

Questions

Q1.

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

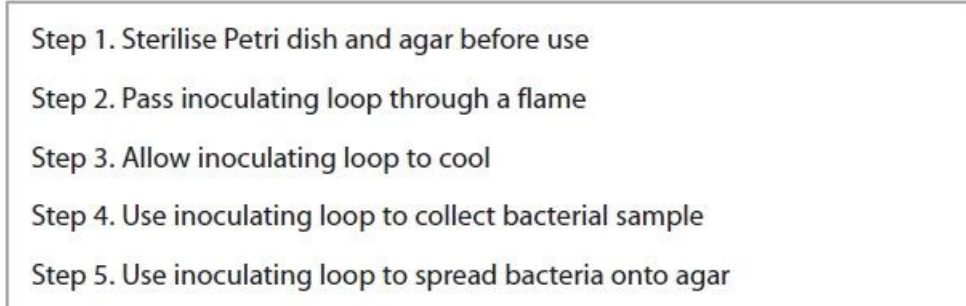


Figure 10

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

(1)

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

(1)

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* (iii) A student wanted to investigate how effective three different antiseptics were at killing bacteria.

The student was provided with:

- an inoculated Petri dish prepared using the method in Figure 10
- three different antiseptics
- filter paper discs
- sticky tape.

Devise a plan for the student to complete this investigation.

Include a control and any variables that the student would need to consider.

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(Total for question = 8 marks)

Q2.

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.

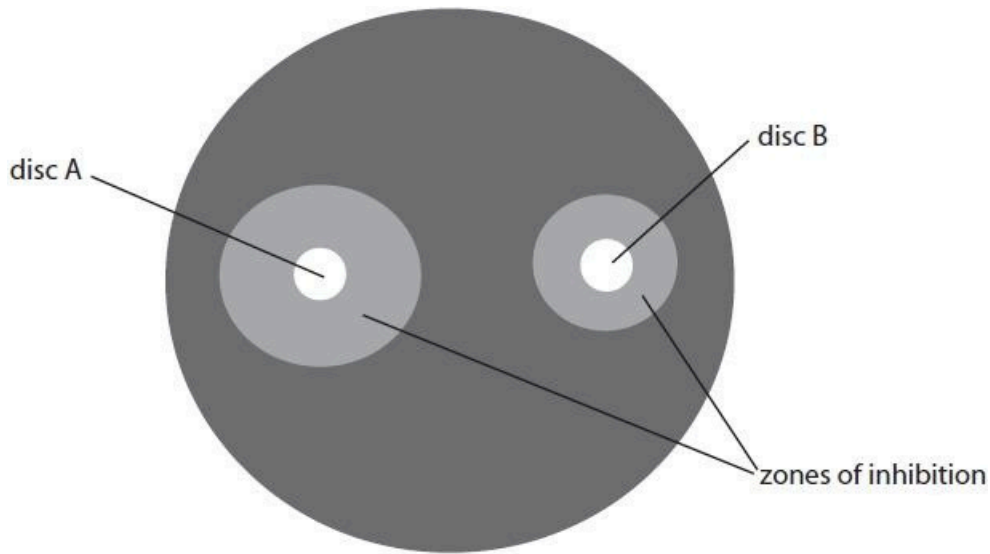


Figure 5

(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)

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

(1)

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

(2)

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(Total for question = 6 marks)

Q3.

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 .

Monoclonal antibodies are proteins.

Figure 16 shows the process of monoclonal antibody production.

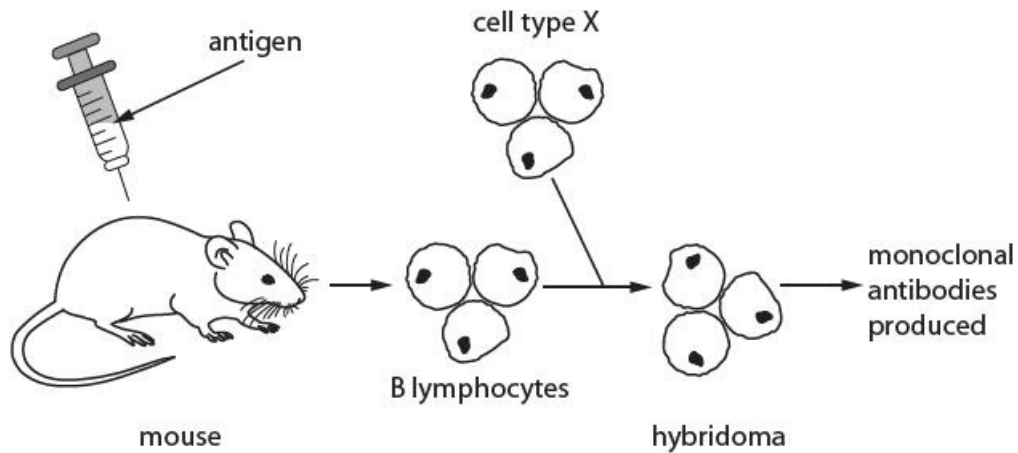


Figure 16

(i) Which type of cell is added to the B lymphocytes to produce the hybridoma?

(1)

- A phagocytic cell
- B red blood cell
- C cancer cell
- D epithelial cell

(ii) A person with blood group A has the A antigen on the surface of their red blood cells.

