Questions

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.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 4 marks)

Q2.

Enzymes are catalysts that are sensitive to changes in temperature.

Some antibiotics affect the enzymes involved in the growth of bacteria.

(i) Explain why Gram positive bacteria and Gram negative bacteria react differently to some antibiotics.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(ii) Explain why viruses are not affected by antibiotics.

(2)

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 5 marks)

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

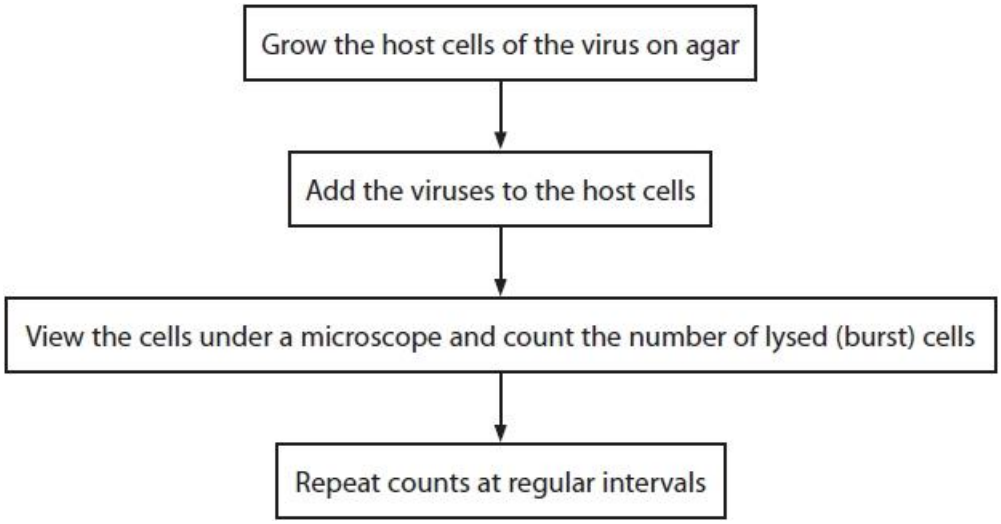
(Total for question = 2 marks)

Q5.

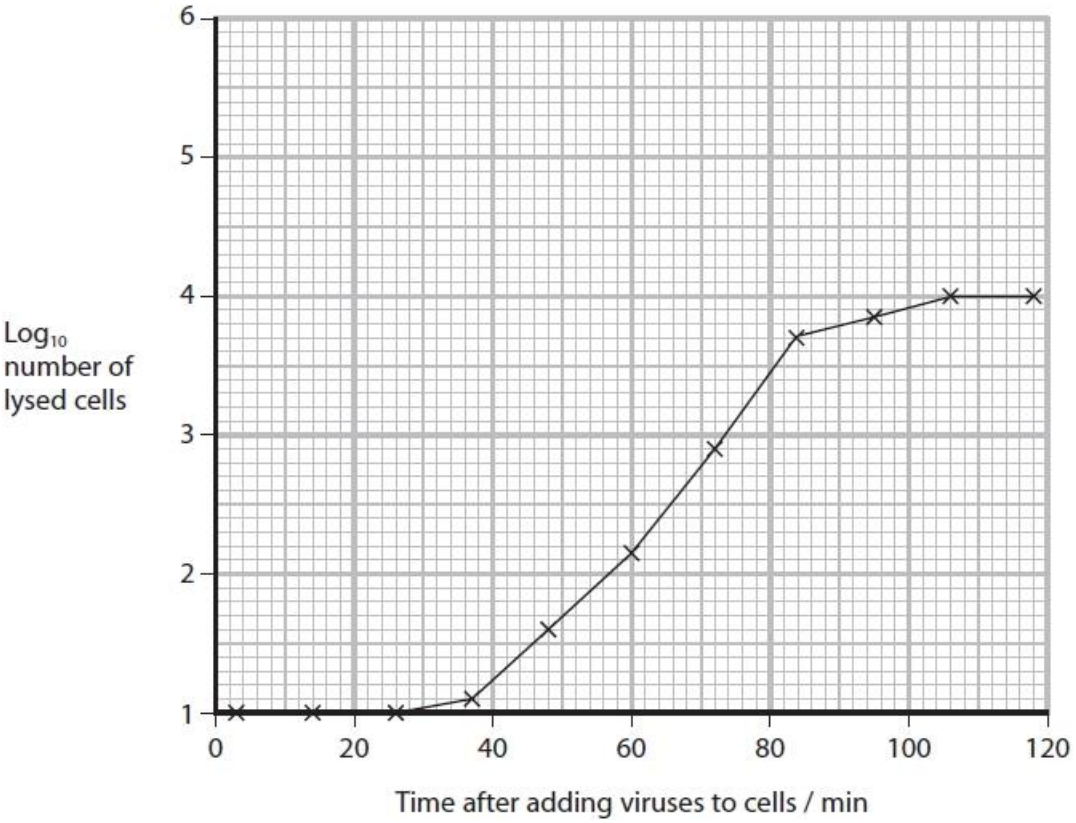
Bacteria are the host cells for λ (lambda) phage viruses.

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.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

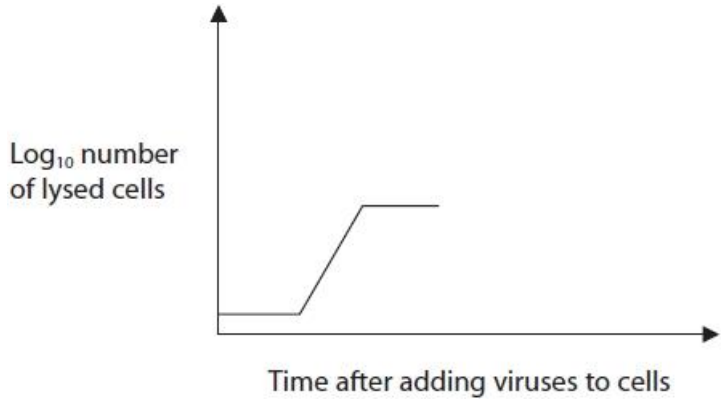
.....

