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EDEXCEL GCSE BIOLOGY: QUESTIONS BY TOPIC

Health, Disease and the Development of Medicines (5)

GCSE Biology (Higher) Topic 5

24 questions · 234 marks · Mark schemes included

Pearson Edexcel GCSE (9-1) Biology 1BI0, Higher Tier, June 2018 - June 2025

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HOW TO USE THIS BOOKLET

Questions run from the lowest mark tariff to the highest, so similar questions sit together.

Click any row below to jump straight to that question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme.

Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

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QUESTIONS

24 questions · 234 marks · lowest tariff first



6-MARK QUESTIONS

1 question in this booklet



1 Between 2013 and 2016 there was an outbreak of a disease called Ebola.

Ebola is estimated to have caused the deaths of more than 11 000 people.

(a) (i) Why is the number of deaths from Ebola only an estimate?

(1)

- ☐ **A** many people were immune to Ebola
- ☐ **B** many deaths were not confirmed to be caused by Ebola
- ☐ **C** Ebola does not spread easily
- ☐ **D** Ebola does not cause any symptoms

(ii) State how Ebola is spread from person to person.

(1)

(iii) The lytic pathway is part of the lifecycle of the Ebola virus.

After infection of the host cell, components of the virus are produced.

Describe the next stages of the lytic pathway.

(2)

(b) The genetic material of a virus can also be inserted into the genome of the host.

(i) Name this type of pathway.

(1)

(ii) State what is meant by the term genome.

(1)

(Total for Question 1 = 6 marks)

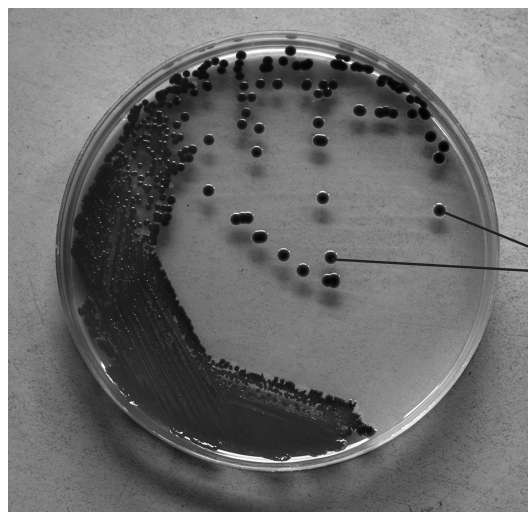


7-MARK QUESTIONS

2 questions in this booklet



3 Figure 4 shows colonies of bacteria growing on an agar plate.



colonies of
bacteria

(Source: © Chatchouliya/Shutterstock)

Figure 4

Each colony starts as one bacterium.

Every time bacteria reproduce, the number of bacteria in each colony doubles.

- (a) Calculate the number of bacteria in a colony after five hours, if each bacterium reproduces every 30 minutes.

(2)

..... bacteria

- (b) Some bacteria are pathogens.

- (i) State the meaning of the term pathogen.

(1)

.....
.....

(ii) Explain why antibiotics can be used to treat bacterial infections.

(2)

(iii) A rod-shaped bacterium is 0.005 mm long.

A student draws the rod-shaped bacterium.

The bacterium in the drawing is 80 mm long.

Calculate the magnification of this drawing.

(2)

magnification = ...

(Total for Question 3 = 7 marks)



3 (a) Malaria is a disease that causes damage to the blood and liver.

(i) Which type of pathogen causes malaria?

(1)

- ☐ A a bacterium
- ☐ B a fungus
- ☐ C a protist
- ☐ D a virus

(ii) State how the pathogen that causes malaria is spread.

(1)

(b) Measles is a disease caused by a virus.

Figure 4 shows the number of measles cases reported in England and Wales from 1985 to 2015.

year	number of measles cases reported
1985	97 408
1995	7 447
2005	2 089
2015	1 193

Figure 4

Explain **one** conclusion that can be made about the change in the number of measles cases reported from 1985 to 2015.

(2)

(c) Describe **two** ways the immune system will respond to an infection by a pathogen.

(2)

1

.....

2

.....

(d) Beriberi is a disease caused by a lack of vitamin B1 in the diet.

Give **one** reason why beriberi is classed as a non-communicable disease.

(1)

.....

.....

(Total for Question 3 = 7 marks)



9-MARK QUESTIONS

10 questions in this booklet



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DO NOT WRITE IN THIS AREA

- 2 (a) Obesity increases the risk of a person developing cardiovascular disease.

Losing weight can reduce the risk of this disease occurring.

Explain why exercise can cause weight loss.

(2)

- (b) Figure 2 shows a gastric band fitted to a stomach.

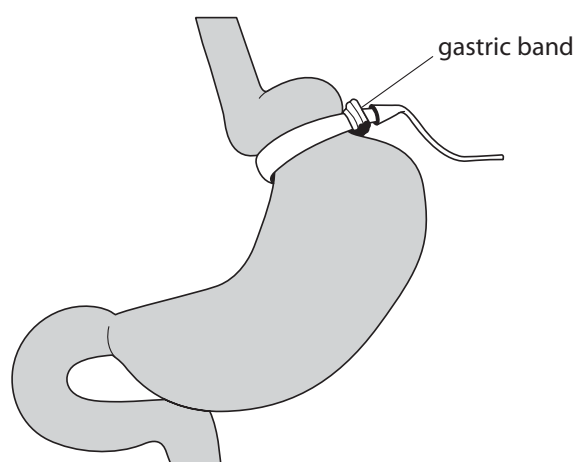


Figure 2

Explain how a gastric band helps a person to lose weight.

(2)



(c) BMI and waist:hip ratio can be used to find out if a person is obese.

Figure 3 shows some data for two males.

male	BMI	waist : hip ratio
A	27.3	0.85
B	?	0.81

Figure 3

BMI is calculated using the equation:

$$\text{BMI} = \frac{\text{mass in kilograms}}{(\text{height in metres})^2}$$

(i) Male B has a mass of 72 kg and a height of 1.81 m.

Calculate the BMI of male B.

Give the answer to 3 significant figures.

(3)

BMI = ...

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DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(ii) Figure 4 shows the interpretation of BMI values.

BMI range	interpretation
below 18.5	underweight
18.5 – 24.9	normal
25.0 – 29.9	overweight
30.0 and above	obese

Figure 4

Males with a waist:hip ratio above 0.90 are defined as abdominally obese.
Explain what the BMI and waist:hip ratio for male A shows about his weight distribution.
(2)

(Total for Question 2 = 9 marks)

5 *Streptococcus* bacteria can cause a sore throat or skin infection.

An illness called scarlet fever can also develop during an infection with this bacterium.

- (a) (i) Give **two** precautions a doctor should take when treating a patient who is infected with *Streptococcus*.

(2)

.....

.....

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.....

- (ii) From September 2013 to March 2014 there were 2 830 cases of scarlet fever in the UK.

From September 2014 to March 2015 there were 5 943 cases of scarlet fever.

Calculate the percentage increase of the number of cases of scarlet fever between the periods September 2014 to March 2015 and September 2013 to March 2014.

(2)

..... %

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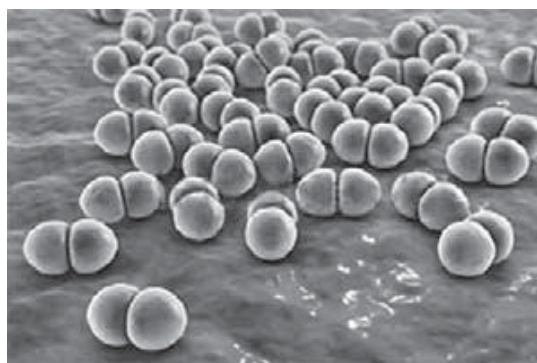


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DO NOT WRITE IN THIS AREA

(iii) Figure 10 shows some *Streptococcus* bacteria.



© Kateryna Kon/Shutterstock

Figure 10

Some bacteria are motile, meaning they can move themselves.

Why is a *Streptococcus* bacterium not motile?

(1)

- ☒ **A** it does not have flagella
- ☒ **B** it does not have plasmids
- ☒ **C** it does not have ribosomes
- ☒ **D** it does not have acrosomes

(b) Patients with scarlet fever can be treated with antibiotics.

New antibiotics need to be tested before they can be used in patients.

Which is the correct sequence for the development of a new medicine?

(1)

- | | | | | | |
|--|-------------------------------|---|---------------------------------|---|---------------------------------|
| ☒ A | testing in healthy volunteers | → | testing using cultured cells | → | double blind trials on patients |
| ☒ B | testing using cultured cells | → | double blind trials on patients | → | testing in healthy volunteers |
| ☒ C | testing in healthy volunteers | → | double blind trials on patients | → | testing using cultured cells |
| ☒ D | testing using cultured cells | → | testing in healthy volunteers | → | double blind trials on patients |



17



(c) Most cases of scarlet fever occur in children.

Adults have usually developed immunity to a toxin that the *Streptococcus* bacteria produce during infection.

Explain how an adult develops immunity to the toxin.

(3)

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DO NOT WRITE IN THIS AREA

(Total for Question 5 = 9 marks)



2 (a) The human immunodeficiency virus (HIV) can cause AIDS.

Which type of cell is destroyed by the HIV virus?

(1)

- ☒ A red blood cell
- ☒ B nerve cell
- ☒ C white blood cell
- ☒ D sperm cell

(b) Describe how the specific immune system defends the body against disease.

(3)

- (c) Figure 1 shows the number of people per million **of the population** in five European countries who were diagnosed with measles in one year.

country	number of people diagnosed with measles per million of the population
Belgium	21.00
France	15.63
Germany	8.42
Italy	20.06
Norway	0.05

Figure 1

- (i) The population of Belgium in that year was 11.18 million.

Calculate the number of people in Belgium diagnosed with measles.

Give your answer to three significant figures.

(3)

..... people



- (ii) Countries do not report the total number of people diagnosed with measles. Countries report the number of people diagnosed with measles per million of the population.

Give **one** reason why this is better.

(1)

- (iii) Give **one** reason why the number of people per million diagnosed with measles is different in these countries.

(1)

(Total for Question 2 = 9 marks)



- 3 (a) Name the organisation which defines health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

(1)

- (b) Tuberculosis (TB) is a communicable disease.

- (i) State **two** ways that communicable diseases are different from non-communicable diseases.

(2)

1

2

- (ii) Explain **one** way that the spread of tuberculosis (TB) can be reduced or prevented.

(2)



(iii) A student researched the number of people with TB in some countries.

Figure 4 shows the student's data.

	Belgium 1000	Portugal 2400
	UK 5400 people	
	Germany 6100	5800 in France

Figure 4

Complete the table to show the student's data.

(2)

(c) Explain why people with AIDS are more susceptible to TB.

(2)

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(Total for Question 3 = 9 marks)

- 6 (a) Figure 8 shows how alcohol consumption increases the risk of developing liver cancer.

Someone who does not drink alcohol has a 1.0 risk of developing liver cancer.

