Infection and response biology Revision materials

Content will be tested on Biology Paper 1

Checklist

Keypoints:	☺	☹
Infection & response		
Define the term 'pathogen'		
Describe the spread, symptoms and treatments of viral diseases such as measles, HIV and Tobacco Mosaic Virus (TMV)		
Describe the spread, symptoms and treatment of the bacterial infections Salmonella and Gonorrhoea		
Describe the symptoms, spread and treatment of the fungal disease Rose black spot		
Describe the spread of malaria and measures to prevent its transmission		
Describe the main physical barriers humans have to infection		
Describe how white cells fight pathogens that do get into the body		
Explain how vaccinations prevent disease		
Explain the use of antibiotics and other medicines in treating diseases		
Describe the origins of many drugs and how new drugs are developed, including the use of placebos		

Sections

4.3.1.1 Communicable (infectious) diseases

Pathogens are microorganisms that cause infectious disease.
Pathogens may be viruses, bacteria, protists or fungi.
They may infect plants or animals and can be spread byt direct contact, by water or by air.

You will need to know be able to explain how diseases can be spread, reduced and prevented.

Bacteria: Not all bacteria are pathogens. Pathogenic bacteria reproduce rapidly inside the body and may produce toxins which make us feel ill.
Viruses: Viruses are much smaller than bacteria. All viruses are pathogens.

- Viruses also produce toxins and they damage the cells in which they reproduce, leading to illness.
- Viruses replicate by invading cells, reproducing inside them and bursting them. This causes damage to tissues, leading to illness.

Microorganism	Viruses	Bacteria (prokaryotes)	Protists (eukaryotes)	Fungi (eukaryotes)
Example in animals	cold, influenza, measles, HIV,	tuberculosis (TB), Salmonella, Gonorrhoea	dysentery, sleeping sickness, malaria	athlete's foot, thrush,
Example in plants	tobacco mosaic virus			rose black spot
Structural differences:	DNA or RNA surrounded by a protein coat	No membrane bound organelles (no chloroplasts, mitochondria or nucleus). Cell wall. Single celled organisms	Membrane bound organelles. Usually single celled.	Membrane bound organelles, cell wall made of chitin. Single celled or multi-cellular

The human body has several non specific ways of defending itself from pathogens getting in

Nose	Nasal hairs, sticky mucus and cilia prevent pathogens entering through the nostrils.
Trachea and bronchus (respiratory system)	Lined with mucus to trap dust and pathogens. Cilia move the mucus upwards to be swallowed.
Stomach acid	Stomach acid (pH1) kills most ingested pathogens.
Skin	Hard to penetrate waterproof barrier. Glands secrete oil which kill microbes

Plants have several ways of defending themselves from pathogens and animals

Physical	Mechanical	Chemical
• Thick waxy layers – difficult to penetrate. • cell walls – tough and so stop pathogen entry	• Thorns, curling up leaves to prevent being eaten. • Layer of dead cells / bark which fall off taking pathogens with them.	• Antibacterial and toxins made by plant and fungi.

You need to know the symptoms, method of transmission of these diseases.

Pathogen	*Disease*	Symptoms	Method of transmission	Control of spread
Virus	***Measles***	Fever, red skin rash.	Droplet infection from sneezes and coughs.	Vaccination as a child.
Virus	***HIV***	Initially flu like systems, serious damage to immune system.	Sexual contact and exchange of body fluids.	Anti-retroviral drugs and use of condoms.
Virus	***Tobacco mosaic virus***	Mosaic pattern on leaves.	Enters via wounds in epidermis caused by pests.	Remove infected leaves and control pests that damage the leaves.
Bacteria	***Salmonella***	Fever, cramp, vomiting, diarrhoea.	Food prepared in unhygienic conditions or not cooked properly.	Improve food hygiene, wash hands, vaccinate poultry, cook food thoroughly.
Bacteria	***Gonorrhoea***	Green discharge from penis or vagina.	Direct sexual contact or exchange of body fluids.	Use condoms. Treatment using antibiotics.
Protists	***Malaria***	Recurrent fever.	By an animal vector (mosquitoes).	Prevent breeding of mosquitoes. Use of nets to prevent bites.
Fungus	***Rose black spot***	Purple black spots on leaves.	Spores carried via wind or water.	Remove infected leaves. Spray with fungicide.

4.3.1.8 Antibiotics and painkillers.

Antibiotics, such as penicillin, are medicines that help cure bacterial disease by killing invective bacteria inside the body.

Antibiotic cannot kill viral pathogens. This is because viruses reproduce inside cells. It is difficult to develop drugs that kill viruses without also damaging the body tissues.

Exam practice 1

Q1. Microorganisms can cause disease.

(a) Draw **one** line from each disease to the correct description.

HIV	Can be spread by not washing hands thoroughly.
	Can increase the chance of infection such as pneumonia.
Malaria	Part of the life cycle includes an insect.
	spread by cough and sneezes.
Salmonella	Treated with stem cell.
	Treated with fungicides.

(3)

(b) Gonorrhoea is a sexually transmitted disease.

A bacterium causes gonorrhoea.

