

OCR A-LEVEL BIOLOGY B • H422

BIOLOGY



EXAM QUESTION PACK

3.2.3 CONTROLLING COMMUNICABLE DISEASES

SCORE

/64

PERCENTAGE

%

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1 Which of the options, **A** to **D**, explains why viruses are not destroyed by antibiotics?

- A** Viruses do not have DNA.
- B** Viruses do not have nuclei.
- C** Viruses do not have plasmids.
- D** Viruses do not have cell walls.

Your answer

[1]

2 A student investigated the effect of different antibiotics on the growth of bacteria.

They prepared two agar plates:

- Plate 1 was inoculated with a non-pathogenic strain of *E. coli* (a Gram-negative bacterium).
- Plate 2 was inoculated with a non-pathogenic strain of *S. aureus* (a Gram-positive bacterium).

Discs of filter paper were soaked in either an antibiotic solution or distilled water. The discs were then placed on the surface of each plate.

The plates were incubated for 48 hours and the zone of inhibition around each disc was measured.

The results are shown in the table.

Solution on filter paper	Zone of inhibition (mm)	
	Plate 1 (<i>E. coli</i>)	Plate 2 (<i>S. aureus</i>)
Water	0	0
Penicillin	2	16
Polymyxin B	15	1
Tetracycline	15	14

The student made the following conclusions:

1. Penicillin and Polymyxin B are both narrow-spectrum antibiotics.
2. Tetracycline is a broad-spectrum antibiotic.
3. Penicillin is active only against Gram-positive bacteria.
4. Polymyxin B is active only against Gram-negative bacteria.
5. Tetracycline is a bacteriostatic antibiotic whereas penicillin and polymyxin B are both bactericidal antibiotics.

(i) Evaluate the student's conclusions.

----- [3]

(ii) Describe **two** improvements that could be made to the student's method to increase the accuracy of their results.

1. -----

2. -----

[2]

(iii) Suggest the mechanism of action of penicillin.

----- [1]

(iv) Suggest how the mechanism of action of polymyxin B differs from that of penicillin.

----- [1]

(v) Outline an experiment to distinguish between a bactericidal antibiotic and a bacteriostatic antibiotic.

[3]

3 Acquired immune deficiency syndrome (AIDS) is caused by the Human Immunodeficiency Virus (HIV).

Discuss the effectiveness of antibiotics in the treatment of AIDS.

[2]

4(a) The human immunodeficiency virus (HIV) is spread through direct contact with body fluids.

Untreated HIV infection causes progressive destruction of the immune system. This leads to acquired immunodeficiency syndrome (AIDS).

Vaccines against HIV are currently being developed:

- to protect individuals from contracting HIV
- to boost the immune response in HIV-positive individuals.

Explain why it is difficult to produce an effective vaccine for HIV.

[3]

(b) HIV destroys the immune system by infecting and killing a type of T helper cell known as a CD4 cell. Therefore, blood levels of CD4 cells can indicate strength of the immune system in patients with HIV.

A clinical trial was conducted to evaluate the safety and effectiveness of a new HIV vaccine in patients with HIV receiving HAART.

(i) The vaccine contains a purified viral protein known as Tat, which is required for transcription of the HIV genome.

State **one** advantage of using purified Tat protein instead of a live, attenuated (weakened) virus.

[1]

(ii) Fig. 31.2 shows CD4 cell levels over time in patients immunised with 7.5 µg or 30 µg Tat protein.

