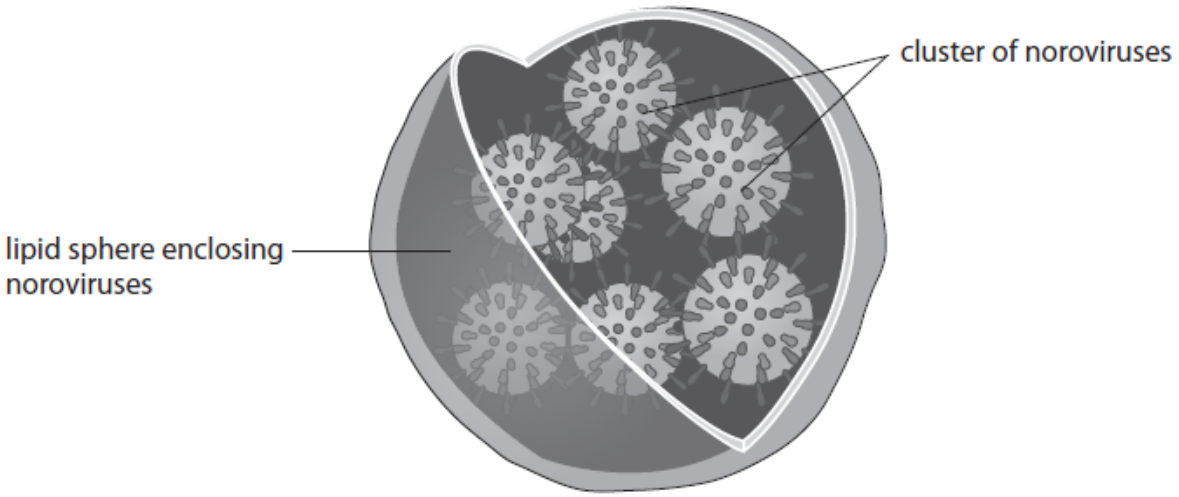
Norovirus is a single-stranded RNA, non-enveloped virus.

Norovirus is the most common cause of gastroenteritis.

Noroviruses can infect an animal as individual viruses or as a cluster of viruses inside a lipid sphere.

A cluster of viruses inside a lipid sphere is called a stealth sphere.

The diagram shows a stealth sphere.



(i) Animals infected with stealth spheres develop gastroenteritis very quickly and with severe symptoms.

Animals infected with individual noroviruses develop gastroenteritis more slowly and with less severe symptoms.

Analyse the information to explain these findings.

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(ii) Scientists are hoping that new treatments for norovirus infections can be developed to target the stealth sphere.

Analyse the information to explain how targeting the stealth sphere could be used to treat these infections.

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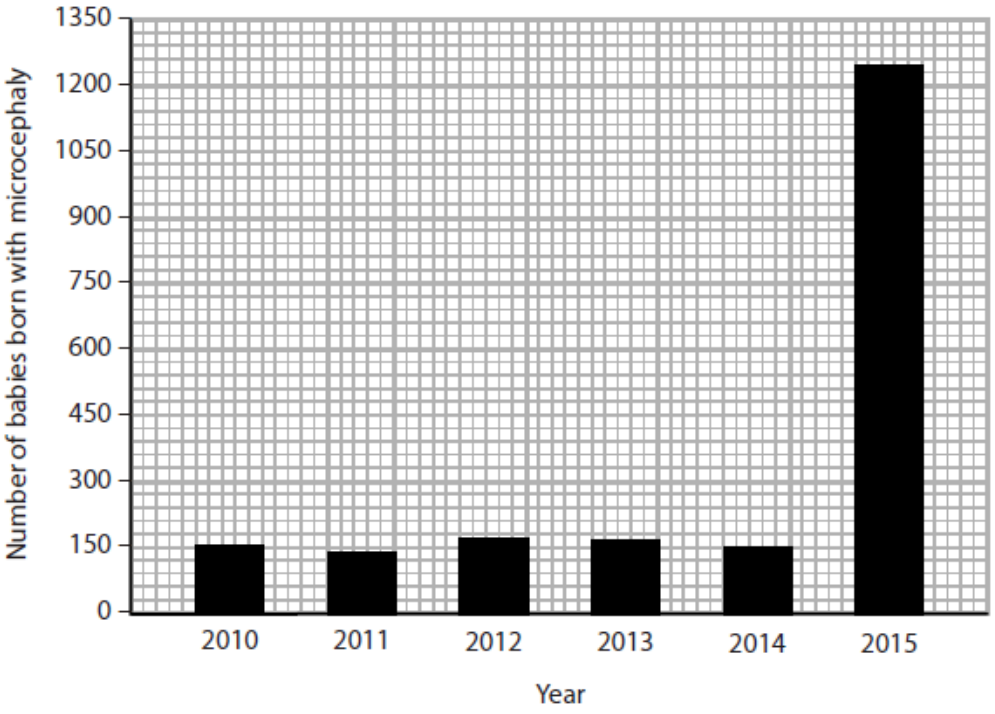
(Total for question = 5 marks)

Q17.

