1.

(i) HIV is an infection which causes a weakened immune system.

State **two** ways of passing HIV from one person to another.

1

2

---

[2]

(ii) People with HIV are at risk from opportunistic infections.

These infections take advantage of a weakened immune system.

The most threatening infections occur when the person has a CD4 count less than 200.

4 individuals with HIV had their CD4 count measured.

Individual	CD4 count
1	500
2	210
3	160
4	175

Place the individuals in order of those with the greatest risk of contracting an opportunistic infection.

....

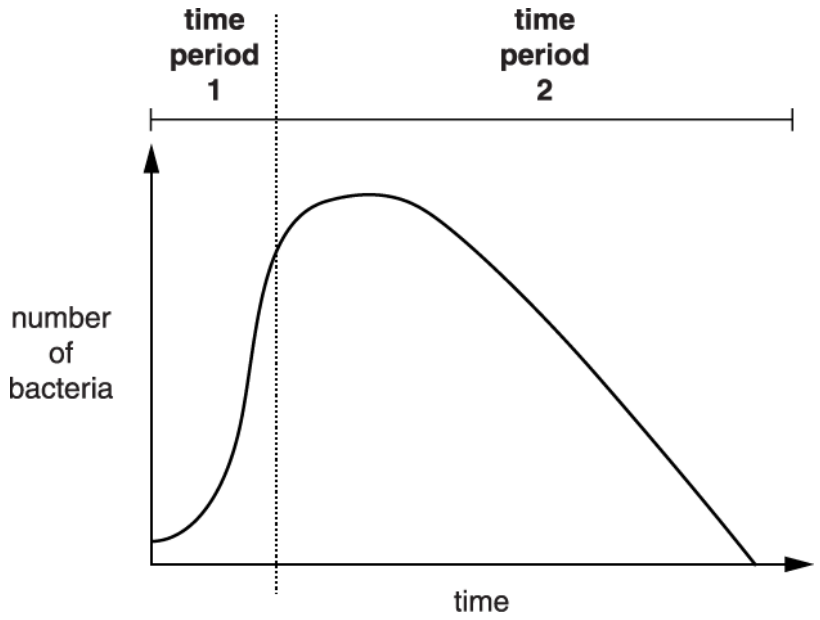
most risk least risk

[1]

2(a). Dan works in his garden. He cuts his leg.

Some bacteria enter the cut. The bacteria start to reproduce.

The graph shows how the number of bacteria in the cut changes over time.



During **time period 1**, the bacteria are reproducing quickly.

Each bacterium divides to produce two bacteria. This happens once every 20 minutes.

(i) At the start of **time period 1** there are 50 bacteria.

Calculate how many bacteria there will be after 2 hours if all bacteria survive.

number of bacteria = _____ **[1]**

(ii) Dan will show symptoms of infection when there are more than 20 000 bacteria in the cut.

Dan thinks this will take days.

Look again at your answer to part **(i)**.

Explain why Dan is wrong.

---

[2]

(iii) Write down **two** ways in which bacteria can cause symptoms of infection in the body.

---

[2]

(b). Look at time **period 2** on the graph.

Some of the bacteria are dying.

(i) Draw an **X** on the graph to show a time when the number of new bacteria being produced is equal to the number of bacteria dying.

[1]

(ii) What actions take place inside Dan's body to cause the shape of the graph in **time period 2**?

---

[2]

3(a). Tony has pneumonia.
His doctor prescribes antibiotics.

Suggest the type of microorganism that causes pneumonia.

---------- [1]

(b). The microorganism reproduces rapidly.
It divides into 2 every 20 minutes.
Starting with 1 microorganism, what is the maximum number that could be present in Tony's body after 2 hours?
You **must** show your working.

Put a tick (✓) in the box next to the correct answer.

32 ☐

64 ☐

128 ☐

256 ☐

[2]

4(a). Jake accidentally cuts himself.

The cut becomes infected with bacteria.

Jake begins to feel ill. He has septicaemia (blood poisoning).

Septicaemia can kill.

Complete the sentences to explain what the bacteria are doing to make Jake feel ill.

Choose only words from this list.

antibiotics **damage** **help** **oxygen** **stimulate** **toxins**

The bacteria in Jake's cut multiply rapidly. They spread into his blood stream.

The bacteria _____ Jake's cells and release

_____ into his blood stream.

[2]

(b). For the first few hours, the bacteria divide into two every twenty minutes.