Monoclonal antibodies can be used to detect the A antigen on red blood cells to determine the blood group of a person.

Explain why monoclonal antibodies, used to detect blood group A, would not react with the blood of a person with blood group B.

(3)

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(Total for question = 4 marks)

Q4.

Describe how the specific immune system defends the body against disease.

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(Total for question = 3 marks)

Q5.

* Some sexually transmitted infections (STIs) can be diagnosed by testing urine samples.

These tests use monoclonal antibodies that bind to an antigen on the pathogen.

Describe how a monoclonal antibody can be developed and used to detect an STI using a urine sample.

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(Total for question = 6 marks)

Q6.

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.

Obesity can also cause cardiovascular disease to develop.

Describe the different treatments available for cardiovascular disease.

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(Total for question = 3 marks)

Q7.

LDL cholesterol is a type of cholesterol which increases the risk of heart disease.

Statins are drugs used to reduce LDL cholesterol levels.

Figure 12 shows the cholesterol levels in the blood of a man.

He started taking statins at the beginning of February and stopped taking them four months later.

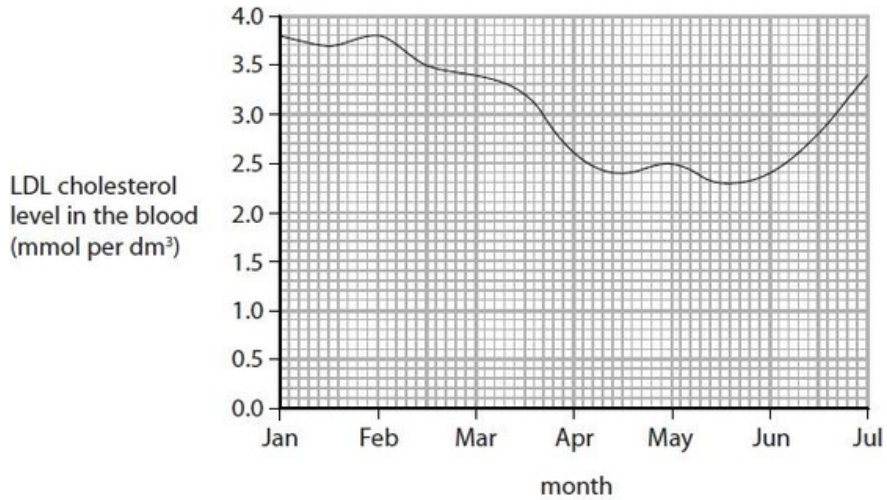


Figure 12

(i) Describe the effect of statins on LDL cholesterol levels in the blood.

Use data from the graph to support your answer.

(2)

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(ii) Use evidence from the graph to explain why statins are usually prescribed as life-long medication.

(2)

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(Total for question = 4 marks)

Q8.

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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(Total for question = 3 marks)

Q9.

Gonorrhoea is a sexually transmitted bacterial infection.

Figure 13 shows the number of people diagnosed with gonorrhoea in the UK.

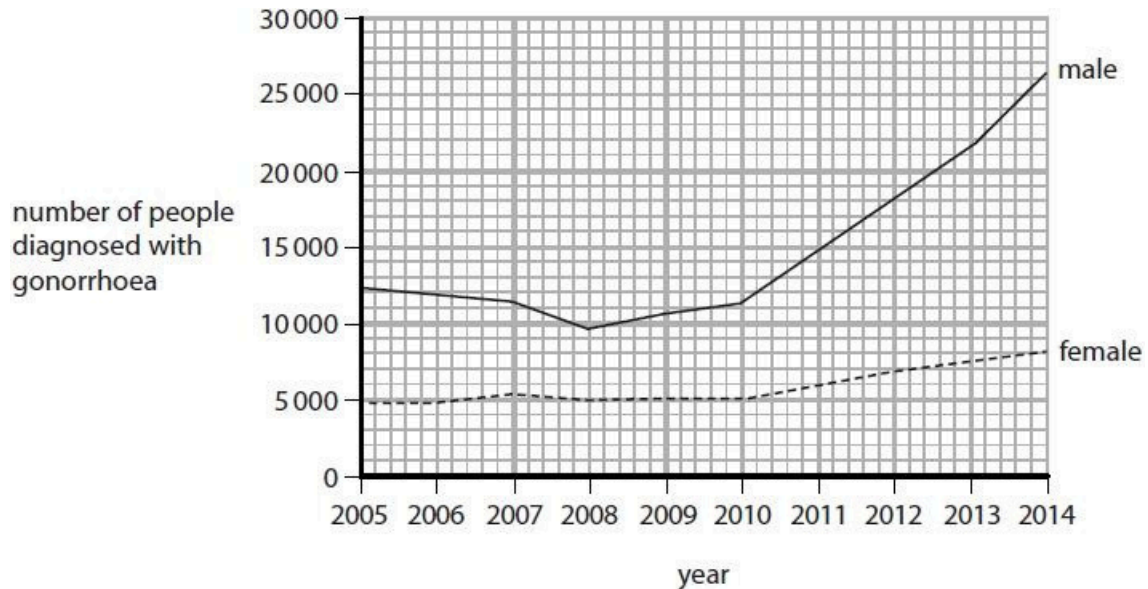


Figure 13

Explain how gonorrhoea is transmitted and how the number of people infected can be reduced.

