Week 27

A-Level Biology

Homework bundle for this week

本周作业合集

exercises.lol

Contents 目录

A-Level Biology Name: _____ Score: _____

1. A pathogen is:

   ☐ an organism that lives in or on a host and causes disease

   ☐ a type of white blood cell

   ☐ a medicine that kills bacteria

   ☐ a vaccine

2. Which helps control the spread of an infectious disease?

   ☐ vaccination

   ☐ eating more sugar

   ☐ ignoring symptoms

   ☐ sharing needles

3. Penicillin kills bacteria by:

   ☐ stopping them building their cell walls, so they take in water and burst

   ☐ breaking down their DNA

   ☐ blocking their ribosomes

   ☐ dissolving their membranes with heat

4. An organism that carries a pathogen from one host to another — like the mosquito for malaria — is a _____.

   _____

5. The most important way to prevent cholera is to:

   ☐ provide clean water and proper sewage treatment

   ☐ sleep under mosquito nets

   ☐ use condoms

   ☐ take a long antibiotic course

6. Why do antibiotics not work against viruses?

   ☐ a virus has no cell wall or reactions of its own to target

   ☐ viruses are too large

   ☐ viruses have thicker cell walls

   ☐ viruses are not alive at all, so nothing affects them

7. Cholera is caused by a bacterium and spreads through water or food contaminated with faeces.

   ☐ True ☐ False

8. Malaria is controlled by attacking the mosquito _____ — with nets, insecticides and by draining breeding pools.

   _____

9. There is currently no cure or vaccine for HIV, so prevention (condoms, clean needles) matters most.

   ☐ True ☐ False

10. Antibiotic resistance spreads by natural _____ — resistant bacteria survive and reproduce.

    _____

10. Infectious diseases

Answers · 答案

A-Level Biology

1. **an organism that lives in or on a host and causes disease**

   A pathogen causes an infectious (transmissible) disease — e.g. a bacterium, virus or protoctist.

2. **vaccination**

   Vaccination, hygiene and quarantine all reduce the spread of disease.

3. **stopping them building their cell walls, so they take in water and burst**

   Penicillin prevents cell-wall synthesis; the growing cell cannot hold the water it absorbs, so it bursts.

4. **vector**

   The mosquito is the vector that transmits the Plasmodium protoctist when it bites.

5. **provide clean water and proper sewage treatment**

   Cholera spreads via faeces-contaminated water, so clean water and good sanitation are key.

6. **a virus has no cell wall or reactions of its own to target**

   Antibiotics target bacterial structures/processes; a virus has none of these, using the host cell instead.

7. **True**

   Cholera (Vibrio cholerae) spreads via contaminated water/food — so clean water and sanitation prevent it.

8. **vector**

   The mosquito is the vector; stop it biting (nets) or breeding (drain still water) and you stop malaria spreading.

9. **True**

   HIV has no cure or vaccine yet; prevention and drugs that slow the virus are the main tools.

10. **selection**

    The antibiotic is the selection pressure; only resistant bacteria survive to pass on their genes.

A-LEVEL BIOLOGY • EXERCISE SHEET

10.1 Infectious diseases

Name: _____ Class: _____ Date: _____ **Total: 27 marks**

KEY WORDS pathogen 病原体 • infectious disease 传染病 • cholera 霍乱 • tuberculosis 结核病 • malaria 疟疾

Objective

Build the skills to answer exam questions on **infectious diseases** — the **pathogens** 病原体 that cause cholera, malaria, TB and HIV, how they are transmitted, and how they are controlled.