In February 2016, the World Health Organisation (WHO) declared a public health emergency because of the spread of the Zika virus.

The mild symptoms, such as joint pains, headaches and a slight temperature increase lasted only a few days. However, Zika virus has been linked to a birth defect called microcephaly.

The graph shows the number of babies born with microcephaly in Brazil from 2010 to 2015.



Scientists have discovered that the Zika virus genome is made of RNA.

This RNA codes for:

- capsid protein with 105 amino acids
- pre-membrane protein with 187 amino acids
- envelope protein with 505 amino acids
- seven nonstructural proteins

(i) State how many bases are needed to code for the capsid protein.

(1)

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(ii) Unlike human immunodeficiency virus (HIV), Zika is not a retrovirus.

Describe what happens to the Zika RNA once it is in the cell.

(2)

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(Total for question = 3 marks)

Q18.

Viruses possess some of the features of living organisms.

(i) Which of the following are found in **all** viruses?

(1)

☒ **A** DNA and protein

☒ **B** RNA and protein

☒ **C** nucleic acid and protein

☒ **D** nucleic acid and ribosomes

(ii) Which of the following is a retrovirus?

(1)

☒ **A** Ebolavirus

☒ **B** human immunodeficiency virus

☒ **C** λ (lambda) phage

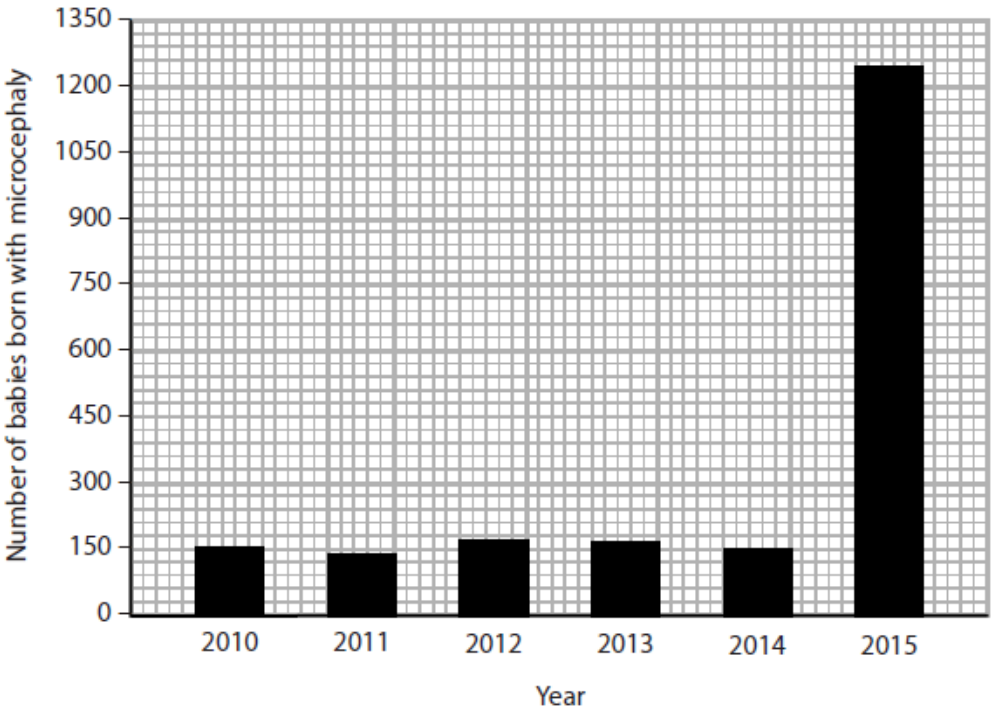
☒ **D** tobacco mosaic virus

Q19.

In February 2016, the World Health Organisation (WHO) declared a public health emergency because of the spread of the Zika virus.

The mild symptoms, such as joint pains, headaches and a slight temperature increase lasted only a few days. However, Zika virus has been linked to a birth defect called microcephaly.

The graph shows the number of babies born with microcephaly in Brazil from 2010 to 2015.



Zika virus is transmitted to humans by infected mosquitoes.

(i) Explain why another type of drug, rather than antibiotics, has to be used to treat Zika virus infections.

(2)

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(ii) Scientists have suggested that genetically modified (GM) mosquitoes could be used to help combat the spread of the Zika virus.

Mosquito eggs are injected with DNA, from GM mosquitoes. This DNA contains a gene for fluorescence. However, only one in a few thousand injected eggs results in a GM mosquito.

Explain how this procedure could help in the production of large numbers of GM mosquitoes.

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(iii) Explain why the Brazilian government has advised people to use mosquito nets, even if they have already contracted the Zika virus.

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(Total for question = 8 marks)

Q20.

Describe two ways in which viruses replicate.

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