Use data from the graph to justify why it is necessary to reduce the number of people infected.

(Total for question = 6 marks)

Q10.

The wire loop used to spread bacteria on an agar plate was heated in a Bunsen burner flame before being used.

Explain why this aseptic precaution was used.

(2)

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(Total for question = 2 marks)

Q11.

When bacteria divide they replicate their genome and synthesise their cell wall.

Figure 12 outlines the stages of bacterial replication.

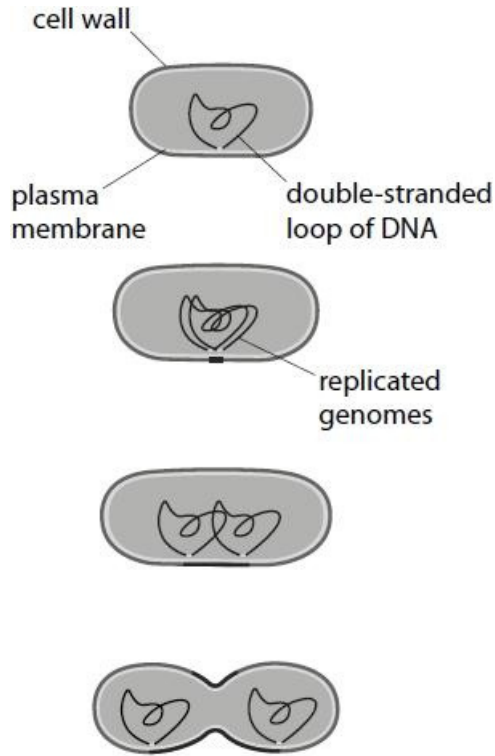


Figure 12

Penicillin inhibits the synthesis of the cell wall in bacteria.

Explain the effect of penicillin on bacterial and human cells.

(3)

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(Total for question = 3 marks)

Q12.

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

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.

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

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

(1)

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

(2)

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(Total for question = 3 marks)

Q13.

Streptococcus pyogenes is a bacterium that causes communicable infections. Scientists tested the ability of two antiseptics to kill *Streptococcus pyogenes* bacteria. They spread *Streptococcus pyogenes* bacteria on two agar jelly plates and placed a small disc of filter paper containing antiseptic in the centre of each dish. Figure 3 shows the results of the test after 24 hours of incubation.

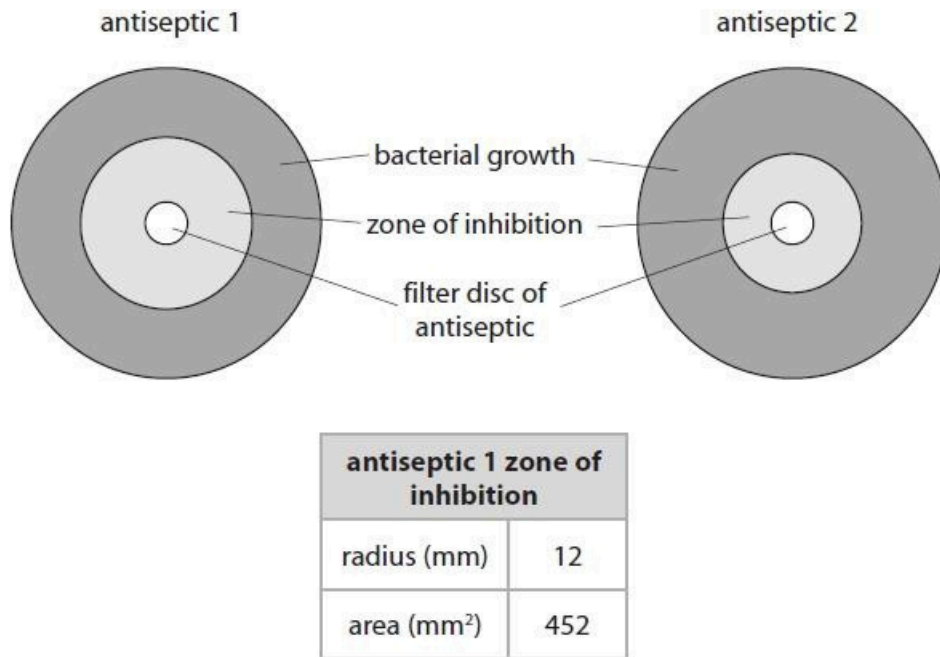


Figure 3

(i) Calculate the area of the zone of inhibition for antiseptic 2.

Give the answer to 3 significant figures.
 ($\pi = 3.14$)

(3)

zone of inhibition for antiseptic 2 = mm²

(ii) Explain which antiseptic is the most effective.

(2)

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(iii) After the bacteria were spread on the plates, both plates were incubated for 24 hours at 37°C.

Give a reason why the plates were incubated at 37°C.

(1)

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(Total for question = 6 marks)

Q14.

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.

