



Mark schemes

Q1.

- (a) pathogens 1
- (b) viruses reproduce inside cells, damaging them 1
- (c) any **one** from:
- they do not have a cell membrane
*do **not** accept they do not have a cell wall*
 - they do not have cytoplasm
 - they do not have a nucleus
 - they do not have mitochondria (like most eukaryotic cells)
 - they do not have ribosomes
*do **not** accept they do not have chloroplasts / chlorophyll*
ignore they are not living / alive
ignore they can only replicate inside cells
ignore virus has a protein coat
- 1
- (d) a weakened form of a virus 1
- (e)
-
- 1
- (f) leaf 1
- (g) y-axis labelled rate of photosynthesis in arbitrary units 1
- correct scale 1
- all bars plotted correctly
allow a tolerance of $\pm \frac{1}{2}$ small square
allow 2 correct bars for 1 mark



	<i>allow bars touching</i>	
	<i>allow any width of bars</i>	
		2
	all bars correctly labelled	
	<i>ignore letters</i>	
		1
(h)	as the level of infection (with TMV) increases, (the rate of) photosynthesis decreases	
	<i>allow as TMV increases, photosynthesis decreases</i>	
	<i>allow (the rate of) photosynthesis decreases as the level of infection (with TMV) increases</i>	
	<i>allow as infection gets worse, photosynthesis decreases</i>	
	<i>allow TMV reduces photosynthesis</i>	
		1
(i)	less chlorophyll	
	<i>allow fewer chloroplasts</i>	
	<i>allow less light absorbed</i>	
	<i>ignore less photosynthesis</i>	
		1
	(so) less glucose / starch / protein made	
		1
		[14]

Q2.

(a)	any one from:	
	• bacteria	
	• fungi	
	• protists	
	<i>allow singular</i>	
	<i>allow names of pathogens</i>	
	<i>e.g. Salmonella</i>	
	<i>ignore virus / germ</i>	
		1
(b)	hydrochloric acid is produced by the stomach	
		1
	the skin is a barrier covering the whole body	
		1
(c)	white blood cells engulf the microorganisms.	
		1
(d)	weakened	
		1



- fast
in this order only 1
- (e) by coughs / sneezes
allow 'by droplets in the air'
*do **not** accept other means of transmission e.g. touch* 1
- (f) (from day) 10 (to day) 18
allow (from day) 18 (to day) 10 1
- (g) 14 (days)
allow in the range 13 to 15 (days) 1
- (h) any **one** from:
 - they had been vaccinated
 - they already had antibodies
 - they were immune
ignore they were resistant
 - they had had it before
 - they did not get any / enough virus from infected child
ignore they wore a mask unqualified
 - they did not play (much) with the infected child
 1
- (i) antibiotics do not kill viruses
allow antibiotics do not work on viruses
allow antibiotics only kill bacteria 1
- [11]**

Q3.

- (a) will stop animals / herbivores eating it
allow it will not be eaten 1
- (b) chemical 1
- (c) thorns / spikes / spines / prickles (to stop animals / herbivores eating it) 1
- (d) for respiration 1
- to store as starch 1
- (e) add Benedict's (solution / reagent to the liquid) 1



- boil / heat *allow any temperature of 65 °C or above* 1
- (if glucose is present the blue) colour changes to yellow / green / orange / brown / (brick) red 1
- (f) (nitrate ions are needed) to make proteins / amino acids
allow to make chlorophyll / DNA / ATP / nucleic acid 1
- which are needed for growth / enzymes / new cells
allow correct process for named molecule in mp1 1
- (g) in / on the (soil) water
allow through air (spaces) in the soil 1
- (h) dosage 1
- toxicity 1
- (i) placebos 1
- [14]**

Q4.