100 bacteria entered Jake's wound when he cut himself.

How many bacteria are in Jake's wound after 2 hours?

Show your working.

number of bacteria in Jake's wound after two hours. _____ **[2]**

(c). It is important for Jake to produce antibodies against these bacteria as quickly as possible.

Use the information from parts **(a)** and **(b)** to explain why.

---

[3]

5. Cancer of the ovaries is a common type of cancer in women.

Complete the following sentences about cancer.

Put a (ring) around the correct option in each sentence.

Cancer is a **communicable** / **non-communicable** / **sexually-transmitted** disease.

It is caused by changes in the **cell membranes** / **DNA** / **mitochondria**.

The changes cause cells to divide many times by

asexual reproduction / **meiosis** / **mitosis**.

This uncontrolled growth and division creates **an infection** / fatty deposits / **a tumour**.

[4]

6. Amir works in a laboratory. His job is to identify the pathogens that cause plant diseases.

Different types of pathogens cause different diseases in plants.

Draw lines to join each **type of pathogen** with the correct **disease** it causes.

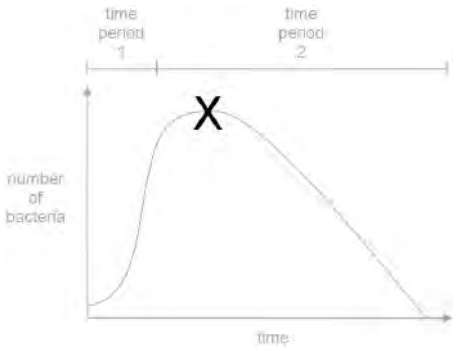
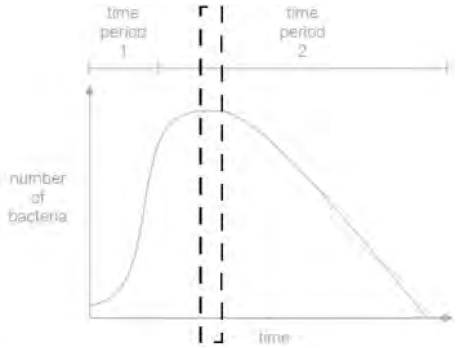
Type of pathogen	Disease
Bacterium	Ash dieback
Fungus	Tobacco mosaic
Virus	Crown gall

[2]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1		i	Any two from Unprotected sex ✓ Sharing used needles ✓ Contaminated blood transfusions ✓	2	
		ii	3, 4, 2, 1 ✓	1	ALLOW 160, 175, 210, 500
			Total	3	
2	a	i	3200	1	Examiner's Comments Many candidates did not realise that the figure required to calculate the number of bacteria came from the stem of the question. Common incorrect answers for this question included 100, 1200 and 6000, with the most common incorrect answer being 1600 indicating that some candidates did not complete the last doubling. Unfortunately, many candidates did not show their working so it was not possible to see how they arrived at their wrong answers. Centres should encourage candidates to show their workings as on many mathematical questions this can often score them a mark.
		ii	It will only take hours/ it will only take 1 more hour/3 hours in total (1)	2	

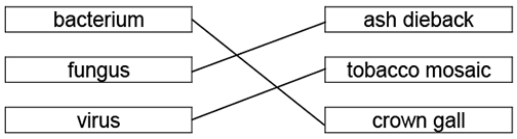
Question			Answer/Indicative content	Marks	Guidance
		ii	the population size/number of bacteria only needs to double three more/a few more times (1)		**credit** correct numerical calculation that shows 3 more divisions equals more than 20000 **credit** 25600 bacteria Examiner's Comments Answers for this question were variable and very much depended on the strategy used to calculate (a) (ii). Those that gained numbers in the thousands for (a) (ii) often went on to discuss the idea that to reach 20 000 bacteria would only take hours and not days. Some candidates went further than this and did include calculations to demonstrate how they had arrived at this decision which was good to see. Those that had struggled to double the numbers in (a) (ii) often failed to score on this question.
		iii	damage cells (1) produce toxins/poisons (1)	2	**ignore** destroys/kills/attacks cells Examiner's Comments Very few candidates scored marks on this question. Many seemed to misinterpret what the question wanted and rather than stating two ways in which bacteria can cause symptoms of infection the candidates gave examples of symptoms of infections such as swelling, vomit, rash, fever etc. Those candidates that did recognise what that question was asking often went on to score both marks.