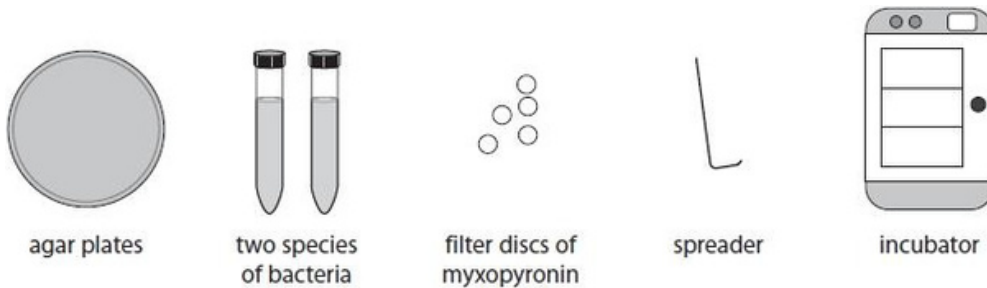


Figure 18

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

(2)

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(ii) Myxopyronin inhibits bacterial RNA polymerase.

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

(4)

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(Total for question = 6 marks)

Q15.

Measles is a disease caused by a virus.

Measles is prevented by immunisation.

(i) State two reasons why people might not be immunised against measles.

(2)

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(ii) The spread of measles is prevented by herd immunity.

Describe herd immunity.

(2)

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(Total for question = 4 marks)

Q16.

* Describe how the physical barriers and chemical defences of the human body provide protection from diseases.

(6)

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(Total for question = 6 marks)

Q17.

Clostridium tetani is a bacterium that can be found in soil.

It causes the infection tetanus.

Children are vaccinated against tetanus.

Explain why these children do not get tetanus if the bacteria enter their body through a cut in the skin.

(3)

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(Total for question = 3 marks)

Q18.

In 2017, a new strain of *Klebsiella pneumoniae* bacteria was discovered that was resistant to 26 different antibiotics.

New antibiotics are being developed to treat the disease caused by *Klebsiella pneumoniae*.

Describe the stages of antibiotic development that would occur after the discovery of a new antibiotic.

(3)

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(Total for question = 3 marks)

Q19.

Garlic is a plant that produces antiseptic chemicals.

Explain one benefit to garlic plants of producing antiseptic chemicals.

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(Total for question = 2 marks)

Q20.

Figure 8 shows a gastric band fitted to a stomach.

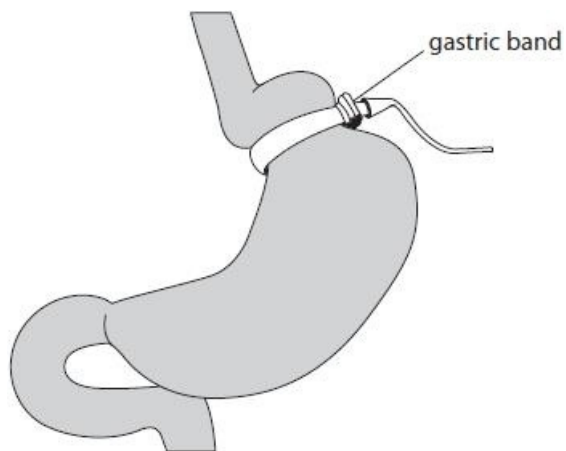


Figure 8

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

(2)

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(Total for question = 2 marks)

Q21.

* Explain how plants protect themselves from being eaten by pests and against diseases caused by pathogens.

(6)

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(Total for question = 6 marks)

Q22.

Figure 4 shows the structures in a leaf.

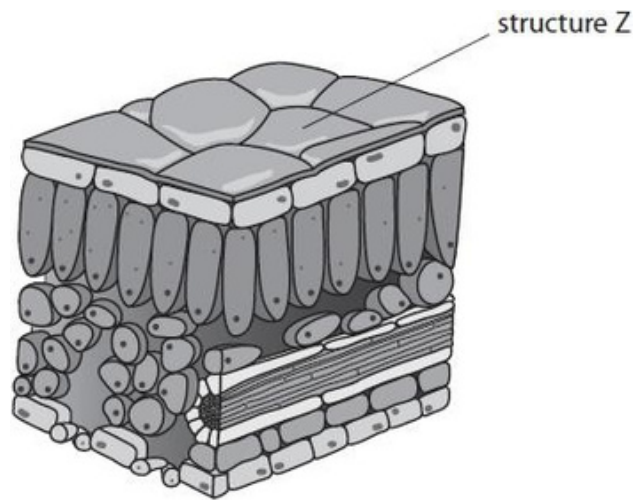


Figure 4

Explain how structure Z is involved in defence against pathogens.

(2)

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(Total for question = 2 marks)

Q23.

* When a person is infected with a disease, the immune system will respond to protect their body.

Explain how the immune system will respond to an infection caused by bacteria.

(6)

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(Total for question = 6 marks)

Q24.

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)

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(Total for question = 2 marks)

Q25.

Streptococcus bacteria can cause a sore throat or skin infection.

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

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

(2)

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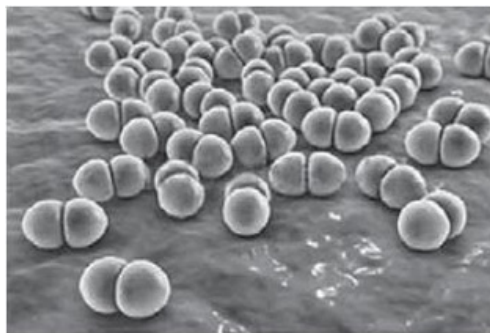
(ii) From September 2013 to March 2014 there were 2 830 cases of scarlet fever in the UK.

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)

..... %

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



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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

(Total for question = 5 marks)

Q26.

