CAMBRIDGE INTERNATIONAL AS & A LEVEL BIOLOGY · 9700

BIOLOGY



MARK SCHEME

10 INFECTIOUS DISEASES

SCORE	PERCENTAGE
/	%

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Paper 1 Multiple Choice Answers: Infectious Diseases

Question	Paper	Q. No.	Answer
1404	9700_m20_qp_12	35	D
1405	9700_m20_qp_12	36	D
1406	9700_s20_qp_11	36	A
1407	9700_s20_qp_11	37	D
1408	9700_s20_qp_12	35	D
1409	9700_s20_qp_13	37	A
1410	9700_w20_qp_11	35	B
1411	9700_w20_qp_11	36	A
1412	9700_w20_qp_12	36	A
1413	9700_w20_qp_13	35	C
1414	9700_w20_qp_13	37	D
1415	9700_m19_qp_12	35	C
1416	9700_m19_qp_12	36	D
1417	9700_s19_qp_11	37	D
1418	9700_s19_qp_11	38	A
1419	9700_s19_qp_12	34	A
1420	9700_s19_qp_12	35	C
1421	9700_s19_qp_12	36	A
1422	9700_s19_qp_12	37	D
1423	9700_s19_qp_13	37	A
1424	9700_s19_qp_13	39	A
1425	9700_w19_qp_12	35	D
1426	9700_w19_qp_13	36	D
1427	9700_m18_qp_12	36	D
1428	9700_s18_qp_11	35	C
1429	9700_s18_qp_12	36	A
1430	9700_s18_qp_12	37	D
1431	9700_s18_qp_13	39	A
1432	9700_w18_qp_11	36	C
1433	9700_w18_qp_11	37	B
1434	9700_w18_qp_12	36	A
1435	9700_w18_qp_13	35	B
1436	9700_m17_qp_12	38	B
1437	9700_s17_qp_11	39	B
1438	9700_s17_qp_12	36	A
1439	9700_s17_qp_12	37	D
1440	9700_s17_qp_12	38	A
1441	9700_s17_qp_13	35	D
1442	9700_w17_qp_11	35	A
1443	9700_w17_qp_12	37	C
1444	9700_w17_qp_13	38	C
1445	9700_m16_qp_12	35	B
1446	9700_m16_qp_12	36	C
1447	9700_s16_qp_11	37	C
1448	9700_s16_qp_11	38	B
1449	9700_s16_qp_12	35	C

Paper 1 Multiple Choice Answers: Infectious Diseases (continued)

Question	Paper	Q. No.	Answer
1450	9700_s16_qp_12	36	C
1451	9700_s16_qp_12	37	A
1452	9700_s16_qp_13	36	B
1453	9700_s16_qp_13	38	B
1454	9700_w16_qp_11	36	C
1455	9700_w16_qp_11	37	A
1456	9700_w16_qp_12	37	B
1457	9700_w16_qp_12	38	C
1458	9700_w16_qp_13	35	A
1459	9700_w16_qp_13	36	D
1460	9700_w16_qp_13	37	B
1461	9700_s15_qp_11	34	B
1462	9700_s15_qp_11	35	A
1463	9700_s15_qp_12	34	A
1464	9700_s15_qp_12	35	B
1465	9700_s15_qp_13	35	C
1466	9700_m20_qp_12	37	A
1467	9700_s20_qp_11	38	D
1468	9700_s20_qp_12	36	B
1469	9700_s20_qp_12	37	D
1470	9700_s20_qp_13	38	D
1471	9700_w20_qp_11	37	B
1472	9700_w20_qp_12	37	A
1473	9700_w20_qp_13	36	D
1474	9700_m19_qp_12	37	D
1475	9700_s19_qp_13	38	C
1476	9700_w19_qp_11	36	A
1477	9700_w19_qp_11	37	C
1478	9700_w19_qp_12	37	D
1479	9700_m18_qp_12	37	C
1480	9700_s18_qp_11	36	B
1481	9700_s18_qp_11	37	D
1482	9700_s18_qp_13	38	D
1483	9700_w18_qp_12	37	B
1484	9700_w18_qp_13	36	D
1485	9700_s17_qp_12	35	D
1486	9700_s17_qp_13	36	C
1487	9700_s17_qp_13	37	D
1488	9700_w17_qp_12	38	A
1489	9700_w17_qp_13	37	B
1490	9700_m16_qp_12	37	D
1491	9700_s16_qp_13	37	C
1492	9700_w15_qp_12	34	B
1493	9700_w15_qp_13	35	D

