Infection and Response 2

headstartscience.co.uk

Name: _____

Class: _____

Date: _____

Time: **96 minutes**

Marks: **90 marks**

Comments:

Q1.

Pathogens cause infectious diseases.

(a) Draw **one** line from each disease to the type of pathogen that causes the disease.

Disease	Type of pathogen
	Bacterium
Gonorrhoea	
	Fungus
	Protist
Measles	
	Virus

(2)

The body defends itself against pathogens in different ways.

(b) Give **two** ways that the body prevents pathogens entering the body.

1. _____

2. _____

(2)

(c) If pathogens do enter the body the immune system tries to destroy the pathogens.

Describe how the immune system defends the body against disease.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(d) Give **one** reason why antibiotics cannot be used to treat HIV infections.

_____

_____

(1)

(e) Give **two** ways to prevent the spread of HIV.

1. _____

_____

2. _____

_____

(2)

(f) Some people with a HIV infection develop AIDS.

Some people with AIDS may die from a different type of infection, such as a chest infection.

Why do people with AIDS die from a different type of infection?

Tick (✓) **one** box.

HIV damages the immune system.	☐
Pathogens enter the body more easily.	☐
People with AIDS are immune to HIV.	☐

(1)

(Total 14 marks)

Q2.

Cells are the basic units of all forms of life.

(a) Describe **four** differences between a bacterial cell and a plant cell.

1. _____

2. _____

3. _____

4. _____

(4)

(b) Gonorrhoea is a bacterial disease.

A new vaccine is being developed against gonorrhoea.

Describe how a vaccine would work to prevent gonorrhoea.

(4)

Another disease caused by bacteria is salmonella food poisoning.

In the UK, chickens are vaccinated against *Salmonella* bacteria to reduce the number of cases of food poisoning in humans.

(c) Explain how vaccinating chickens reduces the number of cases of salmonella food poisoning.

(2)

(d) Give **one** way that the spread of salmonella food poisoning from one human to another is controlled.

Do **not** refer to vaccination in your answer.

(1)

(e) The number of cases of salmonella food poisoning is usually higher in summer than in winter.

Suggest **one** reason why.

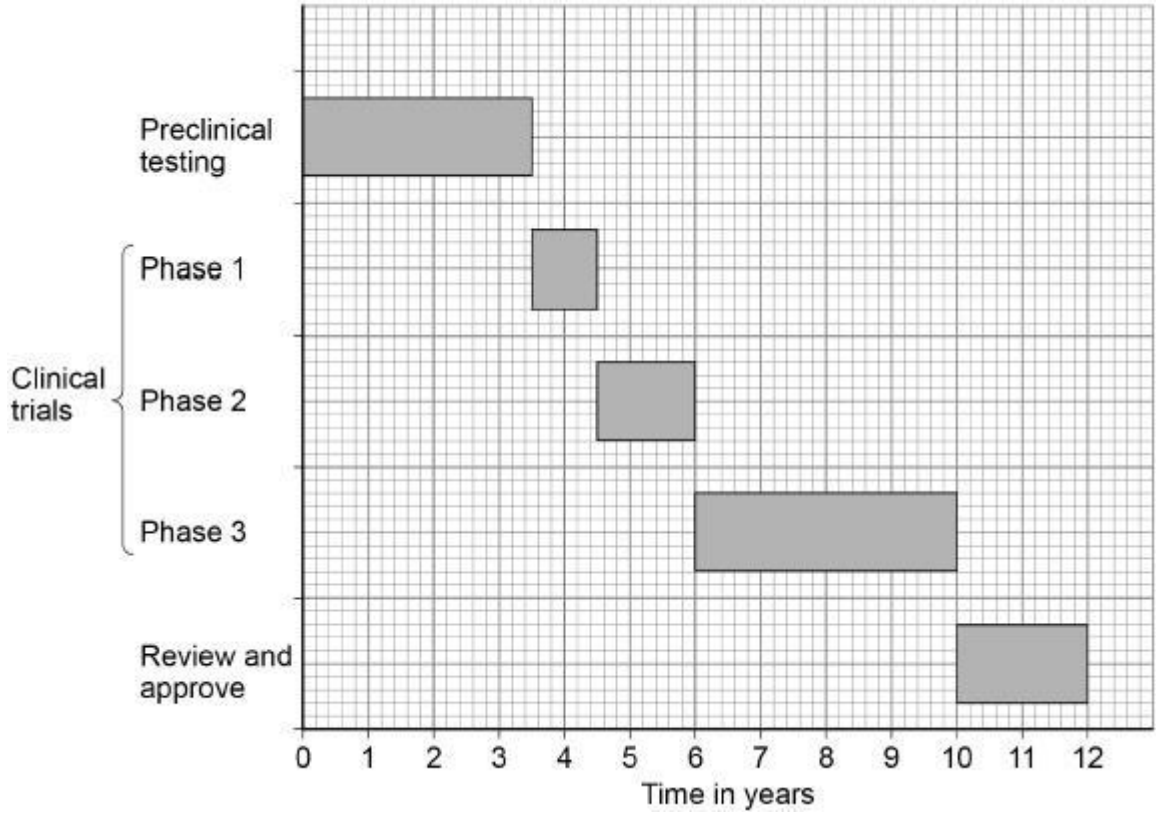
(1)

(Total 12 marks)

Q3.