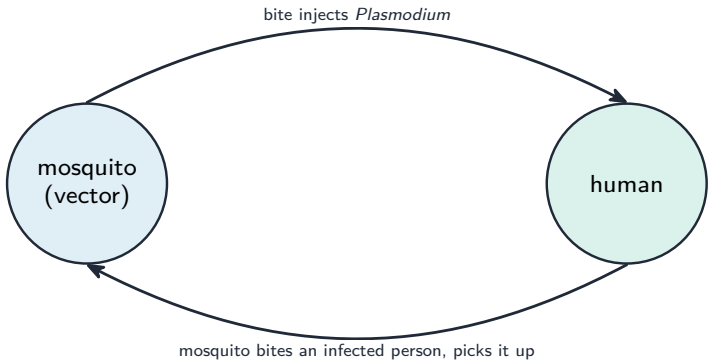
You must be able to:

- name the pathogen and type for cholera, malaria, TB and HIV/AIDS
- explain how each disease is transmitted
- discuss biological, social and economic factors in prevention and control

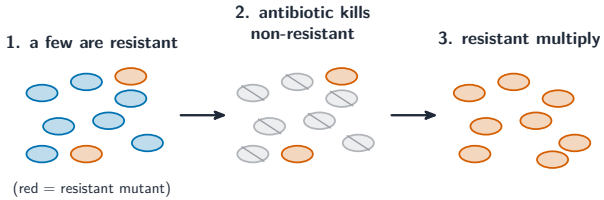
1 Worked examples

The four diseases

disease	pathogen (type)	transmission
cholera 霍乱	*Vibrio cholerae* (**bacterium** 细菌)	water/food contaminated with faeces
malaria 疟疾	*Plasmodium* (**protoctist** 原生生物)	bite of an infected mosquito (**vector** 媒介); infected blood
TB 结核病	*Mycobacterium* (bacterium)	airborne **droplets** 飞沫 from coughs/sneezes
HIV/AIDS	HIV (**virus** 病毒)	unprotected sex; infected blood; mother to baby



Malaria needs a mosquito vector — which is why control targets the mosquito



Antibiotic resistance complicates treating infectious disease

Prevention and control

Control has **biological**, **social** and **economic** sides. Examples: cholera — clean water and sewage treatment; malaria — nets, drain still water, insecticides, drugs; TB — find and treat with antibiotics, BCG vaccine, reduce crowding; HIV — condoms, clean needles, test blood, education (no cure/vaccine yet).

2 Practice

2.1 Name the type of pathogen that causes (a) malaria and (b) HIV/AIDS. [2]

2.2 State how tuberculosis is transmitted from person to person. [1]

3 Exam-style questions

3.1 Which disease is caused by a protoctist and spread by a vector? [1]

- **A** cholera
- **B** HIV/AIDS
- **C** malaria
- **D** tuberculosis

3.2 Cholera is best prevented by: [1]

- **A** sleeping under a mosquito net
- **B** providing clean water and treating sewage
- **C** using condoms
- **D** taking a long course of antibiotics

3.3 (a) Explain why providing clean drinking water reduces the spread of cholera. [2]

(b) Discuss **one** social and **one** economic factor that make malaria hard to control in some countries. [2]

3.4 A region recorded 4000 malaria cases in 2015. After a mosquito-net programme, this fell to 1500 cases in 2020.

(a) Calculate the percentage decrease in cases. [2]

(b) Explain why targeting the mosquito reduces malaria. [2]

3.5 The table gives information about four infectious diseases.

Disease	Pathogen	Type of pathogen	Main method of transmission
Cholera	*Vibrio cholerae*		
Malaria		protoctist	
Tuberculosis	*Mycobacterium tuberculosis*		
HIV/AIDS		virus	

(a) Complete the table. [6]

(b) Explain why cholera is common where there is flooding or a breakdown of sanitation. [3]

(c) Explain why the malarial parasite is difficult to control by vaccination. [2]

(d) Tuberculosis is treated with a combination of antibiotics taken for at least six months. Explain why the course is so long and why more than one antibiotic is used. [3]

Solutions

2.1 (a) a protoctist (*Plasmodium*); (b) a virus (HIV).

2.2 by airborne droplets from coughing/sneezing.