(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.

(2)

.....

.....

.....

.....

.....

(Total for question = 4 marks)

Q7.

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.

(2)

.....

.....

.....

.....

.....

(ii) Some doctors believe that the Ebola virus may undergo latency within body cells.
State what is meant by the term latency.

(2)

.....

.....

.....

.....

.....

.....

(Total for question = 4 marks)

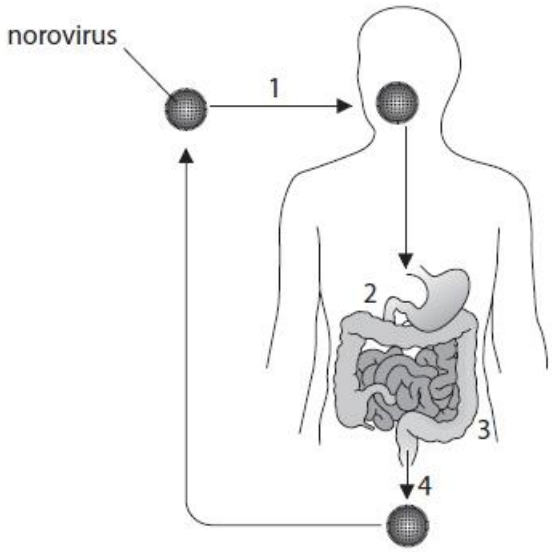
Q8.

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.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 3 marks)

Q9.

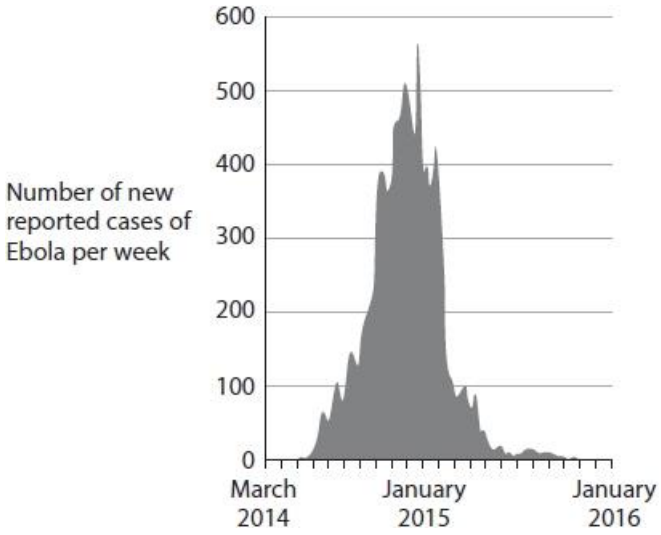
Some viruses cause infections in humans.

Antiviral drugs affect the virus without affecting the cells of the host.

Ebola is a disease that has a high mortality rate.

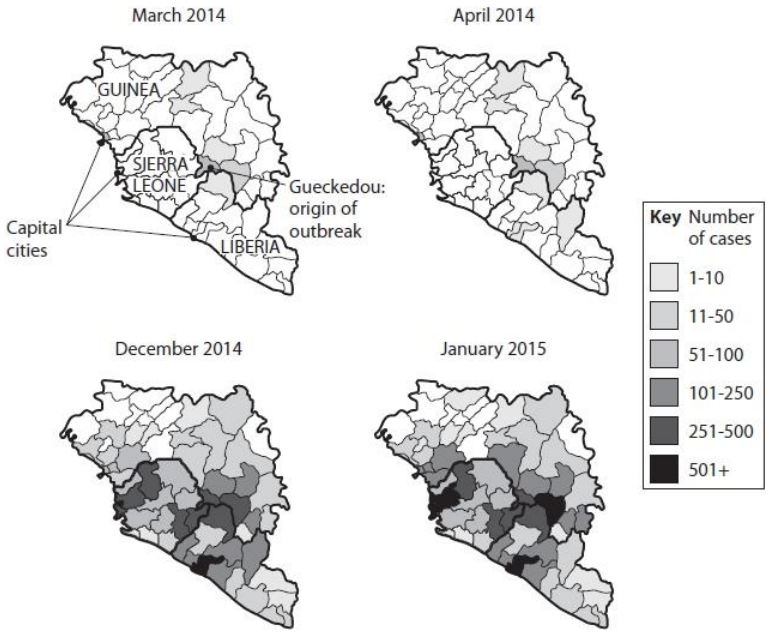
In 2014, there was an outbreak of Ebola in West Africa resulting in the deaths of over 11 000 people.

The graph shows the number of reported cases in Sierra Leone from March 2014 to January 2016.



The maps show the number of reported cases in districts of Sierra Leone, Guinea and Liberia in four months recorded during the outbreak.

The capital cities of these three countries are also shown.



During this outbreak of Ebola, no vaccine had been developed.

The World Health Organisation recommended that untested antiviral drugs could be used to treat patients, due to the scale of the outbreak.

Evaluate the ethical implications of using an untested drug during this outbreak.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 4 marks)

Q10.

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.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 3 marks)

Q11.

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)

Q12.

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)

Q13.