- (a) a protist 1
- (b) lower percentage of people with malaria when using (mosquito) nets
allow converse if clearly describing people who do not use (mosquito) nets
allow fewer people with malaria when using (mosquito) nets
*allow **only** 1.2% of people with malaria when using (mosquito) nets*
ignore reference to data from table
unqualified
*do **not** accept incorrectly calculated figures* 1
- (c) any **one** from:
 - some people who use (mosquito) nets have malaria
allow people can get malaria when they are not sleeping



- data from only one area / part of Africa
 - size of group too small **or** sample size too small **or** only 476 people
allow correlation does not imply causation
 - only 50 people did not use (mosquito) nets
or
uneven group sizes (nets vs. no nets)
 - no other information about people considered
allow examples of information not considered e.g. age, other medical issues such as sickle cell, whether taking anti-malarial medication, vaccination
ignore ref to other factors unqualified
 - people may have lied about using (mosquito) nets
- 1
- (d) any value between 88 - 91
allow decimal values
- 1
- (e) any **one** from:
- improved health care
*allow examples of improved health care such as **more / cheaper / new** treatments / vaccinations / antibiotics*
 - use of mosquito control methods
*allow descriptions such as spraying of insecticides / repellent **or** draining water holes **or** preventing mosquitoes from breeding*
 - changing behaviour to avoid being bitten (by mosquitoes)
*allow descriptions such as wear long clothing **or** avoid going out at dusk*
- 1
- (f) **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**
- prevents pathogens from entering skin***
- tough / dry / dead outer layer
 - skin acts as a barrier
 - sebum / oil on (surface of) skin
 - sebum / oil repels pathogens



- scabs form over cuts **or** scabs form a barrier
- platelets are involved in forming clots / scab

stomach

- contains (hydrochloric) acid
- (HCl) kills bacteria
- in food **or** in swallowed mucus

eyes

- produce tears
- contains enzymes to kill bacteria
- tears are antiseptic

breathing system

- trachea / bronchi / nose produce mucus
- mucus is sticky
- (mucus) traps bacteria
- (mucus) carried away by cilia

defends itself against pathogens inside the body

- immune system / white blood cells (WBCs)
- WBCs engulf pathogens
- antitoxins are produced
- (antitoxins) neutralise toxins / poisons (produced by pathogen)
- antibodies are produced
- (antibodies) help destroy pathogens
- memory cells (are formed)
- (memory cells give a) more rapid response if pathogen re-enters

a **level 2** response should refer to body defence **and** the immune system

[11]

Q5.

- | | |
|--|-----|
| (a) gonorrhoea | 1 |
| (b) the bacteria are resistant to the antibiotics | 1 |
| (c) abstain from sex(ual intercourse)
<i>allow abstinence</i>
or
wash hands after touching penis / urinating / using the toilet
<i>ignore wash hands unqualified</i> | 1 |
| (d) Level 2: Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted. | 4-6 |

Level 1: Relevant features are identified and differences noted.



1-3

No relevant content

0

**Indicative content:
qualitative statements**

- **3** works best on **A**
- **1** works best on **B**
- **2** works best on **C**
- **1** is least effective on **A**
- **3** is least effective on **B**
- **3** is least effective
or has no effect on **C**

quantitative statements

- **1** kills more of **B** and **C** compared to **A**
- **2** kills more of **C** than **A / B**
- **3** kills more of **A** than **B** and **C**
- **2** kills the same amount of **A** and **B**
- **2** and **3** killed similar amounts of **B**
- **C** are resistant to **3**
- only **2** worked well on all of the bacteria
- for **A**, **3** works best, **2** is next and **1** is least effective
- for **B**, **1** works best, **2** is next and **3** is least effective
- for **C**, **2** works best, **1** is next and **3** is least effective

for **level 2** reference to qualitative and quantitative statements is required

(e) sample **E** 1

(f) *an answer of 14 scores 2 marks*

$$\frac{15 + 12 + 13 + 16}{4}$$

1

or

$$\frac{56}{4}$$

14

1

(g) *an answer of 140 000 scores 3 marks
an incorrect answer for one step does
not prevent allocation of marks for
subsequent steps*

(area = $0.1 \times 0.1 =$) 0.01
allow 1×10^{-2}



		1
	(volume = 0.01×0.01 =) 0.0001 <i>allow 1×10^{-4}</i>	1
	(number = $\frac{14}{0.0001}$ =) 140 000 <i>allow ecf from part (f)</i> <i>allow 1.4×10^5</i> <i>do not accept 14×10^4</i>	1
(h)	Q	1
(i)	<i>allow reverse argument</i> (bacteria) could make humans ill <i>allow (bacteria) cause infection / disease</i> or (bacteria) could kill humans <i>allow (bacteria) cause appropriately named disease</i> or (bacteria) could release toxins <i>ignore harmful</i>	1 [17]

Q6.