3.1 C. Malaria is caused by the protoctist *Plasmodium* and spread by the mosquito vector.

3.2 B. Cholera spreads via faeces-contaminated water, so clean water and sewage treatment prevent it.

3.3 (a) the cholera bacterium spreads in water contaminated with faeces; clean water removes this route of transmission.
(b) social, e.g. people may not use nets / lack of education; economic, e.g. cost of nets, drugs or insecticides is too high.

3.4 (a) decrease $= 4000 - 1500 = 2500$; percentage $= \frac{2500}{4000} \times 100 = 62.5\%$.
(b) the mosquito is the vector that transmits *Plasmodium*; killing mosquitoes / stopping bites breaks the transmission cycle.

3.5 (a) Cholera — bacterium; spread in water or food contaminated with faeces. Malaria — *Plasmodium*; spread by the bite of an infected female *Anopheles* mosquito, the vector. Tuberculosis — bacterium; airborne droplets from coughing and sneezing. HIV — human immunodeficiency virus; in body fluids, i.e. unprotected sex, shared needles, infected blood, or mother to child.
(b) Flooding mixes sewage with drinking water; the bacterium is transmitted by the faecal–oral route, so it spreads directly to anyone drinking or washing food in that water; crowded temporary shelters with no clean water or sanitation let one case infect many.
(c) *Plasmodium* has several stages in the human host, each with different surface antigens, so an antibody against one stage does not recognise the others; its antigens also vary between and within strains, so no single vaccine gives lasting immunity.
(d) The bacterium grows very slowly and can survive inside macrophages, so it takes months of treatment to kill every cell; if the course is stopped early the survivors — the most resistant — multiply; using several antibiotics at once makes it very unlikely that any one bacterium is resistant to all of them.

5 Which statement about viruses is correct?

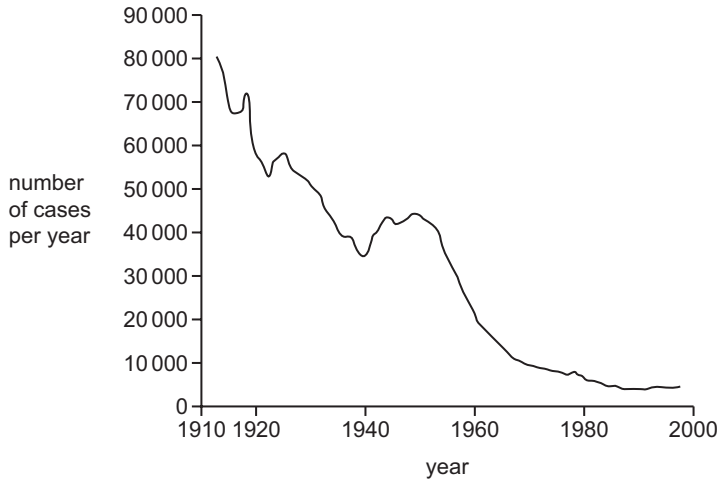
A They are cells with a capsid made of phospholipids.

B They are cells with a capsid made of protein.

C They are particles with a capsid made of phospholipids.

D They are particles with a capsid made of protein.

36 The graph shows the decrease in cases of tuberculosis (TB) in a country between 1910 and 2000.



Which factors could have contributed to the fall over this period?

1 pasteurisation of milk

2 the provision of new housing to reduce overcrowding

3 removing large pools of stagnant water

4 identification of contacts of people infected with TB

A 1, 2 and 4 **B** 1 and 3 **C** 1 and 4 only **D** 2, 3 and 4

37 The pathogens for some diseases are transmitted by vectors.

Which disease is transmitted with the help of a vector that could be controlled by the removal of pools of water?