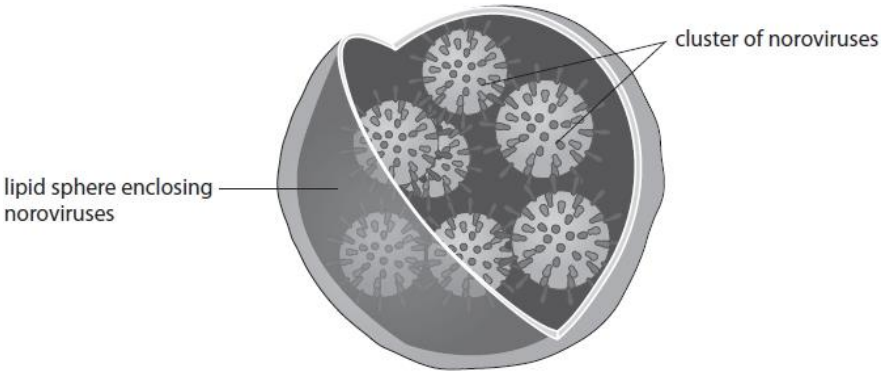
Norovirus is a single-stranded RNA, non-enveloped virus.

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.

(3)

.....

.....

.....

.....

.....

(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.

(2)

.....

.....

.....

.....

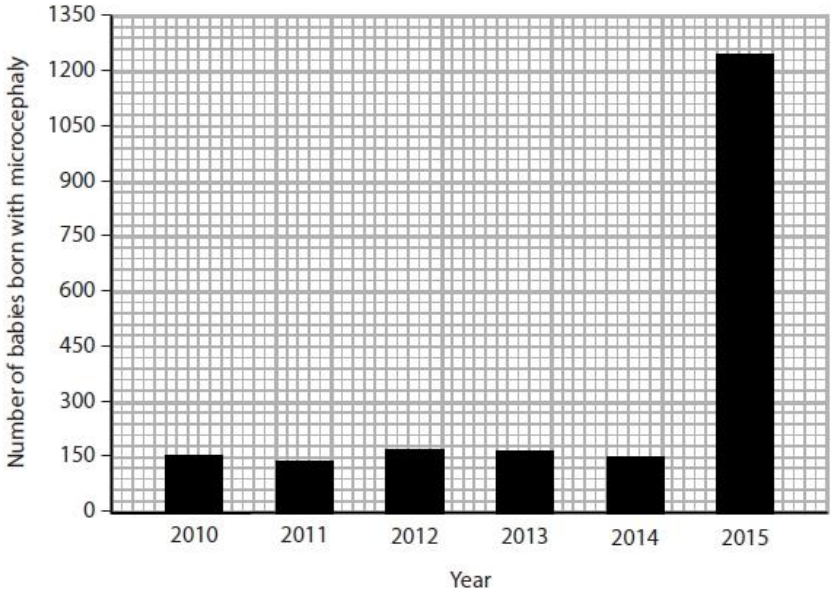
(Total for question = 5 marks)

Q14.

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)

.....

(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)

.....

.....

.....

(Total for question = 3 marks)

Q15.

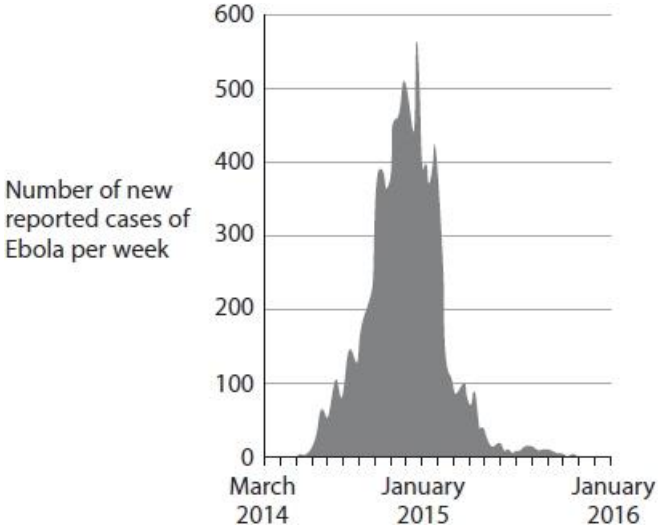
Some viruses cause infections in humans.

Antiviral drugs affect the virus without affecting the cells of the host.

Ebola is a disease that has a high mortality rate.

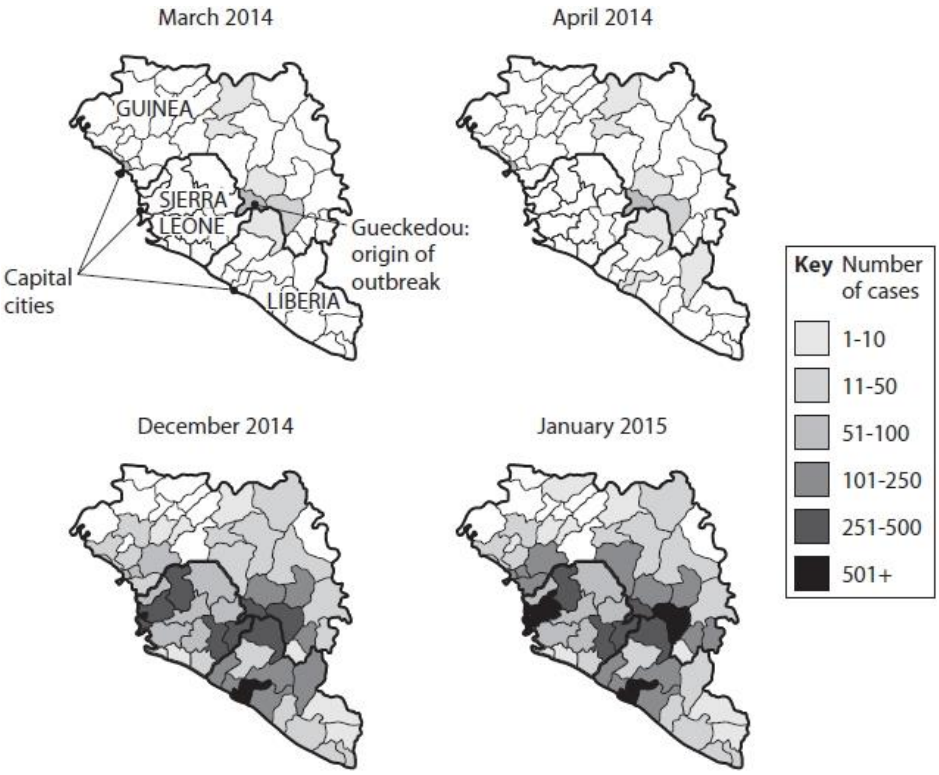
In 2014, there was an outbreak of Ebola in West Africa resulting in the deaths of over 11 000 people.