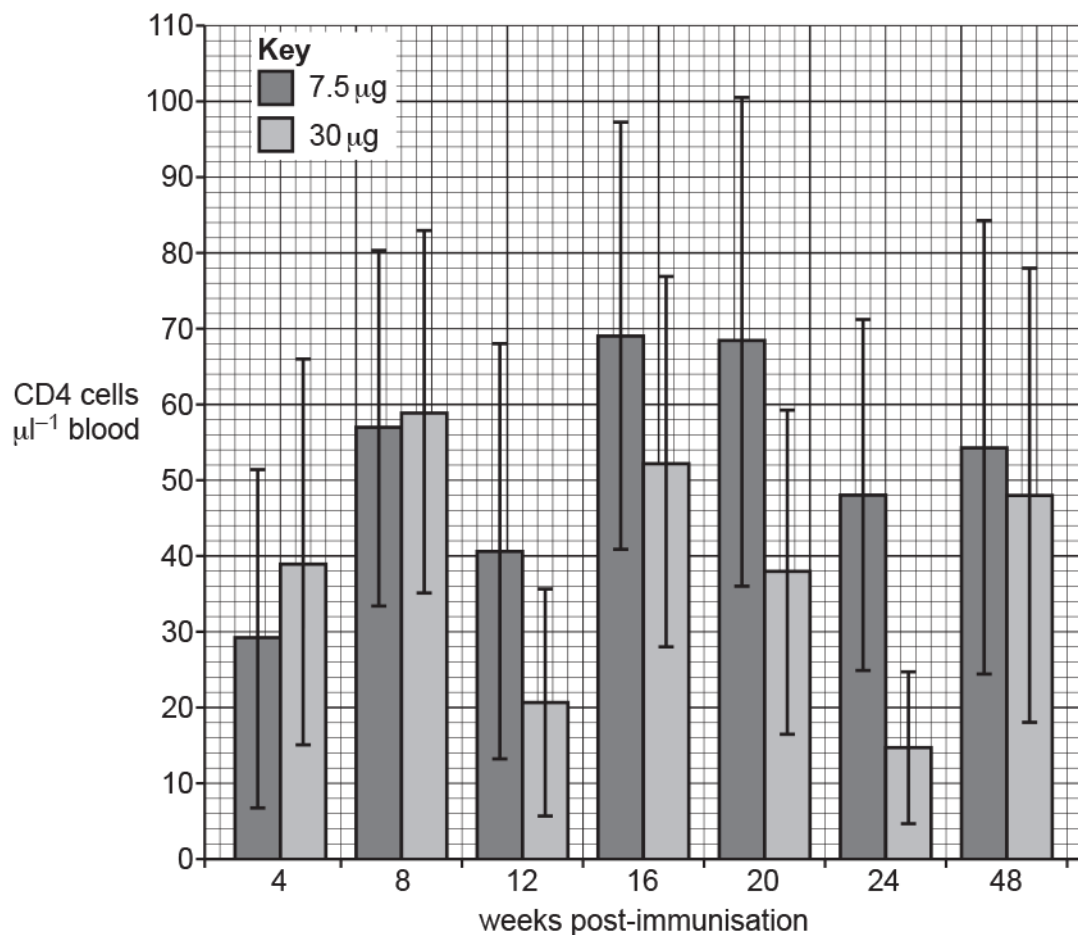


Fig. 31.2

Suggest **two** reasons why the effectiveness of the vaccine can **not** be determined from the data in Fig. 31.2.

- 1 _____
- _____
- 2 _____
- _____

[2]

(c) AIDS is an advanced stage of HIV infection that is defined by the occurrence of opportunistic infections, such as tuberculosis (TB) and hepatitis B and C. TB is the most common opportunistic infection in patients with HIV.

(i) In the UK, TB is a notifiable disease.

State **two** possible consequences of the reporting of a notifiable disease.

1 _____

2 _____

[2]

(ii) Active TB infection is treated with a combination of antibiotics.

The cell wall of the TB pathogen *Mycobacterium tuberculosis* is strengthened by complex lipid molecules.

What term is given to describe antibiotics that inhibit cell wall synthesis?

[1]

(iii) Multi-drug resistance is a major challenge in the treatment of patients with TB.

Outline how a population of *M. tuberculosis* may become resistant to antibiotics.

[3]

5 Scientists are producing a vaccine against a disease-causing bacterium.

The table below shows the locations and mutation rates of four proteins, A to D, in the bacterium.

	Protein location	Mutation rate (per amino acid)
A	cell membrane	2.1×10^{-4}
B	cell wall	4.3×10^{-4}
C	pilus	7.7×10^{-4}
D	ribosome	1.8×10^{-4}

Which of the proteins, A to D, is most suitable as the basis of a vaccine against this bacterium?

Your answer

[1]

6(a) The MenB vaccine was developed to protect against disease caused by the bacterium *Neisseria meningitidis*. Infection with this bacterium (meningococcal infection) is a major cause of meningitis and blood poisoning, particularly in babies and young children.

The MenB vaccine was introduced into the routine UK vaccination schedule on 1st September 2015. It is available to all new babies born on or after 1st July 2015.

(i) The MenB vaccine is a subunit vaccine.

Explain what is meant by a subunit vaccine.

----- [1]

(ii) Parents have been reassured that the MenB vaccine cannot cause meningitis in their children.

Explain why the MenB vaccine cannot cause the disease.

----- [1]

(iii) The MenB vaccine has also been shown to be effective against other types of meningococcal infection.

Suggest why.

----- [2]



[6]

- 7 The human papillomavirus (HPV) can infect the skin and mucous membranes of the body.

Most cases of HPV infection are eradicated naturally by the immune system.

Sometimes HPV cannot be eradicated naturally by the immune system. Persistent HPV infection is the main cause of cervical cancer.

A vaccine against the **HPV-16** and **HPV-18** strains is offered to females aged 12 to 14 years.

Scientists wanted to determine whether the vaccine should be given over two or three doses.