New drugs are tested and trialled before they can be licensed to treat patients.

The graph below shows how much time the different stages of testing took for one new drug.



(a) How much more time did the clinical trials take compared with the preclinical testing?

Tick (✓) **one** box.

3 years ☐

3.5 years ☐

5 years ☐

6.5 years ☐

(1)

During Phase 1 clinical trials low doses of the drug are tested on healthy volunteers.

(b) Suggest **one** reason why **low doses** of the drug are used in Phase 1 clinical trials.

_____

_____

(1)

(c) Suggest **two** reasons why **healthy** volunteers are used in Phase 1 clinical trials.

1. _____

_____

_____

2. _____

_____

_____

(2)

(d) The results of clinical trials can only be published after peer review by other scientists.

Suggest **one** reason why the results must be reviewed by other scientists.

_____

_____

(1)

(e) A drug is only licensed for the medical conditions it was tested to treat in the clinical trials.

Drug regulations:
- control what drugs a doctor can prescribe
- ensure doctors can prescribe a drug with confidence
- protect patients.

AMD is an eye condition that can result in very poor vision.

Doctors treat approximately 40 000 new cases of AMD each year.

Two drugs licensed to treat AMD in the UK are drug **A** and drug **B**.

In many other countries drug **C** is used to treat AMD. Drug **C** is only licensed in the UK to treat cancer.

The cost per injection for each drug is:
- drug **A** £561
- drug **B** £800
- drug **C** £28

The number of injections required to treat AMD is the same for each drug.

In 2018 the High Court in the UK gave permission for drug **C** to be used to treat AMD.

Evaluate the decision to allow the use of drug **C** to treat AMD in the UK.

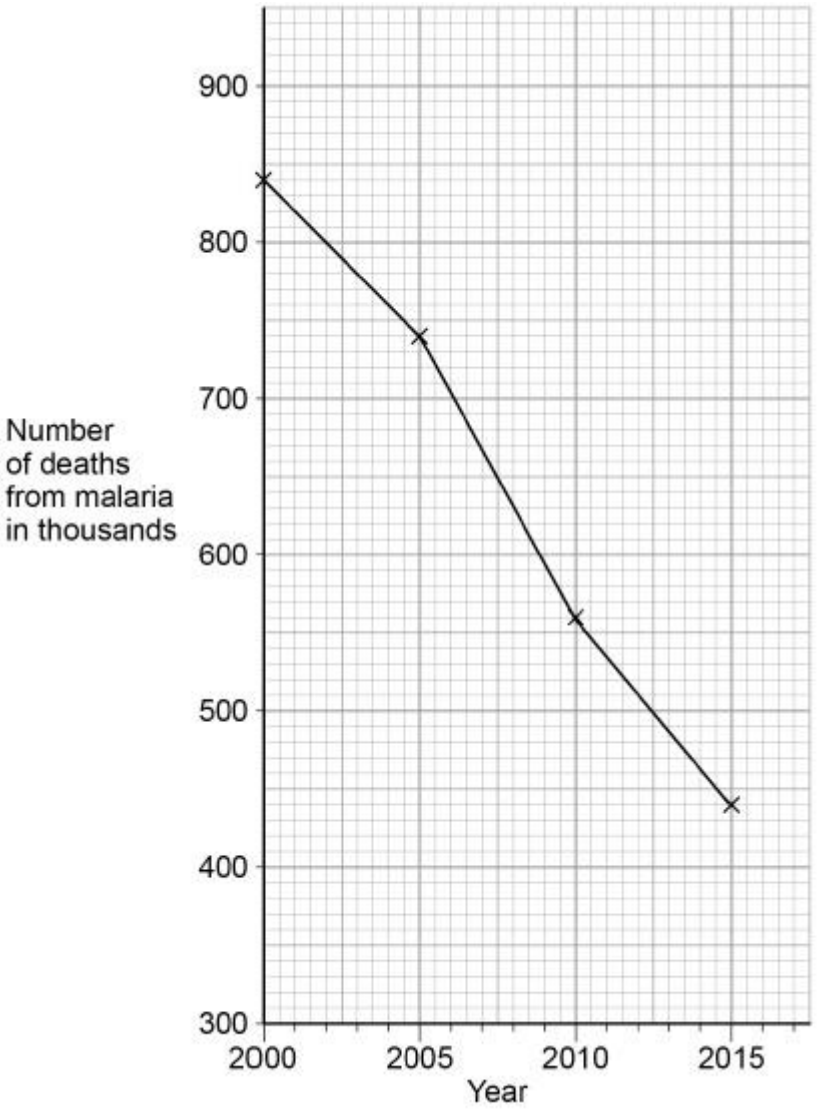
(6)

(Total 11 marks)

Q4.

Malaria is a disease transmitted by mosquitos.

The graph shows information about the number of deaths from malaria.



(a) Calculate the decrease in the number of deaths between 2000 and 2015.

_____

_____

Decrease in number of deaths = _____

(2)

(b) Which time period shows the greatest decrease in the number of deaths?

Tick (✓) **one** box.

2000 to 2005 ☐

2005 to 2010 ☐

2010 to 2015 ☐

(1)

(c) A student looked at the graph above and concluded that there were 800 000 deaths from malaria in 2002.

Suggest **one** reason why this conclusion might **not** be correct.