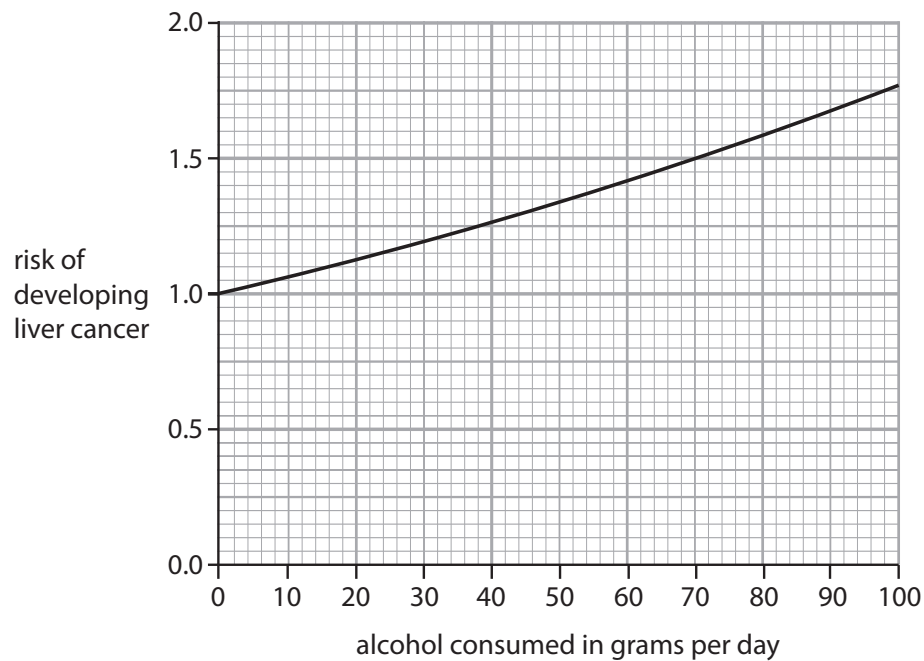


Figure 8

- (i) One unit of alcohol contains 8 grams of alcohol.

Calculate the risk of developing liver cancer for someone who consumes 4 units of alcohol a day.

(2)

..... risk of developing liver cancer

(ii) Describe how cancer develops in the liver.

(2)

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(b) Haemochromatosis is a disease that occurs when iron accumulates in the liver.

A person with haemochromatosis is treated by having 0.5 dm^3 of their blood removed each week.

This lowers the level of iron in their blood.

(i) Give **two** safety precautions needed when blood is removed from this person.

(2)

1

.....

2

.....

(ii) Haemochromatosis can be inherited.

Haemochromatosis occurs when a person inherits two copies of a recessive allele.

Figure 9 shows the inheritance of haemochromatosis in a family.



Figure 9

State and explain the genotype of female Z.

(3)

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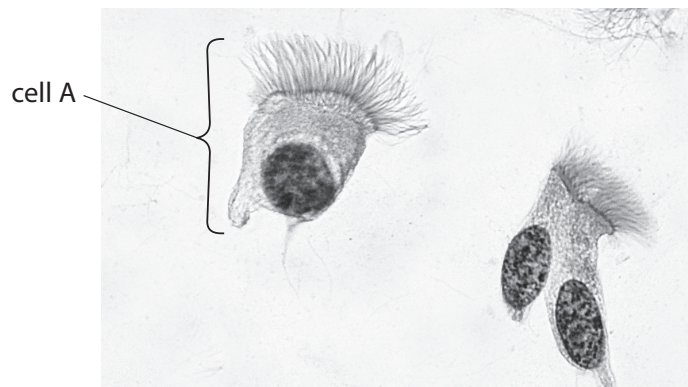
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(Total for Question 6 = 9 marks)

- 3 (a) Figure 4 shows ciliated epithelial cells from the airways of a human as seen using a light microscope.



(Source: © Jose Luis Calvo/Shutterstock)

Figure 4

- (i) Draw the cell labelled A in the box below.
Label **three** parts of this cell on your diagram.

(4)



- (ii) State the function of the ciliated epithelial cells in the airways of the human breathing system.

(1)

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(b) Figure 5 shows equipment used to investigate the rate of respiration in maggots.

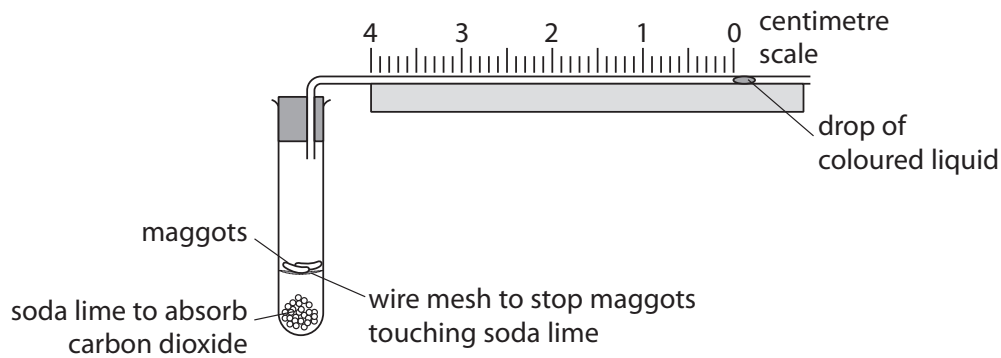


Figure 5

As the maggots respire, the drop of coloured liquid moves towards the test tube.

Figure 6 shows the position of the drop of coloured liquid after ten minutes.

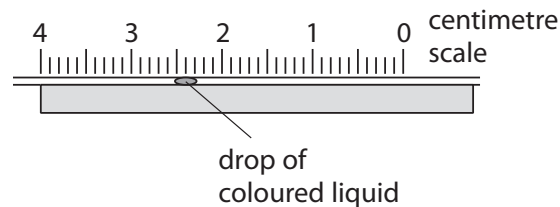


Figure 6

- (i) Use information from Figures 5 and 6 to calculate the mean rate of respiration of the maggots in mm per minute.

(2)

..... mm per minute

- (ii) Describe a control for this investigation.

(2)

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(Total for Question 3 = 9 marks)

- 3 (a) Figure 2 shows the number of people diagnosed with sexually transmitted infections (STIs) in the UK during 2017.

sexually transmitted infection (STI)	number of people diagnosed per 1000 of the population
chlamydia	3.7
gonorrhoea	0.8
genital herpes	0.6
genital warts	1.1
syphilis	0.1

Figure 2

- (i) State the sexually transmitted infection that has the median number of people diagnosed.

(1)

- (ii) The population of the UK in 2017 was 66 million people.

Calculate the total number of people diagnosed with chlamydia in the UK in 2017.

(2)

..... people

- (iii) State why chlamydia can be described as a communicable disease.

(1)

- (iv) Give **one** way the transmission of chlamydia can be prevented.

(1)



(v) Explain why chlamydia can be treated with antibiotics.

(2)

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(b) HIV is another sexually transmitted infection.

Explain how HIV can lead to the onset of AIDS.

(2)

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.....

.....

(Total for Question 3 = 9 marks)

- 2 (a) Tuberculosis is a disease that is spread through airborne droplets.

Give **two** ways of reducing or preventing the spread of tuberculosis.

(2)

1

2

- (b) Obesity is a risk factor for some non-communicable diseases.

(i) State why liver disease is a non-communicable disease.

(1)

.....

.....

- (ii) The waist-to-hip ratio can be used to show if excess weight is a health risk.

An adult has a waist measurement of 80 cm and a hip measurement of 90 cm.

Calculate the waist-to-hip ratio for this adult, using the equation:

$$\text{waist-to-hip ratio} = \frac{\text{waist measurement}}{\text{hip measurement}}$$

Give your answer to **two** decimal places.

(2)

waist-to-hip ratio



(iii) Figure 2 shows the health risk of some waist-to-hip ratios.

health risk	waist-to-hip ratios	
	males	females
low	0.95 or less	0.80 or less
medium	0.96 to 1.0	0.81 to 0.85
high	1.1 or more	0.86 or more

Figure 2

Explain the health risk for a female with a waist-to-hip ratio of 0.75.

(2)

(c) Cancer occurs when cell division by mitosis is uncontrolled.

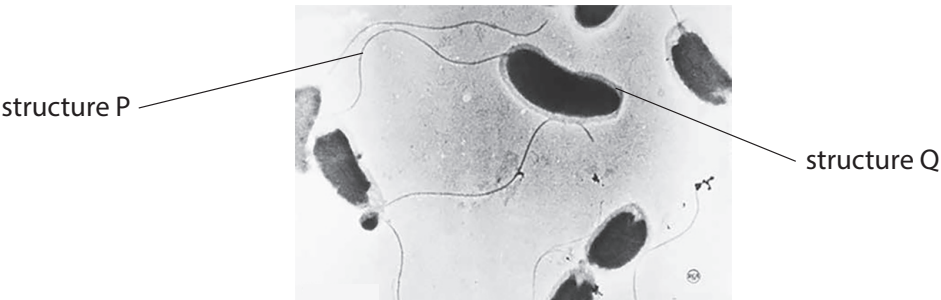
Describe the properties of cells produced by mitosis.

(2)

(Total for Question 2 = 9 marks)

6 (a) The pathogen *Vibrio cholerae* causes the disease cholera.

Figure 7 shows *Vibrio cholerae* bacteria.



(Source: Corbis)

Figure 7

(i) Complete the table to show the function of structure P and structure Q. (2)

structure	function
P	
Q	

(ii) On the original image, the length of one bacterial cell is 12 mm.
The actual length of this bacterial cell is 2.0 μm .
Calculate the magnification. (2)

magnification = ...

(iii) State **one** symptom of the disease caused by *Vibrio cholerae*. (1)

.....

.....

(iv) State how the disease caused by *Vibrio cholerae* is transmitted.

(1)

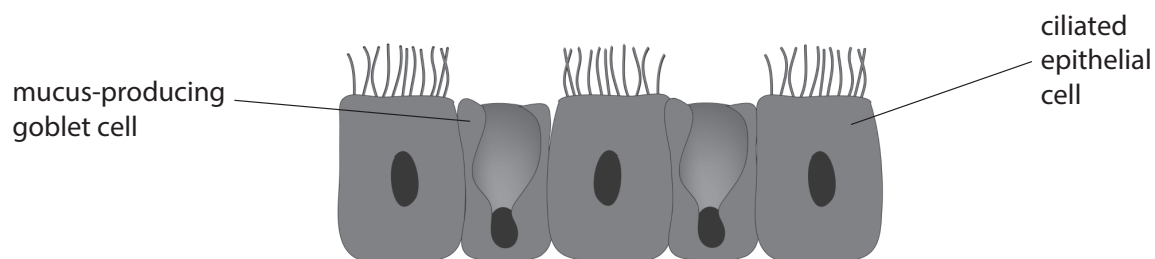
(b) Describe the specific immune response when a pathogen infects the body.

(3)

(Total for Question 6 = 9 marks)



- 2 (a) Figure 2 shows a diagram of mucus-producing goblet cells and ciliated epithelial cells in the airways of the lungs.



(Source: © K.K.T Madhusanka/Shutterstock)

Figure 2

Describe how pathogens are removed from the airways by ciliated epithelial cells.

(2)

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.....

.....

.....

.....

(b) During a race, athletes respire aerobically and anaerobically.

Figure 3 shows an athlete after a race.



(Source: © voronaman/Shutterstock)

Figure 3

Explain how aerobic respiration provides energy for running.

(2)

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.....

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.....

- (c) The rate of respiration of maggots was investigated using the equipment shown in Figure 4.