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

(Total for question = 1 mark)

Q27.

Antibiotics can be used to treat diseases.

Antibiotics kill

(1)

- A** antibodies
- B** antigens
- C** bacteria
- D** viruses

(Total for question = 1 mark)

Q28.

Chemicals can be extracted from plants.

Some of these chemicals can kill bacteria.

A scientist spread some bacteria on a nutrient agar plate as shown in Figure 5.

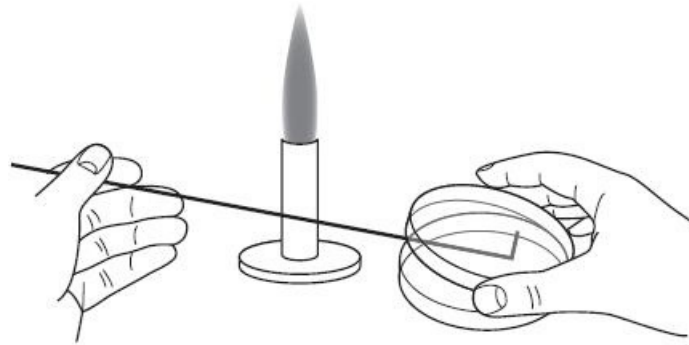


Figure 5

(i) What is being shown in Figure 5?

(1)

- A aseptic technique
- B cloning
- C genetic engineering
- D selective breeding

(ii) Explain why the scientist worked near to a Bunsen burner.

(2)

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(Total for question = 3 marks)

Q29.

HIV is diagnosed by blood tests.

State two safety precautions that need to be taken when handling blood samples.

(2)

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(Total for question = 2 marks)

Mark Scheme

Q1.

Question number	Answer	Additional guidance	Mark
(i)	Any one from: <ul style="list-style-type: none"> • to prevent contamination (1) • {avoid / kill / remove} microorganisms (1) • prevent other microorganisms affecting the results (1) 	accept bacteria / fungi /pathogen /virus for microorganism	(1) A02 1
Question number	Answer	Additional guidance	Mark
(ii)	so the bacteria are not killed / so the bacteria are not {destroyed / harmed / damaged / burnt}	accept microorganism / pathogen for bacteria	(1) A02 1

Question number	Indicative content	Mark
(iii)	<p style="text-align: center;">A02 & A03</p> <p>Plan</p> <ul style="list-style-type: none"> • 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 <p>Results</p> <ul style="list-style-type: none"> • measure radius/diameter • calculate the zone of inhibition around each disc • using πr^2 • antiseptic which killed the most bacteria will have largest zone <p>safety/aseptic</p> <ul style="list-style-type: none"> • 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 <p>Controlled variables</p> <ul style="list-style-type: none"> • incubation time stated • appropriate temperature stated • same size filter disc • same volume of antiseptic / soaked for same time <p>Control</p> <ul style="list-style-type: none"> • soak a fresh filter disc in water or left dry • use a known substance that kills bacteria 	<p>(6)</p> <p>A02 2 A03 3a</p>

Level	Mark	Descriptor
	0	No awardable content
Level 1	1-2	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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.

Q2.

Question Number	Answer	Additional Guidance	Mark
(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 (mm ²)	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 (mm ²) to 1 DP for two marks	(3) AO2 1

Question Number	Answer	Additional Guidance	Mark
(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
(iii)	<p>Any two from:</p> <ul style="list-style-type: none"> 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) 	<p>accept temperature in the mouth may not be 37°C</p> <p>accept the test only uses one type of toothpaste (1)</p>	<p>(2)</p> <p>AO2 2</p>

Q3.

Question Number	Answer	Mark
(i)	<p>C cancer cell</p> <p>The only correct answer is C</p> <p><i>A is not correct because a phagocytic cell is a white blood cell</i></p> <p><i>B is not correct because a red blood cell does not divide</i></p> <p><i>D is not correct because an epithelial cell does not divide rapidly</i></p>	<p>(1)</p> <p>AO1 1</p>

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An explanation linking:</p> <ul style="list-style-type: none"> the shape of the antibody is complementary to the A antigen / antibodies only react with specific antigens the B antigen has a different {shape / structure} (1) (therefore) it will only bind to the A antigen / it will not bind to the B antigen (1) 	<p>accept antigen A has a specific structure</p> <p>accept blood group B does not have the A antigen</p>	<p>(3)</p> <p>AO2 1</p>

Q4.

Question number	Answer	Additional guidance	Mark
	<p>An answer linking three from:</p> <ul style="list-style-type: none"> (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) 	<p>accept bacteria/virus for pathogen</p> <p>ignore WBC</p> <p>accept engulf pathogen</p> <p>accept description of a secondary response e.g. before symptoms/before the person gets ill/can react quickly</p>	<p>(3)</p> <p>AO1 1</p>

Q5.