_____

_____

(1)

(d) What type of pathogen causes malaria?

Tick (✓) **one** box.

Bacterium ☐

Fungus ☐

Protist ☐

Virus ☐

(1)

(e) Scientists are developing a vaccine against malaria.

Suggest how a vaccine against malaria could reduce the spread of the disease.

_____

_____

_____

_____

(2)

(f) Give **one** way of controlling the spread of malaria.

Do **not** refer to a vaccine in your answer.

_____

_____

(1)

(Total 8 marks)

Q5.

Measles is a serious disease. A person can die from measles.

The table below shows the number of medically confirmed cases of measles in England and Wales between 2012 and 2015

Year	Number of medically confirmed cases of measles
2012	2030
2013	1843
2014	121
2015	91

(a) Suggest **one** reason why the actual number of cases of measles in England and Wales might be higher than is shown in the table above

_____

_____

(1)

(b) Calculate the percentage decrease in the number of medically confirmed cases of measles between 2012 and 2015

_____

_____

_____

_____

Percentage decrease = _____ %

(2)

(c) One reason for the decrease in the number of cases of measles is that more children were vaccinated against the disease.

Vaccinating a large proportion of the population reduces the spread of the measles virus.

Explain why.

_____

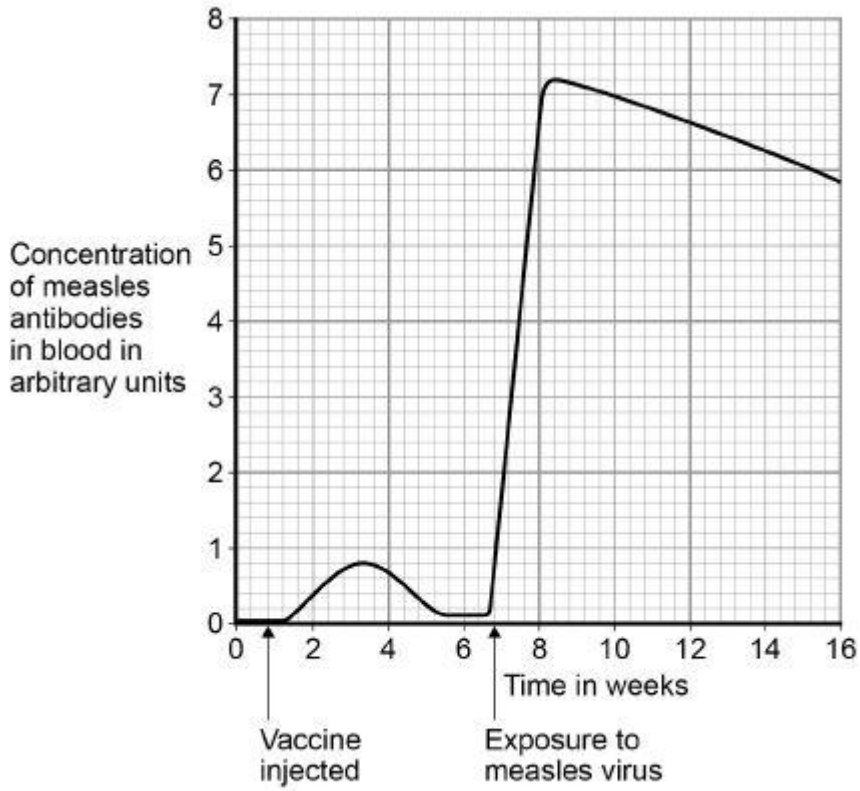
_____

_____

_____

(2)

(d) The graph below shows the concentration of measles antibodies in the blood of a boy.



Explain the differences between antibody production after the vaccine injection and after exposure to the measles virus.

You should include data from the graph above

_____

_____

_____

_____

(6)

(Total 11 marks)

Q6.

Pseudomonas bacteria cause infections in hospital patients.

A new strain of *Pseudomonas* bacteria has evolved. This new strain can only be killed by one antibiotic called fluroquinolone.

Scientists want to prevent the new strain of *Pseudomonas* from spreading in the human population.

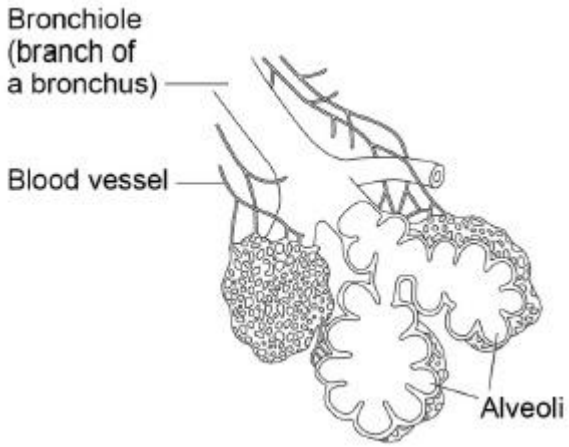
Explain the advice doctors should be given to prevent the spread of the new strain.

(Total 6 marks)

Q7.

Figure 1 shows part of the lungs.

Figure 1



(a) Give **two** ways the lungs are adapted for efficient exchange of gases.

Describe how each adaptation helps to maintain efficient gas exchange.