183. 9700_s19_ms_22 Q: 4

(a)	*max 3* if any membrane-bound organelles drawn inside cell e.g. nucleus, Golgi body, mitochondrion, lysosome, ER, a large vacuole BUT **I** vesicle / small vacuoles **I** detail of cell wall / cell surface membrane around flagellar area *four from:* cell wall ; *must add another line to diagram* **R** cellulose cell wall cell (surface) membrane ; **A** plasma membrane *label line to the inside of cell wall* **I** if outer line labelled as cell membrane DNA ; **A** bacterial chromosome / nucleoid *as label* *allow one or two circular molecules* (*circle, loop, ball of string, tangled)* **R** *if obviously linear* **R** if label includes, histones / histone proteins / chromatin **R** if nuclear, envelope / membrane, shown **R** if nucleolus shown or labelled ribosomes ; **R** 80S ribosomes *shown as, dots / small spheres* cytoplasm / cytosol ; plasmid ; *smaller than DNA, circular* AVP ; e.g. 70S / smaller / 17–20 nm, *for ribosome* murein / peptidoglycan (for cell wall – allow even if cell wall label not added) pilus /pili *drawn as external hair-like structure(s)* basal granule *at base of flagellum* capsule drawn to outside *(some do have a capsule)*	**4**
(b)(i)	0.8 % ; **R** 0.80 %	**1**
(b)(ii)	*any two from:* delay in / no, diagnosis ; delay in / no, treatment / therapy ; **A** feature of, oral rehydration, treatment /solution **A** ORT / ORS e.g. lack of supply of ORT unwillingness by health workers to give ORT greater belief in herbal remedies thinking drug treatment is sufficient lack of clean water to make up ORT solution no rehydration programmes **I** improper treatment / treatment not effective *ref. to* no / lack of, antibiotic therapy ; e.g. lack of supply of / less efficacious (AW) antibiotics used / less supervision in taking full dose *ref. to* antibiotic resistant strains ; *idea that* already have a weak immune system / malnourished ; **A** may have HIV/AIDS (hence weak immune system)	**2**
(c)(i)	*any one from:* damaged sanitation system / poor sanitation following earthquake ; **I** poor sanitation unqualified damage to, sewage treatment plants / water purification plants ; AW (contaminated) sewage contaminates drinking water ; **I** pollution **A** water becomes contaminated lack of purified drinking water; **A** lack of, clean / treated / safe / bottled, water AVP ; no, proper / safe, disposal of sewage	**1**
(c)(ii)	*any three from:* **1** 2011, peak in / highest / AW, number of, cases / countries / countries and cases ; **A** decrease, increase in 2011, decrease *for countries* **A** increase to 2011 and decrease *for cases* **2** (2010 outbreak in) *ref. to* Haiti and epidemic (so high number of 2011 cases) ; **3** *ref. to* spread of disease to countries neighbouring Haiti (hence increase in countries in 2011) ; **4** overall / generally / AW, decrease in number of countries with cases of cholera **or** 2008 54–56 countries and 2015 41–43 countries, with ref. to decrease ; *decrease, peak at 2011 / increase in 2011, decrease is mp1 only* **5** suggestion for trend in decrease in number of countries ; e.g. improved infrastructure for sewage / water treatment improved health education to prevent spread providing piped (treated) water **6** 2008–2010 number of cases increased and number of countries decreased ; **7** AVP ; e.g. lowest / AW, number of cases in 2013 **R** if also state that 2013 is lowest for countries similar number of countries in 2008 and 2011 but, approx 3× / much higher / stated values, number of cases in 2011	**3**