Question number	Indicative content	Mark
*	<p>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.</p> <p>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.</p> <p style="text-align: center;">AO2 (6 marks)</p> <ul style="list-style-type: none"> • isolate an antigen from the pathogen which causes the STI • inject the antigen into a mouse/rodent • collect lymphocytes producing an antibody to the STI antigen • fuse the B-lymphocyte with a myeloma cell • production of a hybridoma • hybridoma produces a monoclonal antibody against the antigen of the STI • attach the monoclonal antibody to coloured bead/indicator • incorporate into a test strip. 	(6)

Level	Mark	Descriptor
	0	No awardable content
Level 1	1-2	<ul style="list-style-type: none"> • The explanation 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) • Lines of reasoning are unsupported or unclear. (AO2)
Level 2	3-4	<ul style="list-style-type: none"> • The explanation 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) • Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
Level 3	5-6	<ul style="list-style-type: none"> • The explanation 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) • Lines of reasoning are supported by sustained application of relevant evidence. (AO2)

Q6.

Question number	Answer	Additional guidance	Mark
	<p>An answer including:</p> <ul style="list-style-type: none"> • 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) 	<p>accept by-pass surgery / stents / heart surgery / other relevant surgeries such as gastric bands</p> <p>accept examples of lifestyle changes e.g. stop smoking</p> <p>accept named medications used for cardiovascular disease</p>	<p>(3)</p> <p>AO1 1</p>

Q7.

Question number	Answer	Additional Guidance	Mark
(i)	<p>An answer including:</p> <ul style="list-style-type: none"> (statins) reduce the level of LDL cholesterol (1) by 1.4 mmol per dm³ / from 3.8 mmol per dm³ to 2.4 mmol per dm³ 	<p>accept LDL cholesterol decreases</p> <p>accept idea that it decreases from 3.8 mmol per dm³ to a lowest value of 2.3 mmol per dm³</p> <p>accept 1.5 mmol per dm³</p>	<p>(2)</p> <p>AO3 (1a+1b)</p>

Question number	Answer	Mark
(ii)	<p>An explanation linking the following:</p> <ul style="list-style-type: none"> level of LDL increases after the medication is stopped (1) increases risk of {heart disease/heart attack/stroke/cardiovascular diseases/high blood pressure} (1) 	<p>(2)</p> <p>AO3 2a+2b</p>

Q8.

Question Number	Answer	Additional guidance	Mark
	<p>An answer linking three of the following:</p> <ul style="list-style-type: none"> • exposure to the {toxin/antigen/pathogen/bacteria} (1) • stimulates an immune response (1) • production of {(B)lymphocytes /antibodies} (1) • production of memory lymphocytes (1) 	<p>accept immunised /vaccinated</p> <p>accept antitoxins</p>	<p>(3)</p> <p>AO 2 1</p>

Q9.

Question number	Indicative content	Mark
*	<p>AO2</p> <ul style="list-style-type: none"> • gonorrhoea is spread by exchange of bodily fluids / sexual contact • from mother to child during childbirth • barrier contraception methods/condoms will reduce spread • abstinence prevents infection • screening for infections • contact tracing partners of infected individuals • education on the disease and ways to reduce its spread • treating infections with antibiotics <p>AO3</p> <ul style="list-style-type: none"> • number of cases in males higher than females • number of cases in males has increased since 2008 • number of cases in males has increased rapidly since 2010 • number of cases in females has increased since 2010 • rate of increases in cases is higher in men than women • comparative manipulation of data 	<p>(6)</p> <p>AO3/AO2</p>

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	<ul style="list-style-type: none"> The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2) Interpretation and evaluation of the information attempted but will be limited with focus on mainly just one variable. Demonstrates limited synthesis of understanding. (AO3)
Level 2	3-4	<ul style="list-style-type: none"> The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2) Interpretation and evaluation of the information on both variables, synthesising mostly relevant understanding. (AO3)
Level 3	5-6	<ul style="list-style-type: none"> The explanation is supported through linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2) Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding. (AO3)

Q10.

Question number	Answer	Mark
	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): <ul style="list-style-type: none"> the Bunsen burner flame kills all microorganisms on the loop (1) so only the desired bacteria are transferred to the loop/no unwanted microorganisms spread on the agar plate (1) 	(2)

Q11.

Question number	Answer	Mark
	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (2 marks): <ul style="list-style-type: none"> penicillin prevents the bacteria from dividing as they cannot make a new cell wall (1) because humans cells do not have a cell wall (1) they are unaffected by penicillin (1) 	(3)

Q12.

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

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>Any two from:</p> <ul style="list-style-type: none"> • 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) 	<p>accept a method of sterilising equipment e.g. flaming loops / disinfect the working area</p> <p>accept use sterile growth medium</p>	<p>(2)</p> <p>AO1 2</p>

Q13.

Question number	Answer	Additional guidance	Mark
(i)	<ul style="list-style-type: none"> radius 10 mm \pm 1 mm (1) area = πr^2 (1) area 314 (mm²) (1) answer must be to 3 significant figures	if radius outside range but area calculated max 2 marks award full marks for correct numerical answer without working	(3)

Question number	Answer	Additional guidance	Mark
(ii)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): <ul style="list-style-type: none"> antiseptic 1 has a larger zone of inhibition (1) so more of <i>Streptococcus pyogenes</i> have been killed (1) 	ecf from (a)(i)	(2)

Question number	Answer	Additional guidance	Mark
(iii)	<ul style="list-style-type: none"> to provide optimal growth conditions 	<i>S. pyogenes</i> grow at body temperature	(1)

Q14.

