CB5a Health and disease

1 any suitable answer that includes physical, social and mental well-being

2 a Exercise can improve physical fitness.

b Answer similar to: exercising as part of a group can improve contact with other people because you are sharing the activity.

c Answer similar to: exercising for fun can make you feel happier.

3 When two factors are correlated, as one factor changes in value so does the other in a similar way.

4 a As income increases, life expectancy also increases (though the increase is greatest at lower incomes than at higher values).

b Any suitable suggestion that relates increase in income to improved health, such as increase in numbers of doctors and hospitals, improved diet, etc.

5 a People with periodontal disease are more likely to suffer from heart disease than people who do not have periodontal disease.

b Pathogens in the mouth are more able to get into the blood system, through bleeding gums. These pathogens could then cause heart disease.

S1 The HIV virus is a pathogen. It can damage the immune system, so the body is not so well protected against infections by other pathogens. So people with HIV are more likely to get other infections.

E1 Where you live will affect factors such as availability of food for a healthy diet, access to good and affordable health care, whether there is a risk of natural disasters or disasters caused by people, such as war. All of these factors are linked to poor health, which can affect how long you live for.

Exam-style question

Difference described, e.g. by definition of terms with suitable examples, between communicable disease (1) and non-communicable disease (1), such as: Communicable diseases, such as flu, are caused by pathogens that can be passed from an infected individual to others. Non-communicable diseases, such as heart disease, are caused by problems in the body, and cannot be passed to people near you.

CB5b Non-communicable diseases

1 Sickle cell disease cannot be passed from a person with the disease to anyone else by normal day-to-day contact/can only be passed to offspring through genes.

2 Scurvy should be treated using vitamin C, because it is caused by a lack of the vitamin in the diet.

3 Kwashiorkor is caused by a lack of protein in the diet, which comes from meat, fish, eggs and other sources. Only very poor people are usually at risk of not getting enough protein in their diet.

4 Deficiency diseases are caused by a poor diet.

5 Liver disease is usually caused by a lifestyle factor/drinking too much alcohol, not by an infection so cannot be passed on to another person.

6 Reducing the amount of alcohol drunk should decrease the number of people who develop liver disease and other problems caused by too much alcohol. This should reduce the impact on people's lives and their families, as well as reduce the costs to the national health system of treatment for these problems.

7 a i Russia, Brazil, UK, USA, Australia

ii Russia and UK, USA and Brazil, Australia

b The correlation is not strong because countries in the same consumption group do not show similar death rates.

S1 Person more likely to suffer from liver disease or other alcohol-related problems. Family have to support person suffering from liver disease, and may have to cope with his or her death. Society has to pay for cost of treating people with liver disease and their care after treatment.

E1 Possible advantages: young children in UK most at risk from vitamin D deficiency and vitamin drops reduce risk of young children developing rickets, which will cause problems for the children and their families as well as a cost to society of treatment and support.

Possible disadvantages: cost of giving vitamin D to all children, some parents may not be able to afford this, some parents may not want to give their children supplements.

Exam-style question

Iron is taken from foods such as red meat and dark green vegetables (1). If the diet is lacking in iron, then the body won't absorb enough to make healthy blood (1).

CB5c Cardiovascular disease

1 being overweight due to too much fat in the body

2 A BMI of 30 or more is considered obese and suggests a lot of fat around the organs, which correlates with an increased risk of cardiovascular disease.

3 Weightlifters may have a high BMI because they have developed large muscles. This means they have a smaller amount of body fat than other people with the same BMI.

4 Chart B shows that the correlation between deaths from heart disease and waist : hip ratio is good because deaths from heart disease increase as waist : hip ratio increases. The correlation with BMI is not as good because deaths from heart disease decrease from the <20 to the 20–24.9 group, but do increase with each group after that. So measuring your waist : hip ratio gives a better indicator of risk of death from heart disease than BMI.

5 Flowchart showing: tobacco smoke enters lungs > substances in smoke diffuse out of lungs/alveoli into blood > substances travel around body in blood > harmful substances damage heart and blood vessels causing cardiovascular disease.

6 Heart muscle needs oxygen and nutrients to keep working. Narrowed or blocked coronary arteries will reduce or stop oxygen and nutrients reaching the heart muscle cells, so the cells may die. If the cells die, the heart will stop working properly and the person may die. Bypassing the damaged arteries allows blood containing oxygen and nutrients to reach the heart muscle cells so they can continue working properly.

S1 Both changes will reduce the risk of heart disease. Stopping smoking will stop harmful substances from tobacco smoke getting into the blood and increasing the risk of damage to the heart and blood vessels. Exercise will help to reduce body mass (fat), which will also reduce the risk of cardiovascular disease.

E1 Prevention of cardiovascular disease can be done by changing some of our behaviour, such as not smoking and controlling body mass/fat by a good diet and exercise. Curing cardiovascular disease involves operations and medicines, which are costly and affect how we live. Preventing cardiovascular disease is more likely to keep you healthier than curing it.