Adaptation 1 _____

_____

Description _____

_____

Adaptation 2 _____

_____

Description _____

_____

(4)

(b) There are 5.4 million people with asthma in the UK.

What type of disease is asthma?

Tick **one** box.

An allergy ☐

A bacterial infection ☐

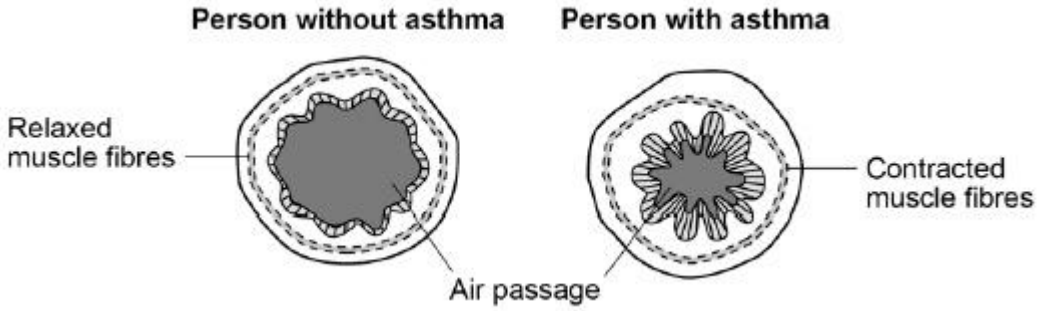
A cancer ☐

A viral infection ☐

(1)

(c) **Figure 2** shows cross-sections of bronchioles of two people.

Figure 2



Suggest why people with asthma often find it difficult to breathe.

_____

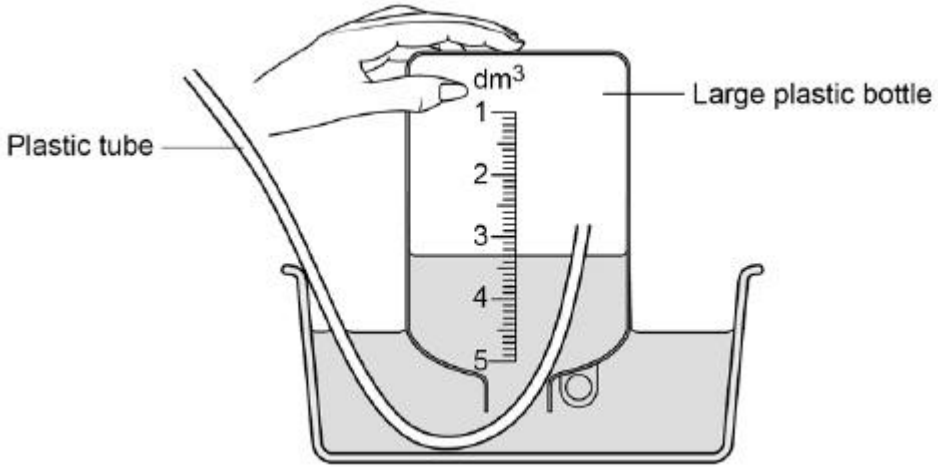
_____

(1)

(d) People with asthma often have a reduced lung volume.

Figure 3 shows the apparatus a student used to measure his lung volume.

Figure 3



This is the method used.

1 Fill the bottle with water.

2 Breathe out through the tube.

The volume of water pushed out of the bottle is equal to his lung volume.

What is the student's lung volume?

Volume = _____ dm^3

(1)

Scientists tested a new drug to treat asthma.

The scientists measured the lung volume of:
- volunteers without asthma
- some volunteers during a mild asthma attack
- other volunteers during a severe asthma attack.

Half the people in each group were given a placebo.

The other half of the people in each group were given the new drug.

The tests were carried out as a double blind trial.

(e) What is a placebo?

_____

_____

(1)

(f) Who knows which volunteers in a double blind trial are given the drug and which volunteers are given the placebo?

Tick **one** box.

The scientists but not the volunteers	☐
The scientists and the volunteers	☐
The volunteers but not the scientists	☐
Neither the volunteers nor the scientists	☐

(1)

(g) Suggest why it is a good idea that double blind trials should be used in drug testing?