What are the symptoms of gonorrhoea?

Tick **two** boxes.

- Headache ☐
- Pain when urinating ☐
- Rash ☐
- Vomiting ☐
- Yellow discharge ☐

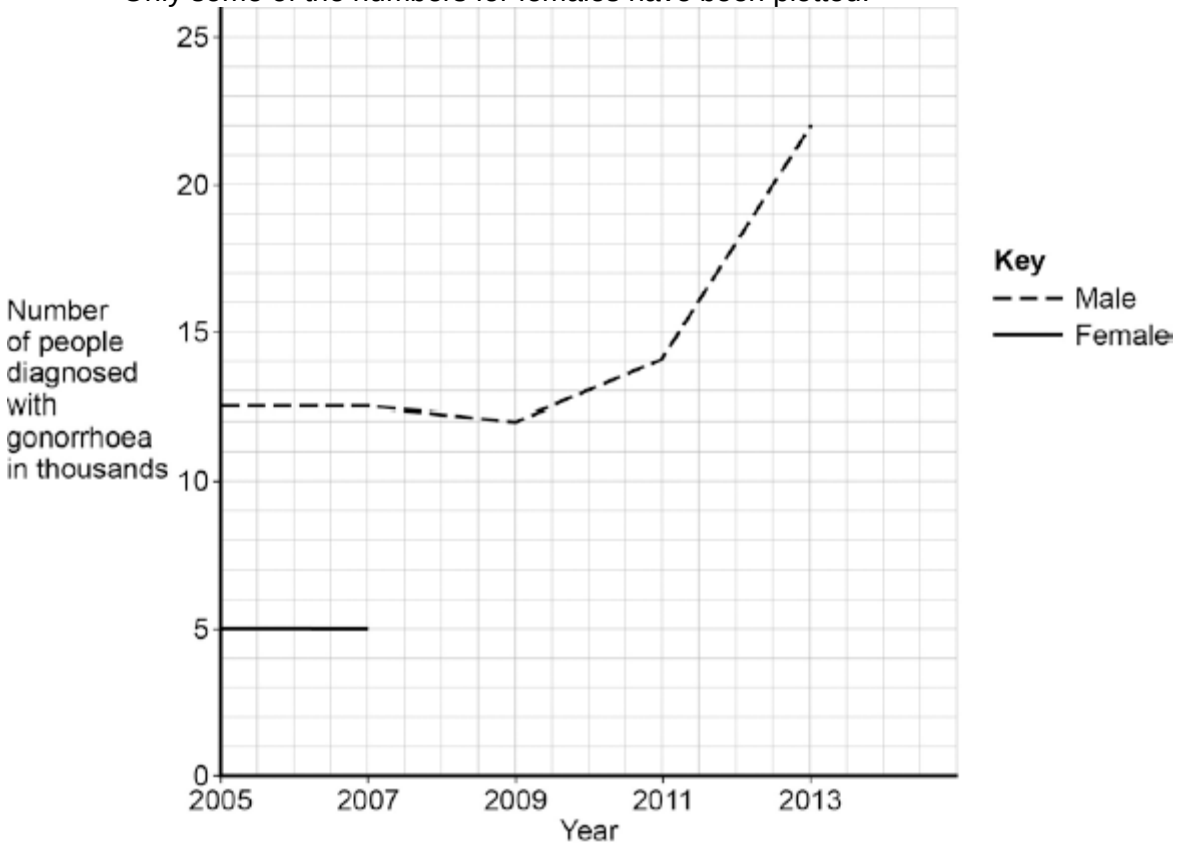
(2)

(c) The table below shows the number of people in the UK diagnosed with gonorrhoea in different years.

	Number of people diagnosed with gonorrhoea in thousands	
Year	**Female**	**Male**
2005	5.0	12.5
2007	5.0	12.5
2009	5.5	12.0
2011	6.0	14.0
2013	7.5	22.0

Use the data in the table to complete the graph below.

- The numbers for males have already been plotted.
- Only some of the numbers for females have been plotted.



(3)

(d) Describe the patterns in the numbers of males and females with gonorrhoea from 2005 to 2013.

Use the data in the graph.

_____

_____

_____

_____

(3)

(e) Gonorrhoea is treated with an antibiotic.

HIV is another sexually transmitted disease.

Explain why prescribing an antibiotic will **not** cure HIV.

_____

_____

_____

_____

(2)

Q2. Viruses and bacteria cause diseases in humans.

(a) Draw a ring around the correct word to complete the sentence.

Organisms that cause disease are called

algae.

pathogens.

vaccines.

(1)

(b) In August 2011 the United Nations gave a warning that there was a new strain of the bird flu virus in China.

Bird flu may kill humans. The new strain of the bird flu virus could cause a *pandemic* very quickly.

(i) What is a *pandemic*?

Tick (✓) **one** box.

A disease affecting the people all over one country.	
A disease affecting hundreds of people	
A disease affecting people in many countries.	

(1)

(ii) The swine flu virus is carried by pigs.

The bird flu virus is likely to spread much more quickly than the swine flu virus.

Suggest **one** reason why.

_____

_____

(1)

This notice is from a doctor's surgery.

