Past-paper walk-through

Antibiotics ▪ 10.2

eXercise

Questions in this set

- 9700/11 N25 Q38 ▪ 1 mark
- 9700/14 N25 Q37 ▪ 1 mark
- 9700/22 N25 Q4 ▪ 7 marks
- 9700/23 N25 Q5 ▪ 4 marks

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

Question 38

9700/11 N25 ▪ Q38 ▪ 1 mark

38 How does penicillin affect bacteria?

A It inhibits DNA replication by binding to nucleotides.

B It inhibits translation by preventing tRNA binding to ribosomes.

C It is a competitive inhibitor of an enzyme in cell wall synthesis.

D It is a competitive inhibitor of an enzyme in protein synthesis.

Solution 38

Answer: **C**

Why

- Penicillin blocks an enzyme needed to cross-link the peptidoglycan cell wall.
- The weakened wall cannot resist the osmotic pressure, so the bacterium bursts.
- Human cells have no cell wall, which is why the antibiotic is selective.

Question 37

9700/14 N25 ▪ Q37 ▪ 1 mark

37 Scientists investigated the sensitivity and resistance of a bacterium called *Clostridium difficile* to four antibiotics. Colonies of bacteria were grown on agar plates for 24 hours, after which a different antibiotic was added to each plate. The number of bacterial colonies that died, stopped growing and continued growing were then counted. A bacterial colony is a group of bacterial cells that have multiplied from one bacterium.

Which antibiotic would be the best to treat a person infected with *Clostridium difficile*?

	antibiotic	number of colonies that died	number of colonies that stopped growing	number of colonies that continued growing
A	ampicillin	2	5	13
B	clindamycin	4	8	6
C	metronidazole	13	6	1

Question 37

D	cefoxitin	9	5	4

Solution 37

Answer: **C**

Why

- Compare how many colonies survived each antibiotic.
- Many surviving colonies means the bacterium is resistant to that antibiotic.
- Few or none surviving means it is sensitive, so that antibiotic would be the effective treatment.

Question 4

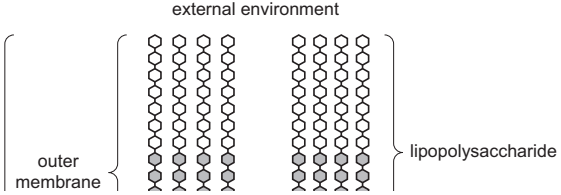
9700/22 N25 ▪ Q4 ▪ 7 marks

4 Bacteria can be classified according to the type of cell wall they have.

Gram-negative bacteria have a cell wall with an outer layer known as the outer membrane.

Gram-positive bacteria do not have an outer membrane, but have a much thicker peptidoglycan layer than Gram-negative bacteria.

Fig. 4.1 is a diagram of a section through the cell wall of a **Gram-negative** bacterium.



Question 4

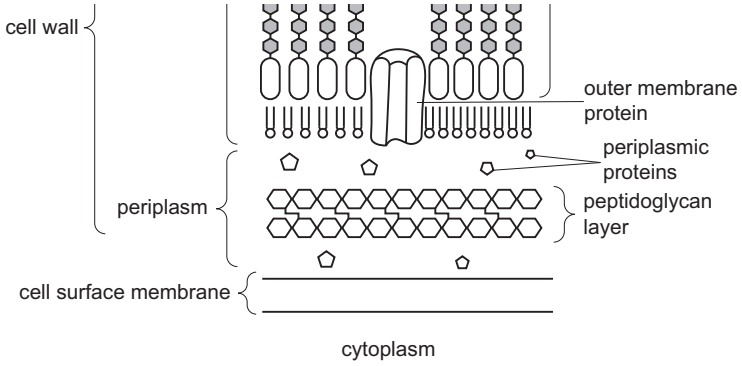


Fig. 4.1

(a) With reference to Fig. 4.1, outline the similarities **and** differences between the outer membrane of a Gram-negative bacterial cell and the cell surface membrane of a **eukaryotic** cell.