They compared the effectiveness of two-dose and three-dose regimes by measuring antibody levels in the blood one month and three years after completion.

The results are summarised in Table 34 below.

Data group	Number of subjects	HPV-16 antibody level (mMU dm ⁻³)		HPV-18 antibody level (mMU dm ⁻³)	
		Median	Range	Median	Range
Two-dose regime after one month	102	830	761–882	812	704–866
Two-dose regime after three years		739	729–755	214	101–483
Three-dose regime after one month	116	829	781–893	820	794–860
Three-dose regime after three years		731	718–754	747	709–773

Table 34

- (i) Using the information in Table 34, evaluate the effectiveness of different vaccination regimes.

[4]

- (ii) Antibody levels were also measured two weeks after the first dose of vaccine. They were significantly lower than those measured after the second and third doses of vaccine.

Explain why.

[3]

- 8 Which of the options, A to D, is a cellular target of a bacteriostatic antibiotic?

- A cell wall
- B plasma membrane
- C 70S ribosome
- D 80S ribosome

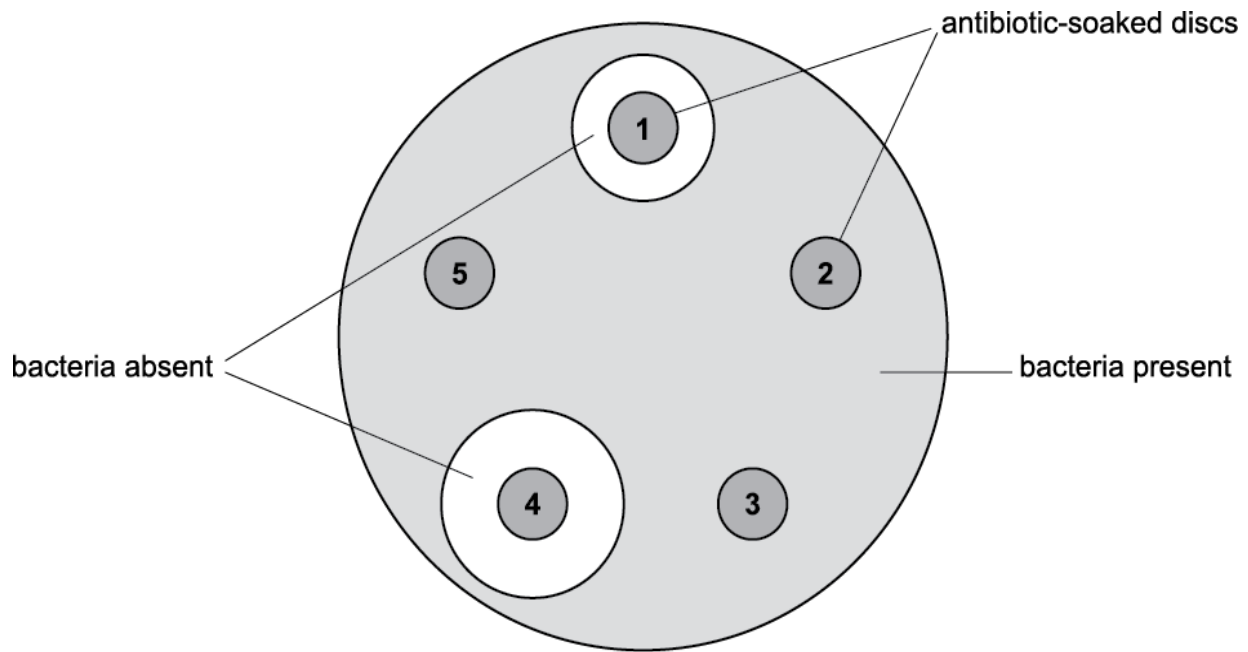
Your answer

[1]

- 9 The Kirby-Bauer test is used to determine the sensitivity of bacteria to various antibiotics.

A sample of bacteria was swabbed across an agar plate. Five antibiotic-soaked discs were then placed on the agar.

The diagram below shows the appearance of the plate after incubation overnight.



Key

- 1 = vancomycin
- 2 = amoxicillin
- 3 = cefoxitin
- 4 = minocycline
- 5 = methicillin

Which of the following statements is/are correct?

- 1 Vancomycin and minocycline show bactericidal, but not bacteriostatic, activity.
- 2 The tested bacteria could be MRSA.
- 3 The result for amoxicillin, cefoxitin and methicillin could be due to mutation of bacterial genes.

- A 1, 2 and 3 are correct
- B Only 1 and 2 are correct
- C Only 2 and 3 are correct
- D Only 1 is correct

Your answer

[1]

10(a) A horse being treated by a vet appears to have pneumonia caused by a bacterial infection.