	(a) toxins / poisons (secreted by / from / in bacteria)	1
	(b) any two from: <ul style="list-style-type: none"> • wash hands after using toilet / being sick or wash hands before preparing / handling food or do not prepare food (whilst infected) <i>ignore 'wash hands' unqualified</i> <i>ignore reference to coughing / sneezing</i> • isolate yourself <i>allow examples of how isolation could be achieved</i> • disinfect clothes / surfaces • do not share utensils / cutlery / towels 	2



- (c) antibiotics *allow named examples of antibiotics* 1
- (d) immune system is damaged / weakened **or** immune system doesn't function properly
allow immunocompromised
allow lack of / no white blood cells 1
- white blood cells cannot kill bacteria / *Salmonella* (as effectively)
allow no / fewer antibodies so bacteria not killed or less phagocytosis so bacteria not killed or no / fewer antitoxins to counter toxins 1
- (e) any **one** from:
- (give chickens) antibiotics
allow (give chickens) monoclonal antibodies
 - don't sell infected chickens / eggs
allow don't sell the chickens / eggs
ignore don't sell chickens / eggs
 - keep infected chickens isolated / indoors
allow keep the chickens indoors
ignore keep chickens indoors
 - slaughter the infected chickens
ignore vaccination / chlorination / disinfection
- 1
- (f) (cleaning liquid) B
and
 greater reduction in number of bacteria (after cleaning) in both locations
ignore few bacteria in both locations
*allow neither / both **and** idea of experimental error* 1
- (g) radius (of area with no bacteria growing)
allow diameter (of the area with no bacteria growing)
ignore πr^2 unqualified
allow idea of placing agar plate onto graph paper and counting the squares not covered with bacteria 1



- (h) repeat **and** look to see if results are similar
ignore repeat unqualified
*allow repeat **and** look to see if results are different*
allow repeat and see if there are anomalies
ignore repeat and identify anomalies
ignore repeat and compare unqualified

1

- (i) any **one** from:
- toxicity / side / health effects
ignore harmful / dangerous
allow reference to allergies

 - effect on other types of bacteria / pathogens
allow not tested on other types of bacteria
ignore germs

 - interaction with other cleaners
 - ease of use
 - dilution factor of each cleaner (vs. cost)
ignore concentration unqualified

 - time cleaner is effective for
ignore how long the cleaner lasts for
allow reference to odour of cleaning liquid
ignore reference to cost unqualified
ignore environmental effects / flammability

1

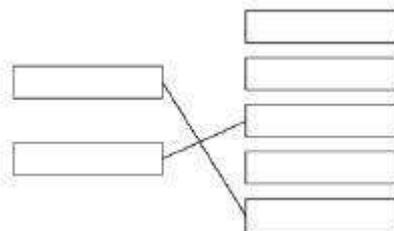
[11]

Q7.

(a) bacteria

1

(b)



extra line from a drug negates the mark for that drug

2



- (c) any **one** from:
- to check they are safe
 - to check they are effective
allow to check they work or to check for the (right) dose
 - to check for side effects
allow to check for toxicity

1

- (d) testing on healthy volunteers

1

- (e) **Level 2 (3-4 marks):**

Relevant points (reasons / causes) are identified, and there are attempts at logical linking.

Level 1 (1-2 marks):

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

0 marks:

No relevant content

Indicative content

- dead / inactive pathogen
- introduced to the body
- white blood cells respond
- produce antibodies
- antibodies are specific to pathogen
- antibodies produced quickly (on reinfection) / rapid response
- in larger quantities
- killing the pathogen

[9]

Q8.