A cholera

B HIV/AIDS

C malaria

D tuberculosis

38 Which factors affect the global pattern of distribution of malaria?

1 the disease is mainly restricted to tropical and subtropical environments

2 the effective vaccine has eradicated the disease in many countries

3 the vector required for transmission of malaria parasites

	1	2	3
A	✓	✓	✗
B	✓	✓	✓
C	✓	✗	✓
D	✗	✓	✓

key

✓ = effect

✗ = **not** an effect

36 Which row correctly identifies the pathogens causing malaria and TB?

	malaria	TB
A	protoctist	virus
B	protoctist	bacterium
C	prokaryote	bacterium
D	prokaryote	virus

37 What could be used to help prevent an outbreak of cholera in a town?

A treatment of sewage waste

B spraying still water with insecticides to kill mosquito larvae

C increased use of antiviral medicine

D preventing the reuse of hypodermic needles

36 Infectious diseases may be caused by bacteria, protoctists and viruses. Different pathogens may be transmitted by airborne droplets, from faeces to mouth (faecal-oral), by sexual intercourse and by vectors.

Four examples of infectious diseases are listed.

1 cholera

2 HIV/AIDS

3 malaria

4 tuberculosis

Which table classifies the four diseases correctly to show the type of pathogen that causes the disease and the mode of transmission?

A

	bacterium	protoctist	virus
droplet			2
faecal-oral	1		
sexual		3	
vector			4

B

	bacterium	protoctist	virus
droplet		2	
faecal-oral	1		
sexual			3
vector		4	

C

	bacterium	protoctist	virus
droplet	4		
faecal-oral	1		
sexual			2
vector		3	

D

	bacterium	protoctist	virus
droplet	3		
faecal-oral		2	
sexual	1		
vector			4

2 Cholera is an infectious intestinal disease caused by a bacterial pathogen.

(a) Name the species of bacterium that causes cholera.

..... [1]

(b) The World Health Organization (WHO) recommends a number of different approaches for the prevention and control of cholera. Two of these are:

- Authorities should provide access to safe drinking water.
- Individuals and communities should practise preventive personal hygiene.

Suggest **and** explain how these two approaches help in the prevention and control of cholera.

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..... [4]

(c) Mass vaccination using an oral cholera vaccine (OCV) can be carried out in situations where there is a high risk of people developing the disease.

Passive immunisation involves transferring antibodies into a person for the prevention or treatment of an infectious disease. Some of the infectious diseases for which passive immunisation is available use monoclonal antibody. Passive immunisation for cholera using monoclonal antibody could be available in the future.

(i) Complete Table 2.1 to compare an OCV and passive immunisation for cholera:

- fill in the empty box in **row 1**
- circle the correct answers from the choices given in **rows 3**, **4** and **5**.

Table 2.1

row	feature	oral cholera vaccine	passive immunisation for cholera
1	component causing the desired response		antibody
2	type of immunity gained	artificial active	artificial passive
3	stimulates production of memory lymphocytes	yes / no	yes / no
4	length of time needed to have an effect	shorter same longer	longer same shorter
5	duration of immunity	shorter same longer	longer same shorter

[4]

(ii) The production of monoclonal antibodies for treatment involves the formation of hybridoma cells from two different cell types.

Name the **two** types of cell that fuse to form a hybridoma cell **and** explain why this fusion is necessary.

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..... [3]

[Total: 12]

2 Cholera, malaria and tuberculosis (TB) are infectious diseases caused by unicellular organisms.

(a) For each of the diseases listed, state whether the disease is caused by a eukaryotic or prokaryotic organism.

cholera .....

malaria .....

TB .....

[1]

(b) State the term given to an organism that causes diseases such as cholera, malaria and TB.

..... [1]

(c) Malaria is caused by species from the genus *Plasmodium*.

Ring cells are one stage in the complex life cycle of *Plasmodium* that are found within red blood cells. Fig. 2.1 is a scanning electron micrograph showing two ring cells, surrounded by the membrane of a red blood cell, which has just lysed (burst).