Unfortunately, antibiotics will NOT get rid of your flu.

(c) (i) Why will antibiotics **not** get rid of flu?

_____

_____

(1)

(ii) The symptoms of flu include a sore throat and aching muscles.

What would a doctor give to a patient to relieve the symptoms of flu?

_____

(1)

(iii) It is important that antibiotics are **not** overused.

Explain why.

Use words from the box to complete the sentence.

antibody	**bacteria**	**immune**	**resistant**	**viruses**

Overuse of antibiotics might speed up the development

of _____ strains of _____ .

(2)

(Total 7 marks)

Q3. Rose black spot is a disease of roses.

(a) What type of microorganism causes rose black spot?

Tick **one** box.

A bacterium ☐

A fungus ☐

A protist ☐

A virus ☐

(1)

(b) Explain how different **types of organism** defend themselves against microorganisms.

_____

_____

_____

_____

_____

_____

_____

_____

(6)

Q5. Eating food containing *Salmonella* bacteria can cause illness.

(a) Two symptoms of infection by *Salmonella* are vomiting and diarrhoea.

What causes these symptoms?

_____

_____

(1)

(b) Give **two** ways a person with a mild infection of *Salmonella* can help prevent the spread of the bacteria to other people.

1. _____

_____

2. _____

_____

(2)

(c) In very serious infections of *Salmonella*, a doctor can prescribe drugs to kill the bacteria.

What type of drug can the doctor prescribe to kill the bacteria?

_____

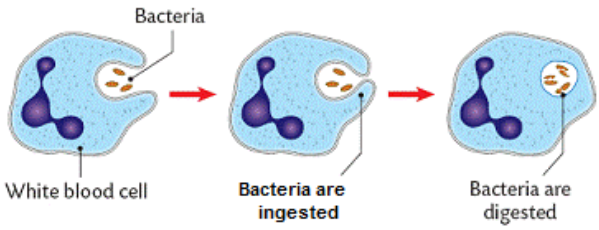
_____

(1)

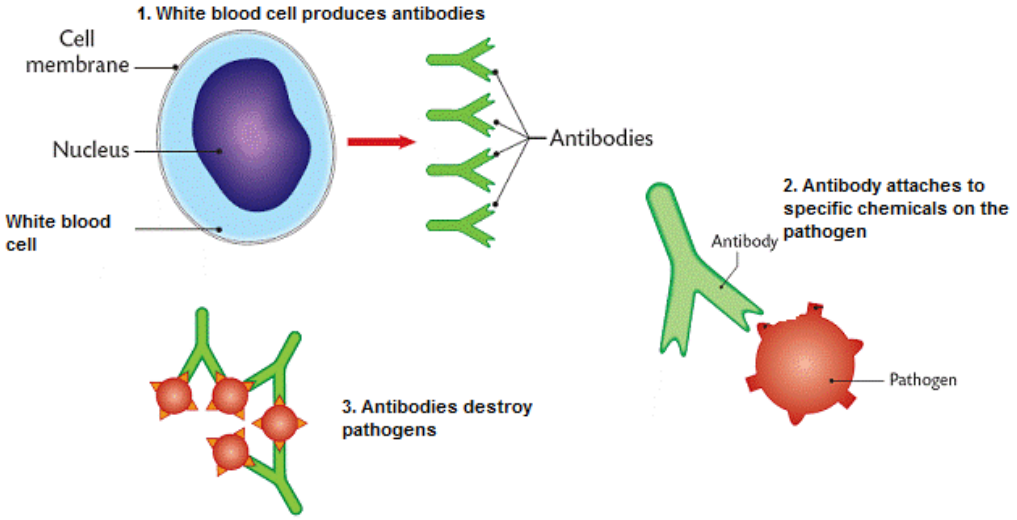
4.3.1.6 Human defence systems

<u>The immune system:</u> The body has different ways of protecting itself against pathogens. White blood cells defend our internal environment from pathogens. These form part of our immune system.

- <u>There are **TWO MAIN** types of white blood cells:</u>
  1) Cells that ingest and destroy microorganisms **(PHAGOCYTES)**



  2) Cells that produce antitoxins that destroy toxins released by pathogens **(LYMPHOCYTES)**
  3) Cells that produce antibodies that destroy specific pathogens: **(LYMPHOCYTES)**
     - They produce specific antibodies to kill a particular pathogen.
     - This leads to immunity from that pathogen.
     - The body is able to rapidly produce large numbers of the specific antibodies if it is exposed to the same pathogen in the future.
     - In some cases, dead or inactivated pathogens stimulate antibody production.
     - This also leads to immunity.



White blood cell	*Function*	
Phagocytes	***Phagocytosis***	Phagocytes engulf the pathogens and digest them.
Lymphocytes	***Antibody production***	Specific antibodies destroy the pathogen. This takes time so an infection can occur. If a person is infected again by the same pathogen, the lymphocytes make antibodies much faster.
	Antitoxin production	Antitoxin is a type of antibody produced to counteract the toxins produced by bacteria.