- Antibiotics will be used to treat the horse, but the vet must first find out which species of bacterium is causing the pneumonia.
- A sample of fluid containing the bacteria is taken from the horse and sent to a laboratory for analysis in a small lidded bottle.

* Write a method for **safely** obtaining a pure culture of the bacteria from the fluid sample.

You should name any equipment needed and justify your choice of equipment.

Your method must be based on the assumption that you are provided with school or college resources.

[9]

- (b) The vet discovers that two different species of bacteria are present which may be causing the pneumonia.

Once suitably prepared and stained using the Gram staining technique, a sample of the bacteria are observed using the high power lens of a light microscope.

In one of the bacterial species, the cells are seen to be stained red / pink.

- (i) Why must a high power lens be used to view the bacteria?

----- [1]

- (ii) What does the red / pink colour of the stained bacteria suggest about the structure of the cells?

----- [1]

- (c) Fig. 2.1 is a photomicrograph of the bacterium, *Klebsiella pneumoniae*, the probable cause of the pneumonia.

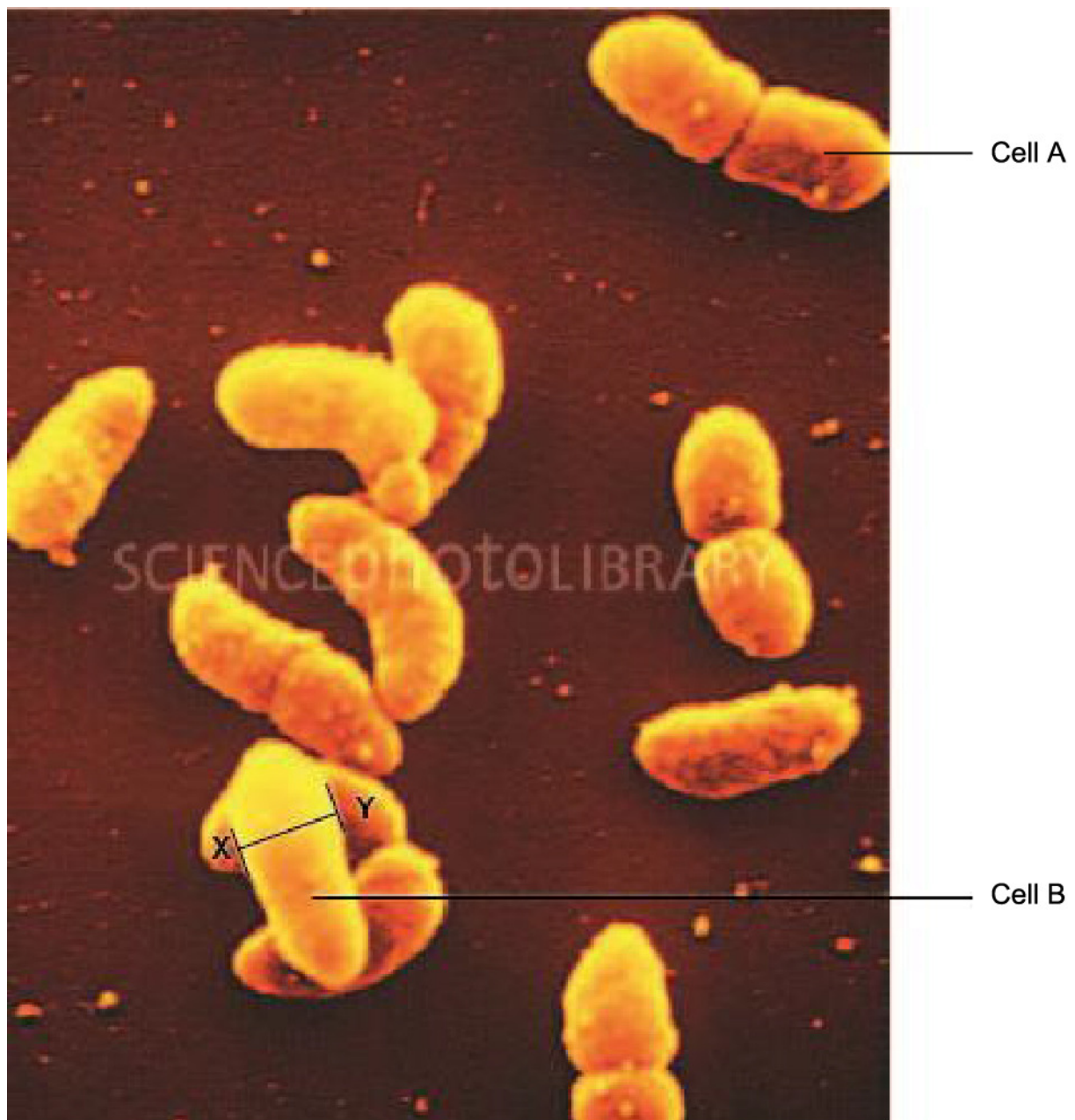


Fig. 2.1

- (i) The cell labelled **A**, in Fig. 2.1, is undergoing cell division by a process called binary fission.