The graph shows the number of reported cases in Sierra Leone from March 2014 to January 2016.



The maps show the number of reported cases in districts of Sierra Leone, Guinea and Liberia in four months recorded during the outbreak.

The capital cities of these three countries are also shown.



* (i) Analyse the information in the graph and maps to comment on the spread of Ebola in West Africa.

(6)

(ii) Describe the methods used to prevent the spread of Ebola.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 9 marks)

Q16.

When a bacterial cell is infected with *λ* (lambda) phage, the virus will enter the lytic cycle.

(i) Describe the lytic cycle of a virus.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

(ii) The multiplicity of infection (MOI) is one factor that determines whether a virus enters the lytic cycle or latency.

$$\text{MOI} = \frac{\text{number of infectious virus particles}}{\text{number of target cells present}}$$

A scientist needed to use a MOI of 0.5 for an investigation.
The virus particles were at a concentration of 2×10^9 cm^{-3} and the bacteria were at a concentration of 8×10^8 cm^{-3}.
Calculate the volume of virus particles that should be added to 0.25 cm^3 of bacteria.

(3)

Answer ..... cm^3

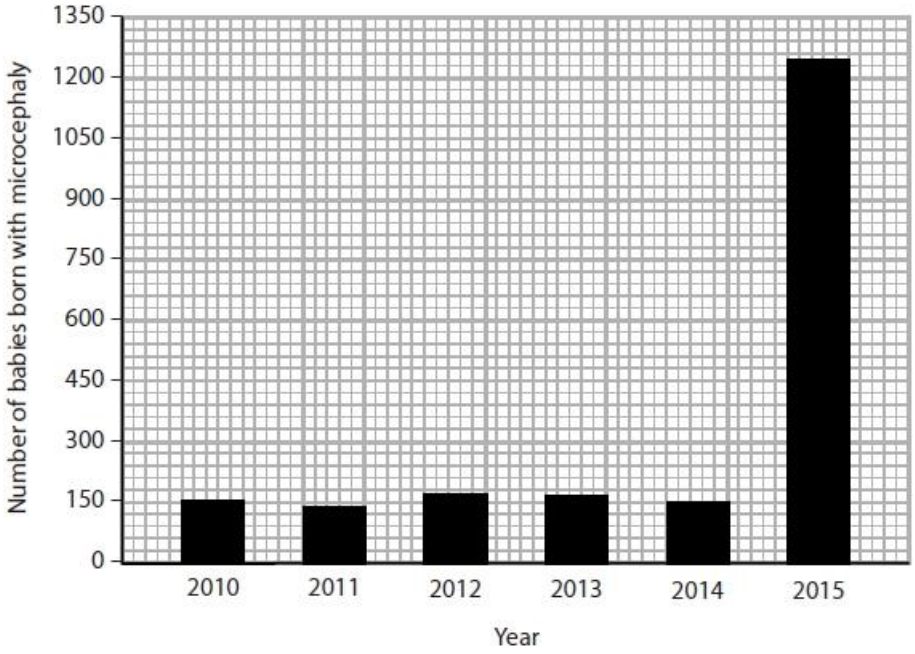
(Total for question = 6 marks)

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.



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)

.....

.....

.....

.....

(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.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

(2)

.....

.....

.....

.....

.....

(Total for question = 8 marks)

Q18.

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 ☒.

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

Norovirus is the most common cause of gastroenteritis.

The table shows some features used to classify viruses.

Which box in each row shows how these viruses are classified?

(3)

Virus	Classification of viruses			
	DNA enveloped	DNA non-enveloped	RNA enveloped	RNA non-enveloped
Ebola	☐	☐	☐	☐
λ (lambda) phage	☐	☐	☐	☐
Tobacco mosaic	☐	☐	☐	☐

(Total for question = 3 marks)

Q19.

The classification of viruses is based on structure and nucleic acid types.

(i) Which of the following pairs of viruses both have an envelope?

(1)

- ☒ **A** Ebola and *λ* (lambda) phage
- ☒ **B** human immunodeficiency virus and Ebola
- ☒ **C** *λ* (lambda) phage and tobacco mosaic virus
- ☒ **D** tobacco mosaic virus and human immunodeficiency virus

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

(1)

- ☒ **A** Ebola and tobacco mosaic virus
- ☒ **B** *λ* (lambda) phage and Ebola
- ☒ **C** human immunodeficiency virus and *λ* (lambda) phage
- ☒ **D** tobacco mosaic virus and human immunodeficiency virus

(Total for question = 2 marks)

Q20.

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 ☒.

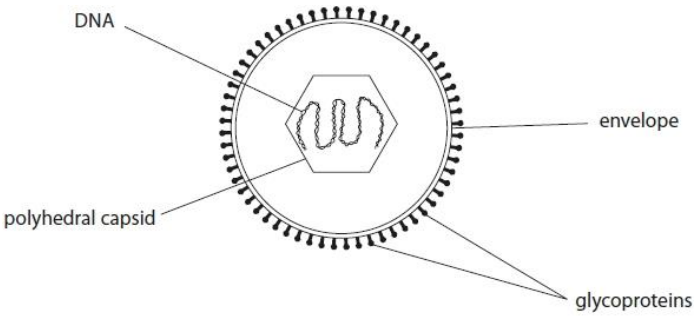
Glandular fever is caused by infection with the Epstein–Barr virus (EBV).