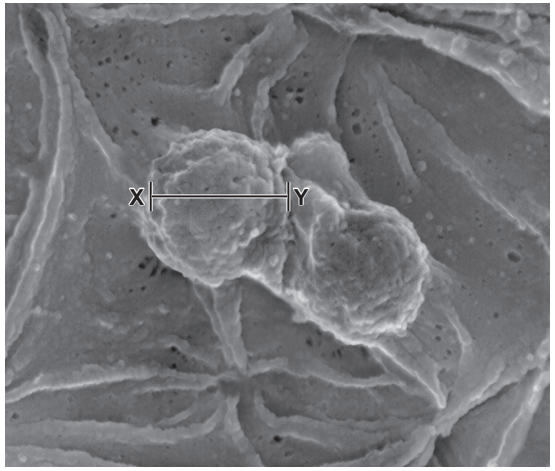

Fig. 2.1

(i) The actual diameter of the ring cell along the length **X–Y** is 2 μm.

Calculate the magnification of the image shown in Fig. 2.1.

Give your answer to 3 significant figures.

magnification = × ..... [2]

(ii) Describe how *Plasmodium* is transmitted from a person with malaria into the blood stream of an uninfected person.

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..... [3]

(d) In a person with malaria, phagocytes destroy infected red blood cells. The phagocytes respond to the presence of particular molecules in the outer phospholipid bilayer of the cell surface membrane.

The cell surface membrane of a healthy, uninfected red blood cell shows an uneven distribution of types of phospholipid making up the bilayer (membrane asymmetry). For example, most of the phospholipid phosphatidylserine (PS) is located in the inner layer, facing the cytoplasm.

(i) After a red blood cell is infected, a much higher proportion of PS is found in the outer layer of the cell surface membrane, facing blood plasma.

Suggest how the presence of PS in the outer layer can cause a response in a phagocytic cell.

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..... [2]

(ii) Suggest why some **uninfected** red blood cells in a person with malaria can also be destroyed by phagocytic cells.

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..... [1]

(e) Research has shown that *Plasmodium* uses cholesterol from the cell surface membrane of the red blood cell it has infected.

(i) Suggest why cholesterol is needed by *Plasmodium*.

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..... [1]

(ii) The use of cholesterol by *Plasmodium* causes a decrease in the quantity of cholesterol in the cell surface membrane of the red blood cell.

Outline how a decrease in cholesterol could affect the cell surface membrane of the red blood cell.

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..... [2]

(f) To achieve membrane asymmetry, which is an essential feature of a healthy cell, the red blood cell needs a supply of ATP and must maintain a very low concentration of calcium ions (Ca^{2+}) within the cytoplasm.

Table 2.1 shows details of three membrane enzymes that are involved in the movement of phospholipids between the inner and outer layers.

Table 2.1

key
PS = phosphatidylserine
PE = phosphatidylethanolamine
PC = phosphatidylcholine
} type of phospholipid

enzyme	enzyme action
flippase	hydrolyses ATP and moves PS and PE from the outer to the inner layer
floppase	hydrolyses ATP and moves PC from the inner to the outer layer
scramblase	after binding Ca^{2+}, randomly moves PS, PE and PC between layers

A healthy red blood cell has most PS and PE located in the inner layer and most PC located in the outer layer.

(i) Phospholipids can occasionally move between layers without the action of an enzyme, so the continued activity of flippase and floppase is needed.

With reference to Table 2.1, explain why the action of the enzymes flippase and floppase involves the hydrolysis of ATP.

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.....

..... [1]

(ii) Blood plasma has a higher concentration of Ca^{2+} than the cytoplasm of red blood cells.

Suggest **one** way in which a red blood cell can have a very low concentration of Ca^{2+} when blood plasma has a higher concentration of Ca^{2+}.

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..... [1]

(iii) The concentration of Ca^{2+} within the red blood cell increases when the cell is infected with the malarial parasite. This leads to the loss of membrane asymmetry.

With reference to Table 2.1, suggest **and** explain how membrane asymmetry is lost when the concentration of Ca^{2+} within the red blood cell increases.