Q1. Hepatitis B is a liver disease caused by a virus. The virus is found in body fluids such as blood, saliva and urine. Diagram **1** shows the structure of the virus in cross section.

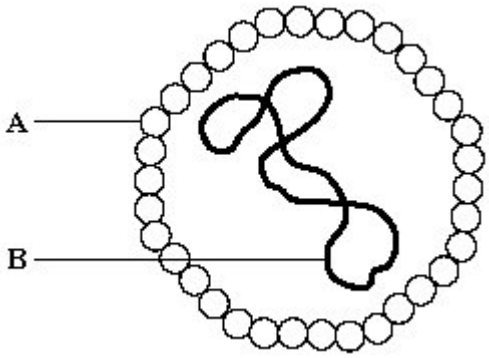
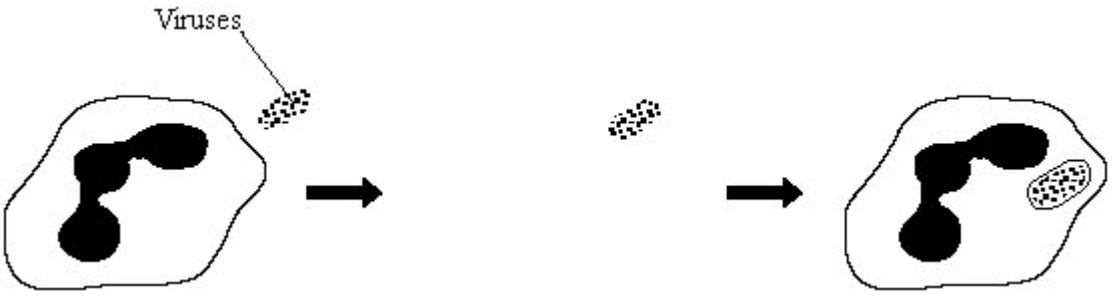


Diagram 1

(a) The human body has several natural defences against viruses. Some of these prevent viruses from entering the body. Others act once the viruses have entered.

(i) Diagram **2** shows a white blood cell attacking a group of viruses.

Complete diagram **2** by drawing the 2nd stage.



1st stage **2nd stage** **3rd Stage**

Diagram 2

(1)

(ii) What type of chemical is released by some white blood cells to attack viruses?

_____

(1)

(b) Hepatitis B is more likely to be spread among people who share needles when they inject drugs. Use information given at the beginning of this question to explain why this is so.

_____

_____

_____

_____

(2)

(Total 4 marks)

Q2. (c) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

White blood cells are part of the immune system. White blood cells help the body to defend itself against pathogens.

Describe how pathogens cause infections **and** describe how the immune system defends the body against these pathogens.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(Total 11 marks)

Q3. White blood cells protect the body against pathogens such as bacteria and viruses.

(a) (i) Pathogens make us feel ill.

Give **one** reason why.

_____

_____

(1)

(ii) White blood cells produce antibodies. This is one way white blood cells protect us against pathogens.

Give **two** other ways that white blood cells protect us against pathogens.

1. _____

_____

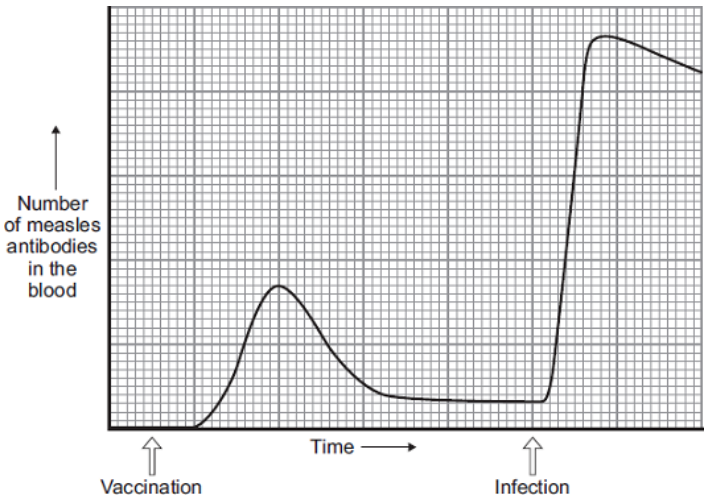
2. _____

_____

(2)

4.3.1.7 Vaccination

- Vaccinations: People can be immunised against a disease by introducing small quantities of **dead or inactive forms of the pathogen** into the body.
    - Vaccines stimulate the white blood cells to produce antibodies that destroy the pathogens.
    - This makes the person immune to future infections by the microorganism.
    - The body can **respond by rapidly making** the correct antibody, in the same way as if the person had previously had the disease.
      e.g. MMR vacci ne used to protect children against measles, mumps and rubella.