The virus infects B lymphocytes and epithelial cells.

On infection of these cells, the virus enters the lytic cycle.

After the lytic cycle is brought under control by the immune system of the body, latency takes place.

The diagram shows the structure of EBV.



Source from: https://www.hindawi.com/journals/jir/2012/370516/

(i) Which virus has both a polyhedral capsid and an envelope?

(1)

- ☒ **A** Ebola
- ☒ **B** human immunodeficiency virus
- ☒ **C** λ (lambda) phage
- ☒ **D** tobacco mosaic virus

(ii) State what the genes in the DNA of EBV code for, other than glycoproteins.

(1)

.....

.....

.....

(iii) Describe the role of the glycoproteins in EBV.

(2)

.....

.....

.....

.....

(Total for question = 4 marks)

Q21.

Glandular fever is caused by infection with the Epstein–Barr virus (EBV).

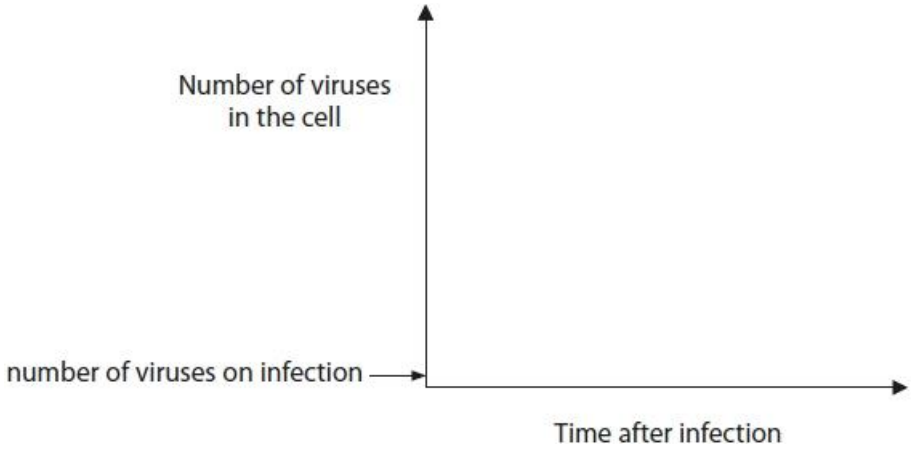
The virus infects B lymphocytes and epithelial cells.

On infection of these cells, the virus enters the lytic cycle.

After the lytic cycle is brought under control by the immune system of the body, latency takes place.

Complete the graph to show the shape of the growth curve of EBV as a result of one lytic cycle after infection of a cell.

(2)

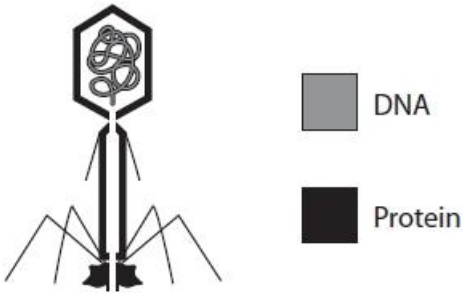


(Total for question = 2 marks)

Q22.

An investigation used radioactively labelled phages.

Phages are viruses that consist of DNA contained within a protein head.



Phages inject their DNA into a host bacterial cell, but leave the protein heads (called phage ghosts) on the outside of the infected cell.

Two different types of phage were developed by growing the phages in cultures of bacteria in two separate media.

Medium (**A**) contained radioactive phosphorus (^{32}P).

Medium (**B**) contained radioactive sulfur (^{35}S).

Type A phage had DNA that included the ^{32}P.

Type B phage had proteins that included the ^{35}S.

(i) State why radioactive carbon, nitrogen or oxygen were not used in this experiment.

(1)

.....

.....

.....

.....

(ii) Separate cultures of the bacteria *E. coli* were infected with either type A or type B phage.

After infection the empty phage heads (phage ghosts) were separated from the bacterial cells.

Each was tested for radioactivity.

Complete the table to show where radioactivity was present (**Y**) or absent (**N**).

(1)

Phage type (label)	Bacterial cells	Phage ghosts
A (^{32}P)		
B (^{35}S)		

(Total for question = 2 marks)

Q23.

Some viruses cause infections in humans.

Antiviral drugs affect the virus without affecting the cells of the host.

Explain why viruses are dependent on living cells.

(2)

.....

.....

.....

.....

.....

.....

.....

.....

.....

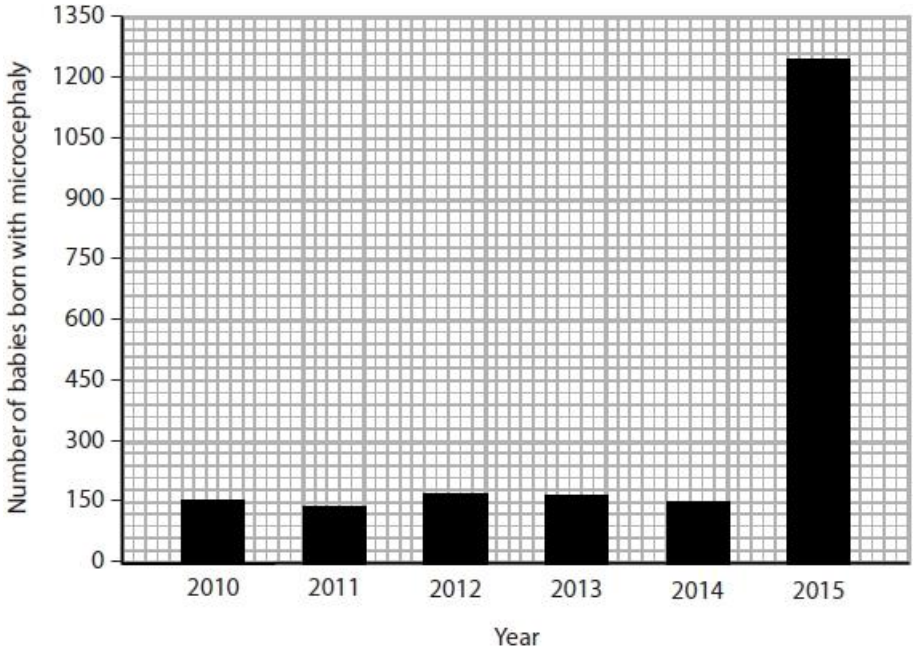
(Total for question = 2 marks)