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..... [3]

[Total: 18]

A-LEVEL BIOLOGY • EXERCISE SHEET

10.2 Antibiotics

Name: _____ Class: _____ Date: _____ **Total: 14 marks**

KEY WORDS resistance 耐药性 • penicillin 青霉素 • antibiotic resistance 抗生素耐药性 • antibiotic 抗生素 • cell wall 细胞壁

Objective

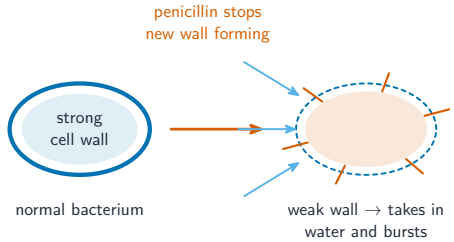
Build the skills to answer exam questions on **antibiotics** — how **penicillin** 青霉素 acts, why antibiotics do not affect viruses, and **antibiotic resistance** 抗生素耐药性.

You must be able to:

- outline how penicillin acts on bacteria and why antibiotics do not affect viruses
- explain how antibiotic resistance arises and spreads
- state steps to reduce the impact of resistance

1 Worked examples

How penicillin works

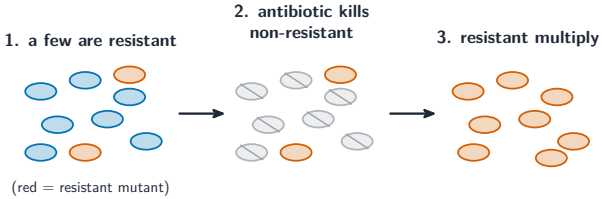


Penicillin stops new cell wall forming, so the bacterium takes in water and bursts

Penicillin stops bacteria building their **cell walls** 细胞壁. As the bacterium grows, its weak wall cannot hold it, so water enters by osmosis and the cell bursts.

Antibiotics do **not** work on **viruses** 病毒: a virus has no cell wall and no reactions of its own to attack — it uses the host cell's machinery, so there is no antibiotic target.

Antibiotic resistance



Resistance spreads by natural selection: the antibiotic kills the rest, so resistant survivors take over

A chance **mutation** 突变 can make a bacterium **resistant**. When the antibiotic is used, non-resistant bacteria die but resistant ones survive and multiply, so resistance spreads. **Steps to slow it:** use antibiotics only when needed (not for colds), finish the full course, use the correct antibiotic, and reduce use in farming.

2 Practice

2.1 Explain why penicillin causes a growing bacterium to burst. [2]

2.2 State **two** steps that help slow the spread of antibiotic resistance. [2]

3 Exam-style questions

3.1 Why do antibiotics **not** kill viruses? [1]

- **A** viruses are too small
- **B** viruses have no cell wall or metabolism of their own to target
- **C** viruses live outside cells
- **D** viruses reproduce too quickly

3.2 Antibiotic resistance spreads in a bacterial population because: [1]

- **A** the antibiotic causes the mutations
- **B** resistant bacteria survive treatment and reproduce
- **C** all bacteria become resistant at once
- **D** antibiotics make bacteria grow faster

3.3 Explain, using the idea of natural selection, how a population of bacteria can become resistant to an antibiotic. [4]

3.4 In a sample of 800 bacteria, 12 survived treatment with an antibiotic.

(a) Calculate the percentage of bacteria that were resistant. [2]

(b) Explain why finishing the full course of an antibiotic helps prevent resistance. [2]

Solutions

2.1 penicillin prevents the bacterium making/repairing its cell wall; so as it grows, water enters by osmosis and the weak wall lets the cell burst.

2.2 any two: only use antibiotics when needed; finish the full course; use the correct antibiotic; reduce use in farming.

3.1 B. Viruses have no cell wall or metabolism of their own, so there is no antibiotic target.

3.2 B. Resistant bacteria survive treatment and reproduce, passing on the resistance.

3.3 there is variation in the population — a chance mutation makes some bacteria resistant; when the antibiotic is used, the non-resistant bacteria die; the resistant ones survive and reproduce; so the proportion of resistant bacteria increases over generations.

3.4 (a) $\frac{12}{800} \times 100 = 1.5\%$.
(b) finishing the course kills all the bacteria, including any that are slightly less susceptible, so none survive to reproduce and spread resistance.

Name:

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.