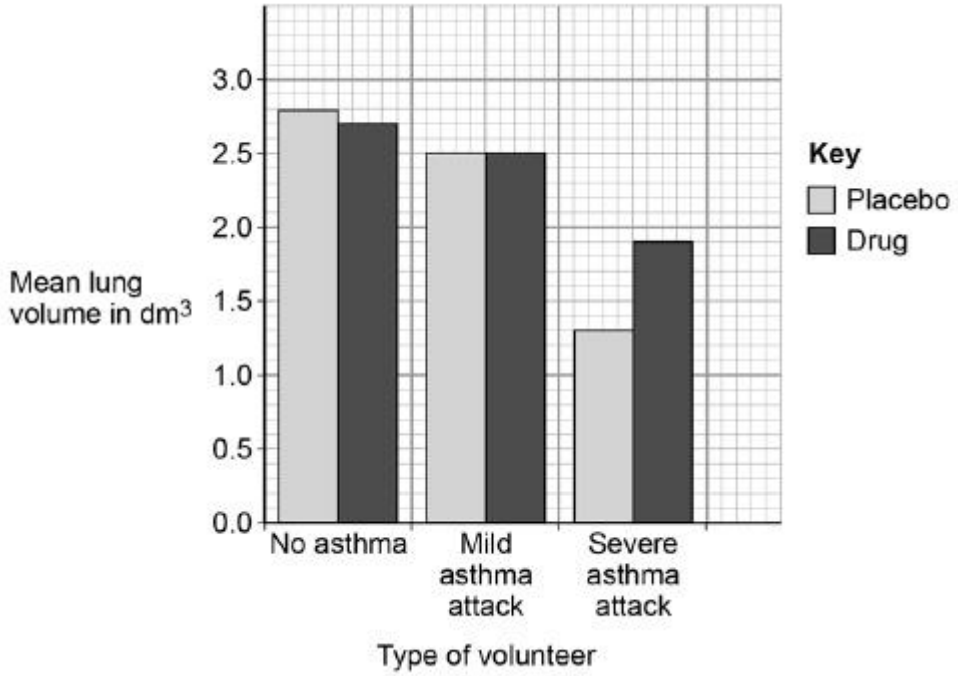
_____

_____

(1)

(h) **Figure 4** shows the results of the drug tests.

Figure 4



Give **two** conclusions that can be made about the usefulness of the drug.

1. _____

_____

2. _____

_____

(2)

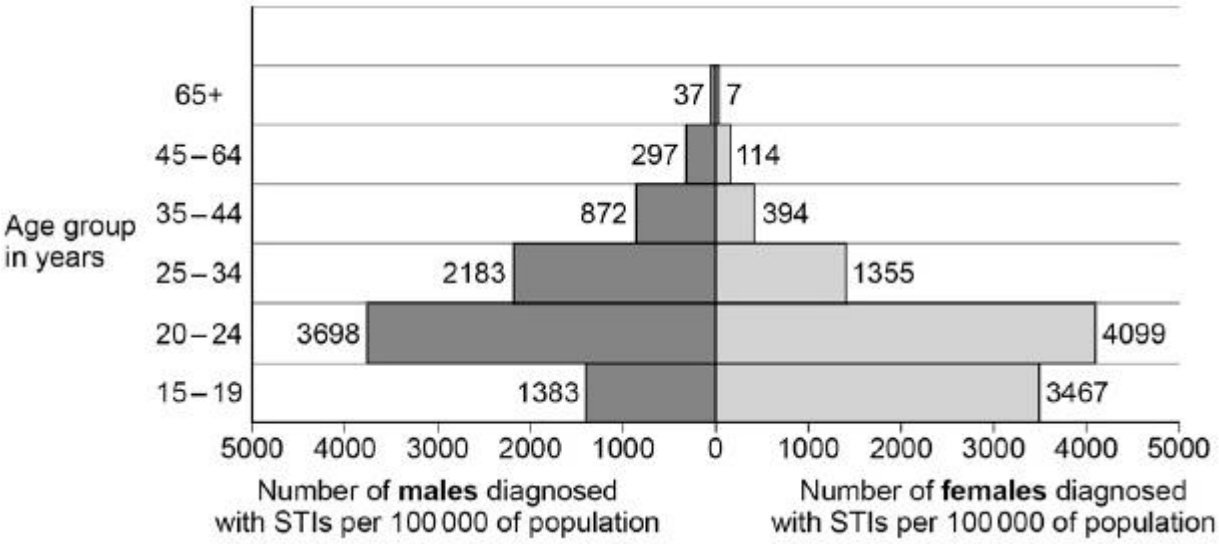
(Total 12 marks)

Q8.

This question is about sexually transmitted infections (STIs).

Figure 1 shows the number of STIs diagnosed in England in 2015.

Figure 1



(a) The total population of females aged 15–19 was 1 572 189

Calculate the number of females aged 15–19 who were diagnosed with an STI.

_____

_____

_____

_____

Number of females = _____

(3)

(b) Suggest why the data is given per 100 000 of the population and **not** as the number of people.

_____

_____

(1)

(c) Gonorrhoea is an STI.

Describe the symptoms of gonorrhoea.

_____

and

_____

(1)

Gonorrhoea was treated using penicillin until resistant strains of Gonorrhoea bacteria appeared.

A new antibiotic is tested to treat gonorrhoea.

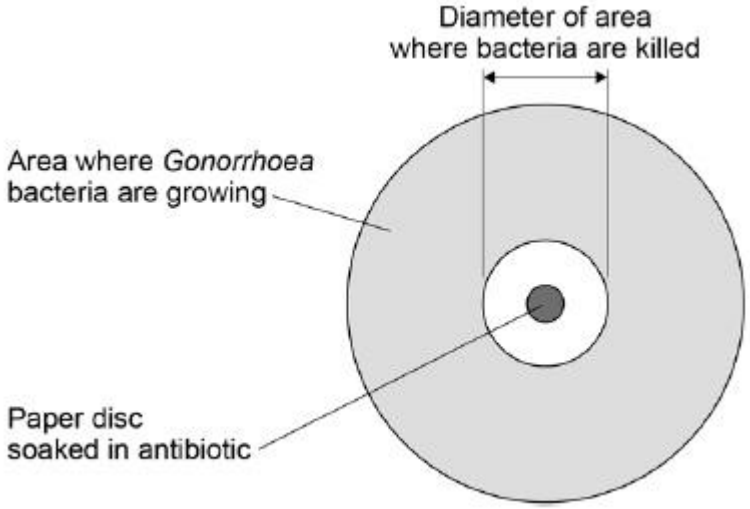
Scientists need to know the concentration of antibiotic that will be most effective and safe.