Suggest why these bacterial cells do not divide by mitosis.

[1]

- (ii) The cell labelled **B**, in Fig. 2.1, has a width of $5\text{ }\mu\text{m}$ measured between X and Y.

Calculate the magnification of the photomicrograph.
Show your working. Give your answer to **three** significant figures.

Answer X [2]

Fig. 2.2 shows the results of a test carried out using the *Klebsiella pneumoniae* bacteria cultured from the horse. The bacterial culture was spread on an agar plate and discs containing antibiotics A to D were placed on the agar as shown. The plate was then incubated overnight.

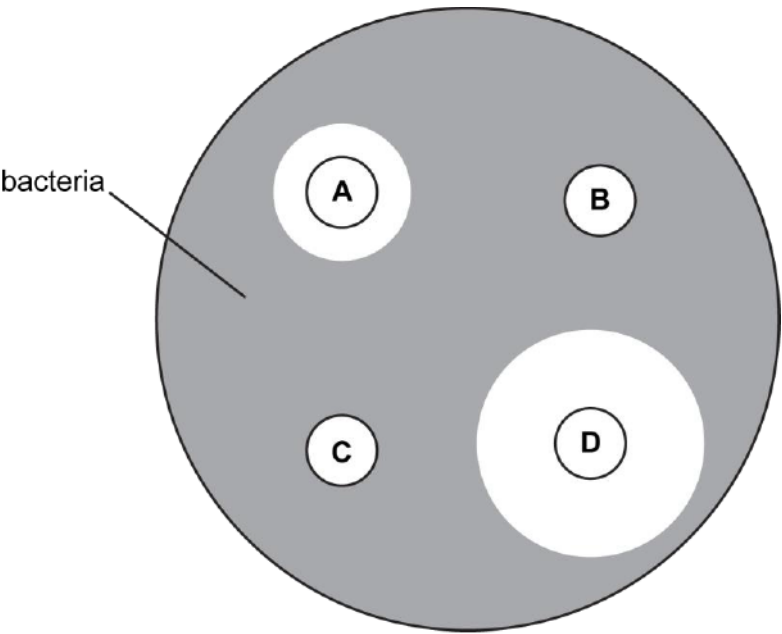


Fig. 2.2

Table 2.1 shows information about the 4 antibiotics used in the test.

Antibiotic	Mode of Action	Notes
A	Inhibits the synthesis of protein by bacteria, leading to cell death	Family of over 20 antibiotics
B	Inhibits bacterial cell wall synthesis	Most widely used antibiotics
C	Inhibits bacterial cell wall synthesis	Resistance evolves rapidly
D	Interferes with bacterial DNA replication and transcription	Common ‘drug of last resort’ used with resistant strains

Table 2.1

(d) The vet chooses to use antibiotic A. Using Fig 2.2 and Table 2.1, justify this decision.

[2]

11 Penicillin is **not** effective against Gram negative bacteria and has no effect on plant and animal cells.

(i) Explain why penicillin has no effect on Gram negative bacteria.

[2]

(ii) Explain why penicillin has no effect on plant or animal cells.

[1]

END OF QUESTION PAPER

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1			D	1(AO1.1)	
			Total	1	
2		i	any three from: conclusions 1 & 2 are correct ✓ conclusion 3 & 4 may be incorrect (based on small zone of inhibition) ✓ <i>idea that</i> definitive conclusions cannot be made with small number of , strains / antibiotics ✓ conclusion 5 cannot be made based on this evidence ✓	3 AO 3.2	
		ii	any two from: repeat with more plates and calculate mean ✓ (use) same / control , concentration of antibiotic ✓ (use) same / control , volume of antibiotic solution ✓	2 AO 3.3	ALLOW use same area / diameter filter paper
		iii	(penicillin) destroys / disrupts assembly , of bacterial cell wall / peptidoglycan (in Gram-positive bacteria) ✓	1 AO 2.5	ALLOW murein for peptidoglycan ALLOW just 'attacks the cell wall'
		iv	(polymyxin B) damages plasma membrane (in Gram-negative bacteria) ✓ polymyxin B disrupts another (named) process in (Gram-positive) bacteria ✓	1 AO 2.5	ALLOW response based on differences in cell wall of Gram-positive and -negative bacteria.
		v	any three from: prepare bacterial , plate / culture / lawn ✓ add antibiotic and look for , zone of killing / evidence that bacteria have been killed ✓ only bactericidal antibiotics will show killing ✓ repeat with , different bacterial species / Gram-positive or Gram-negative bacteria ✓	3 AO 3.3	ALLOW bacteriostatic antibiotic will not show killing