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
D	cefoxitin	9	5	4

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.

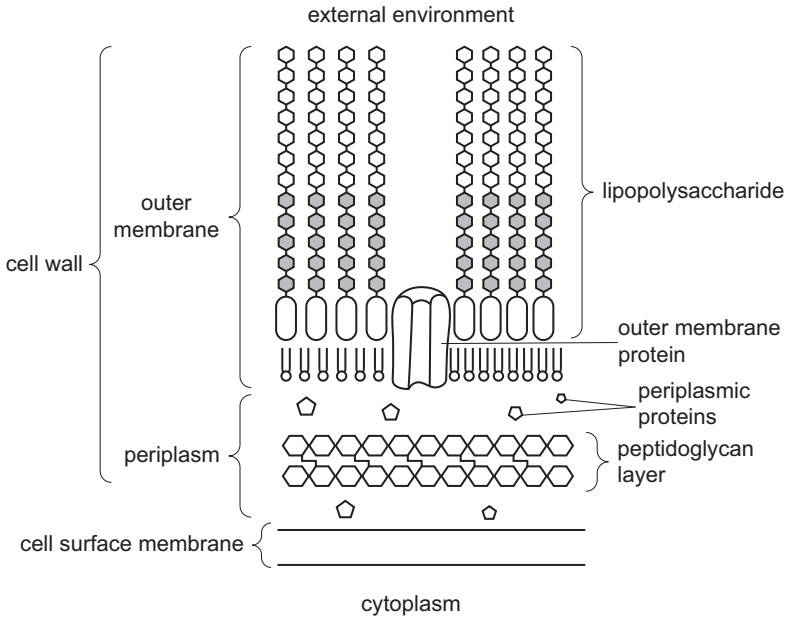


Fig. 4.1

(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.

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..... [3]

(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.

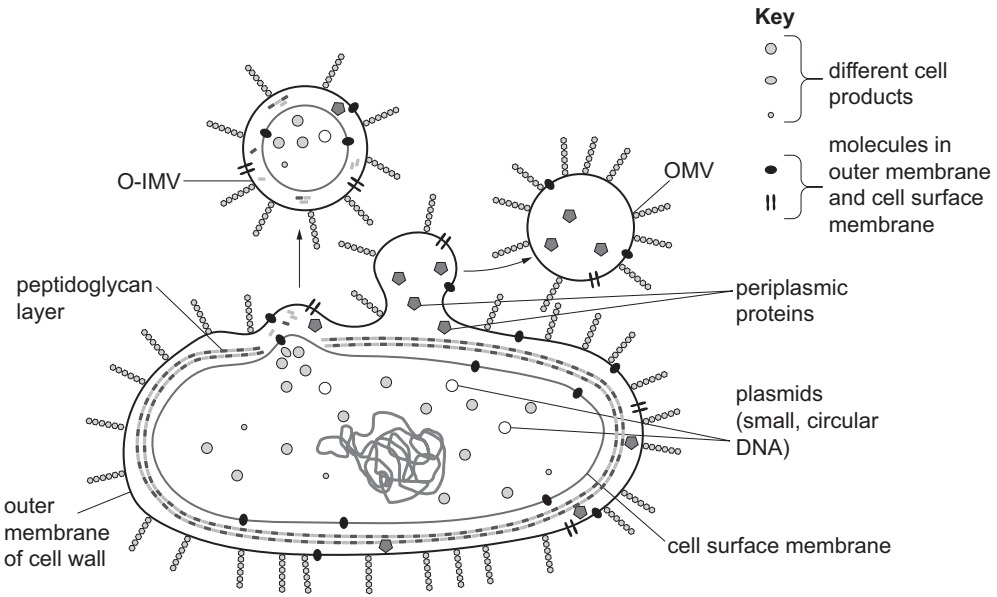

Fig. 4.2

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

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..... [1]

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

.....

..... [1]

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

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..... [2]

[Total: 7]

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.

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..... [2]

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

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..... [1]

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

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.....

..... [1]

[Total: 4]