Exam-style question

Any two suitable examples with appropriate explanations (1 mark for each), such as:

- A heart bypass operation inserts new arteries in the heart, to carry blood to damaged areas of the heart so that the cells contract properly.
- Narrowed blood vessels can be widened with a stent, to allow blood to flow through more easily.

CB5d Pathogens

1 pathogen

2 The pathogen can pass from an infected person to other people, causing disease in them also.

3 blood in mucus after coughing and fever and weight loss

4 **a** highest percentage: 755 000 ÷ 124 000 000 × 100% = 6.1%

lowest percentage: 755 000 ÷ 283 000 000 × 100% = 2.7%

b fever, weakness and sickness

5 Calculation will depend on dimensions measured. *Vibrio* bacterium cell body is about 1.5 µm long, total length including flagellum up to 5 µm long, cell width about 0.5 µm. Ebola virus particle about 1000 nm = 1 µm long, and about 50 nm wide. By length, *Vibrio* about five times longer; by width, *Vibrio* is 500 nm/50 nm = 10 times wider.

6 **a** $\dfrac{\text{people with TB and HIV}}{\text{people with TB}}$ × 100% = $\dfrac{326}{8070}$ × 100% = 4.04%

6 **b** People with HIV are less able to fight off infections, and so more likely to suffer from other diseases, e.g. TB.

7 Some people develop stomach ulcers, where the bacteria attack the stomach lining.

S1 Table with the following headings, content similar to below.

Name of disease	Name of pathogen	Type of pathogen	Host organism	Symptoms of disease
cholera	*Vibrio cholerae*	bacterium	human	diarrhoea
tuberculosis	*Mycobacterium tuberculosis*	bacterium	human	blood in mucus from lungs, fever, weight loss
chalara dieback	*Hymenoscyphus fraxineus*	fungus	ash trees	lesions on branches and trunk, dying leaves, crown dieback
malaria	*Plasmodium*	protist	human	fever, weakness and sickness
haemorrhagic fever	Ebola virus	virus	human	internal bleeding and fever
HIV/AIDS	HIV (human immunodeficiency virus)	virus	human	destruction of white blood cells leading to other/secondary infections by other pathogens
stomach ulcers	*Helicobacter pylori*	bacterium	human	sore ulcers in stomach lining

E1 Pacini showed that there were *Vibrio* bacteria in people with cholera. This only shows that *Vibrio* might be the cause. Koch also showed that people who had diarrhoea caused by other infections did not have *Vibrio* in their bodies. This is more convincing, because it excludes other causes.

Exam-style question

Any appropriate pathogens with signs of the disease they cause, such as:

(**a**) chalara dieback of ash trees, causes lesions in trunk and branches, death of leaves and dieback of crown of tree (1)

(**b**) malaria causes fever, weakness and sickness (1).

CB5e Spreading pathogens

1 a TB bacteria are spread in the droplets from coughs and sneezes. If the droplets are caught in a tissue and binned, they are less likely to reach other people nearby and infect them.

b keeping the environment clean by removing all dust, because the bacteria can survive in dust for months and so could infect more people for a long time

2 Spores can be carried long distances by the wind. To prevent the disease in the UK, it would be necessary to clear the disease in countries near enough for spores to reach the UK.

3 a Damaged water pipes meant there was no clean drinking water. Other sources of water were polluted and contained cholera bacteria, so people were infected when they drank the dirty water.

b any suitable answer with an explanation of how it would prevent cholera bacteria being ingested, such as only drink bottled water, boil water for drinking and cooking before use to kill the bacteria, treat water chemically to kill the bacteria before drinking or cooking

4 Any two suitable suggestions with an explanation that shows how each suggestion would prevent *Helicobacter* being ingested, such as washing hands properly after going to the toilet, keeping flies off food.

5 Ebola virus is extremely infectious, so you only need a tiny amount of body fluid from a live or dead infected person to become infected. This could easily happen if an infected person sneezed or coughed, or by a single touch. Only full body protection would stop this happening.

6 Mosquitoes are the vectors for the malarial protist *Plasmodium*. If there are no mosquitoes, then there is no vector to carry the *Plasmodium* from an infected person to other people, so this stops malaria spreading.

S1 Faeces contain many infectious pathogens. Washing hands thoroughly after going to the toilet removes pathogens from the hands and so reduces the chance of them being passed to food or to the mouth and infecting others.

E1 Isolating people stopped the pathogens being passed from an infected person to others. Full-body protective clothing used by people looking after those with the disease or clearing the bodies of those who had died from the disease helped protect those people from being infected.

Exam-style question

Any two suitable ways that clearly show prevention of transmission from infected people/faecal material to uninfected people by water (1 mark for each way), such as:

- Provide clean, boiled or sterilised water for drinking and washing.
- Make sure people wash their hands properly after going to the toilet.

CB5f Physical and chemical barriers

1 *Plasmodium*, which causes malaria, gets through the skin barrier when it is injected directly into the blood by the mosquito vector.

2 Lysozyme reacts with bacterial cell walls and causes their breakdown.

3 a physical barrier, as the pathogens have difficulty getting past it to the cells

4 Cilia are extensions to the cell surfaces that can move dust and pathogens out of the lungs and so reduce the risk of infection.