4.3.1.8 Antibiotic and painkillers

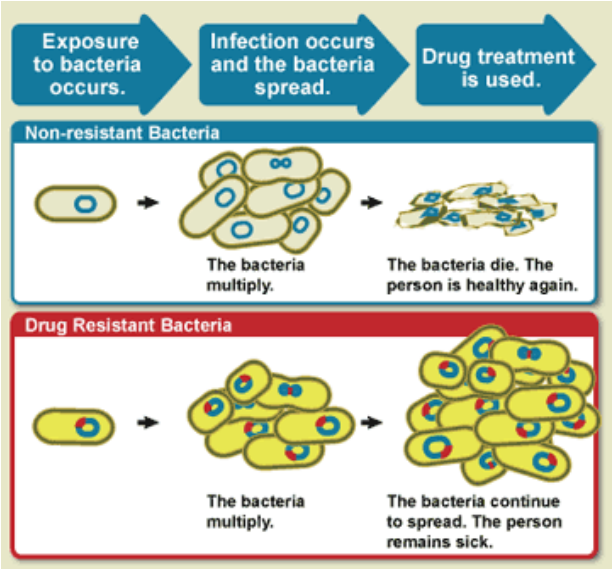
Antibiotics have greatly reduced deaths from infectious bacterial disease

antibiotics	***e.g. penicillin***	Kill infective bacteria inside the body. Specific bacterial infections require specific antibiotics.
Painkillers and other medicines	***e.g. aspirin, paracetamol, ibuprofen***	Drugs that are used to treat the symptoms of a disease. They do not kill pathogens

Reminder:
Antibiotics cannot be use to treat viral pathogens

It is difficult to develop drugs to kill viruses without harming body tissues because viruses live and reproduce inside cells

Antibiotic resistance: Overuse and inappropriate use of antibiotics has increased the rate of development of antibiotic resistant strains of bacteria.



What can be done?

- Doctors should only prescribe antibiotics when necessary – and not for viruses.
- It is important that if you are prescribed antibiotics you take the whole course.
    - A lot of people will stop taking the antibiotic when they feel better.
    - If you do this, you leave a few bacteria inside your body.
    - These will reproduce, increasing the chance of some developing resistance.
- Scientists are trying to develop new versions of the antibiotics.
    - Some antibiotics are developed but not used – just in case

Q1.(a) **List A** gives the names of three substances. The substances can help ill people.

List B gives information about the three substances.

Draw a line from each substance in **List A** to the correct information in **List B**.

List A **Substance**	**List B** **Information**
	White blood cells produce this substance
Antibiotic	
	This substance is used to kill bacteria
Antitoxin	
	This substance lowers blood cholesterol levels
Painkiller	
	This substance relieves only the symptoms of a disease

(3)

(b) Complete the sentences.

A vaccine contains an _____ form of a pathogen.

(1)

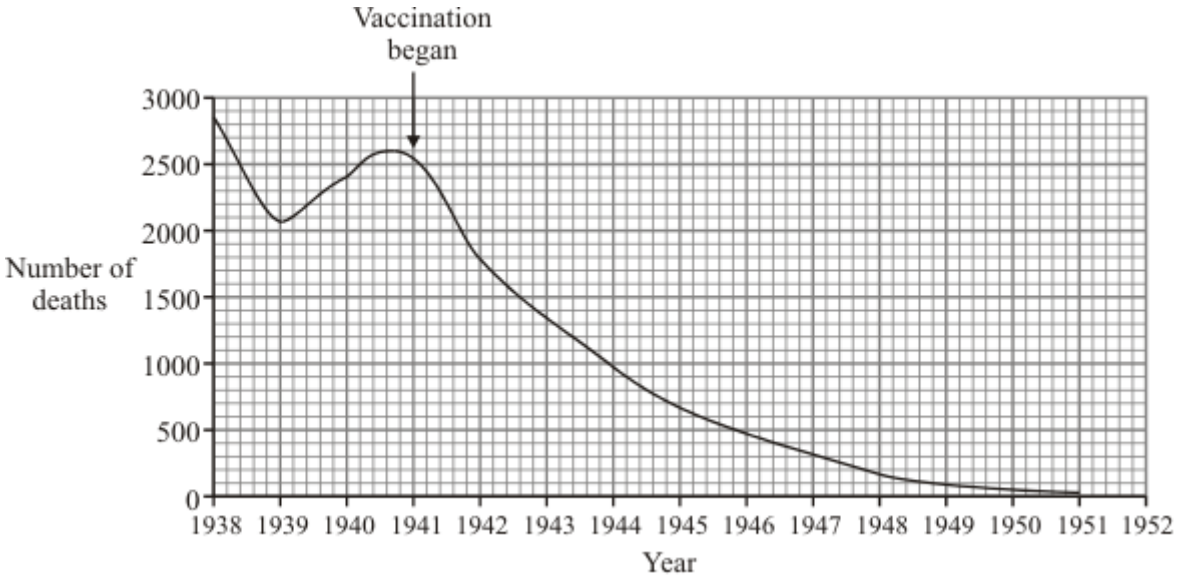
The MMR vaccine protects children against measles,

mumps and _____

(1)

(Total 5 marks)

Q2. Diphtheria is a disease of the human breathing system. The graph shows the number of deaths from diphtheria in the United Kingdom between 1938 and 1951. Vaccination against diphtheria was begun in 1941.



(a) What evidence in the graph suggests that vaccination protects people from diphtheria?