Q24.

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.



Calculate the percentage increase in the number of babies born with microcephaly in 2015 compared with 2014.

(2)

Answer ..... %

(Total for question = 2 marks)

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to four of the following: • Zmapp is effective / more people survive when treated (1) • Zmapp has {little / no} effect up to {5/6} days /deaths rates are the same up to day {5/6} / Zmapp is effective after day {5/6} (1) • 3 doses / treatments are needed (1) • Zmapp side effects decrease over time (1) • sample size is {small / age unknown / sex unknown / trial only lasted nine days (1)	**ACCEPT** deaths with Zmapp level off at 28 **ACCEPT** no more deaths after 3 doses **ACCEPT** converse	**4**

Q2.

Question Number	Answer	Additional Guidance	Mark
i	An explanation that makes reference to the following: • Gram positive bacteria have a thick layer of peptidoglycan in their cell wall (1) • some antibiotics inhibit (enzymes involved in) the formation of peptidoglycan so are effective against Gram positive bacteria (1) • some antibiotics are not able to cross the peptidoglycan layer so they are {more / only} effective against Gram negative bacteria (1)	accept converse, accept reference to teichoic acid	**(3)**

Question Number	Answer	Additional Guidance	Mark
ii	An explanation that makes reference to the following: • because viruses are not living cells (1) • because viruses do not have a cell wall (1)	accept antibiotics usually target {cell walls / cell membranes / replication / translation / metabolism }	**(2)**

Q3.

Question Number	Answer	Additional Guidance	Mark
	The only correct answer is A **B** is incorrect because the capsid is complex not helical **C** is incorrect because DNA is the genetic material not RNA **D** is incorrect because DNA is the genetic material not RNA		(1) COMP

Q4.

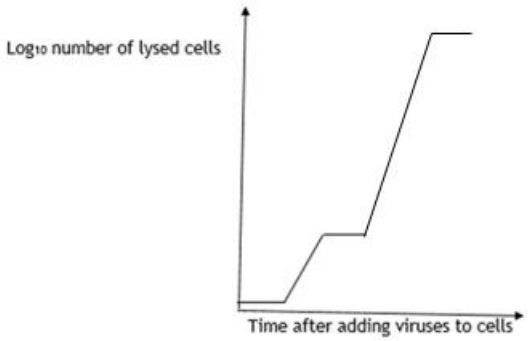
Question Number	Answer	Additional Guidance	Mark
	• drawing length of bacteria given in μm or nm / drawing length of virus given in μm or nm **OR** • ratio of drawing length (1) • actual length of virus given in nm, to the nearest whole number, value between 103 and 143 (1)	**ACCEPT** between 95 000 μm / 95 000 000 nm and 115 000 μm / 115 000 000 nm for bacteria between 7 000 μm / 7 000 000 nm and 8 000 μm / 8 000 000 nm for virus **ACCEPT** between 95 mm and 115 mm for bacteria and between 7 mm and 8 mm for virus ecf if numerals correct but order of magnitude wrong	(2) EXP

Drawing length of bacteria / mm	Drawing length of bacteria / µm or nm	Length of virus / mm	Length of virus / µm or nm	Actual length of virus / nm	Bacteria drawing length: virus drawing length
95	95 000 or 95 000 000	7 8	7 000 or 7 000 000 8 000 or 8 000 000	125 143	95:7 13.571:1 95:8 11.875:1
100	100 000 or 100 000 000	7 8	7 000 or 7 000 000 8 000 or 8 000 000	119 136	
105	105 000 or 105 000 000	7 8	7 000 or 7 000 000 8 000 or 8 000 000	113 130	
110	110 000 or 110 000 000	7 8	7 000 or 7 000 000 8 000 or 8 000 000	108 124	
115	115 000 or 115 000 000	7 8	7 000 or 7 000 000 8 000 or 8 000 000	103 118	115:7 16.428571:1 115:8 14.375 :1

Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to three of the following: • virus to attach to host cells / {genetic material / DNA} to enter host cells (1) • synthesis of DNA (1) • {protein synthesis / transcription and translation} (1) • assembly of new viruses (1)	**ACCEPT** virus {enters / infects} **DO NOT ACCEPT** RNA **IGNORE** nucleic acid **DO NOT ACCEPT** RNA unless already penalised in mp 1 / in the context of {proviruses / latency} **ACCEPT** capsid / capsomeres / tail / base plate / tail (fibres) / collar / J protein / enzymes / protease / permease / other named proteins will need to be checked **DO NOT ACCEPT** reverse transcriptase / integrase **NB ACCEPT** (time for) {replication / multiplication} of the virus in correct context if no other marks awarded.	(3) EXP

Question Number	Answer	Additional Guidance	Mark
(ii)	• correct values read from graph and divided by the time (1) • mean rate calculated (1)	3.8 and 1.7 and a division by 40 / 0.0525 / 3.147 **IGNORE** ref to logs 156 ecf wrong time value but correct answer to whole number e.g.(30 mins) 209 Correct answer only = 2 marks	(2) EXP

Question Number	Answer	Additional Guidance	Mark
(iii)	• line going up and (generally) levelling off (1) • increase greater than the first increase (1)	**IGNORE** a third increase  	(2) EXP

Q6.