This is the method used.

1. Soak paper discs in different concentrations of antibiotic solution.
2. Place one disc in the centre of an agar plate where Gonorrhoea bacteria are growing.
3. Incubate the agar plate at 37 °C for 24 hours.
4. Measure the diameter of the clear area where the bacteria are killed.
5. Repeat steps 2–4 for each concentration of the antibiotic solution.

Figure 2 shows the results for one concentration of the antibiotic solution.

Figure 2



The table shows the results.

Concentration of antibiotic in mg/dm^3	Diameter of clear area in mm
0	0
1	0
3	8
5	15
10	16
20	17

(d) What was the dependent variable in this investigation?

_____

_____

(1)

(e) Calculate the area where bacteria were killed when the antibiotic concentration was 20 mg/dm^3

Use the equation: area = πr^2

Use 3.14 as the value for π

r is the radius of the circle.

Give your answer to 3 significant figures.

_____

_____

_____

Area = _____ mm^2

(2)

(f) The scientists recommended that the antibiotic should be used at a concentration of 5 mg/dm^3

Suggest **two** reasons why the scientists recommended this concentration.

1. _____

_____

2. _____

_____

(2)

(g) The antibiotic needs further testing before it can be licensed for human use.

The first stage is pre-clinical tests using live cells, tissues and animals.

Describe the other stages of drug testing.

Give reasons for each stage.

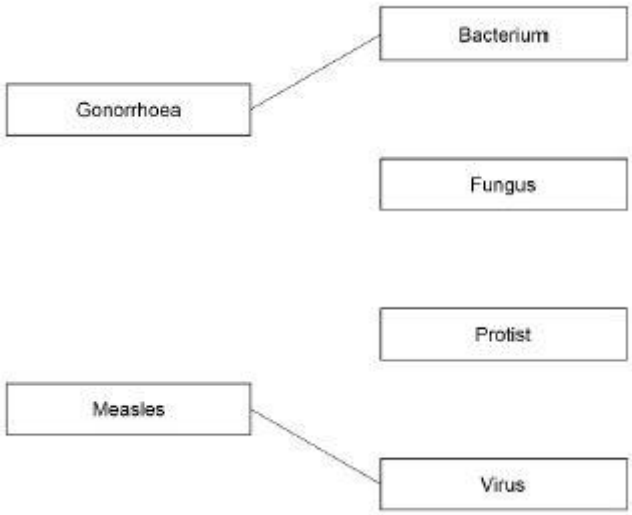
(6)

(Total 16 marks)

Q1.

(a) extra line(s) from a disease negates that mark

1



1

(b) any **two** from:

- skin (acts as a barrier)
  ignore references to the immune response
- *mucus in trachea / bronchi
  allow mucus in airways
- *mucus in nose
  - **allow mucus unqualified if **neither** idea given*
- cilia (in trachea / bronchi / respiratory tract)
  ignore references to hairs
- (hydrochloric) acid in stomach
  allow scab forms (if you cut yourself)
  allow tears

2

(c) **Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.

4–6

Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.

1–3

No relevant content

0

Indicative content

- white blood cells
- detect / identify foreign antigens / cells / pathogens / bacteria
- destroy / kill invading cells

- phagocytes
- engulf invading cells
- digest / kill invading cells

- produce antibodies
- (antibodies) attach to invading cells
- (antibodies) destroy / kill invading cells
- (antibodies) make invading cells clump together
- (so) phagocytes can engulf more cells / pathogens / bacteria

- produce antitoxins
- to destroy toxins
- (so) less tissue damage
- (therefore) don't feel as ill

- produce memory cells
- (so) immune response (to later exposure) is faster

A description of the ways that white blood cells act is needed for Level 2.

(d) any **one** from:
- HIV is a virus

  *allow HIV is **not** a bacterium*
- antibiotics do **not** kill viruses
- antibiotics (are used to) kill bacteria

1

(e) any **two** from:
- avoid sexual intercourse

  ignore handwashing
  ignore social distancing

- use a condom

  allow practise safe sex
  ignore use protection unqualified
  ignore use contraception unqualified

- do not share needles

- use antiretroviral drugs

  ignore use medication unqualified

- screen blood used for transfusions

  allow have regular checks / tests to see if you have HIV

  *if no other marks awarded allow **1** mark for do not exchange body fluids*

2

(f) HIV damages the immune system

1

[14]

Q2.