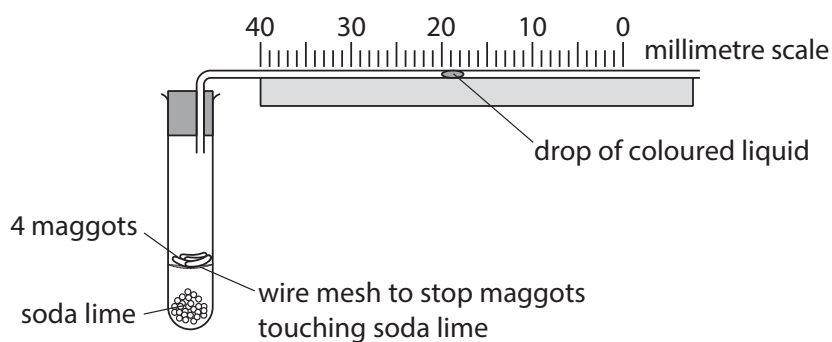


Figure 4

- (i) State the reason why the soda lime is placed in the test tube.

(1)

- (ii) The drop of liquid in Figure 4 is at 20 mm.

The drop of coloured liquid moved at a mean rate of 2 mm per minute.

Draw, on Figure 5, the new position of the bubble after the five minutes.

(1)

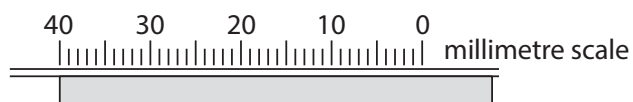


Figure 5

(iii) The investigation was repeated with two maggots.

Explain how the movement of the drop of coloured liquid would be affected if the investigation was repeated using fewer maggots.

(2)

(iv) State **one** way this investigation can be improved to obtain more reliable results.

(1)

(Total for Question 2 = 9 marks)



11-MARK QUESTIONS

8 questions in this booklet



- 9 Cancer Research UK found that many people do not realise that obesity is linked to an increased risk of developing cancer.

In the body, fat tissue sends signals that cause other cells to divide.

- (a) (i) Describe how this could cause cancer to develop.

(3)

- (ii) Cell division occurs during the cell cycle.

During which stage of the cell cycle is DNA replicated?

(1)

- ☐ A anaphase
- ☐ B prophase
- ☐ C interphase
- ☐ D telophase

- (iii) Obesity is linked to 1 in 20 cases of **all** types of cancer.

Approximately 13% of cases of bowel cancer are caused by obesity.

Determine how the impact of obesity on bowel cancer compares to the impact of obesity on all types of cancer.

(2)

(b) Two men have the same mass of 80 kg.

One man's BMI is categorised as normal weight, the other man's BMI is categorised as obese.

Explain why the men have different BMI values.

(2)

(c) Obesity can also cause cardiovascular disease to develop.

Describe the different treatments available for cardiovascular disease.

(3)

(Total for Question 9 = 11 marks)



4 *Streptococcus mutans* is one species of bacteria which causes tooth decay.

A scientist tested the effectiveness of toothpaste at killing this species of bacteria.

The scientist spread the bacteria *Streptococcus mutans* across an agar jelly plate.

(a) (i) Which word describes the techniques used to prevent contamination of the agar jelly plate?

(1)

- ☐ A clinical
- ☐ B diagnostic
- ☐ C aseptic
- ☐ D lysogenic

(ii) Give **two** precautions needed to prevent contamination of the agar jelly plate.

(2)

1

.....

2

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- (b) The scientist placed a filter paper disc soaked in toothpaste mixed with saliva (disc A) on one half of the agar jelly plate.

A filter paper disc soaked in only saliva (disc B) was placed on the other half of the agar jelly plate.

The agar jelly plate was kept at 37°C for 24 hours.

Figure 5 shows the results.

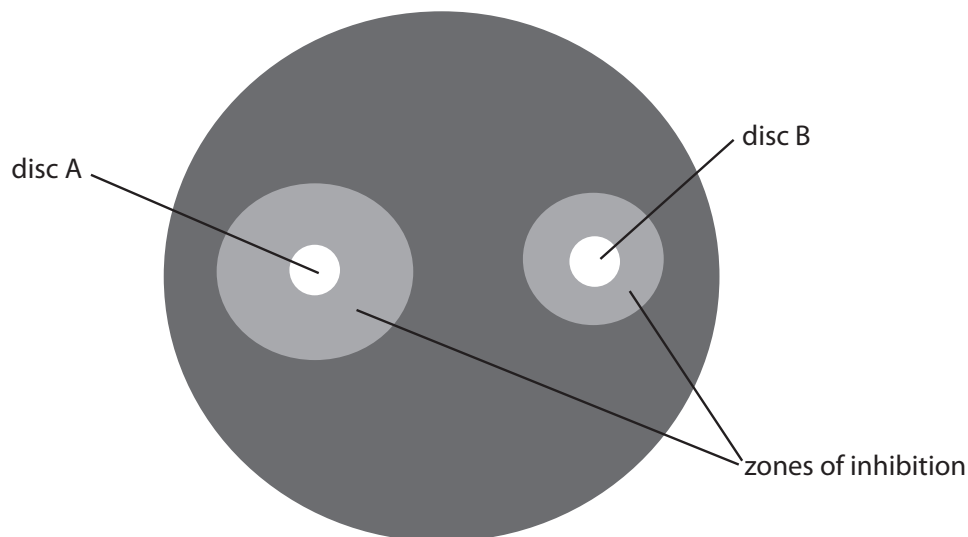


Figure 5

- (i) The diameter of the zone of inhibition around disc A is 9 mm.

Calculate the area of this zone of inhibition using the equation πr^2 .

Use a value of 3.14 for π .

Give your answer to 1 decimal place.

(3)

..... mm²

- (ii) Give a reason why disc B, soaked in only saliva, was included in this test.

(1)

.....

.....

(iii) Suggest **two** reasons why this test does not prove that toothpaste kills all bacteria on teeth.

(2)

1

2

(c) Before a new toothpaste can be sold, the toothpaste has to be tested on cultured human cells.

Cultured human cells were placed into four identical flasks.

Saliva was added to each flask and a different brand of toothpaste was added to each of three flasks.

The human cells were left for two hours and the percentage of cells that were healthy was recorded.

Figure 6 shows the results.

substance added to the human cells	percentage of healthy cells after 2 hours (%)
saliva only	85
toothpaste brand 1	84
toothpaste brand 2	86
toothpaste brand 3	85

Figure 6

Explain the conclusion that can be made from this data.

(2)

.....

.....

.....

.....

(Total for Question 4 = 11 marks)



- 7 (a) A hospital patient was tested for diabetes.

A nurse recorded his mass and height.

Figure 10 shows these measurements.

mass in kg	height in metres
124	1.8

Figure 10

Calculate the BMI of this patient using the information in Figure 10.

(2)

BMI = ...



(b) Blood samples were taken from this patient every four hours.

The glucose concentrations were recorded in Figure 11.

time in hours	blood glucose concentration in milligrams per decilitre
0	100
4	131
8	139
12	90
16	92
20	134
24	137

Figure 11

(i) Describe the trends shown in this data.

(3)

(ii) This patient was diagnosed as being type 2 diabetic.

Explain why the blood glucose concentration of this patient remained high from 4 hours to 8 hours.

(3)

(iii) This patient did some exercise during these 24 hours.

Explain how the data in Figure 11 shows that this exercise occurred after 8 hours but before 12 hours.

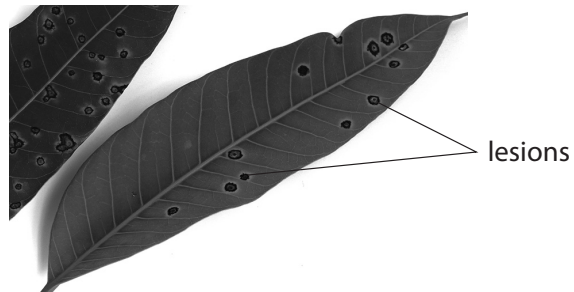
(3)

(Total for Question 7 = 11 marks)

7 Plant growth can be affected by the environment, by pathogens, or both.

(a) A farmer found lesions on crop plants growing in one of their fields.

Figure 11 shows lesions on leaves.



(Source: © nang nang/Shutterstock)

Figure 11

***(i)** Discuss how the cause of the lesions and their spread through the crops could be investigated.

You should refer to distribution analysis in your answer.

(6)

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(ii) The farmer decides to dig up the affected crop plants.

Give **one** precaution the farmer should take when digging up the affected crop plants.

(1)

(b) The genetic material of some plant viruses is single-stranded RNA.

The RNA is copied by the infected host cell and acts as a mRNA molecule.

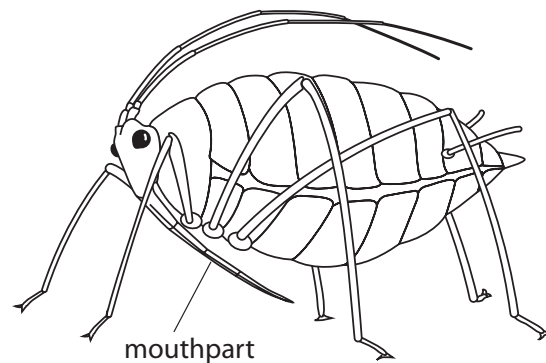
Describe how protein synthesis makes viral proteins from this mRNA.

(4)

(Total for Question 7 = 11 marks)

7 (a) Figure 9 shows an aphid.

An aphid inserts its mouthpart into plant tissue to feed on plant sap.



(Source: <http://www.biology-resources.com/drawing-aphid-wingless.html>)

Figure 9

(i) Aphids can transfer plant viruses from one plant to another.

Which term describes the role of the aphid in the transmission of plant viruses?

(1)

- ☐ **A** the aphid is a vector
- ☐ **B** the aphid is a pathogen
- ☐ **C** the aphid is a protist
- ☐ **D** the aphid is a fungus

(ii) Describe the physical barriers of a leaf that the virus gets through when an aphid feeds.

(2)

.....

.....

.....

.....

(b) The genetic material from the virus is transcribed by the plant cell.

(i) Describe how mRNA is produced during transcription.

(4)

(ii) Name the stage of protein synthesis after transcription.

(1)

(c) Biological control can be used on aphid populations feeding on crops.

Explain the advantages of using biological control on aphid populations.

(3)

(Total for Question 7 = 11 marks)



8 Statins are a type of medicine used to treat cardiovascular disease.

Some people taking statins have reported muscle pain as a side effect.

Scientists analysed data from double-blind trials to determine if there was a correlation between statin use and muscle pain.

In these double-blind trials, neither doctors nor patients knew whether the patient had been given statins or not.

(a) (i) Describe the benefits of using double-blind trials.

(2)

(ii) Which stage of the process for testing new medicines could involve a double-blind trial?

(1)

- ☐ **A** discovery
- ☐ **B** development
- ☐ **C** preclinical
- ☐ **D** clinical

(b) In a study, people were given statins or a placebo.

The percentage of people who reported muscle pain was recorded.

Figure 10 shows the results of this study.

years after starting to take statins or placebo	people reporting muscle pain taking statins (%)	people reporting muscle pain taking placebo (%)
1	14.8	14.0
2	7.4	7.5
3	5.1	5.3
4	3.0	3.1

Figure 10

(i) In year one, 9 199 people taking statins reported muscle pain.

Calculate the total number of people taking statins in this study.

Give your answer to 4 significant figures.