Question Number	Answer	Additional guidance	Mark
(i)	<ul style="list-style-type: none"> 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
(ii)	<p>An explanation that links four of the following:</p> <ul style="list-style-type: none"> • 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) 	<p>ignore inhibit the bacteria/inhibit cell processes</p> <p>accept does not harm humans</p> <p>accept RNA polymerase produces mRNA</p>	<p>(4)</p> <p>AO 2 1</p>

Q15.

Question number	Answer	Additional Guidance	Mark
(i)	<p>An answer including two of the following:</p> <ul style="list-style-type: none"> concerns over side effects of immunisation / concerns over the risk of allergic reactions (1) medical reason for not being immunised (1) too young for the vaccination programme (1) no access to healthcare (1) 	<p>accept named religious objections</p> <p>accept not in the country for the vaccination as a child</p> <p>they have already had measles (1)</p> <p>scared of needles (1)</p> <p>ignore didn't get a vaccine</p>	<p>(2)</p> <p>AO2(1)</p>

Question number	Answer	Additional Guidance	Mark
(ii)	<p>An answering including:</p> <ul style="list-style-type: none"> most people are immunised / high level of immunity in the population (1) so non-immunised people are protected from measles infection as they are {less likely to come into contact with the pathogen/someone with measles/measles is less likely to spread through the population} (1) 	<p>reject it means non-vaccinated people are immune</p> <p>accept disease/pathogen/infection for measles</p>	<p>(2)</p> <p>AO1(1)</p>

Q16.

Question Number	Indicative content	Mark
*	<p>Physical barriers</p> <ul style="list-style-type: none"> • mucus is produced by cells that line some surfaces of the body • mucus traps pathogens • cilia are found on epithelial / lining cells • ciliated cells line the inside of the respiratory system • cilia move mucus across the surface of cells • cilia move pathogens out of the body / into the throat • skin is a thick covering over the body • skin has dead cells on its surface • skin is waterproof • pathogens are unable to enter the body through the skin • tears wash pathogens away • ear wax traps pathogens • nasal hairs trap pathogens • blood clots / scabs cover wounds to prevent the entry of pathogens 	<p>(6)</p> <p>AO1 1</p>
	<p>Chemical defences</p> <ul style="list-style-type: none"> • skin has glands that secrete lysozymes • lysozymes are enzymes found in tears, saliva and mucus • lysozymes kill some bacteria • hydrochloric acid is in the stomach • hydrochloric acid has a low pH which kills many pathogens • antibodies are present on mucus linings 	

Level	Mark	Descriptor
	0	<ul style="list-style-type: none"> No rewardable material.
Level 1	1-2	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 1	1-2	<ul style="list-style-type: none"> a physical barrier OR a chemical defence is identified a function of the physical barrier OR a chemical defence is described
Level 2	3-4	<ul style="list-style-type: none"> more than one physical barrier OR more than one chemical defence is identified functions of the physical barriers OR chemical defences are described <p>OR</p> <ul style="list-style-type: none"> a physical barrier AND a chemical defence are identified a function of the physical barrier AND a function of the chemical defence are described
Level 3	5-6	<ul style="list-style-type: none"> more than one physical barrier AND more than one chemical defence are identified functions of most of these physical barriers AND chemical defences are described

Q17.

Question number	Answer	Additional Guidance	Mark
	<p>An explanation linking three of the following:</p> <ul style="list-style-type: none"> • they are immune (to <i>Clostridium tetani</i>) (1) • because the vaccination contained an antigen / bacteria have antigens (1) • memory lymphocytes (1) • leading to the production of antibodies (1) • leading to a secondary (immune) response (1) 	<p>accept idea of inactive/dead bacteria in the vaccine</p> <p>accept bacteria killed {faster/ quicker/ quickly}</p>	<p>AO2(1) (3)</p>

Q18.

Question number	Answer	Additional guidance	Mark
	<p>A description including three of the following:</p> <ul style="list-style-type: none"> the antibiotic would go through a development phase (1) pre-clinical (stage / trials) (1) testing on animals / testing <i>in-vitro</i> / on cells (1) clinical (stage / trials) (1) testing on (healthy) volunteers / testing on patients (1) double-blind trials (1) 	<p>accept examples of the development phase</p> <p>accept named animals</p> <p>accept a description of double-blind trials e.g. placebo and drug</p>	<p>(3)</p> <p>A02 1</p>

Q19.

Question number	Answer	Mark
	<p>An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark):</p> <ul style="list-style-type: none"> prevents damage to the plant (1) because the chemicals produced by garlic kills pathogens/pests (1) 	<p>(2)</p>

Q20.

Question Number	Answer	Additional guidance	Mark
	<p>An explanation linking two of the following:</p> <ul style="list-style-type: none"> • 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

Q21.

Question number	Indicative content	Mark
	<p>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.</p> <p>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.</p> <ul style="list-style-type: none"> • Plants have physical and chemical defences <p>Physical defences</p> <ul style="list-style-type: none"> • Plant leaves have waxy cuticles • Waxy cuticles are impermeable • Plant cells have cell walls • Cell walls are made of cellulose and are difficult for pests or pathogens to penetrate • Leaf cuticle and cell walls are physical defences • Some plants have spines or hairs which deter pests <p>Chemical defences</p> <ul style="list-style-type: none"> • Chemicals can deter pests • Production of chemicals which are toxic to pests and pathogens • Chemicals have anti-microbial properties • Unpleasant taste which deters pests • Unpleasant smell which deters pests 	(6) AO 1 1

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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)

Q22.