(a) any **four** from:

- bacterial cell is smaller (than a plant cell)

  allow converse statements 'it' refers to bacteria

- bacterial cell does **not** have chloroplasts (plant cell does)

  ignore chlorophyll

- bacterial cell does **not** have its DNA / genetic material inside a nucleus (plant cell does)

  *allow bacterial cell does **not** have a nucleus (plant cell does)*

  allow bacterial cell has DNA / genetic material in a ring / loop (plant cell does not)

  allow bacterial cell has DNA / genetic material free in cytoplasm

- bacterial cell (may) have plasmids (plant cell does not)

- bacterial cell does **not** have mitochondria (plant cell does)

- cell wall in bacterial cells is **not** made of cellulose (cell wall in plant cells is)

- bacterial cell does **not** have a large / permanent vacuole (plant cell does)

- bacterial cell has smaller ribosomes (than plant cells)

  *do **not** accept idea that bacterial cells do not have ribosomes*

  allow bacterial cell (may) have a flagellum (plant cells do not)

  allow bacterial cell (may) have a slime capsule (plant cell does not)

4

(b) any **four** from:

- dead / inactive / weakened form of pathogen / bacterium / microorganism is introduced / injected

  allow introduce / inject antigen(s) from the pathogen

  allow dead / inactive / weakened form of Gonorrhoea (bacteria) introduced / injected

  *do **not** accept inject Gonorrhoea disease*

- white blood cells stimulated to produce antibodies

  *do **not** accept incorrect white blood cell, eg phagocyte*

- reference to memory cells made or remain

- on re-exposure specific / correct antibodies are made (very) quickly

  allow on re-exposure specific / correct antibodies are produced in large quantities

- bacteria / pathogens / microorganisms killed and do not produce a large enough population to cause the disease

  allow bacteria / pathogens / microorganisms killed and do not produce a large enough population to produce toxins

4

(c) fewer bacteria / pathogens in chicken / eggs / food

ignore references to immunity unqualified

allow fewer chickens / eggs will carry the bacteria / pathogens ignore chickens do not get disease / infected

1

(so) fewer bacteria are ingested (by humans)

allow idea of fewer bacteria being passed on to humans in food

or

fewer bacteria / pathogens ingested (by humans) (1)

(so) fewer toxins produced (1)

allow idea of fewer bacteria being passed on to humans in food (1)

1

(d) wash hands before preparing food

ignore wash hands unqualified

allow good food hygiene

wash hands after using the toilet

allow clean areas where a person has been ill

allow do not shake hands (with someone who has food poisoning)

1

(e) warmer weather so bacteria reproduce / increase faster

ignore bacteria are killed at low temperatures

allow food not cooked properly on barbeques

1

[12]

Q3.

(a) 3 years

1

(b) any **one** from:

- to reduce any risk

  allow idea (if it is unsafe) less harm will be caused with a lower dose

  ignore that it may be unsafe / dangerous unqualified

- to look for side effects

  ignore unknown side effects unqualified

1

(c) too great a risk for ill person / patient

allow may make their condition worse

allow less risk to healthy person

ignore references to immune system

1

patient might be taking another drug

allow unhealthy person might be taking another drug

or

side effects of drug are easier to identify

ignore to see side effects unqualified

1

(d) any **one** from:

- to prevent false claims
- to make sure the results / conclusions are correct / valid

  ignore references to accuracy, reliability or precision
- to avoid bias

1

(e) **Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.

5–6

Level 2: Some logically linked reasons are given. There may also be a simple judgement.

3–4

Level 1: Relevant points are made. They are not logically linked.

1–2

No relevant content

0

Indicative content

arguments for use:

- will save the NHS money
- (approximately) 20 times as many people or 19 more people can be treated compared to Drug A
- (approximately) 29 times as many people can be treated compared to Drug B (allow 28 times **or** 28 / 27 more people)
- more people can be treated for the same cost
- patients will be treated sooner
- improves patient choice
- used in other countries so likely to be effective
- used in other countries so likely to be safe
- likely to have been tested in other countries

arguments against use:

- injections of drug not tested (in UK)

- cannot be sure it is as effective as Drug A / Drug B
- cannot be sure if it is safe to use
- may have unknown side effects
- doctors cannot be confident in prescribing Drug C
- goes against regulations / laws regulating drug development / use
- might set a precedent for other drugs not to be fully tested
- might set a precedent for other non- approved / unlicensed drugs to be used

Need advantages and disadvantages for Level 2

[11]

Q4.

(a)

*an answer of 400 000 scores **2** marks*

840 000 − 440 000

allow tolerance of +/- half a small square

allow 840 − 440 = 400

1

400 000

1

(b) 2005 to 2010

1

(c) any **one** from:
- data not collected (for 2002)
- only shows a trend line
- not all deaths reported / recorded

allow no data plotted for 2002

1

(d) protist

1

(e) makes people immune
or
they do not develop the disease

allow ecf from part (d)

allow correct description of immunity

1

(so) fewer (infected) people to pass pathogen on (to mosquitos)

allow idea of disrupting life cycle of parasite

1

(f) any **one** from:
- (mosquito) nets / long clothing
- prevent mosquitos breeding

- insect repellents
- anti-malarial tablets

- kill mosquitos

allow specific method e.g. drain swamps, release GM mosquitos

allow DEET / mosquito band

allow names e.g. Larium / Malarone

allow antibiotics

1

[8]

Q5.

(a) any **one** from:

- not everyone would go to the doctor

  allow not all cases recorded
  allow only medically confirmed cases recorded
  ignore some cases are unknown

- sample will not always be sent for analysis
- some cases not tested / diagnosed / confirmed

  allow idea that doctor may make a judgemental error or mis-diagnosis

1

(b) $\frac{1939}{2030} \times 100$

*allow for **1** mark:*

$\left(\frac{91}{2030} \times 100 =\right) 4.5\%$

1

96 / 95.5

*allow **2** marks for correct rounding of 95.51724138*

*allow **1** mark for correct calculation using incorrect subtraction **only** if working shown*

1

*an answer of 96 / 95.5 scores **2** marks*
*allow **1** mark only for 95 or other incorrect rounding*

(c) most people are **immune** so do **not become ill** (from infection)

allow herd / community immunity so do not become ill (from infection)

allow most people are immune so do not become infected

ignore most people are immune so don't get / catch it

1

less chance of **non-immune** / **unvaccinated** individuals being exposed to pathogen / measles / virus

reference to an organism is needed

allow 'it' for the measles virus

allow fewer people to pass it on to non-immune people

1

(d) **Level 3:** Relevant points (comparisons / reasons) are identified, given in detail and logically linked to form a clear account.