(3)

..... people

- (ii) The scientists concluded that most of the muscle pain reported was not due to the use of statins.

Explain, using information from the table in Figure 10, why the scientists made this conclusion.

(3)

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- (iii) The results of the study are reliable because the data was obtained from a large sample of people.

Describe **two** factors that should have been considered when selecting people for the study.

(2)

1

.....

2

.....

.....

(Total for Question 8 = 11 marks)



10 Stomach ulcers can be caused by bacteria.

(a) (i) Name the bacteria that cause stomach ulcers.

(1)

(ii) People with a stomach ulcer are treated with antibiotics and an alkaline medicine to reduce symptoms.

Give a reason why the alkaline medicine is used.

(1)

(b) Antibiotics are used to treat stomach ulcers.

Bacteria have become resistant to some antibiotics.

A scientist has an agar plate spread with the bacteria that cause stomach ulcers and discs containing different antibiotics.

Describe how the scientist could use these to determine which antibiotic can kill the bacteria.

(3)

*(c) A bacteriophage is a type of virus that can infect bacterial cells.

Figure 12 shows a bacteriophage infecting a bacterial cell.

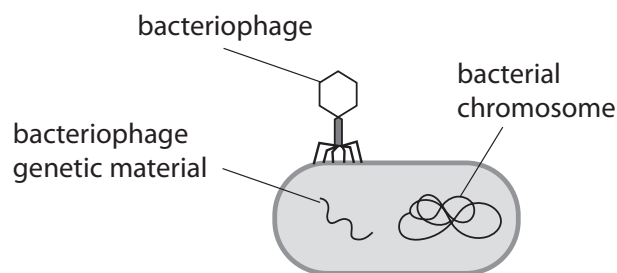


Figure 12

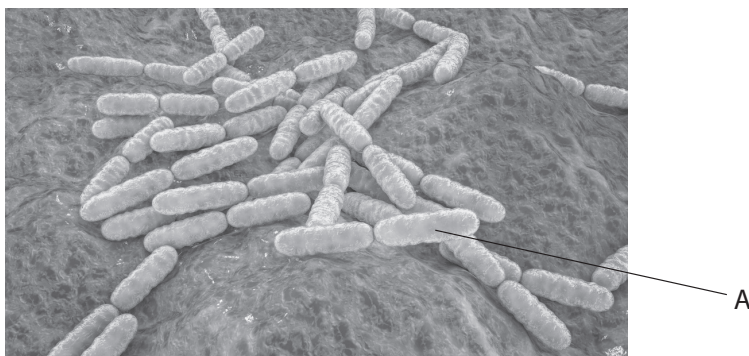
Scientists are investigating if a bacteriophage could be used as an alternative to antibiotics.

Describe the lytic lifecycle of a virus and suggest why a bacteriophage could be used as an alternative to antibiotics.

(6)

(Total for Question 10 = 11 marks)

- 4 (a) Figure 7 shows a type of bacteria (*Lactobacillus acidophilus*) that is found in cow's milk.



(Source: © Kateryna Kon/Shutterstock)

Figure 7

The magnification of this image is $\times 18\,000$.

Measure the length of the bacterium labelled A.

Use your measurement to calculate the actual length of this bacterium in millimetres.

Give your answer in standard form.

(3)

..... mm

(b) Figure 8 shows the growth rate of two species of bacteria at different pH values.

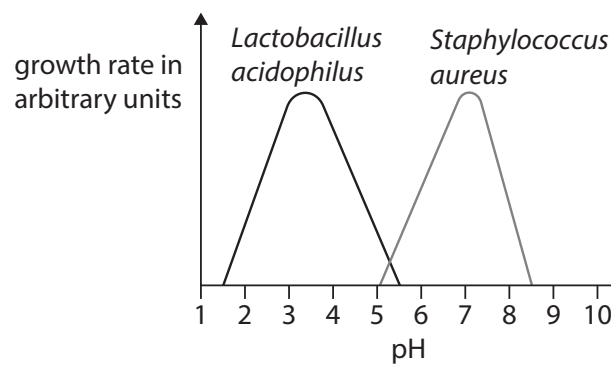


Figure 8

- (i) State a pH that allows the growth of both *Lactobacillus acidophilus* and *Staphylococcus aureus*.

(1)

- (ii) Describe the relationship between pH and the growth of *Staphylococcus aureus*, as shown in Figure 8.

(2)

(c) A student investigated the effect of temperature on the decay of milk.

Milk was placed in a beaker in a water bath at 5 °C for 72 hours.

The pH of the milk was measured every 24 hours using a pH probe.

The investigation was repeated at different temperatures.

Figure 9 shows the results of this investigation.

temperature in °C	pH			
	at 0 hours	at 24 hours	at 48 hours	at 72 hours
5	6.6	6.6	6.6	6.5
10	6.6	6.5	6.4	6.3
20	6.6	6.0	5.6	5.2
30	6.6	5.8	5.0	4.8

Figure 9

(i) Which is a variable that the student needs to control in this investigation?

(1)

- ☐ **A** pH of the milk
- ☐ **B** temperature of the milk
- ☐ **C** incubation time
- ☐ **D** volume of the milk

(ii) Describe the changes in the pH of the milk at 30 °C from 0 hours to 72 hours, as shown in Figure 9.

(2)

(iii) Calculate the rate of decay of the milk at 20°C for the 72 hours of this investigation.

Use the equation:

$$\text{rate of decay} = \frac{\text{change in pH}}{\text{time taken}}$$

(2)

..... change in pH per hour

(Total for Question 4 = 11 marks)



12-MARK QUESTIONS

3 questions in this booklet



- 10 A scientist was planning to compare the effectiveness of the antibiotic myxopyronin on two different species of bacteria.

Figure 18 shows the equipment the scientist can use.

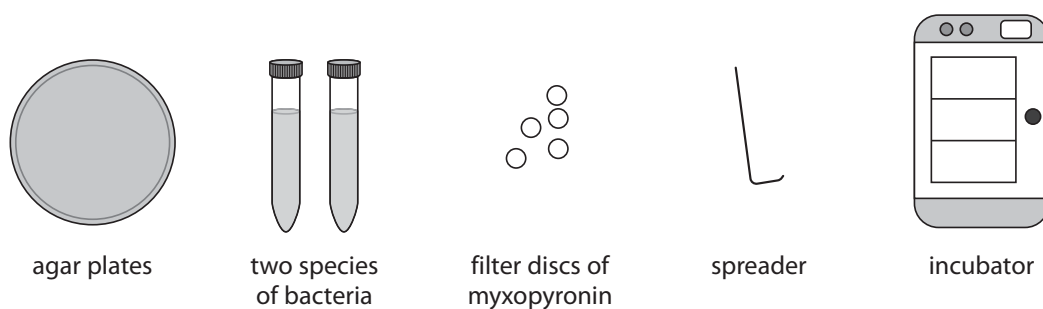


Figure 18

- (a) (i) Describe how the scientist could determine the effectiveness of myxopyronin on the two species of bacteria.

(2)

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DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



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DO NOT WRITE IN THIS AREA

(ii) Myxopyronin inhibits bacterial RNA polymerase.

Explain why the antibiotic myxopyronin can be used to treat bacterial infections in humans.

(4)

QUESTION 10 CONTINUES ON THE NEXT PAGE.



35



*(b) Infections can also be caused by viruses.

Describe the lytic pathway of a virus and how this causes the spread of infection through a population.

(6)

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DO NOT WRITE IN THIS

(Total for Question 10 = 12 marks)

- 7 Bacteria grown in a liquid medium is called a bacterial culture.
As the number of bacteria increases the bacterial culture becomes opaque.
This is because light is absorbed by the bacterial culture.

- (a) To measure the increase in the number of bacteria, a scientist took a sample from the culture every 20 minutes.

The apparatus shown in Figure 7 detects the amount of light transmitted through the bacterial sample and uses it to calculate the amount of light absorbed.

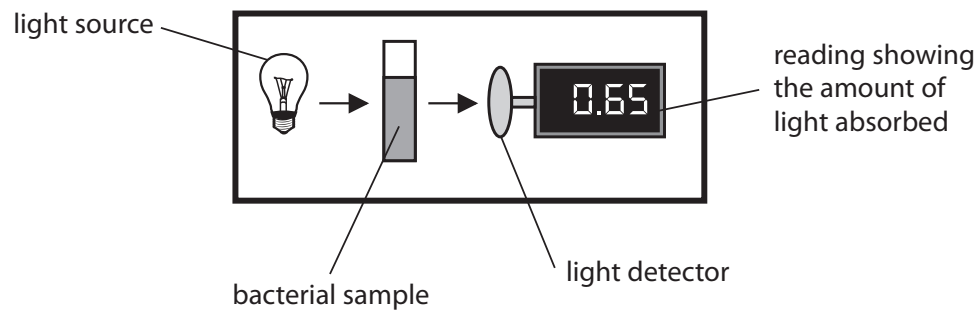


Figure 7

- (i) Give **two** aseptic techniques the scientist should use when taking samples from the bacterial culture.

(2)

1.

2.

(ii) Figure 8 shows the amount of light absorbed by the bacterial sample.

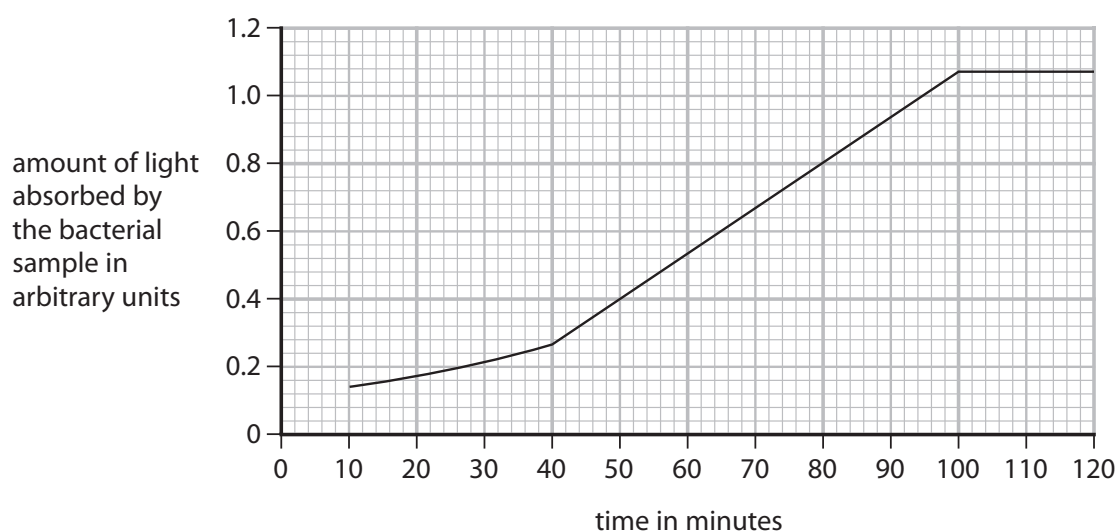


Figure 8

The bacterial population increases rapidly between 40 and 100 minutes.

Calculate the time taken for the amount of light being absorbed by the bacterial sample to double from 0.5 to 1.0 arbitrary units.

(2)

..... minutes

(iii) The scientist put a small sample of the bacteria on a microscope slide and used a magnification of $\times 1000$ to view the sample.

The bacteria could not be seen very clearly.