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184. 9700_s18_ms_22 Q: 5

(a)	*three from:* any four named structures ; mouth / nose / nostrils / nasal passages (count as one structure) pharynx larynx trachea **A** windpipe bronchus / bronchi bronchiole / bronchioles alveolus / alveoli / alveolar ducts / alveolar sacs lungs trachea, branches / divides, into (two main) bronchi ; correct sequence from bronchus (branching) to bronchioles to (end with) alveoli ; further detail ; ; e.g. trachea has, C-shaped / incomplete rings, of cartilage bronchus has cartilage, plates / AW diameters of gas exchange structures / respiratory tubes, decrease (towards alveoli)	**3**
(b)	*two from:* blood pressure, decreases / returns to normal ; platelets no longer sticky / risk of thrombosis decreases / risk of blood clotting decreases ; endothelial repair (more likely to be) successful ; **A** endothelium no longer damaged **A** decreased risk of, atheroma / atherosclerosis **I** less fatty deposits heart rate, decreases / returns to normal ; **I** heartbeat decreases AVP ; e.g. increased peripheral circulation / AW blood vessels, not / less, constricted **A** less vasoconstriction **A** blood vessel (lumen) diameter increases / vasodilation occurs	**2**
(c)	*four from:* *assume from point of view of giving up smoking unless stated otherwise* *in lungs / at high partial pressures of oxygen* 1 (so) more oxygen taken up by haemoglobin / haemoglobin more saturated (with oxygen) / AW ; **A** haemoglobin has, increased / normal, affinity for oxygen 2 before and after data / calculated difference in data, to support, from 10 kPa ; 3 carbon monoxide no longer binding to haemoglobin / AW ; **A** carboxyhaemoglobin no longer forming / ora with ref. to smoking **A** haemoglobin has a higher affinity for CO than oxygen 4 more (sites on) haemoglobin available to take up oxygen ; *in respiring tissues* 5 more oxygen dissociates from (oxy)haemoglobin / AW, at, lower partial pressures / below 4 kPa / in (respiring) tissues (after stopping) ; **A** haemoglobin less saturated (with oxygen) **A** haemoglobin has, less / decreased, affinity for oxygen 6 before and after data / calculated difference in data, to support ; 7 ref. to increase in allosteric effect / regains ability for conformational change / AW ; *health benefits after stopping* 8 more / sufficient, oxygen to, transport / deliver to, tissues / body **or** more oxygen to reach (respiring) tissues ; **A** less, tired / fatigued **A** more able to, do work / carry out exercise / be mobile **R** more energy unless qualified with link to aerobic respiration	**4**
(d)	*two from:* *non-infectious* not from a pathogen ; **A** bacteria / viruses / fungi *for pathogens* **A** from lifestyle **A** tar / carcinogen in smoke, causes mutation (in cells of lung) cannot be passed onto another person / not transmissable / AW ; *disease* abnormal condition (affecting an organism) / condition that reduces the effectiveness of the functions of the organism / AW ;	**2**