Question Number	Answer	Mark
(i)	**The only correct answer is C** ***A*** *is not correct because cellulose is not found in a bacterial cell* ***B*** *is not correct because cellulose and nucleoli are not found in a bacterial cell* ***D*** is not correct because nucleoli are not found in a bacterial cell	**(1)**

Question Number	Answer	Mark
(ii)	**The only correct answer is C** ***A*** *is not correct because Ebola contains RNA* ***B*** *is not correct because HIV contains RNA* ***D*** *is not correct because tobacco mosaic virus contains RNA*	**(1)**

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to the following: • the resolution is higher / better (1) • because wavelength of electrons is short(er) (1)	**ACCEPT** converse **ACCEPT** smaller wavelength	**(2)**

Q7.

Question Number	Answer	Additional Guidance	Mark
(i)	A description that makes reference to the following: • viral proteins / capsids made (1) • {viruses multiply / genetic material / RNA / DNA replicate} and {cells lyse / cells burst / viruses released from cell} (1)	**ACCEPT** viral RNA is translated	2

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to two of the following: • virus {nucleic acid / RNA / DNA / genome} incorporated / integrated (into the host cell) (1) • virus is {dormant / inactive} (1) • virus nucleic acid replicates when host cell divides (1)	**ACCEPT** virus is not virulent **ACCEPT** viral RNA is not translated **ACCEPT** viral DNA is replicated when host cell DNA is replicated	2

Q8.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to the following: • (viral) RNA made (1) • (viral) {capsid / protein} made (1) • assembly of viruses (1)	**ACCEPT** new virus particles made	(3)

Q9.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to four of the following, including a conclusion: reasons for – • Ebola has high mortality (1) • new drug is unlikely to affect other people (1) • may help develop the drug for other patients (1) reasons against – • unknown side effects (1) • patient may not be able to provide informed consent (1) • who decides who can be treated if the drug is in limited supply (1) • conclusion reached (1)	epidemic may be difficult to control e.g. benefits may outweigh the risks due to the severity of the Ebola outbreak	**(4)**

Q10.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to the following: **Similarities** • both contain DNA (1) **Differences** • HPV is surrounded by {protein / capsid} and chlamydia by {a cellwall / peptidoglycan} (1) • HPV is hollow and chlamydia has {cell membrane / cytoplasm / ribosomes / glycogen granules / lipid droplets / plasmids}	**ACCEPT** DNA strands in HPV **ACCEPT** chlamydia has {cell membrane / cytoplasm / ribosomes / glycogen granules / lipiddroplets / plasmids} but HPV does not	(3)

Q11.

Question Number	Answer	Mark
	The only correct answer is B human immunodeficiency virus (HIV) *A is incorrect because Ebola virus does not have reverse transcriptase* *C is incorrect because lambda phage has DNA* *D is incorrect because tobacco mosaic virus does not contain reverse transcriptase*	1

Q12.

Question Number	Answer	Mark
(i)	**The only correct answer is C** ***A** is not correct because not all RNA viruses have envelopes and only the retroviruses contain reverse transcriptase* ***B** is not correct because only the retroviruses contain reverse transcriptase* ***D** is not correct because not all RNA viruses have envelopes and they are not all helical*	**(1)**

Question Number	Answer	Mark
(ii)	**The only correct answer is A** ***B** is not correct because λ phage has DNA* ***C** is not correct because λ phage has DNA* ***D** is not correct because λ phage has DNA*	**(1)**

Q13.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to three of the following: • because more viruses delivered (1) • because {lipid / sphere} can pass through cell membrane / no need to bind to (cell) receptors / can bind to any cell (1) • because {lipid / sphere} protects viruses from {enzymes / stomach acid / phagocytes / immune system} (1) • credit a link between one reason and the information given (1)	e.g. more cells infected so symptoms develop faster more cells infected so symptoms are worse virus particles not destroyed so more cells infected	(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to two of the following: • because the lipids could be {targetted / broken down} (1) • by an enzyme (that breaks down lipid) (1) • resulting in {fewer virus particles arriving at cells (in one go) / exposure to immune system} (1)	**ACCEPT** using a drug that can penetrate the lipid **ACCEPT** therefore destroying the viruses **ACCEPT** {fewer / no} viruses (arriving at the cells)	(2)

Q14.

Question Number	Answer	Additional Guidance	Mark
(i)	315		(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	A description that makes reference to the following: • used in translation to make (viral) protein (1) • more RNA is produced (1)		(2)

Q15.

Question Number	Indicative content
* i	Answers will be credited according to candidates' deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • graph shows rapid rise between April and December 2014 in Sierra Leone
	• maps show rapid spread between April and December 2014 in all three countries • initial outbreak at border between Guinea, Sierra Leone and Liberia • more case in Guinea in March 2014 • greater increase in Sierra Leone compared with Liberia and Guinea • greater density of cases in Sierra Leone at high of outbreak • some areas of Guinea have {few/no } cases (even at height of outbreak • spread in Sierra Leone has come from {Guinea / western districts of Sierra Leone} • in April 2014 month Ebola has spread further into Liberia • January 2015 graph shows slight decrease and so does one region in Sierra Leone • most rapid increase near capital cities • because of high population density • maps show significant variation in number of cases in different districts • graph shows rapid fall in Sierra Leone after January 2015 • no information provided whether there was also a fall in Guinea and Liberia after January 2015

Level	Marks	
0	0	No awardable content
1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information with a focus on mainly one piece of scientific information. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.
2	3-4	An explanation will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure.
3	5-6	An explanation is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning which is clear, coherent and logically structured.