Give **one** improvement the scientist could make to view the bacteria more clearly.

(1)

.....

.....

- 10** (a) Figure 10 shows part of a method used to produce a bacterial culture on a Petri dish.

Step 1. Sterilise Petri dish and agar before use

Step 2. Pass inoculating loop through a flame

Step 3. Allow inoculating loop to cool

Step 4. Use inoculating loop to collect bacterial sample

Step 5. Use inoculating loop to spread bacteria onto agar

Figure 10

- (i) State why step 1 and step 2 are necessary.

(1)

.....

.....

.....

- (ii) Give **one** reason why step 3 is included.

(1)

.....

.....

.....

(b) Viruses can cause disease.

Describe how the lytic pathway is involved in the reproduction of viruses.

(4)

(Total for Question 10 = 12 marks)

MARK SCHEMES

official Pearson Edexcel mark schemes



Question number	Answer	Mark
1(a)(i)	B many deaths were not confirmed to be caused by Ebola The only correct answer is B <i>A is not correct because people are not immune to Ebola</i> <i>C is not correct because Ebola spreads easily</i> <i>D is not correct because Ebola causes symptoms</i>	(1)

Question number	Answer	Additional Guidance	Mark
1(a)(ii)	(exchange of) bodily fluids / named body fluids / contact with body fluids	accept any contact or body fluid transmission	(1)

Question number	Answer	Additional guidance	Mark
1(a)(iii)	A description including: - virus particles are assembled (1) - virus lyses the cell / virus exits the cell (1)	accept virus is made/produced ignore virus reproduces	(2)

Question number	Answer	Mark
1(b)(i)	lysogenic (pathway) accept phonetically correct misspellings	(1)

Question number	Answer	Additional guidance	Mark
1(b)(ii)	all the {genetic material/DNA} of an organism	accept all the genes of an organism	(1)

(Total for question 1 = 6 marks)

Question number	Answer	Additional guidance	Mark
3 (a)	Calculation $300 \div 30 / 2^{10}$ / indication that there are 10 divisions (1) Evaluation 1024	award full marks for the correct answer with no working accept 512 for one mark only	(2)

Question number	Answer	Additional guidance	Mark
3(b)(i)	(pathogens are organisms) that cause disease	ignore examples of pathogens unless linked to causing disease accept cause disease / illness / infections	(1)

Question number	Answer	Additional guidance	Mark
3(b)(ii)	An explanation including two from: - they inhibit processes (in bacteria) (1) - so bacteria {are destroyed / are killed / growth stops / reproduction stops} (1) - but antibiotics {do not affect/damage} the host cell (1)	accept named processes e.g. disrupt cell walls accept slows down for stopped	(2)

Question number	Answer	Additional guidance	Mark
3(b)(iii)	Substitution $80 \div 0.005$ (1) 16 000	award full marks for the correct answer with no working	(2)

(Total for question 3 = 7 marks)

Question number	Answer	Mark
3(a)(i)	C a protist The only correct answer is C <i>A is incorrect because malaria is not caused by a bacterium</i> <i>B is incorrect because malaria is not caused by a fungus</i> <i>D is incorrect because malaria is not caused by a virus</i>	(1) AO1 1

Question number	Answer	Additional guidance	Mark
3(a)(ii)	by vectors / mosquitoes	accept blood transfusions / through blood / sharing contaminated needles ignore insects / animals	(1) AO1 1

Question number	Answer	Additional guidance	Mark
3(b)	An explanation linking: • (the number of measles cases reported) has decreased (1)	accept herd immunity accept by vaccines /	(2) AO2 1

Question number	Answer	Additional guidance	Mark
3(c)	Any two from: - white blood cells {kill / destroy} pathogens (1) (WBC) produce {antibodies / antitoxins} (1) - memory lymphocytes (are produced) (1)	accept named pathogens accept phagocytosis accept WBC engulf pathogens reject antigens accept memory cells accept rise in body temperature / inflammation / more mucus produced / more WBC are produced / WBC move to site of infection (1)	(2) AO1 1

Question number	Answer	Additional guidance	Mark
3(d) Overlap	(beriberi) is not spread from person to person / is not caused by a {pathogen	accept organisms for people	(1) A02 1

	/ named pathogen}	ignore it is a deficiency disease / not infectious / not contagious / it is caused by a lifestyle factor	
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(Total for question 3 = 7 marks)

Question Number	Answer	Additional guidance	Mark
2(a)	An explanation linking: • exercise {requires energy/ uses respiration} (1) • {obtain from/reducing} fat (1)	accept burns calories accept sweating causes water loss for 1 mark	(2) AO 1 1

Question Number	Answer	Additional guidance	Mark
2(b)	An explanation linking two of the following: • reduces the volume of the stomach (1) • so it reduces food intake (1) • so stored {fat/lipids} is used up (1)	accept restricts the amount of food entering the stomach	(2) AO 2 1

Question Number	Answer	Additional guidance	Mark
2(c)(i)	substitution (1) $72 \div 1.81^2$ evaluation (1) $= 21.977 / 21.98 / 22$ 3 s.f. (1) 22.0	accept $72 \div 3.2761$ award 2 marks for correct evaluation award full marks for correct numerical answer without working accept 21.9 for 2 marks	(3) AO 1 1

Question Number	Answer	Additional guidance	Mark
2(c)(ii)	- the BMI shows male A is overweight but his waist:hip ratio {shows he is not abdominally obese / is below 0.9/is healthy} (1) - male A's weight distribution is not around the {vital organs/abdomen} (1)	accept male A's weight is distributed evenly over the body accept more weight on the hips than the waist accept mass for weight	(2) AO 3 2a AO 3 2b

Total for Question 2 = 9 marks

Question Number	Answer	Additional guidance	Mark
5(a)(i)	Any two from: - wash hands after contact (1) - avoid direct contact / wear {gloves/protective clothes} (1) - wear a (protective) mask (1) sterilise equipment {before /after} use (1)	accept hand gels accept protect your face be immunised (1)	(2) AO 2 2

Question Number	Answer	Additional guidance	Mark
5(a)(ii)	subtraction $5943 - 2830 = 3113$ (1) $3113 \div 2830 \times 100 = 110\%$	accept $5943 - 2830 \div 2830$ award full marks for correct numerical answer without working accept other valid methods for the calculation	(2) AO 2 1

Question Number	Answer	Mark
5(a)(iii)	A it does not have flagella 1. The only correct answer is A <i>B is not correct because plasmids do not allow motility.</i> <i>C is not correct because it does have ribosomes.</i> <i>D is not correct because acrosomes are not found in bacteria.</i>	(1) AO 2 1

Question Number	Answer	Mark
5(b)	D testing using cultured cells → testing in healthy volunteers → double blind trials on patients 1. The only correct answer is D <i>A is not correct because the medicine is tested on cultured cells first.</i> <i>B is not correct because double blind trials are used after testing in healthy volunteers.</i> <i>C is not correct because the medicine is tested on cultured cells first.</i>	(1) AO 1 1

Question Number	Answer	Additional guidance	Mark
5(c)	An answer linking three of the following: • exposure to the {toxin/antigen/pathogen/bacteria} (1) • stimulates an immune response (1) • production of {(B)lymphocytes/antibodies} (1) • production of memory lymphocytes (1)	accept immunised /vaccinated accept antitoxins	(3) AO 2 1

Total for Question 5 = 9 marks



Question number	Answer	Mark
2(a)	C white blood cell The only correct answer is C <i>A is not correct because the HIV virus does not destroy red blood cells</i> <i>B is not correct because the HIV virus does not destroy nerve cells</i> <i>D is not correct because the HIV virus does not destroy sperm cells</i>	(1)

Question number	Answer	Additional guidance	Mark
2(b)	An answer linking three from: • (pathogens have) antigens (1) • (that trigger) antibodies to be produced (1) • by lymphocytes (1) • (leads to the) destruction of the pathogen (1) • memory {cells/ lymphocytes} produced (1) • cause a secondary response (in the event of infection by the same pathogen) (1)	accept bacteria/virus for pathogen ignore WBC accept engulf pathogen accept description of a secondary response e.g. before symptoms/before the person gets ill/can react quickly	(3)

Question number	Indicative content	Additional guidance	Mark
2(c)(i)	Substitution (1) 21.00×11.18 Evaluation (1) 234.78 3 significant figures 235	award full marks for correct numerical answer without working award 2 marks for correct evaluation ecf for the incorrect calculation correctly rounded to 3 s.f.	(3)

Question number	Indicative content	Additional guidance	Mark
2(c)(ii)	One from: - each country has a different size population (1) - allows comparisons to be made between countries (1)	ignore it is easier to read/easier to analyse	(1)

Question number	Indicative content	Additional Guidance	Mark
2(c)(iii)	One from: - vaccination (1) {reporting/diagnosis} systems (1) {access to/quality of} healthcare (1) - environmental factors (1)	accept examples of relevant environmental factors e.g. population density, proximity of country to others. (1) accept herd immunity (1)	(1)

Question Number	Answer	Mark
3(a)	World Health Organization / WHO	(1) AO1 1

Question Number	Answer	Additional guidance	Mark
3(b)(i)	An answer including two from: (communicable) is passed from person to person (1) (communicable) caused by {pathogens / example of pathogen} (1) (communicable diseases) cannot be inherited (1)	accept reverse arguments for non-communicable diseases	(2) AO1 1

Question Number	Answer	Additional Guidance	Mark
3(b)(ii)	An explanation including: • {cough / sneeze} into a tissue / avoid close contact with infected people / avoid cramped living conditions (1) • because spread of TB is airborne droplets / TB is spread through the air (1) OR • vaccination / immunisation (1) • to provide immunity / reduces the chance of a person getting infected (1) OR • treat infected people with antibiotics (1) • reduces the number of infected people (1)	accept regular hand washing / wear a mask / isolate an infected person accept spread by coughing / breathing it {in / out} accept reduces the chances of contact with an infected person	(2) AO2 1

Question Number	Answer	Additional guidance	Mark
3(b)(iii)	• suitable heading for each column, with country in the left column (1) • all data entered accurately (1)	accept country / region / number of people / people with TB countries can be entered in any order	(2) AO2 1

Question Number	Answer	Additional guidance	Mark
3(c)	An explanation linking the following: - HIV destroys white blood cells / HIV weakens the immune system (1) - so the body is unable to {destroy the TB pathogen / prevent the pathogen invading the body} (1)	accept people with AIDS have fewer white blood cells accept unable to produce antibodies to TB ignore fight off the disease	(2) AO1 1

(Total for Question 3 = 9 marks)

Question Number	Answer	Additional Guidance	Mark
6(a)(i)	$(8 \times 4) = 32$ (grams of alcohol) (1) $1.2 / 1.20$ (x risk)	award full marks for the correct answer with no workings	(2) AO3

Question Number	Answer	Additional Guidance	Mark
6(a)(ii)	An answer including two from: • mutations in DNA (1) • cell division is uncontrolled (1) • leading to the formation of a tumour / growth / mass of cells (1)	accept change in the gene/cell mutates accept {rapid / continuous} cell division	(2) AO2 1

Question Number	Answer	Additional Guidance	Mark
6(b)(i)	Any two from: - wear gloves (1) - clean the area of skin where blood being removed (1) - cover the wound after (1) - use a sterile needle (1)	accept wash hands / wear a mask accept disinfect / clean the wound ignore clean accept sit the person down (1) ignore references to removing the correct volume of blood	(2) AO2 2