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			Total	10	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
3			antibiotics cannot destroy (HIV) virus ✓ can kill opportunistic (bacterial) pathogens ✓	2 AO2.1	ACCEPT named example of an opportunistic pathogen that is killed
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
4	a		high mutation rate ✓ variability of antigens (on pathogen surface) ✓ antibodies no longer, complimentary / bind, to antigen ✓ ref to delay between emergence of new strain and development of new vaccine ✓ recombination of / hybrid, strains ✓	max 3 AO1.1 1.2	<u>Examiner's Comments</u> While this question is asking about the issues of vaccine development such as high mutation rates and antigen variability; several candidates restricted their answer to the idea that HIV reproduces within body cells making it inaccessible.
	b	i	live virus may, revert / mutate / become pathogenic ✓	1 AO1.1	ORA e.g. purified protein cannot mutate
		ii	no data at, baseline / week 0 ✓ large error bars ✓ no overall trend (over time) ✓ CD4 cell level not the only indicator of immune health ✓ trial period not long enough (given longevity of the virus) ✓ no control ✓	max 2 AO3.4	ALLOW large standard deviations ALLOW idea of no pattern <u>Examiner's Comments</u> Several candidates stated that the error bars overlapped which was too vague, given that overlapping error bars often occurred between the two doses (although there was no overlap at 24 weeks), but not always between weeks e.g. 30mg at 8 weeks and 30mg at 24 weeks. The key point about the data is the fluctuations (so large error bars/standard deviations was acceptable) and lack of overall trend.
	c	i	publishing of data which monitors trends ✓ educate/inform ✓ improve vaccination ✓ initiate contact tracing ✓ ensures availability of vaccine ✓ isolation of affected individuals ✓	max 2 AO1.1	ALLOW ring vaccination <u>Examiner's Comments</u> This question was generally well answered although some candidates suggested consequences which would not be practical and thus were not credited. For example, isolation of affected individuals would be accepted but it would be impractical to isolate a human population.
		ii	bacteriocidal ✓	1 AO1.1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	genetic variation / mutations, are present ✓ acquisition of new mutations over time ✓ antibiotics provide <u>selection pressure</u> ✓ (resistant/most adapted) bacteria survive and multiply ✓ advantageous mutation / allele passed on ✓	max 3 AO1.2	<u>Examiner's Comments</u> Most candidates scored at least one mark on this question, most commonly for identifying that a mutation may give rise to resistance. A few candidates mistakenly suggested that the use of antibiotics caused mutations to arise rather than identifying the antibiotics as the selection pressure that causes the population to evolve.  OCR support OCR's delivery guide on controlling communicable disease offers support in the development of antibiotic resistance: https://www.ocr.org.uk/qualifications/as-a-level-gce-biology-b-advancing-biology-h022-h422-from-2015/delivery-guide/module-bb03-module-3-cell-division-development-and-disease-control/delivery-guide-bbdg017-controlling-communicable-disease-323
			Total	12	
5			B	1	<u>Examiner's Comments</u> Candidates realised that a vaccine would be more useful against a protein with a low mutation rate. However, very few appreciated that the vaccine would only work if the protein were on the outside of the bacterial cell. The correct answer was therefore B.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
6	a	i	contains (purified) <u>antigens</u> ✓ from (several) different strains ✓	1 max	Examiner's Comments In (a)(i) most candidates realised that the vaccine contains antigens although it was often stated as attached to the pathogen, not the idea of purified antigens. Some candidates confused this with booster vaccines. Few candidates appreciated that this was antigens from different strains of bacteria.
		ii	vaccine does not contain any, bacterial genetic material / virulence factor ✓ vaccine does not contain bacteria that could replicate ✓	1	IGNORE ref to viruses ALLOW DNA / nucleic acid / nucleus DO NOT ALLOW RNA Examiner's Comments Candidates struggled with (a)(ii). Most candidates stated that the pathogen could not cause disease but failed to elaborate on what that actually means. Candidates should realise that pathogens cause disease by being able to replicate and then release toxins/destroy cells.
		iii	(because) related strains of bacteria have, similar / same, antigens / glycoproteins / surface proteins ✓ antibodies (produced after vaccine), recognise / AW, antigens on (these) related strains of bacteria ✓	1	Examiner's Comments In responses to (a)(iii) , most candidates showed a good understanding of antigens being similar but often stated between meningococcal infections without stating bacteria. Candidates should appreciate that structural features, like antigens, should be discussed in the context of an organism not in the context of a possible consequence of that organism. Few candidates related antibodies to binding to the antigens, instead the secondary response was discussed in general terms only or antibodies were mentioned as being more effective, without reference to binding or recognition.