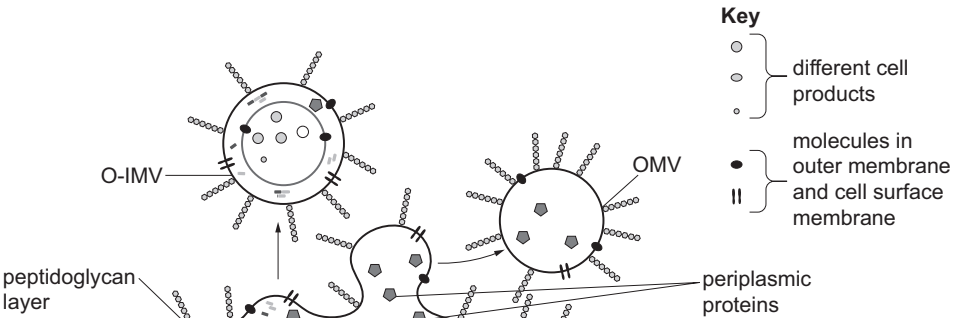
Question 4

of a Gram-negative bacterial cell and the cell surface membrane of a **eukaryotic** cell.

Question 4

(b) Pathogenic and non-pathogenic Gram-negative bacteria can produce extracellular vesicles. Fig. 4.2 summarises how two types of extracellular vesicle, OMVs and O-IMVs, are formed.

O-IMVs are formed from the outer membrane and the cell surface membrane. O-IMVs can contain ATP and DNA.



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Question 4

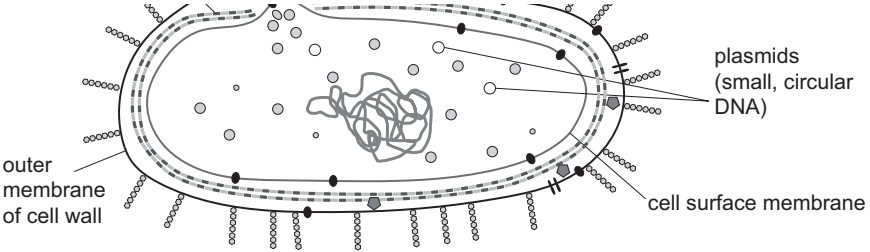

Fig. 4.2

(i) With reference to Fig. 4.2, suggest why fewer O-IMVs are formed than OMVs.

Question 4

(ii) Suggest why ATP is found within O-IMVs but **not** in OMVs.

Question 4

(iii) Suggest **and** explain why the discovery that O-IMVs contain DNA has implications for antibiotic resistance.

Question 4

[Total: 71

Solution 4

(a) Mark scheme

- any three from:
- max 2 for similarities, max 2 for differences
- similarities, both have
- phospholipids ;
- channel / transport, protein ; A intrinsic / integral / transmembrane, protein
- R carrier / pump, protein
- a bilayer / two layers ;
- differences

Solution 4

- do not need to have ‘outer membrane’ ‘bacterial’ if context is clear
- (bacterial outer membrane) has lipopolysaccharides ; ora
- (cell surface membrane / eukaryote) has, phospholipid bilayer / both layers with phospholipids ; ora
- if ora also given (bacterial) only has outer layer of (outer) membrane with phospholipids, can also award mp1
- AVP ;; e.g. cell surface membrane has, glycocalyx / glycolipids / glycoproteins
- cell surface membrane has cholesterol
- outer membrane does not have extrinsic proteins
- 3

Solution 4

(b)(i) Mark scheme

- any one from:
- formation of O-IMV
- involves a more complex process ; e.g. greater variety of, contents / cell structures
- R organelles
- ref. to needing to make a vesicle with two 'membranes' / AW A 'layers'
- peptidoglycan, chains / layer / bonds, need to be broken ; A peptidoglycan wall needs to be broken
- causes, (temporary) weakness in cell wall / risk of lysis ;

Solution 4

- idea that more resources required to form vesicle or too great a loss of important cell, components / structures
- ref. to take more time to produce ;
- uses (more) energy to, break wall / repair wall / make the vesicle ;I ref. to organelles
- AVP ; e.g. suggestion that periplasmic proteins need to be released in greater numbers so more OMVs formed
- 1