_____

(1)

(b) Complete the passage by choosing the correct words from the box.

antibodies	**bacteria**	**platelets**
red blood cells	**white blood cells**	

During vaccination, harmless _____ are injected into the body.

This causes _____ to make _____ which help to protect the body against diphtheria.

(3)

(Total 4 marks)

Q3. Antibiotics can be used to protect our bodies from pathogens.

(a) What is a pathogen?

_____

_____

(1)

(b) Bacteria may become resistant to antibiotics.

How can doctors reduce the number of bacteria that become resistant to antibiotics?

_____

_____

_____

_____

(2)

Q4. (b) Vaccination can protect us from the diseases pathogens cause.

(i) One type of virus causes measles.

A doctor vaccinates a child against measles.

What does the doctor inject into the child to make the child immune to measles?

_____

_____

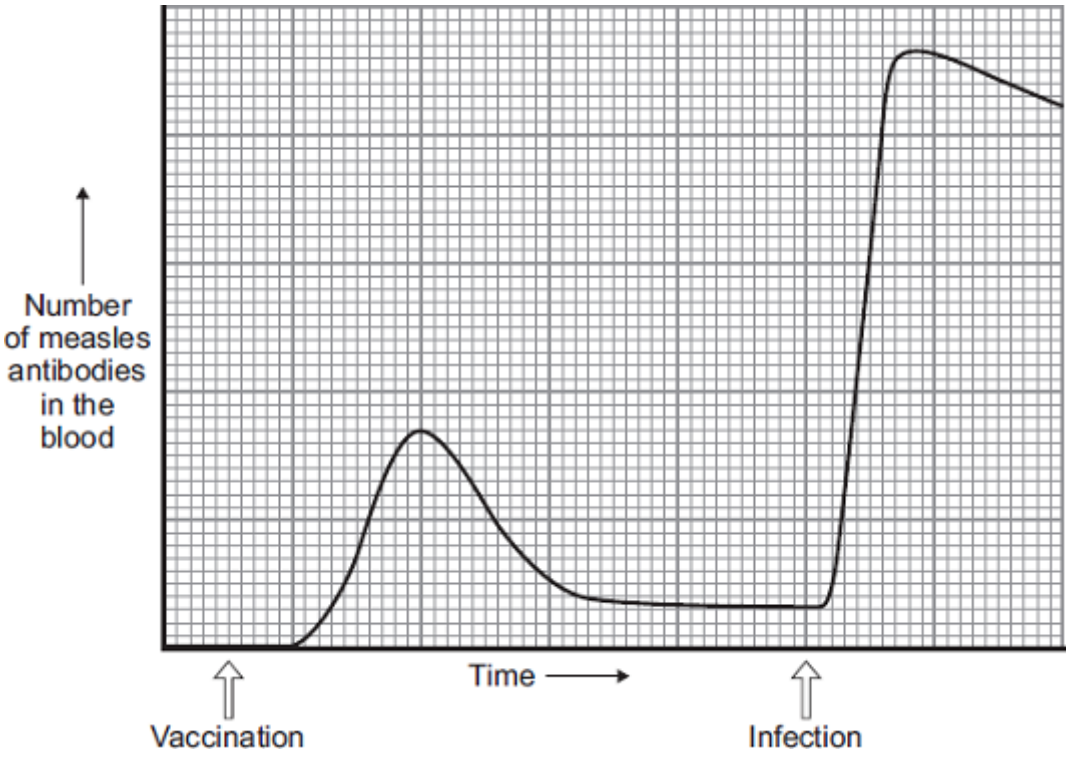
_____

_____

(2)

(ii) A few weeks after the vaccination, the child becomes infected with measles viruses from another person.

The graph shows the number of measles antibodies in the child's blood from before the vaccination until after the infection.



More measles antibodies are produced after the infection than after the vaccination.

Describe other differences in antibody production after infection compared with after vaccination.

_____

_____

_____

_____

_____

_____

(3)

(iii) Vaccination against the measles virus will **not** protect the child against the rubella virus.

Why?

_____

(1)

(c) What is the advantage of vaccinating a large proportion of the population against measles?

_____

(1)

(Total 10 marks)

Q5. Mumps is a disease caused by a virus. Mumps vaccine is usually given to children as part of the MMR vaccine.

(a) What diseases, other than mumps, does the MMR vaccine protect against?

_____

(2)

(b) Mumps vaccines contain mumps viruses. Suggest why these viruses do not cause mumps.

_____

_____

(1)

(c) Explain how the vaccine makes someone immune to mumps.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

_____

_____

_____

_____

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_____

_____

_____

_____

(5)

4.3.1.9 Discovery and development of drugs.

Traditionally drugs were extracted from plants and microorganisms

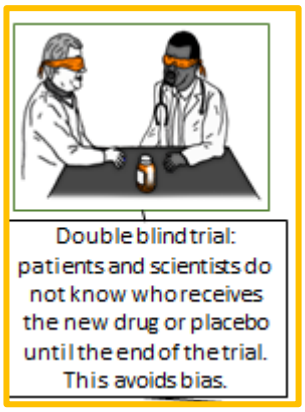
Digitalis	*Aspirin*	*Penicillin*
Extracted from foxglove plants and used as a heart drug	A painkiller and anti-inflammatory that was first found in willow bark	Discovered by Alexander Fleming from the *Penicillium* mould and used as an antibiotic

Most new drugs are synthesised by chemists in the pharmaceutical industry.