5–6

Level 2: Relevant points (comparisons / reasons) are identified and there are attempts at logical linking. The resulting account is not fully clear.

3–4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1–2

No relevant content

0

Indicative content

differences (after exposure to measles virus):

- greater number / higher concentration of antibodies produced
- quantitative statement, e.g. 9 times higher **or** 0.8 to 7.2
- antibodies produced sooner − idea of immediate response
- antibodies produced quicker
- antibodies stay (in higher concentration) for longer

explanation

- white blood cells / leucocytes / lymphocytes / B cells
  ignore phagocytes / macrophages
- reference to previous exposure (of white blood cells) to pathogen / virus
- (white blood cells) recognise pathogen / virus / antigen
- memory cells
- production of specific / correct antibodies

[11]

Q6.

Level 3: Relevant points (advice / reasons) are identified, given in detail and logically linked to form a clear account.

5–6

Level 2: Relevant points (advice / reasons) are identified, and there are attempts at logical linking. The resulting account is not fully clear.

3–4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1–2

No relevant content

0

Indicative content

precautions with reasons

- do not prescribe fluroquinolone / antibiotics for mild infections
- because they will get better due to the body's normal immune system

- do not prescribe fluroquinolone / antibiotics for viral infections / colds / flu
- because antibiotics do not kill viruses

- if you do prescribe fluroquinolone / antibiotics make sure the patient finishes the course
- because any bacteria left may develop resistance, survive and reproduce rapidly (due to lack of competition)

- only prescribe fluroquinolone if the patient has the new strain
- because routine use would lead to an increase in resistant bacteria

other relevant content
- doctors and nurses in the practice / hospital should be using antibacterial / alcohol hand wash between each patient **and / or** disinfectant to clean wards
- to kill (resistant) bacteria

- doctors should isolate patients with this strain of bacteria
- to prevent other patients getting the resistant infection

[6]

Q7.

(a) any **two** adaptations with linked descriptions from:

- many alveoli to provide a large surface area
- good blood supply to maintain steep diffusion / concentration gradient
- thin walls so gases do not have far to diffuse / travel
- well ventilated to maintain steep diffusion / concentration gradient

__1__ mark for adaptation and __1__ mark for linked description
allow to collect oxygen __or__ to bring carbon dioxide to lungs

4

(b) an allergy

1

(c) any **one** from:

- narrow(er) / small(er) (air) passages / bronchioles
- less air / oxygen can pass through

1

(d) 3.3 (dm^3)

1

(e) any **one** from:

- fake drug
- inactive form of drug

1

(f) neither the volunteers nor the scientists

1

(g) to avoid / reduce bias

1

(h) any **two** from:

- drug only works for severe asthma attacks
  or
  drug only increased lung capacity in severe asthma attacks
- drug had little effect **or** slight reduction in healthy people
- drug had no effect in mild asthma attacks
- drug does not alleviate the problem entirely

2

[12]

Q8.

(a) (1 572 189 × 3 467) / 100 000

1

54 507.79263 or any correct rounding

1

54 508

*an answer of 54 508 scores **3** marks*

1

(b) to control for the different (group) population sizes

allow so the different groups can be compared

1

(c) thick yellow / green discharge from penis / vagina
and
pain on urinating

*allow any **two** correct symptoms*

1

(d) diameter of clear area

1

(e) 3.14 × 8.5 × 8.5

1

227

*allow 226.865 or any correct rounding for max **1** mark*
*an answer 227 scores **2** marks*

1

(f) comment relating to data, eg higher concentrations did not show much improvement
or
5 mg/dm^3 was much more successful at killing bacteria than at lower concentrations

1

comment relating to patient safety eg much less likely to cause toxic / side effects than at higher concentrations

1

(g)

Level 3: Relevant points (correct stages / reasons) are identified, given in detail and linked logically to form a clear account.	5-6
Level 2: Relevant points (correct stages / reasons) are identified and there are attempts at logical thinking. The resulting account is not fully clear.	3-4
Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical thinking.	1-2
No relevant content	0
Indicative content names of stages are not required, but a logical progression through stages of testing is required for Levels 2 and 3. **phase 1 clinical testing:** • tested on healthy volunteers • low doses used **reason:** • to test for side effects / toxicity / safety **phase 2 clinical testing:** • tested on patients • patients given placebo or drug • double blind trial **reason:** • to test for side effects / toxicity / safety • to test its efficacy / effectiveness **phase 3 clinical testing:** • larger numbers of patients used • patients given placebo or drug • double blind trial **reason:** • to verify efficacy / effectiveness • to determine correct dose	

prior to licensing: • analysis of results • peer review **reason:** • to check results are valid • to avoid bias	

6

[16]