Additional Guidance

Level 1 response = either the graph or maps have been analysed with some relevant trends and patterns identified.

Level 2 response = data from both the graph and the maps are used and some links are made between the two sets of data

Level 3 response = detailed trends in both the graph and maps are compared and there is some consideration given to the evaluation of the data e.g. what data is missing for relevant conclusions to be reached.

Question Number	Answer	Additional Guidance	Mark
ii	A description that makes reference to three of the following: • rapid {identification of disease / diagnosis} (1) • methods used to prevent transmission described (1) • identify who may have been in contact with the infected individual and isolate them (1) • education program for burial of corpses (1)	Accept: hygiene / barrier methods of contraception / isolate infected individuals / sterilisation or disposal of equipment, bedding or clothes / wear protective clothing / increased border security	**(3)**

Q16.

Question Number	Answer	Additional Guidance	Mark
(i)	A description that makes reference to the following: • virus {attaches to / penetrates} host cell **(1)** • assembly of virus particles from synthesised {DNA / RNA} and proteins **(1)** • (immediate) lysis of the host cell **(1)**	 **ACCEPT** virus genetic material goes into the cell **ACCEPT** virus replicates **DO NOT ACCEPT** exocytosis	**(3)**

Question Number	Answer	Additional Guidance	Mark
(ii)	 • number of bacteria in 0.25 cm^3 **(1)** • number of phage needed to give MOI of 0.5 **(1)** • answer = volume of phage needed **(1)**	<u>Example of calculation</u> $8 \times 10^8 \div 4 = 2 \times 10^8$ $0.5 \times 2 \times 10^8 = 1 \times 10^8$ $1 \times 10^8 \div 2 \times 10^9 = 0.05\ cm^3$ **ACCEPT** 1 mark for calculation of MOI as 2.5 for using equal volumes of the concentrations given Correct answer with no working gains full marks	**(3)**

Q17.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: • because viruses are {not living / not cells / have no metabolism / have no protein synthesis organelles / lack a cell wall / lack peptidoglycan} (1) • antiviral drugs used because they inhibit replication (1)		**(2)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to four of the following: • identify mosquitoes that fluoresce (1) • because these mosquitoes are {genetically modified / contain the gene} (1) • allow {those that fluoresce / GM mosquitoes} to interbreed (1) • repeat for several generations (1) • offspring with the gene for fluorescence are selected to produce a population of GM mosquitoes (1)	**Do not accept** eggs	(4)

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to two of the following: • to prevent (people with Zika) being bitten (1) • therefore preventing {spread of Zika / biting uninfected people / increase in infected mosquitoes} (1) • mosquitoes spread other diseases (1)		(2)

Q18.

Question Number	Answer	Additional Guidance	Mark
			(3)

Virus	Classification of viruses			
	DNA enveloped	DNA non-enveloped	RNA enveloped	RNA non-enveloped
Ebola	☐	☐	X	☐
λ (lambda) phage	☐	X	☐	☐
Tobacco mosaic	☐	☐	☐	X

Q19.

Question Number	Answer	Mark
(i)	**The only correct answer is B** ***A*** *is not correct because lambda phage does not have an envelope* ***C*** *is not correct because both lambda phage and tobacco mosaic virus do not have envelopes* ***D*** *is not correct because tobacco mosaic virus does not have an envelope*	**(1)**

Question Number	Answer	Mark
(ii)	**The only correct answer is A** ***B*** *is not correct because lambda phage does not have a helical capsid* ***C*** *is not correct because neither HIV or lambda phage have a helical capsid* ***D*** *is not correct because HIV does not have a helical capsid*	**(1)**

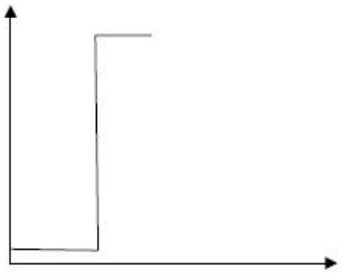
Q20.

Question Number	Answer	Additional Guidance	Mark
(i)	B		**(1)** **comp**

Question Number	Answer	Additional Guidance	Mark
(ii)	• (protein) capsid / protein coat		**(1)** **GRAD**

Question Number	Answer	Additional Guidance	Mark
(iii)	A description that makes reference to the following: • attach the virus to {receptors / attachment molecules} (1) • on the {epithelial cells / B lymphocytes} (1)		**(2)** **EXP**

Q21.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to the following: • the delay before number of viruses increase (1) • the one step growth curve (1)	**ACCEPT** steep line / ignore steep downward line after peak due to cellbursting 	(2) **EXP**

Q22.

Question Number	Answer	Additional Guidance	Mark
(i)	carbon, oxygen and nitrogen are found in both DNA and protein (1)		(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	<table><tr><th>Phage type (label)</th><th>Bacterial cells</th><th>Phage ghosts</th></tr><tr><td>A (^{32}P)</td><td>Y</td><td>N</td></tr><tr><td>B (^{35}S)</td><td>N</td><td>Y</td></tr></table>		(1)

Q23.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • unable to {replicate / reproduce} independently (1) • because they do not have appropriate {organelles / enzymes} (1)		**(2)**

Q24.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to the following: • correct reading for 2014 and 2015 (1) • correct percentage increase calculated (1)	<u>Example of calculation:</u> 150 and 1240 to 1245 1240 – 150 = 1090 (1090 ÷ 150) ×100 = 727 1245 – 150 = 1095 (1095 ÷ 150) ×100 = 730 **Accept** range 727 to 730 Correct answer with no working gains full marks	**(2)**