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185. 9700_s18_ms_23 Q: 4

(a)	*answers must be in context of oxygen* *three from:* 1 diffusion 2 movement, down a, concentration / diffusion, gradient / from high(er) to low(er) concentration ; **A** in terms of partial pressure 3 passive (process) ; 4 through alveolar wall / across alveolar cells / across squamous epithelial cells (of alveolus) / across pavement cells (of alveolus) ; **A** squamous cells 5 across, endothelium / endothelial cells / capillary wall ; **A** squamous, epithelium / cells (in context of capillary wall) 6 ref. to diffusion / AW, through the phospholipid bilayer of cell surface membranes / between the phospholipids of the bilayer (of squamous or endothelial cells) ;	**3**
(b)(i)	65 / 66 / 67 (%)	**1**
(b)(ii)	1 higher partial pressures in lungs / lower partial pressures in (respiring) tissues ; **A** correct values / range of values, of kPa **A** in alveoli *advantages of differences (higher v lower partial pressure)* *only higher partial pressure or lower partial pressure explanation required to gain mark* 2 oxygen, binds to v released from, haemoglobin **or** oxyhaemoglobin, is formed v dissociates / AW ; 3 (so) percentage saturation of haemoglobin (with oxygen) high v low ; 4 affinity of haemoglobin for oxygen high v low ; 5 data from Fig. 4.1 to support ; 6 (body), cells / tissues, need oxygen for aerobic respiration ;	**3**
(c)	*idea of* abnormal, change in the body / condition, which produces, poor / ill-, health **or** absence of, good health / well-being ; **A** disorder / illness further detail ; e.g. having an adverse effect reduces the effectiveness of functions produces, (specific) signs / symptoms lack of social, physical and mental, well-being can be infectious or non-infectious AW	**2**
(d)	*five from:* 1 base substitution (in gene coding for, β-globin / polypeptide) ; 2 different / altered, mRNA codon ; 3 different tRNA brings a different amino acid (to ribosome) / leads to a change in one amino acid (in the polypeptide chain) ; 4 altered, primary structure / sequence of amino acids (in β-globin) ; 5 changed, tertiary / quaternary, structure ; 6 haemoglobin / molecule, less soluble ; 7 (haemoglobin) molecules, stick together / form fibres ; 8 (haemoglobin) less able to bind oxygen / AW ; *points above may be qualified* 9 details ; ; + e.g. thymine / T, replaces, adenine / A 10 in sixth, codon / triplet **or** sixth amino acid in sequence is changed (non-template strand) GTG instead of GAG / GTA instead of GAA **or** (template strand) CAC instead of CTC / CAT instead of CTT mRNA codon is, GUG instead of GAG / GUA instead of GAA 11 (amino acid change is) valine instead of glutamic acid ; 12 amino acid with non-polar side chain instead of polar side chain ; 13 position of amino acid, is to the exterior / faces cytosol ;	**5**

186. 9700_s18_ms_23 Q: 6

(a)	**A** HIV / AIDS, measles, smallpox ; **B** cholera, tuberculosis ; **C** cholera ; **D** malaria ;	**4**
(b)	one mark for each correct column ; ; nuclear envelope circular / (closed) loop / **A** ring of 80S mitochondria / chloroplasts **A** nucleus murein / peptidoglycan	**2**

187. 9700_w18_ms_23 Q: 5

(a)(i)	*Mycobacterium*, *tuberculosis* / *bovis* ;	**1**
(a)(ii)	*any three from* **1** phagocytes / macrophages / neutrophils / elastase, breaks down / weakens, alveolar walls ; **2** (reduced elastin so) alveoli cannot stretch and recoil / alveoli overstretch ; **3** alveoli burst / one large air sac formed ; **4** surface area (for gas exchange) is reduced ; **5** less oxygen absorbed by blood / reduced oxygen supply (to tissues) / not enough oxygen for (aerobic) respiration / AW ;	**3**
(b)	**R** cost *any five from* **1** *Transmission* ; e.g. aerosol / droplet, infection **I** airborne **A** lack of pasteurised milk overcrowded, housing / living conditions / AW migration / travel, from areas with high rates of TB reservoir of infection in people not, diagnosed / not treated **2** *HIV / immunodeficiency* ; e.g. infection with HIV may activate (dormant) TB (pathogen) immunodeficiency / AW, makes people more susceptible to TB intravenous drug taking increases risk of, immunodeficiency / HIV **3** *Diagnosis is difficult* ; e.g. TB (pathogen) remains dormant / symptomless carriers limited access to health care for diagnosis / AW *idea that* contact tracing is difficult	**5**
(b)	**4** *Treatment* ; e.g. treatment is long term / treatment may not start early enough people may not finish the course of treatment limited access to health care for treatment **5** *Acquired resistance* ; e.g. bacterium / TB (pathogen), develops resistance to, antibiotic(s) / drug(s) multi-drug resistance / MDR-TB / XDR-TB **6** *Vaccination* ; e.g. vaccine may not always be effective in providing protection difficult to achieve herd immunity concerns / misconceptions, about vaccination limited access to vaccination (programmes) poor (immune) response in people who are malnourished poor thermostability of vaccine **7** *Education* ; e.g. limited education / low awareness, about prevention for general population limited education / low awareness, for health care professionals	**5**