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
	b	Summary of instructions to markers: <i>Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.) Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.</i> <i>Then, award the higher or lower mark within the level, according to the Communication Statement (shown in italics):</i> ◦ award the higher mark where the Communication Statement has been met. ◦ award the lower mark where aspects of the Communication Statement have been missed. • <i>The science content determines the level.</i> • <i>The Communication Statement determines the mark within a level.</i> Level 3 (5—6 marks) A comprehensive evaluation of the importance of herd immunity in the control of epidemics, including risks and benefits of vaccination. A reasoned conclusion is drawn about the benefits to society and/or the individual resulting from herd immunity including ethical issues. <i>There is a well-developed line of reasoning which is clear and logically structured and uses scientific terminology at an appropriate level. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) A limited evaluation of the importance of herd immunity, with some reference to risks and/or benefits. An attempt is made to link ethical issues with the benefits of	6	Indicative scientific points may include: Epidemic is a sudden increase in incidence of infectious disease in an area. Herd immunity Successful vaccination programme requires large population to be immune. Can eradicate an infectious disease Reduces chances of pathogen being passed on, so reduces risk of epidemics. Requires 80 – 95% of population to be immune. Depends on how easily pathogen is spread. Reference to ring vaccination Vaccination risks Live-attenuated vaccines may revert and cause disease.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			herd immunity. <i>There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented in the most part relevant and supported by some evidence.</i> Level 1 (1–2 marks) A description of herd immunity and link to epidemics. Little or no mention of risks or ethical issues. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit.</i>		Possibility of allergic reaction / anaphylaxis / side effects May not be effective in all individuals due to genetic differences Reference to discredited study of MMR risks. Ethical issues Balance between individual's right to refuse consent and need to establish minimum immunity levels. Herd immunity protects those who cannot be immunised. Helps to eradicate a pathogen so it cannot spread to other countries where immunisation levels low due to socioeconomic reasons Helps to contain the spread so it doesn't reach those who cannot be immunised. Examiner's Comments was generally not well answered with many candidates failing to appreciate the relevance of herd immunity, not mentioning vaccination and just discussing immunity in general with many stating all the population being immune. The candidates that gave a clear description of an epidemic often achieved high marks as they related it well to protecting those un-vaccinated individuals and preventing the spread of a pathogen. Very few candidates discussed the risks of vaccination.
			Total	10	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
7		i	3 FROM <i>Idea that:</i> for HPV 16, no significant difference between the 2 dose and the 3 dose regime ✓ for HPV18, two-dose less effective than three-dose ✓ for both HPV16 and HPV18, both regimes produce similar antibody levels at 1 month / 3 years (3 dose) – equally effective ✓ comparison of median or range values in support of one of the above statements ✓ 1 FROM EITHER: top of range for HPV18 antibody levels at 3 years in two- dose schedule does not overlap with ranges in other datasets ✓ OR very large range for HPV18 antibody levels at 3 years in two-dose schedule ✓	4	Examiner's Comments (b)(i) was a demanding question with many candidates not understanding that each dosage regime was one experiment and that the number of antibodies was measured after one month and then after 3 years. The question asked candidates to compare the 2-dose regime with the 3-dose regime for both viral strains. It was common for candidates to focus on the differences in the data instead of explaining how similar most of the data was. Many candidates highlighted tiny differences in median antibody levels despite the extremely large and overlapping ranges. The only candidates to gain full marks were those who appreciated that the 2-dose regime after 3 years was the only data set that had a significantly different median antibody level to all other data because the range did not overlap with any other.
		ii	first exposure no <u>memory</u> B cells prior to first dose ✓ <i>idea that:</i> it takes time for clonal selection / clonal expansion / small number of plasma cells to produce antibodies ✓ second / third exposure memory cells stimulated to divide rapidly / clonal selection faster / clonal expansion faster ✓ memory cells <u>differentiate</u> into (many) <u>plasma</u> cells ✓ <u>plasma</u> cells produce antibodies faster and in greater numbers ✓	max 3	ALLOW small number of B cells produce antibodies Examiner's Comments (b)(ii) was a stretch and challenge question and the marks reflected this. Many candidates were clearly familiar with the primary and secondary immune response but relatively few could explain this in good biological detail. Few candidates mentioned the lack of memory cells prior to the first dose or the idea that clonal selection / expansion took time. Similarly, after the second exposure many candidates failed to mention memory cells differentiating and the subsequent plasma cells producing antibodies. Overall, answers were too generalised to gain marks.
			Total	7	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
8			C ✓	1	Examiner's Comments Less than half of all candidates were correctly able to identify the target of bacteriostatic antibiotics, the most common error being option A – the cell wall.
			Total	1	
9			C ✓	1	
			Total	1	