Drug trials: Scientists are continually developing new drugs. When new medical drugs are devised, they have to be extensively tested and trialled before being used.

New drugs are extensively tested for:	*Efficacy*	Make sure the drug works
	Toxicity	Check that the drug is not poisonous
	Dose	The most suitable amount to take

- Drugs are tested in a series of stages to find out if they are safe and effective.
- New drugs are extensively tested for toxicity, efficacy and dose:
    - **Preclinical trials** - using cells, tissues and live animals - must be carried out before the drug can be tested on humans.
    - clinical trials involving healthy volunteers and patients:
        1) **Very low doses** of the drug are given at the start of the clinical trial.
        2) If the drug is found to be safe, **further clinical trials** are carried out to find the optimum dose for the drug.
        3) In some **double blind trials**, some patients are given a **placebo**, which does not contain the drug.
        4) Neither the doctors nor the patients know who has received a placebo and who has received the drug until the trial is complete.


Double blind trial: patients and scientists do not know who receives the new drug or placebo until the end of the trial. This avoids bias.

Stage 1	*Stage 2*	*Stage 3*	*Stage 4*
Healthy volunteers try small dose of the drug to check it is safe record any side effects	A small number of patients try the drug at a low dose to see if it works	A larger number of patients; different doses are trialled to find the optimum dose	A double blind trial will occur. The patients are divided into groups. Some will be given the drug and some a placebo.

A placebo can look identical to the new drug but contain no active ingredients

Q1. Many diseases can be treated using drugs.

(b) Some drugs were originally extracted from living organisms.

Draw **one** line from each drug to the organism it was originally extracted from.

Drug	Organism the drug was originally extracted from
Aspirin	A mould
Digitalis	A virus
	Foxglove
	Rose
	Willow Tree

(2)

(c) New drugs must be tested before they can be used.

Give **one** reason why drugs should be tested.

_____

_____

(1)

(d) Doctors have developed a new drug.
The new drug has been tested on live animals.

What is the next stage in testing the new drug?

Tick **one** box.

- Testing on animal tissues in a laboratory ☐
- Testing on healthy volunteers ☐
- Testing on patients with the disease ☐
- Testing on the whole human population ☐

(1)

Q2.(a) **List A** gives the names of three stages in trialling a new drug.

List B gives information about the three stages.

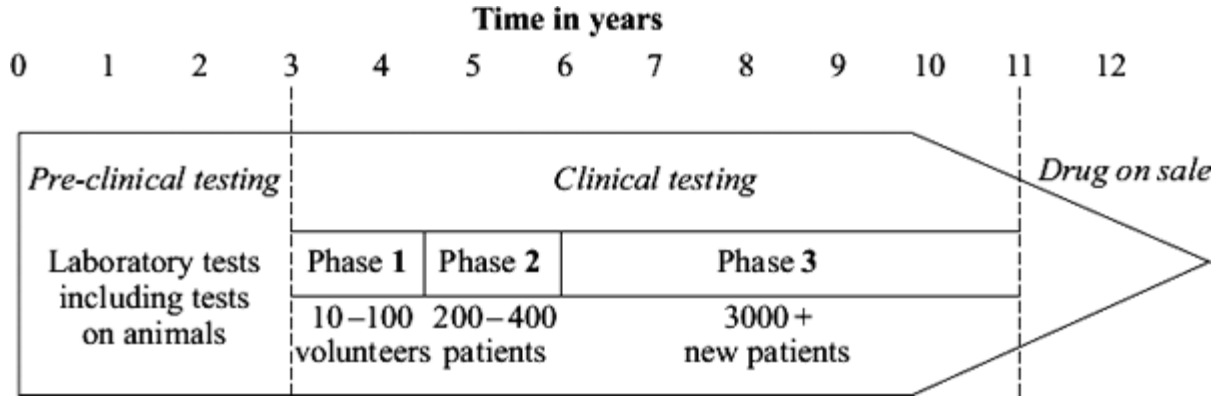
Draw a line from each stage in **List A** to the correct information in **List B**.

List A Stage	**List B Information**
	Used to find if the drug is toxic
Tests on humans including a placebo	
	The first stage in the clinical trials of the drug
Tests on humans using very small quantities of the drug	
	Used to find the optimum dose of the drug
Tests on animals	
	Used to prove that the drug is effective on humans

3)

Q3. (b) New drugs need to be tested before going on sale.

The diagram shows a time line for the testing of a new drug.



(i) How long do trials on humans take? _____ years

(1)

(ii) What is the minimum number of humans the drug is tested on throughout *clinical testing?*

_____

(1)

(c) Draw a ring around the correct answer to complete each sentence.

(i) A new drug is first tested in the laboratory to find

if it is toxic.
if it is cost effective.
the optimum dose.