Solution 4

(b)(ii) Mark scheme

- any one suggestion that:
- must be in context of a fully formed O-IMV
- function of O-IMVs require, energy / ATP ;
- A suggested function e.g. DNA transcription / metabolic reactions / for active transport I cell processes
- O-IMV (formation) has cytoplasm, which contains ATP ;
- OMVs formed only from periplasm, which has no ATP ; A no ATP in outer membrane space

Solution 4

- AVP ; e.g. no / few, ATP transporters / transport proteins, for exit of ATP into periplasm (in area where OMV forms)
- 1
- 9700/22
- October/November 2025

Solution 4

(b)(iii) Mark scheme

- ref. to DNA in O-IMVs being passed on to other bacteria ; e.g. O-IMVs may, fuse with / be taken up by / AW,
- plasmids / DNA, in (degraded) O-IMVs may enter other bacteria
- qualified ref. to O-IMV DNA and antibiotic resistance ; e.g.
- O-IMVs have, alleles / genes / plasmid, that, give / confer / AW, antibiotic resistance
- DNA may mutate to give (a, gene / allele, for) antibiotic resistance
- DNA, codes for / expresses / AW, a protein involved in antibiotic resistance

Solution 4

- example of gene conferring resistance e.g. enzyme to breakdown antibiotic
- change to ribosome structure (to prevent antibiotic attachment)
- efflux pump for / membrane protein to pump out, antibiotic
- 2
- 9700/22
- October/November 2025

Question 5

9700/23 N25 ▪ Q5 ▪ 4 marks

5 Inhibitors are substances that prevent biological processes in a variety of different ways.

Table 5.1 shows some antibiotics, their modes of action and the diseases which they are used to treat.

Table 5.1

antibiotic	mode of action	disease
erythromycin	binds to ribosomes to inhibit translation	cholera
penicillin	enzyme inhibitor	tetanus
rifampicin	inhibits the function of RNA polymerase in transcription	tuberculosis

(a) Suggest why erythromycin can inhibit translation in the bacterium that causes cholera **and not** inhibit translation in humans who are infected with this pathogen.

Question 5

and not inhibit translation in humans who are infected with this pathogen.

Question 5

(b) State why penicillin does **not** act on human cells.

Question 5

(c) Explain **one** way in which rifampicin may inhibit the action of RNA polymerase in transcription.

Question 5

[Total: 4]

Solution 5

(a) Mark scheme

- any two from:
- 1
- bacteria, have 70S ribosomes and humans have 80S ribosomes / only have 70S ribosomes ;
- 2
- antibiotic, cannot bind to 80S / human ribosomes
- or
- can only bind to 70S / bacterial ribosomes ;

Solution 5

- 3
- antibiotic, binding site / target site, not present on 80S ribosomes / only present on 70S ribosomes ;
- A ref. to complementary / specfic – alternative to second part of the MP
- 4
- antibiotic cannot enter mitochondria to reach 70S ribosomes (in humans) ;
- 5
- AVP ; different combinations of proteins in ribosomes / different rRNAs in ribosomes
- 2

Solution 5

(b) Mark scheme

- any one from:
- 1
- penicillin acts on cell walls and human cells have no, peptidoglycans / cell walls / enzyme(s) that make cell walls;
- A murein
- penicillin
- 2

Solution 5

- prevents formation of peptide / cross, bridges / linkages, (between peptidoglycans) in (bacterial) cell wall ;
- 3
- prevents repair of, gaps / holes / AW, in (bacterial) cell walls caused by autolysins ;
- I ref. to penicillinase
- 1

Solution 5

(c) Mark scheme

- any one from:
- rifampicin
- 1
- blocks / fits into / binds to / competes for, the active site of, RNA polymerase / enzyme ;
- 2
- binds, to allosteric site / site away from active site, to, change shape of active site / prevent it forming phosphodiester

Solution 5

- bonds ;
- 3
- attaches to DNA template blocking RNA polymerase moving along it ;
- 4
- can be incorporated into RNA but no nucleotide can be added to it ;
- 5
- AVP ; e.g. attaches to the promoter to stop RNA polymerase, binding to DNA / moving along DNA / AW
- 1
- 9700/23

Solution 5

- October/November 2025