Question Number	Answer	Additional Guidance	Mark
6(b)(ii)	- heterozygous An explanation linking: - affected offspring must have inherited the recessive allele (1) - unaffected offspring must have inherited dominant allele (1)	accept carrier / dominant and recessive allele / Hh accept one offspring is homozygous recessive accept one / two offspring are homozygous dominant accept a labelled Punnett square for any mark point	(3) AO3

(Total for question 6 = 9 marks)



Question Number	Answer	Additional guidance	Mark
3(a)(i)	- a diagram of the cell that reflects its shape and some of the structures (1) - with any three cell structures from {nucleus / cytoplasm / membrane / cilia} (3)	ignore a 'textbook' diagram that does not resemble cell A	(4) AO1 2

Question Number	Answer	Additional guidance	Mark
3(a)(ii)	to {move/waft} {mucus / bacteria / dust}	ignore stop bacteria entering the body / trap bacteria	(1) AO1 1

Question Number	Answer	Additional guidance	Mark
3(b)(i)	measurement $(2.5 - 0 =) 2.5 \text{ (cm)}$ (1) calculation $(25 \div 10 =) 2.5 \text{ (mm per minute)}$	accept 25 (mm) ecf for incorrect reading divided by 10 award full marks for correct answer with no working	(2) AO1 1

Question Number	Answer	Additional guidance	Mark
3(b)(ii)	A description including: - apparatus set up as the initial investigation (1) - using {no living organisms / glass beads} instead of living organisms (1)	accept alternatives to glass beads / non living	(2) AO1 1

(Total for question 3 = 9 marks)

Question number	Answer	Mark
3(a)(i)	gonorrhoea	(1) AO3 1a

Question number	Answer	Additional guidance	Mark
3(a)(ii)	$(66\,000\,000 \div 1000) = 66\,000$ (1) $(66\,000) \times 3.7 = 244\,200$ (people) or $(3.7 \div 1000) = 0.0037$ (1) $(0.0037) \times 66\,000\,000 = 244\,200$ (people) or $(66\,000\,000 \times 3.7) = 244\,200\,000$ (1) $(244\,200\,000 \div 1000) = 244\,200$	award full marks for correct answer no working accept answers in standard form accept 244200 to any incorrect magnitude for one mark	(2) AO2 1

Question number	Answer	Additional guidance	Mark
3(a)(iii)	Any one from: - it is {passed/spread} from person to person (1) - caused by bacteria (1)	accept spread by {sexual contact / body fluids} accept pathogen ignore caused by a virus	(1) AO1 1

Question number	Answer	Additional guidance	Mark
3(a)(iv)	Any one from: • avoid sexual contact (1) • use a {condom/femidom} (1) • screen people for an infection (1) • treat the infection/give antibiotics (1)	accept use a barrier form of contraception ignore protection / contraception	(1) AO2 1

Question number	Answer	Additional guidance	Mark
3(a)(v)	An explanation including the following: • it is {killed/inhibited} by antibiotics (1) • because chlamydia is caused by bacteria (1)	accept disrupt cell processes (in bacteria) /prevent (bacteria) reproducing accept antibiotics are used to kill bacteria for 2 marks	(2) AO2 1

Question number	Answer	Additional guidance	Mark
3(b)	An explanation linking the following: • HIV {destroys white blood cells / reduces the number of white blood cells} (1) • which compromises the immune system / making the person more susceptible to other {pathogens / infections / diseases} (1)	accept named white blood cells accept weakens the immune system ignore more susceptible to AIDS	(2) AO2 1

Total for question 3 = 9 marks



Question number	Answer	Additional guidance	Mark
2 (a)	Any two from: • take antibiotics (1) • vaccination / immunisation (1) • covering mouth when sneezing or coughing / wear a (face) mask (1) • isolation of (infected individuals) / avoid contact with infected people (1) • washing hands / disinfecting surfaces (1)	ignore take medicine / drugs ignore PPE accept avoid mixing in groups / more ventilation / air filters	(2) AO1 1

Question number	Answer	Additional guidance	Mark
2(b)(i)	(because) it cannot be passed from person to person / it is not caused by a pathogen	ignore it cannot be spread unqualified accept it is caused by consuming alcohol (1)	(1) AO1 1

Question number	Answer	Additional guidance	Mark
2(b)(ii)	calculation $(80 \div 90) = 0.8888$ (1) 0.89	award full marks for the correct answer with no working accept 0.88 / 0.8 / 0.9 / 0.90 / 1.13 for one mark	(2) AO2 1

Question number	Answer	Additional guidance	Mark
2(b)(iii)	An explanation linking: - the risk to health is low (1) (because excess mass) is not around the {waist / vital organs}	ignore no risk accept because the {WHR / 0.75} is less than 0.80 (1)	(2) AO3 2a2b

Question number	Answer	Additional guidance	Mark
2(c)	An answer including two from: - two (cells produced) (1) - diploid / two sets of chromosomes (1) genetically identical (1) - body cells (1)	ignore they double / duplicate accept a full set of chromosomes reject haploid accept somatic cells	(2) AO1 1

Total for Question 2 = 9 marks

Question number	Answer	Additional guidance	Mark
6(a)(i)	An answer including: • (structure P) is for movement / swimming (1) • (structure Q) is for protection / maintain the structure / prevents cell bursting (1)	accept it controls what {enters / leaves} the cell accept to adhere to other cells	(2) AO1 1

Question number	Answer	Additional guidance	Mark
6(a)(ii)	unit conversion $12 \times 1000 / 12\ 000 / 2.0 \div 1000 / 0.002$ (1) substitution $(12\ 000 \div 2.0 / 12 \div 0.002)$ = 6000	award full marks for correct answer with no working ecf for incorrect unit conversion award one mark for the answer with a power of ten error ignore units	(2) AO2 1

Question number	Answer	Additional guidance	Mark
6(a)(iii)	diarrhoea	accept nausea / vomiting / dehydration / stomach pain	(1) AO1 1

Question number	Answer	Additional guidance	Mark
6(a)(iv)	by (contaminated) water	accept by (contaminated) food / oral-faecal route / water-borne	(1) AO1 1

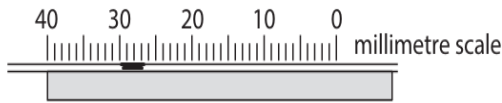
Question number	Answer	Additional guidance	Mark
6(b)	An answer linking: • pathogens have antigens (1) • (trigger the production of) antibodies (1) • (by) lymphocytes / memory lymphocytes produced (1)	accept antitoxins accept memory cells accept phagocytosis / phagocytes destroy pathogens (1)	(3) AO1 1

Total for Question 6 = 9 marks

Question number	Answer	Additional guidance	Mark
2(a)	A description including: • (pathogens) get stuck in the mucus (1) • cilia {move / waft} the {pathogens / mucus} (1) • to the throat / up the {trachea / bronchiole} / to be swallowed (1)	accept micro-organisms for pathogens accept hairs for cilia accept away from the lungs	(2)

Question number	Answer	Additional guidance	Mark
2(b)	An explanation linking two from: • glucose and oxygen (1) • (to form) carbon dioxide and water (1) • in an exothermic reaction (1) • which takes place in the mitochondria (1)	accept $C_6H_{12}O_6 + O_2$ accept $CO_2 + H_2O$ accept correct equation for aerobic respiration for 2 marks	(2)

Question number	Answer	Additional guidance	Mark
2(c) (i)	to absorb the carbon dioxide	accept CO_2	(1)

Question number	Answer	Mark
2(c) (ii)		(1)

Question number	Answer	Additional guidance	Mark
2(c)(iii)	An explanation linking two from: • (the drop) would move more slowly / shorter distance (1) • as less oxygen would be used (1) • so less respiration would occur (1)	accept less carbon dioxide {produced / absorbed}	(2)

Question number	Answer	Mark
2(c)(iv)	repeat the investigation / calculate a mean	(1)

Total for Question 2 = 9 marks

Question number	Answer		Mark
9(a)(i)	An answer including three from: • (cells are triggered to divide) by mitosis (1) • this division is uncontrolled (1) • creates a mass/large number of cells /tumour (1)	accept cells won't stop dividing/faster cell division/increased cell division	(3)

Question number	Answer	Mark
9(a)(ii)	C interphase The only correct answer is C <i>A is not correct because the DNA is not replicated in anaphase</i> <i>B is not correct because the DNA is not replicated in prophase</i> <i>D is not correct because the DNA is not replicated in telophase</i>	(1)

Question number	Answer	Additional guidance	Mark
9(a)(iii)	An answer combining: • 1 in 20 is a rate of 5% (1) • obesity increases the risk of bowel cancer more (than other types of cancer) (1)	accept 13% is 1 in 8/1 in 7.7 accept other correct manipulation of figures accept obesity is less of a contributing factor to other types of cancer	(2)

Question number	Answer	Additional guidance	Mark
9(b)	An explanation linking: - BMI calculation takes into account height / divides mass by height² (1) - the obese man must be shorter / the normal man is taller (1)	ignore references to muscle mass accept BMI relies on measurements of height and weight/mass accept equation for BMI accept the men are different heights	(2)

Question number	Answer	Additional guidance	Mark
9(c)	An answer including: - surgery to treat narrow or blocked arteries (1) - lifestyle changes including { healthy diet/more exercise } (1) (life-long) medication to { prevent blood clots/reduce blood pressure/thin the blood } (1)	accept by-pass surgery / stents / heart surgery / other relevant surgeries such as gastric bands accept examples of lifestyle changes e.g. stop smoking accept named medications used for cardiovascular disease	(3)

(Total for question 9 = 11 marks)

Question Number	Answer	Mark
4 (ai)	C aseptic The only correct answer is C <i>A is not correct because clinical is not a technique</i> <i>B is not correct because diagnostic does not prevent contamination</i> <i>D is not correct because lysogenic describes a stage of the virus lifecycle</i>	(1) AO1 2

Question Number	Answer	Additional Guidance	Mark
4 (a)(ii)	Any two from: • keep the lid on at all possible times (1) • use sterile equipment (1) • autoclave agar (1) • wear gloves / mask (1) • work close to a Bunsen (burner) (1)	accept a method of sterilising equipment e.g. flaming loops / disinfect the working area accept use sterile growth medium	(2) AO1 2

Question Number	Answer	Additional Guidance	Mark
4 (b)(i)	radius 4.5 mm (1) calculation ($3.14 \times 4.5 \times 4.5 / 3.14 \times 4.5^2$) = 63.585 (1) evaluation 63.6 (mm²)	award full marks for correct answer with no working accept 63.617 ecf if diameter used 254.469 / 254.34 for one mark ecf if diameter used 254.5 / 254.3 (mm²) to 1 DP for two marks	(3) AO2 1

Question Number	Answer	Additional Guidance	Mark
4 (b)(ii)	as a control / to compare	accept to see the effect without using toothpaste / to see the effect of just saliva	(1) AO2 2

Question Number	Answer	Additional Guidance	Mark
4 (b)(iii)	Any two from: - the test only uses one species of bacteria (1) - there are still bacteria on the agar plate (1) - the test is not done on teeth (1) - the conditions in the mouth are different (1) - toothpaste is only used on teeth for a short time (1)	accept temperature in the mouth may not be 37°C accept the test only uses one type of toothpaste (1)	(2) AO2 2