- (a) a fungus

1

- (b) **Level 3 (5-6 marks):**

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

Level 2 (3-4 marks):

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

Level 1 (1-2 marks):

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

Level 0

No relevant content



Indicative content

	defence	description of defence
animals	skin	sebum / oils to kill microbes dead layer difficult to penetrate
	nose	hairs keep out dust and microbes
	trachea / bronchi	mucus traps microbes cilia moves mucus
	stomach	(hydrochloric) acid kills bacteria
	white blood cells	produces antibodies produces antitoxins engulf microbes / phagocytosis
plants	cell wall	tough / difficult to penetrate
	waxy cuticle	tough / difficult to penetrate
	dead cells / bark	fall off, taking pathogens with them
	production of antibacterial chemicals	kill bacteria
fungi	antibiotic production	kill bacteria

6

(c) any **three** from:

- sterilise agar (before use)
- sterilise (Petri) dish before use
- disinfect bench (before use)
- pass inoculating loop (through flame)
- secure lid with (adhesive) tape
- minimise exposure of agar / culture to air / lift and replace lid as quickly as possible

allow:

- *dip loop into ethanol (after flaming)*
- *keep the lid on the plate for as long as possible*
- or**
- minimise exposure of agar to air*
- or**
- only tilt the lid off (rather than remove it)*
- *flame the neck of the bottle*

3

(d) to prevent the growth of a harmful pathogen

1



[11]

Q9.

- (a) any **two** from:
- regular hand washing
 - or**
 - use hand sanitiser / alcohol gel
 - cover nose / mouth when coughing / sneezing
allow wear a face mask
 - put used tissues (straight) in the bin
 - don't kiss uninfected people
allow isolate patient from others
 - or**
 - don't share cutlery / cups / drinks with uninfected people
 - clean / disinfect / sterilise surfaces regularly
ignore responses referring to infected people
- 2
- (b) any **three** from:
- stimulate (mouse) lymphocytes to produce antibody
for marking points 1 and 2 lymphocyte must be used at least once
 - combine (mouse) lymphocyte with tumour cell
 - or**
 - (create a) hybridoma
 - clone (hybridoma) cell
 - (hybridoma) divides rapidly **and** produces the antibody
- 3
- (c) any **two** from:
- (monoclonal) antibody binds to virus **or** antibody binds to antigen on surface of virus
 - (monoclonal) antibody is complementary (in shape) / specific to antigen (on surface of virus)
 - white blood cells / phagocytes kill / engulf the virus(es)
- 2
- (d) as a control
- or**
- to see / compare the effects of the treatment (vs. no treatment)
- 1
- (e) $(4.8 + 10.4) \div 2 \div 100 \times 1500$
- or**
- $(4.8 \div 100 \times 750) + (10.4 \div 100 \times 750)$
- 1
- 114
- an answer of 114 scores 2 marks*
- allow 228 for 1 mark*
- 1
- (f) **(supports the conclusion because)**
over double the number / % of patients (in the trial) were hospitalised with



the placebo (compared to MAB)

1

(does not support the conclusion because)