188. 9700_s17_ms_22 Q: 3

(a)	*(Plasmodium) falciparum / malariae / ovale / vivax* ;	**1**
(b)	*Anopheles* ; **I** female / male **I** specific epithet e.g. *gambiae*	**1**
(c)	*look for ora* **1** higher / better / AW, resolution / resolving power ; **2** { 0.5 nm (**A** 0.2–1 nm) compared to, 200 nm 0.2 μm (**A** range 100–300 nm) **or** electrons have shorter wavelength ; **R** electron microscope has a shorter wavelength **or** *idea that* cell structures too small to interfere with light waves ora } **3** better able to distinguish between two points ; **A** as a definition if mp 1 achieved **4** (can see) more detail ; *treat 'clearer' as neutral* **5** able to make thinner sections / able to see inside (oocyst) ; **6** can continue to obtain higher magnifications and see more detail ;	**max 2**
(d)	(magnification =) $\frac{\text{image / scale bar (length)}}{\text{actual / object (length)}}$; **A** triangle / letters only (x) 500 ;; *using 10 mm as measured length* **A** calculated values for measured length of 9 mm or 11 mm *allow one mark if correct answer given with units* *allow one mark if incorrect answer and* *correct measurement and correct working* *correct measurement and formula but incorrect conversion* *measurement ±2 mm and correct working*	**3**
(e)	vector ; *ref. to* feeding / taking / AW, blood (from a person) ; e.g. taking blood meals / *Plasmodium* enters blood during feeding infective cells / *Plasmodium* / pathogen / parasite / AW, enter (person) with, anticoagulant / saliva ; **I** malaria / disease, enters **A** *idea that,* infective cells / *Plasmodium*, in saliva / salivary glands AVP ; e.g. *ref. to* providing correct conditions for, part of *Plasmodium* life cycle / sexual reproduction in *Plasmodium*	**max 2**
	Total:	**9**

189. 9700_s16_ms_21 Q: 1

must have correct spellings of Plasmodium *and* Vibrio cholera

feature	malaria	tuberculosis	cholera
name of pathogen	*Plasmodium* ;	*Mycobacterium tuberculosis*	*Vibrio cholerae* ;
type of organism	protoctist / protoctistan ; **A** protist / protozoan / sporozoan	bacterium	bacterium ; **A** bacteria
mode of transmission	by, a vector **or** (feeding or biting by) *Anopheles* / mosquito ;	via, (airborne) droplets / aerosol(s) (infection) ;	drinking water and food contaminated with human faeces

[6]

[Total: 6]

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190. 9700_s15_ms_22 Q: 2

(a) **1** cilia, qualified **;** e.g. absent / short / destroyed / smaller / damaged / AW
R cilia killed **R** hairs for cilia **R** mucus damages cilia
A ciliated (epithelial) cells, absent / destroyed / damaged

2 ref. to presence of, scar tissue / scarring **; BOD** scar
R cilia are scarred (idea is, scar tissue formation / more connective than usual)
note idea of scar tissue in place of, cilia / ciliated epithelium = 2 marks

3 idea of affecting, coordinated movement / synchronous rhythm, (of cilia) **;**
A cilia paralysed
A if stated that excess mucus inhibits movement
A ecf if 'hairs' instead of cilia for mp 1

4 mucus, not moved (effectively) **/** accumulates **;**

5 idea that, bacteria / *B. pertussis* / *Bordetella* / pathogens, accumulate (in airways) / are trapped in mucus
A mucus, good growth medium for pathogens / AW **[max 3]**

(b) mucous gland **;** **A** mucous glands **[1]**

(c) if another mode of transmission given (e.g. faecal-oral / contact / sexual transmission) = 0 marks for this part-question **I** in unpasteurised milk