Question Number	Answer	Additional Guidance	Mark
4(c)	An explanation linking: - the toothpastes were not harmful to the cells (1) - because the % of healthy cells after 2 hours was similar to saliva (1)	accept toothpaste has the same effect as saliva accept toothpaste 2 is less harmful to cells accept a description of the data values to illustrate a similar effect	(2) AO3 2a + 2b

(Total for question 4 = 11 marks)

Question Number	Answer	Additional guidance	Mark
7(a)	substitution $124 \div 1.8^2$ (1) evaluation $BMI = 38.27$	award 2 marks for correct answer with no working accept 38 / 38.3 accept 68.9 / 68.89 for 1 mark accept answers correctly rounded to any number of decimal places	(2) AO1 1

Question Number	Answer	Additional guidance	Mark
7(b)(i)	A description including: - blood glucose concentration increased from {0 – 8 hours / from 100 to 139 / by 39 mg/dL} (1) - then blood glucose concentration decreased [at 12 hours / to 90 mg/dL / by 49 mg/dL] (1) - blood glucose concentration increased {at 20 hours / after 12 hours / to 134 mg/dL / by 44 mg/dL} (1)	accept blood glucose concentration increased {at 24 hours / to 137 mg/dL / by 47 mg/dL} accept other calculated increases between 12 and 24 hours	(3) AO3 1 a + b

Question Number	Answer	Additional guidance	Mark
7(b)(ii)	An explanation linking: - the pancreas produced insulin (1) - but the cells in the {liver / muscles} were resistant to insulin (1) - so glucose was not taken up by the {liver / muscles / cells} (1)	accept but there is insulin resistance accept so the glucose is not converted to glycogen in the {liver / muscles}	(3) AO2 1

Question Number	Answer	Additional guidance	Mark
7(b)(iii)	An explanation linking: - the blood glucose concentration decreased (at 12 hours) (1) - because the patient has used up the glucose in his blood (1) - due to increased respiration (during exercise) (1)	accept glucose used by {muscles / cells}	(3) AO3 2ab

(Total for question 7 = 11 marks)

Question number	Indicative content	Mark
*7 (a)(i)	AO1 6 marks Fieldwork • check other plants in the field or other fields / find the distribution of affected plants • examine the area around the affected plants • examine the lesions on the leaf • take a sample the soil / take a sample of the plant • eliminate an environmental factor that could be causing the symptoms e.g. pollution / contamination / pests / mineral ion deficiency / pH • use of a pesticide / fertiliser to see if this clears the lesions • compare with known plant diseases • use books / internet / apps • use drones / mapping • to determine how the disease could be spread e.g. wind, animal or water spread • clustering indicating contact or soil spread • downwind indicating airborne Testing • test the soil e.g. for pH / nutrient levels / mineral ion deficiency • test {swabs/samples} from the lesions / plant / cuttings • culture the pathogen • identify the {pathogen/bacteria/fungus/virus} • e.g. DNA analysis / microscope / monoclonal antibodies	(6)

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	- Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. - Presents an explanation with some structure and coherence.
Level 2	3-4	- Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and /or developed. - Presents an explanation that has a structure which is mostly clear, coherent and logical.
Level 3	5-6	- Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed. - Presents an explanation that has a well-developed structure which is clear, coherent and logical.

Additional Guidance

Level 1	1-2	- A brief description of fieldwork or testing that could be completed - The description makes a link to observed patterns, an environmental cause or identifying the pathogen
Level 2	3-4	- A brief description of fieldwork AND testing that could be completed OR a detailed description of fieldwork - Response makes a link between observed patterns for distribution and why the patterns would be seen.
Level 3	5-6	- A detailed description of fieldwork AND some reference to testing that could be completed - Distribution analysis makes links between observed patterns and why the patterns would be seen.

Question number	Answer	Additional guidance	Mark
7(a)(ii)	One from: - wear protective footwear (1) - wear gloves (1) {sterilise/clean} equipment (1) - avoid {trampling / touching / damage to /contact with} unaffected crops (1) - ensure all the affected plants removed (1)	ignore prevent the pathogen spreading to healthy crops / transmission of disease to humans accept make sure all the roots are removed / remove surrounding soil	(1)

Question number	Answer	Additional guidance	Mark
7(b)	An answer linking four from: - translation occurs (1) - mRNA {binds to the ribosome / goes to the ribosome} (1) {three bases / triplet / codon / anticodon} codes for one amino acid (1) - tRNA transfers the amino acid (1) - peptide bond forms between amino acids / a polypeptide is formed (1) {amino acid sequence / polypeptide/protein} folds into (a viral protein) (1)	accept is read by the ribosome accept tRNA has an anticodon accept tRNA {binds to / is complementary to} the codon accept the mRNA sequence determines the order of the amino acids ignore polypeptide bond / protein is synthesised accept a chain of amino acids is formed ignore amino acids fold	(4)

(Total for question 7 = 11 marks)

Question number	Answer	Mark
7(a)(i)	A the aphid is a vector The only correct answer is A <i>B is not correct because the aphid is not the pathogen</i> <i>C is not correct because the aphid is not a protist</i> <i>D is not correct because the aphid is a fungus</i>	(1) A02 1

Question number	Answer	additional guidance	Mark
7(a)(ii)	An answer including: • (the mouthpart goes through) the waxy cuticle (1) • (and through) the cell wall (1)	accept through the cuticle / waxy outer layer accept (goes through) the cellulose ignore cell membrane	(2) A02 1

Question number	Answer	additional guidance	Mark
7(b)(i)	An answer linking: - DNA helix unwinds (1) RNA Polymerase (1) (enzyme) binds to the non-coding region (1) (mRNA) strand is complementary / mRNA is a chain of nucleotides (1) - it contains U (instead of T) (1)	accept unzips / DNA bonds broken /strands separated accept mRNA polymerase accept binds to the promoter accept (mRNA) bases are complementary accept nucleotides are joined together (by RNA polymerase) accept A pairs with U	(4) AO2 1

Question number	Answer	Mark
7(b)(ii)	translation	(1) AO1 1

Question number	Answer	additional guidance	Mark
7(c)	An answer linking three from: - uses other organisms / different species (to reduce aphids) - which is specific to {aphids / the pest} (1) {maintains / less effect on} biodiversity (1) - meaning {chemicals / named chemicals} do not need to be {used / reapplied} (1) - aphids cannot develop resistance (1) - therefore increases crop yield / less damage to the crops / aphids can't feed on crops (1)	accept ladybirds / insects / predator / animals accept it only affects aphids accept increases biodiversity accept less pollution / harm to the environment / less bioaccumulation accept biological control doesn't need to be reapplied accept idea of organic farming ignore fertilisers / herbicides reject immune accept increased profit accept crops safe to eat / less disease in crops	(3) A02 1
		ignore doesn't affect the food chain / ecosystem	

(Total for question 7 = 11 marks)

Question number	Answer	additional guidance	Mark
8(a)(i)	An answer including two from: • reduce bias (by the doctor) (1) • placebo effect (1) • know whether the side effects are due to statins (1) • allows effectiveness of statins to be {determined / compared} (1)	allow the drug / medicine / pills for statins accept a description of the placebo effect ignore identify side effects / test safety	(2) AO2 1

Question number	Answer	Mark
8(a)(ii)	D clinical The only correct answer is D <i>A is not correct because double-blind trials are not the discovery stage</i> <i>B is not correct because double-blind trials are not the development stage</i> <i>C is not correct because double-blind trials are not the preclinical stage</i>	(1) AO1 1

Question number	Answer	additional guidance	Mark
8(b)(i)	$14.8 \div 100$ or 0.148 (1) $9\,199 \div 0.148 = 62\,155$ (1) Evaluation 62 160 OR $9\,199 \div 14.8$ or $621.55(1)$ $621.55 \times 100 = 62\,155$ (1) Evaluation 62 160 OR $100 \div 14.8$ or 6.757 (1) $6.757 \times 9199 = 62155$ (1) Evaluation 62160	Award full marks for the correct answer with no working accept any number of d.p. accept any number of d.p. accept any number of d.p. accept 62155 or 62150 or 62200 for 2 marks maximum of one mark for an answer using a percentage other than 14.8 given to 4 s.f.	(3) A03 1

Question number	Answer	additional guidance	Mark
8(b)(ii)	An answer linking three from: - the data for the placebo and the statins are very similar (1) - in year one more people taking statins reported muscle pain (1) (in year 1) difference was only 0.8% (1) - over time the muscle pain is reduced in those people taking statins (1) - in {year 2/year 3/year 4} more people taking the placebo reported muscle pain (1)	accept quoted data from a year to illustrate the similarity accept calculated differences for years 2, 3 or 4.	(3) A03 1

Question number	Answer	additional guidance	Mark
8(b)(iii)	Any two from: age (1)		(2) A02 1

	- sex (1) - ethnicity (1) - mass / weight / height (1) - medical history / not on other medication (1) - lifestyle (1)	accept gender accept race / genetic background accept BMI accept level of cardiovascular disease / all healthy accept level of exercise / diet / fitness	
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(Total for question 8 = 11 marks)

Question number	Indicative content	Mark
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Question number	Answer	Mark
10(a)(i)	<i>Helicobacter</i> / <i>Helicobacter pylori</i> / <i>H. pylori</i> / <i>pylori</i> accept close phonetic spellings	(1) A01 1

Question number	Answer	additional guidance	Mark
10(a)(ii)	to neutralise acid / reduce acidity	accept stomach {contains acid / is acidic} accept to increase pH ignore to make it more alkaline	(1) A02 1

Question number	Answer	additional guidance	Mark
10(b)	An answer including three from: • place the antibiotic discs on the plate (1) • use aseptic techniques (1) • (incubate the plate) for 24 hours (1) • at 37°C (1) • use a filter disc with water / use a control disc (1) • measure the zone of inhibition / zone of	accept use the antibiotics on the {agar plate / bacteria} accept use of suitable equipment accept other suitable time scales accept temperatures in range of 25°C – 40°C / optimum temperature accept zones of inhibition show effectiveness of the	(3) A03 3a

	inhibition shows bacteria have been killed (1)	antibiotic	
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Question number	Indicative content	Mark
* 10(c)	AO1 (6 marks) Infection - virus binds to the host cell - viral genetic material injected into the host cell Lytic - virus is replicated - uses the host cell resources / named resources - to produce more viral genetic material - produce viral proteins - new viruses assemble - the host cell is lysed Use - to kill bacteria (instead of antibiotics) - reducing the problem caused by antibiotic resistance / people not finishing the course - bacteriophage do not affect animal cells - replicate themselves (so will continue to have an effect)	(6) AO1 AO2

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail.

		• Presents a description with some structure and coherence.
Level 2	3–4	• Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. • Presents a description that has a structure which is mostly clear, coherent and logical.
Level 3	5–6	• Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed. • Presents a description that has a well-developed structure which is clear, coherent and logical.