5 Many pathogens get into the stomach in food and drink. Most are destroyed by the hydrochloric acid/low pH in the stomach, which is a chemical defence against infection.

6 Screening identifies people who are infected with the STI. They can then be treated for the disease, and they will also know that they should not have unprotected sex until they are clear of the infection, so that they do not spread the STI to other people. Sexual partners can also be called for screening.

S1 The pathogens are trapped in mucus in the nose, which either leaves the nose to the outside of the body or drips down the back of the throat and into the oesophagus/gullet. Pathogens that get past the nose and into the tubes at the top of the lungs may be trapped in mucus and carried back out of the lungs by the action of ciliated cells. Pathogens in the mouth may be killed by lysozyme in saliva. Any pathogens in the mouth and throat that pass into the stomach may be killed by hydrochloric acid.

E1 *Chlamydia* is spread by sexual activity without protection against the exchange of sexual fluids (semen and vaginal fluids). Younger people are more likely to have unprotected sex and so to become infected by someone who is already infected. They are also more likely to have more than one sexual partner, so increasing the chance of coming into contact with someone who is infected.

Exam-style question

Answer should contain one physical barrier (1) and one chemical defence (1), with explanation of how it protects against pathogens entering the body, such as:

physical: skin is thick, so pathogens can't get through it; mucus traps pathogens entering through nose and breathing tubes; cilia move mucus containing pathogens out of tubes

chemical: lysozyme in tears, mucus and saliva kills bacteria or makes them inactive; hydrochloric acid destroys pathogens that enter the stomach in food, drink or mucus from throat.

CB5g The immune system

1 A molecule on the outside of a cell or virus particle that triggers a response of the immune system.

2 The immune system can distinguish between the antigens on the outside of cells or viruses from outside the body and the antigens on cells in the body.

3 Different lymphocytes have different antibodies. Only lymphocytes with the antibodies that match the antigen on the pathogen are activated.

4 **a** The secondary response is faster and produces many more antibodies than the primary response.

b The more rapid production of larger amounts of antibody in the secondary response will kill or stop the pathogens before there are enough of them to make you feel ill.

6th **5** Something that contains antigens of a pathogen that can trigger an immune response without you having the disease.

8th **6** Different pathogens have different antigens. Vaccination against a particular pathogen will only result in memory cells in the blood for the antigens of that pathogen, not for others.

S1 The immune system attacks the pathogen by producing antibodies to the antigens on the pathogen. The antibodies either kill the pathogens or stop them growing or reproducing.

E1 The body's natural immune response requires infection with the pathogen. Antigens on the pathogen trigger the release of antibodies by the immune system that attack and destroy the pathogen. Memory cells left after the first infection will trigger a more rapid and larger secondary response if you are infected again. Immunisation using a vaccine containing antigens of the pathogen can trigger the primary response without you being infected with the pathogen and being ill. This leaves memory cells in the blood that will produce the secondary response if you are then infected with the pathogen.

Exam-style question

Vaccination causes the body to make memory lymphocytes to the antigens of the measles pathogen in the vaccine (1). The memory lymphocytes will recognise the measles antigens if you are infected by the measles virus and cause a rapid secondary response that will stop you being ill (1).

CB5h Antibiotics

7th **1** There is a clear area around the mould where bacteria had been growing but have died.

7th **2** Pathogens, including bacteria, can easily enter the body through wounds. Once they are in the body they can cause disease and even death. Penicillin can kill the bacteria, preventing disease and death.

6th **3** Flu and HIV/AIDS are caused by viruses. Antibiotics kill bacteria, so they will not affect viral diseases.

6th **4** It damages the cell wall so the bacterium breaks open, releasing the cytoplasm and killing the cell.

6th **5** **a** Discovery > pre-clinical stages of testing on cells, tissues and/or organs, then sometimes on animals > small-scale clinical trial on healthy people > large-scale trial on many people with the disease

7th **5** **b** Testing on cells, tissues or organs makes sure that the medicine affects the disease but does little harm to the cells.

Testing on animals makes sure the medicine works in a complete body, without harming the organism.

Testing on a few healthy people checks that the medicine is safe in humans and looks for side effects.

Testing on a large number of people with the disease makes sure the medicine helps them get better, identifies the right dose and looks for a wider range of side effects in different people.

S1 tested on cells, tissue or organs in the lab; tested on animals; tested on a few healthy people; tested on a large number of people with the disease

E1 Advantages include: only medicines that are effective and safe are developed; medicines that are dangerous to cells are less likely to reach clinical trials where they could harm people.

Disadvantages include: takes a long time to develop a new medicine from when it is discovered to when a doctor can prescribe it; every stage costs, so this makes the whole process more expensive (so the medicine may be more expensive for doctors to prescribe).

Exam-style question

First stage on cells, tissues or organs in the lab, to make sure that the antibiotic gets into the cells properly and does what is expected/kills the pathogen or stops it working (1). Second stage on animals to test that the antibiotic works well in a whole body and is safe in other animals (1).