no information on patients not hospitalised / still unwell at home
or

other factors may have affected those admitted to hospital

allow correct named factor e.g. age / gender / other illness

or

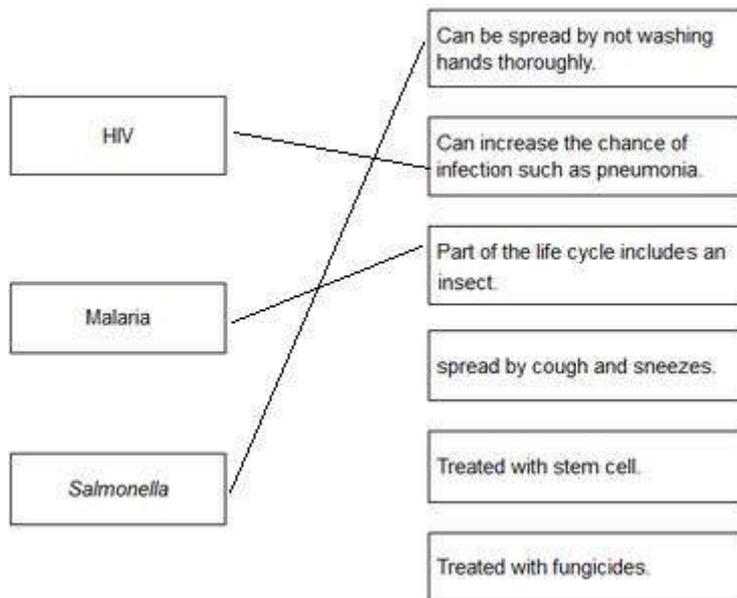
don't know if it was a double blind trial

1

[12]

Q10.

(a)



each extra line negates a mark

4

(b) pain when urinating

1

yellow discharge

1

(c) three correct plots

allow 1 mark for two correct plots

2

correctly drawn line

1

(d) any **three** from:



- (fairly) level / steady up to 2009
*allow numbers of males fall (slightly) **and** females rise (slightly) up to 2009*
- (there is a) rise after 2009
- males are (always) higher than females
- males rising faster than females
allow overall increase (from 2005 to 2013)

3

(e) HIV is a virus

1

(and) antibiotics are only effective against bacteria
or
antibiotics do not kill viruses
allow viruses live inside cells

1

[13]

Q11.

(a) any **two** from:

- acid in the stomach kills pathogens in food
 - skin forms a barrier / produces antimicrobial secretions
 - hairs in the nose trap (particles which may contain) pathogens
 - trachea / bronchi has mucus which traps pathogens
- or**
- bronchi have cilia which waft mucus to throat to be swallowed

2

(b) **Level 3 (5–6 marks):**

A clear, logical and coherent answer, with no significant redundancy. The student understands the process and links this to reasons for clinical trials.

Level 2 (3–4 marks):

A partial answer with errors and ineffective reasoning or linkage.

Level 1 (1–2 marks):

One or two relevant points but little linkage of points or logical reasoning.

0 marks:

No relevant content.

Indicative content

- pre-clinical trials of the new drug on cells / tissues / live animals
- to test toxicity, dosage and efficacy
- clinical trials / test on healthy volunteers and Ebola patients at very low doses
- so that you can monitor for safety / side effects
- and only then do trials to find the optimum dosage and test for efficacy
- double blind trial / use of placebo
- which does not contain the new drug
- random allocation of Ebola patients to groups
- so no one knows who has placebo / the new drug



- peer review of data
 - to help prevent false claims
- 6
[8]

Q12.

- (a) vector 1
- (b) any **three** from:
- destroy the snails
 - isolate infected dogs
 - treat infected dogs
 - allow vaccination*
 - educate owners about picking up dog faeces 3
- (c) stop mosquitoes breeding 1
- allow correct description*
- use mosquito nets 1
- allow use of insect repellent* 1
- [6]

Q13.

- (a) (i) small amounts of dead pathogens 1
- (ii) decrease 1
- by 60 (%) 1
- allow from 70(%) to 10(%)*
- allow other correct data treatment*
- (b) (i) penicillin 1
- (ii) any **two** from:
- antibiotics only kill bacteria *allow antibiotics do not kill viruses*
 - some bacteria are resistant (to antibiotics) *allow MRSA not killed by antibiotics*
 - (correct) antibiotics not always used *allow course not completed*
 - deficiency disease(s) not caused by bacteria **or** cannot be treated by antibiotics
 - inherited disease(s) not caused by bacteria **or** cannot be treated by antibiotics
 - 'lifestyle' diseases not caused by bacteria **or** cannot be treated



by antibiotics
eg heart disease / cancer
if no other mark given allow **1** mark for not all
diseases are caused by bacteria **or** some diseases
are caused by viruses

2

- (c) bacteria grow faster
allow this is body temp (at which pathogens grow)

1

[7]