Level	Mark	Additional guidance
Level 1	1–2	• A brief description of the lytic cycle or the process of infection. • Links this to an indication of how bacteriophage could be used as an alternative to antibiotics
Level 2	3–4	• A good description of the lytic cycle of a virus including the production of virus components or the use of host cell machinery • Gives a reason why bacteriophage could be used as an alternative to antibiotics and does not refer to lysogenic steps
Level 3	5–6	• A detailed description of the lifecycle of a virus including the production of viral proteins using the host cell machinery. • Gives reasons why bacteriophage could be used as an alternative to antibiotics and does not refer to lysogenic steps

Question number	Answer	Additional guidance	Mark
4(a)	Measurement 15 mm (1) Substitution $15 \div 18\,000 = 0.00083$ (1) Standard form 8.3×10^{-4}	accept correct answer for full marks with no working. accept 14mm –16mm accept reading in cm Accept 0.00078 / 0.00086 / 0.00089 accept 8.9×10^{-4} 8.6×10^{-4} 7.8×10^{-4}	(3)

Question number	Answer	Mark
4(b)(i)	5 / 5.0 / 5.1 / 5.2 / 5.3 / 5.4	(1)

Question number	Answer	Mark
4(b)(ii)	A description including - from pH 5 to pH 7 the growth of the bacterium increased (1) - pH 7 is optimum (1) - from pH 7 to pH 8.5 the growth of the bacteria decreased (1)	(2)

Question number	Answer	Mark
4(c)(i)	The only correct answer is D volume of the milk A is incorrect as pH is an dependent variable B is incorrect as temperature is a independent variable C is incorrect as incubation time is set by the student	(1)

Question number	Answer	Additional guidance	Mark
4(c)(ii)	An answer including: - pH decreases (1) (from 6.6) to 4.8 / by 1.8 (1)	accept becomes more acidic	(2)

Question number	Answer	Additional guidance	Mark
4(c)(iii)	Substitution Change in pH = 1.4 (1) Evaluation: answer divided by 72 0.019	award full marks for correct answer with no working accept 0.0194 / 0.02	(2)

Total for Question 4 = 11 marks

Question Number	Answer	Additional guidance	Mark
10(a)(i)	- spread {each bacterial species/the bacteria} on a different agar plate, add myxopyronin discs and incubate the plates (1) {measure / compare} the zone of inhibition (1)	accept filter discs for myxopyronin discs accept descriptions of a zone of inhibition	(2) AO 1 2

Question Number	Answer	Additional guidance	Mark
10(a)(ii)	An explanation that links four of the following: - antibiotics destroy bacteria / prevent them reproducing (1) - doesn't affect {eukaryotic cells/host cells/human cells/human RNA polymerase} (1) - prevents production of mRNA /prevents RNA polymerase binding (1) - during transcription /prevents transcription (1) - prevents proteins being produced /no protein synthesis (1)	ignore inhibit the bacteria/inhibit cell processes accept does not harm humans accept RNA polymerase produces mRNA	(4) AO 2 1

Question Number	Indicative content	Mark
10(b)	Answers will be credited according to candidate's 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 therefore not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. Lytic lifecycle • viruses cannot replicate outside a host • virus binds to host cells • inserts genetic material into the host cell • use the cells machinery to produce viral proteins • use the cells machinery to produce nucleic acids • components assemble into new viral particles • viruses exit the cell through the host cell membrane • or causes lysis of the host cell • allows production of many virus particles Spread of infection • virus particles leave the host • virus released into body fluids • spread through airborne droplets/contact • allowing spread to another host	(6) AO 1 1

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	• Demonstrates elements of biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Total for Question 10 = 12 marks

Question number	Answer	Additional guidance	Mark
7(a)(i)	Any two from: - wash hands/wear gloves (1) - keep lid on the samples/only remove the lid for a short time (1) - work close to a Bunsen flame (1) - use sterile equipment (1)	accept {flame/heat} the loop before taking the sample accept clean bench with ethanol/sterilising fluid (1)	(2)

Question number	Answer	Additional guidance	Mark
7(a)(ii)	{57/58} minutes / {94/95} minutes (1) 37 minutes	two marks for correct answer with no working	(2)

Question number	Answer	Additional guidance	Mark
7(a)(iii)	use a stain/focus the microscope/increase the magnification	accept use an electron microscope	(1)

Question number	Answer	Mark
7(b)(i)	C genetic engineering The only correct answer is C <i>A is not correct because selective breeding is not a method of inserting genes</i> <i>B is not correct because asexual reproduction is not a method of inserting genes</i> <i>D is not correct because tissue culture is not a method of inserting genes</i>	(1)

Question number	Indicative content	Mark
*7(b)(ii)	Advantages • less damage to crops • increased yield/more food • more profit • that the toxin only affects target insects • less use of chemical insecticides • no need to buy chemicals Disadvantages • insects develop resistance to the toxin • plants are more expensive to produce initially • risk of cross fertilisation with wild plants/other crops • reduces biodiversity • detrimental impact on the food web in the area • possibility of bioaccumulation • reliance on seed companies • consumer concerns with eating GM crops	(6)

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. • Presents an explanation with some structure and coherence.
Level 2	3–4	• Demonstrates biological understanding, which is mostly

		relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. • Presents an explanation that has a structure which is mostly clear, coherent and logical.
Level 3	5–6	• Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed. • Presents an explanation that has a well-developed structure which is clear, coherent and logical.

Level	Mark	Descriptor
Level 1	1-2	A simple discussion of either advantages or disadvantages of growing plants that produce toxins. The response clearly distinguishes advantages and disadvantages.
Level 2	3-4	A simple discussion of both advantages and disadvantages of the growing plants that produce toxins OR a detailed discussion of advantages or disadvantages of the growing plants that produce toxins. The response clearly distinguishes advantages and disadvantages and uses some key scientific terms correctly.
Level 3	5-6	A detailed discussion of advantages and disadvantages of the growing plants that produce toxins. The response clearly distinguishes advantages and disadvantages and uses key scientific terms correctly.

Level	Mark	Examples of possible responses
	0	• No rewardable material.
Level 1	1	• Less crops are eaten by insects
	2	• A disadvantage is that insects may develop resistance to the toxin
Level 2	3	• Less crops are eaten by insects, increasing the yield. The toxin gene could spread to other plants.
	4	• An advantage is that less crops are eaten by insects increasing the yield. A disadvantage is that the insects could become resistant to the toxin.
Level 3	5	• Less crops are eaten by insects increasing the yield and the farmer does not need to use pesticides. The toxin gene could spread to other plants or it could spread through the food chain and affect other organisms.
	6	• The advantages are that less crops are eaten by insects increasing the yield and the farmer does not need to use pesticides on the crop. The disadvantages are that the insects could become resistant to the toxin, it reduces the biodiversity, and the toxin could build up in the food chain by bioaccumulation.

Total for question 7 = 12 marks

Question number	Answer	Additional guidance	Mark
10(a)(i)	Any one from: - to prevent contamination (1) {avoid / kill / remove} microorganisms (1) - prevent other microorganisms affecting the results (1)	accept bacteria / fungi /pathogen /virus for microorganism	(1) AO2 1

Question number	Answer	Additional guidance	Mark
10(a)(ii)	so the bacteria are not killed / so the bacteria are not {destroyed / harmed / damaged / burnt}	accept microorganism / pathogen for bacteria	(1) AO2 1

Question number	Indicative content	Mark
10(a)(iii)	A02 & A03 Plan • soak one filter disc in antiseptic 1 • repeat for with fresh filter disc for antiseptic 2 • repeat with fresh disc for antiseptic 3 • soak fresh filter disc in distilled water • place one disc in each quarter and / space the discs out • label the Petri dish • incubate the petri dish Results • measure radius/diameter • calculate the zone of inhibition around each disc • using πr^2 • antiseptic which killed the most bacteria will have largest zone safety/aseptic • use aseptic techniques/description of techniques • work near a Bunsen • only lift the lid slightly/keep covered most of the time • use sticky tape to seal the lid to the base of the Petri dish on each side • wash hands Controlled variables • incubation time stated • appropriate temperature stated • same size filter disc • same volume of antiseptic / soaked for same time Control • soak a fresh filter disc in water or left dry • use a known substance that kills bacteria	(6) A02 2 A03 3a

Level	Mark	Descriptor
	0	No awardable content
Level 1	1–2	- The plan attempts to link and apply knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. (AO2) - Analyses the scientific information but understanding and connections are flawed. An incomplete plan that provides limited synthesis of understanding. (AO3)
Level 2	3–4	- The plan is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. (AO2) - Analyses the scientific information and provides some logical connections between scientific enquiry, techniques and procedures. A partially completed plan that synthesises mostly relevant understanding, but not entirely coherently. (AO3)
Level 3	5–6	- The plan is supported throughout by linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. (AO2) - Analyses the scientific information and provide logical connections between scientific concepts throughout. A well-developed plan that synthesises relevant understanding coherently. (AO3)

Level	Mark	Indicative content
	0	No rewardable material.
Level 1	1–2	- response gives at least one element of the plan or how the results would be measured - refers to one from a controlled variable, safety/aseptic working or a control
Level 2	3–4	- response provides a plan that would allow results to be obtained - refers to at least two points from at least one of controlled variables, safety/aseptic working or a control
Level 3	5–6	- produces an error free workable plan which includes safety/aseptic working and one variable controlled - the plan describes the use of a control

Level	Mark	Examples of answers
	0	No rewardable material.
Level 1	1–2	- Control the amount of antiseptic used – 1 mark - Spread the antiseptics on the plate and label the plate – 1 mark - Spread the antiseptics on the plate and label the plate, leave the plate to incubate for 24 hours – 2 marks
Level 2	3–4	- Soak the discs in the antiseptics and place them onto the agar plate, lift the lid only a little. After the bacteria have grown measure the zone of inhibition – 3 marks. (only one aspect from the second bullet point) - Soak the discs in the antiseptics and place them onto the agar plate, lift the lid only a little. Incubate the plate overnight. After the bacteria have grown measure the zone of inhibition – 4 marks. (two aspects from second bullet point) - Soak the discs in the antiseptics and place them onto the agar plate, add a 4th disc which is dry. Lift the lid only a little. Tape the plate and after the bacteria have grown measure the zone of inhibition – 4 marks.
Level 3	5–6	- Add the same volume of antiseptic onto the discs. Using sterile tongs place them onto the agar plate. Lift the lid only a little. Tape the plate and incubate the plate for a set time. After the bacteria have grown measure the zone of inhibition – 5 marks. - Soak the discs in the antiseptics and soak one disc in water. Using sterile tongs place them onto the agar plate. Lift the lid only a little. Tape the plate and incubate the plate for 24 hours. After the bacteria have grown measure the zone of inhibition – 6 marks. - Add the same volume of antiseptic onto the discs. Using sterile tongs place them onto the agar plate. Lift the lid only a little. Tape the plate and incubate the plate for a set time. After the bacteria have grown measure the zone of inhibition – 5 marks. - Soak the discs in the antiseptics and soak one disc in water. Using sterile tongs place them onto the agar plate. Lift the lid only a little. Tape the plate and incubate the plate for 24 hours. After the bacteria have grown measure the zone of inhibition – 6 marks.

Question number	Answer	Additional guidance	Mark
10(b)	A description linking the following: - virus inserts its genetic material into the host cell (1) - uses the host cell {machinery / organelles / resources} - virus {components /protein/genetic material} are made (1) - virus components are assembled inside the cell (1) - cell lyses to release the virus / viruses released from cell (1)	ignore the virus enters a cell accept it takes over the host cell accept appropriate named organelles accept new viruses produced/replicated inside the cell ignore the virus reproduces / divides / grows accept host cell bursts ignore the host lyses	(4) AO1 1

Total for question 10 = 12 marks