Question			Answer/Indicative content	Marks	Guidance
	b	i		1	X should be on the horizontal portion of the curve, or anywhere directly above or below it (see dashed box for guidance)  **Examiner's Comments** Many candidates gained credit for placing the cross on the correct part of the graph. Centres are asked to encourage candidates to be as accurate as possible with such questions as some candidates narrowly missed out on the mark. Common errors included placing the cross on the line where it met the X axis. Some candidates did not attempt the question - this could be a result of candidates not realising that it was there and so candidates should be reminded to look for the marks at the side of the question paper to ensure they don't miss out a question by accident.
		ii	**any 2 from**: immune system/white blood cells ; (by) producing antibodies ; ii clumping of bacteria ; releases/produces antitoxins ;	2	 **accept** agglutination

Question			Answer/Indicative content	Marks	Guidance
		ii	(by white blood cells) engulfing/digesting the bacteria (destroying bacteria)		**ignore** eating/fighting/killing/attacking bacteria **credit** bacteria have run out of food/oxygen/nutrients **credit** waste products are killing the bacteria Examiner's Comments This question was answered well by many candidates. It was pleasing to see that candidates clearly had knowledge about the roles of the white blood cells in defending against disease. Many in-depth responses were seen. Weaker candidates lost marks for incorrect terminology such as eating/fighting or attacking bacteria and there was evidence of candidates being confused as to whether the white blood cells produced antibodies or antigens. Some candidates also incorrectly identified the antibodies as engulfing the white blood cells.
			Total	8	

Question			Answer/Indicative content	Marks	Guidance
3	a		bacteria / fungi;	1	**reject** virus **Examiner's Comments** Called for candidates to recall that bacteria and fungi can cause disease and can also be treated by antibiotics. A number of responses offered viruses as a cause of pneumonia, ignoring the point about antibiotic treatment.
	b		evidence of doubling in the working; 64;	2	correct response = 2 marks **Examiner's Comments** Was generally well answered. It is worth stressing to candidates that there were examples of scoring 1 mark here for showing evidence of doubling in the working out even if the wrong box was ticked.
			Total	3	

Question			Answer/Indicative content	Marks	Guidance
4	a		damage; toxins	2	**accept** any indication of correct choice eg lines from words **Examiner's Comments** This was a well answered question, many candidates knew both damage and toxins.
	b		idea of doubling; 6400	2	**accept** doubling even if does not start from 100, for 1 mark or **allow** 1 numerical mistake with correct method for 1 mark Doubling must be **bacteria numbers** not time correct answer scores 2 marks **Examiner's Comments** This question asked the candidates to calculate the number of bacteria present in Jake's cut after 2 hours and required them to be able to show how they arrived at their answer. Very few of the candidates were awarded 1 mark for demonstrating that they knew that doubling had occurred and this mark was awarded for their working. Centres need to remind candidates that showing the working is important and may lead to marks being awarded even if the answer is incorrect.
	c		bacteria multiply **rapidly;** dead / damaged cells and / or toxins will increase **rapidly;** antibodies kill bacteria / lock onto; the sooner the antibodies are produced, the **less** damage will be caused	3	first, second, fourth points must be qualified **ignore** grow **ignore** spread **ignore** “fight” **reject** antibodies engulf (and kill) bacteria **Examiner's Comments** This question required candidates to use the information from parts (a) and (b) to explain why it was important to produce antibodies quickly. It was disappointing to see that many had not followed the guidance in the stem of the question.
			Total	7	

Question			Answer/Indicative content	Marks	Guidance
5			non-communicable ✓ DNA ✓ mitosis ✓ tumour ✓	4 (AO 1.1 × 4)	<u>Examiner's Comments</u> This question assessed AO1. Almost all candidates scored at least one mark on this question, with many scoring three or four marks. Candidates commonly knew what type of disease cancer is, and what a tumour was. Those who did not score full marks were less confident in equal measures as to the cause of cancer and the type of cell division involved.
			Total	4	
6				2 (AO 1.1 × 2)	two or three correct lines = 2 marks one correct line = 1 mark IGNORE any line that branches/splits IGNORE any box with more than 1 line joined to it <u>Examiner's Comments</u> Plant pathogens and plant disease are new to the specification this year, so it was pleasing to see almost half of candidates scoring 1 mark here, and a quarter of candidates scoring 2 marks.
			Total	2	