(1)

(ii) The drug is then tested on a few volunteers to find

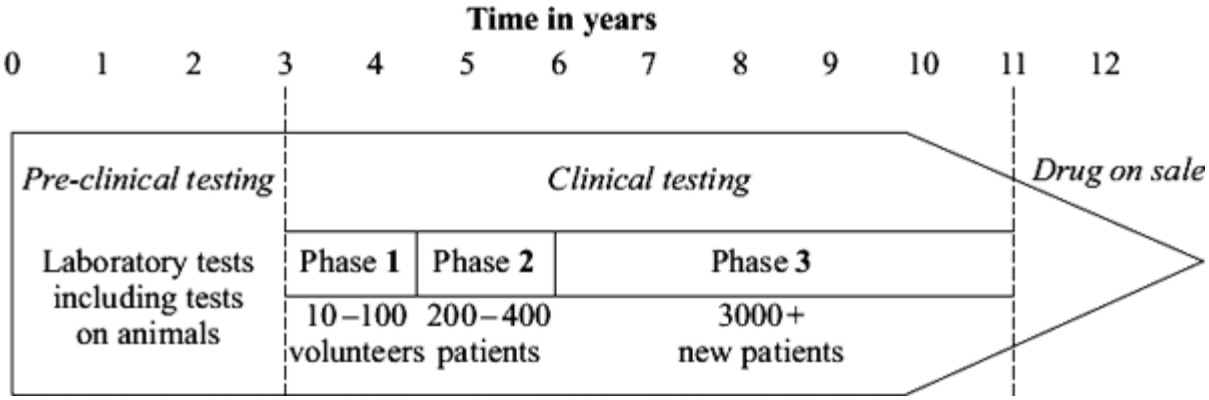
if it is cost effective.
if it has side effects.
the optimum dose.

(1)

(Total 7 marks)

Q4. New drugs have to be thoroughly tested before they are sold.

The diagram shows a time line for the testing of a new drug.



(a) What is the main purpose of *pre-clinical testing?*

_____

_____

(1)

(b) In Phase **1** of the *clinical testing,* very low doses of the new drug are used on a small number of volunteers.

(i) What is the main purpose of Phase **1** testing?

_____

_____

(1)

(ii) In Phase **1** testing, healthy volunteers are used rather than patients.

Suggest **one** reason for this.

_____

_____

(1)

(c) What is the main purpose of the Phase **2** and Phase **3** testing?

_____

_____

(1)

(d) During Phase **3** testing, many of the patients are given a *placebo.*

(i) What is meant by a *placebo?*

_____

_____

(1)

(ii) During the testing, who knows which patients are receiving the *placebo?*

Tick (✓) **one** box.

Only the patients	
Only the doctors	
Both patients and doctors	
Neither patients nor doctors	

(1)

(Total 6 marks)

Q5. Scientists have trialled a new statin called rosuvastatin.

- 17 802 people took part in the trial.
- All of these people had high levels of a protein called CRP in their blood.
- The higher the level of CRP in the blood, the higher the risk of a heart attack.
- None of these people had heart conditions at the beginning of the investigation.
- None of these people had high LDL (low density lipoprotein) levels.
- All of these people were aged 50 or above.
- Half the people were given a rosuvastatin tablet each day; the other half were given a placebo.
- The trial was stopped 7 months early when it was found that the people given rosuvastatin were 54% less likely to have a heart attack than people given the placebo.

(a) Give **two** control variables in this investigation.

1. _____

2. _____

(2)

(b) What would the placebo be in this investigation?

_____

_____

(1)

(c) The trial gave reliable results.

Give **one** reason why.

_____

_____

(1)

(d) The trial was stopped 7 months early.

Give **one** reason why.

_____

_____

(1)

(e) The manufacturers of rosuvastatin paid for the trial.

However, the manufacturers took no part in the trial.

Suggest **one** reason why the manufacturers did not take part in the trial.

_____

_____

(1)

Q6. Drugs must be trialled before the drugs can be used on patients.

(a) (i) Before the clinical trials, drugs are tested in the laboratory.
The laboratory trials are **not** trials on people.

What is the drug tested on in these laboratory trials?

_____

(1)

(ii) Drugs must be trialled before the drugs can be used on patients.

Give **three** reasons why.

_____

_____

_____

_____

_____

_____

(3)

(b) Read the information about cholesterol and ways of treating high cholesterol levels.

Diet and inherited factors affect the level of cholesterol in a person's blood.
Too much cholesterol may cause deposits of fat to build up in blood vessels and reduce the flow of blood. This may cause the person to have a heart attack.
Some drugs can lower the amount of cholesterol in the blood.

The body needs cholesterol. Cells use cholesterol to make new cell membranes and some hormones. The liver makes cholesterol for the body.

Some drugs can help people with high cholesterol levels.

Statins block the enzyme in the liver that is used to produce cholesterol.
People will normally have to take statins for the rest of their lives. Statins can lead to muscle damage and kidney problems. Using some statins for a long time has caused high numbers of deaths.

Cholesterol blockers reduce the absorption of cholesterol from the intestine into the blood.
Cholesterol blockers can sometimes cause problems if the person is using other drugs.

Evaluate the use of the two types of drug for a person with high cholesterol levels.

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