Question number	Answer	Additional guidance	Mark
	An answer linking: <ul style="list-style-type: none"> • waxy cuticle / (physical) barrier (1) • to prevent entry to pathogens (1) 	accept waxy layer / waterproof surface	(2) AO1(1)

Q23.

Question number	Indicative content	Mark
	<p style="text-align: center;">AO2</p> <p>Area A</p> <ul style="list-style-type: none"> • antigens are on the bacteria • which are detected by WBCs / phagocytes • white blood / phagocytes engulf bacteria (phagocytosis) • swelling / inflammation of tissues / fever <p>Area B</p> <ul style="list-style-type: none"> • number of white blood cells increases • antibodies are produced • by lymphocytes / white blood cells • antibodies surround / cover / inactivate the antigens / pathogens <p>Area C</p> <ul style="list-style-type: none"> • memory lymphocytes / cells are produced • which remain in the blood • then if a secondary infection occurs • memory lymphocytes produce antibodies faster / in greater numbers • so the bacteria / pathogens are destroyed faster 	<p>(6)</p> <p>A01 1</p>

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	<ul style="list-style-type: none"> • Demonstrates elements of biological understanding, some of which is accurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. • Presents a description which is not logically ordered and with significant gaps.
Level 2	3-4	<ul style="list-style-type: none"> • Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. • Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing.
Level 3	5-6	<ul style="list-style-type: none"> • Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. • Presents a description that has a well-developed structure which is clear, coherent and logical.

Level	Mark	Additional Guidance	General additional guidance
	0	No rewardable material	The level is determined by the areas of indicative content covered within the response. The mark within the level is determined by the detail and /or use of biological terms within each description.
Level 1	1-2	Makes a simple reference to a feature of the immune response	<u>Possible candidate responses</u> <ul style="list-style-type: none"> • White blood cells are involved • White blood cells engulf bacteria
Level 2	3-4	Refers to two areas of indicative content OR Gives an explanation of one area of indicative content	<u>Possible candidate responses</u> <ul style="list-style-type: none"> • Bacteria have antigens on them and white blood cells make antibodies • Infection by bacteria causes more white blood cells to be produced. Lymphocytes make antibodies which inactivate antigens on the pathogens
Level 3	5-6	Refers to three areas of indicative content OR Gives an explanation of two areas of indicative content	<u>Possible candidate responses</u> <ul style="list-style-type: none"> • There are antigens on bacteria which are detected by white blood cells. Lymphocytes make antibodies and then memory lymphocytes are produced for a faster secondary response • Phagocytes detect antigens on the bacteria and engulf them. This is called phagocytosis. People might also develop a fever. Memory lymphocytes are produced and these stay in the blood to produce specific antibodies very quickly if there is a secondary infection by the same bacteria

Q24.

Question Number	Answer	Additional guidance	Mark
	An explanation linking: <ul style="list-style-type: none"> • exercise {requires energy/ uses respiration} (1) • {obtained from/reducing} fat (1) 	accept burns calories accept sweating causes water loss for 1 mark	(2) AO 1 1

Q25.

Question Number	Answer	Additional guidance	Mark
(i)	Any two from: <ul style="list-style-type: none"> • 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
(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
(iii)	<p>A it does not have flagella</p> <p>1. The only correct answer is A</p> <p><i>B is not correct because plasmids do not allow motility.</i></p> <p><i>C is not correct because it does have ribosomes.</i></p> <p><i>D is not correct because acrosomes are not found in bacteria.</i></p>	<p>(1)</p> <p>AO 2 1</p>

Q26.

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

Q27.

Question Number	Answer	Mark
	<p>C bacteria</p> <p>1. The only correct answer is C</p> <p><i>A is not correct because antibiotics do not kill antibodies</i></p> <p><i>B is not correct because antibiotics do not kill antigens</i></p> <p><i>D is not correct because antibiotics do not kill viruses</i></p>	<p>(1)</p> <p>AO 1 1</p>

Q28.

Question number	Answer	Mark
(i)	<p>A aseptic technique</p> <p>i The only correct answer is A</p> <p><i>B is not correct because the technique shown is not cloning</i></p> <p><i>C is not correct because the technique shown is not genetic engineering</i></p> <p><i>D is not correct because the technique shown is not selective breeding</i></p>	<p>(1)</p> <p>AO2(2)</p>

Question number	Answer	Additional guidance	Mark
(ii)	<p>An answer that links the following:</p> <ul style="list-style-type: none"> • Bunsen burner creates {a convection current/uplift} (1) • prevents microorganisms in the air falling onto the agar plate / contamination (1) <p>OR</p> <ul style="list-style-type: none"> • to sterilise the loop / spreader (1) • to prevent transfer of unwanted microorganisms / contamination (1) 	<p>accept kill bacteria on the loop / spreader /metal wire</p>	<p>(2)</p> <p>AO2(2)</p>

Q29.

Question Number	Answer	Additional guidance	Mark
	Any two from: <ul style="list-style-type: none">• wear gloves/ goggles/cover wounds/cover cuts (1)• clean up spills/use tongs to handle sample (tubes) (1)• store samples in sealed containers (1)• dispose of samples safely (1)	accept store in fridge/cooler accept burn/incinerate/sterilise(1)	(2) AO 2 1