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
10	a	<i>* Please refer to the marking instruction point 10 for guidance on how to mark this question.</i> <i>In summary:</i> <i>Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)</i> <i>Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.</i> <i>Then, award the higher or lower mark within the level, according to the Communication Statement (shown in italics):</i> • <i>award the higher mark where the Communication Statement has been met.</i> • <i>award the middle mark where aspects of the Communication Statement have been missed</i> • <i>award the lower mark where the Communication Statement has not been met.</i> • <i>The science content determines the level.</i> • <i>The Communication Statement determines the mark within a level.</i> Level 3 (7–9 marks) Details of apparatus and a method to produce bacterial colonies are provided. A thorough risk assessment is written which includes most of the high risk hazards and suitable control methods. The importance of aseptic technique is evident and most examples are given. <i>There is a well-developed line of reasoning which is clear and logically structured and uses scientific terminology at an appropriate level. All the information presented is relevant and forms a</i>	9	Indicative scientific points may include: Equipment correctly identified with a reason • container / named container (e.g. Petri dish, flask, bottle, flat) because sterile / easily sterilised / lidded • culture medium because provides food / nutrients / water IGNORE moist • incubator because gives controlled optimum temperature • inoculating loop because allows for, accurate transfer / transfer of a small number / one colony, of bacteria • spreader because enables bacteria to be dispersed across / through medium • nutrient agar plates / broth because supplies the nutrients for bacterial growth ALLOW references to different nutrient agars Aseptic technique • flaming of flask / bottle neck • flaming of inoculation loop / spreader • keeping lids on culture dishes / flasks (when not in use) • keeping Petri dishes upside down • work next to Bunsen flame to carry away contaminating bacteria in convection current / rising hot air OR to stop bacteria in air from falling onto / contaminating plates Method • detail of removal of fluid from bottle and transfer to nutrient plate / broth • detail of streak plating after initial culture • incubation of sample / kept at constant optimum temperature • detail of selecting bacteria with differing colony morphology to separate bacterial species

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			<i>continuous narrative.</i> Level 2 (4–6 marks) The apparatus and a method to produce bacterial colonies are provided although some details may be missing. There is an outline risk assessment including some control measures. Aseptic technique is evident and some examples are given. <i>There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented is mostly relevant.</i> Level 1 (1–3 marks) The apparatus and an outline method are suggested which will allow for bacterial culture. A risk assessment is present but incomplete. Information about aseptic technique is limited. <i>There is a logical structure to the answer. The explanation, though basic, is clear.</i> 0 marks No response or no response worthy of credit.		Hazards identified with an appropriate control measure • (zoonotic) bacteria (on surfaces / from fluid touched by hands – wear gloves • (zoonotic) bacteria (on surfaces / from fluid transferred to clothes – wear a lab coat / remove lab coat before exiting lab • flammable liquids / ethanol used (e.g. in irrigating during Gram staining / flaming) – ensure bottles / flasks kept away from ignition sources / Bunsen burner / flame • 100% ethanol used risks intoxication – use at arm's length / use in a well-ventilated space
	b	i	bacteria very small / too small to be seen with low power lens	1	ALLOW because the bacteria are only 5 μm wide / shape of individual bacterium cannot be seen with LP IGNORE bacteria are small / bacteria can't be seen with a low power, lens / microscope
		ii	cells have thin(ner) (peptidoglycan) cell walls	1	
	c	i	Bacteria do not have a nucleus / nuclear membrane	1	ALLOW bacteria only have a single / one chromosome (plus plasmids)
		ii	$\times 3000$ (1) (1)	2	ALLOW one mark for correct working [15 mm $\times$ 1000] / 5 μm

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	d		D is largest clear zone (diameter) indicates more bacteria killed is not selected because this antibiotic is used as a last resort / with resistant strains (so) A is selected as next largest clear zone (diameter) / next largest number of bacteria killed, and inhibits protein synthesis / prevents bacteria, dividing / reproducing, without risk of selecting antibiotic resistant strains	2	Candidates may describe A being tried and, if found not to work, vet has another antibiotic to choose. ALLOW if correct ref is also given to mode of action (second mark point only)
			Total	16	
11		i	Any 2 from: (Gram negative bacteria have) outer, membrane / lipopolysaccharide layer <i>idea that</i> this is impermeable to penicillin <i>idea that</i> penicillin cannot reach, murein / peptidoglycan layer	2	
		ii	animal cells do not have a cell wall AND cell wall in plants is, cellulose / not peptidoglycan	1	Both needed for one mark
			Total	3	