1 <u>aerosol / droplet, infection</u> **;**

only need to have one of 'infected' / 'uninfected' to gain mps 2 and 3

2 infected / AW, person, coughs / breathes / spits / talks / sneezes **;**

3 uninfected / AW, person, inhales / inspires / breathes in, droplets **;**

2 / 3 *allow one mark if mps 2 and 3 given with no reference to, infected / uninfected*

4 organism / pathogen / bacteria / *B. pertussis*, in, airborne droplets / droplets in air **;**
A without 'airborne' or 'in air' *if mp 2 gained* **[max 2]**

(d) (i) **1** DNA / gene / *MUC5AC*, unwinds / AW ; **I** unzips
2 H-bonds break between, (complementary) bases / base pairs / strands ;
I unzips
3 one / a, strand, acts as template / (complementary) copied ;
I ref. to, sense / coding and antisense / non coding
4 ref. to (involvement of) RNA polymerase ;
I ref. to direction of, movement / strand formation
5 (free) complementary RNA nucleotides added ;
A described in terms of correct base-pairs (C with G and A with U minimum)
6 step-by-step / sequentially / AW ;
7 sugar phosphate backbone sealed / phosphodiester bonds formed ;
A sugar phosphate backbone formed
8 (product is) messenger RNA / mRNA ; **A** primary transcript
9 AVP ; e.g. transcription factors required to initiate transcription
RNA polymerase binds to promoter (sequence)
helicase unwinds
ref. to activated (RNA) nucleotides
ref. to proof reading
(transcription ends at) transcription terminator **[max 4]**

(ii) Golgi (body / complex / apparatus) ;
A RER / rough ER / rough endoplasmic reticulum
one of
2 transport / movement, to cell (surface) membrane (from Golgi) ;
A through cytoplasm (for Golgi or RER)
A transport to Golgi *if RER given in mp1*
3 ref. to bulk transport, across cytoplasm / to cell surface membrane ;
4 ref. large size and difficulty of movement across, cell / cell surface membrane ;
5 it, functions extracellularly / is released to the outside of the cell / is secreted ;
I ref. to exocytosis *as it is in the question* **[max 2]**

(e) **1** shortness of breath / dyspnea / difficulty breathing / restriction of airflow ;
A rapid breathing **R** heavy breathing
2 chronic / persistent / AW, cough / coughing ; **I** cough, blood / mucus
A constant coughing **A** smoker's cough
3 chest tightness ; **A** chest pain **R** heart pain
4 wheezing ;
5 fatigue / weakness ;
6 difficulty, when exercising / with physical activity / with mobility ;
7 more prone to / frequent, chest / respiratory / named, infections ;
8 barrel (shaped) chest ;
9 cyanosis (blue, face / fingers)
10 AVP ; e.g. weight loss / anorexia
swollen, ankles / feet
not excess mucus as this is in the question **[max 4]**

[Total: 16]

191. 9700_w15_ms_22 Q: 5

(a) *assume response refers to infectious unless otherwise stated*

caused by a pathogen **;** **ora A** microorganism / microbe
transmissible / communicable / passed from one, organism / person, to another **;**
ora

examples to support explanation
two examples of pathogen types **;** *two of:*
bacterium / bacteria
virus / viruses
fungus / fungi
protoctist **A** protozoa

example of non-infectious, disease / category **;**
e.g. genetic disorders / named (e.g. sickle cell anaemia / cystic fibrosis)
cancer / named cancer (e.g. lung)
degenerative disease / named (e.g. chronic bronchitis, emphysema / COPD / coronary heart disease) lifestyle / AW

(b) (red blood cells contain) haemoglobin **;**
plasma proteins **;** **A** plasma contains proteins
named protein in blood plasma or within (red / white) cells **;**
e.g. fibrinogen / albumin / globulin / antibodies / (protein) hormone / enzyme / transport proteins / membrane proteins
R steroid hormone / named steroid hormone [max 2]

(c) **(i)** not all countries with *Anopheles* have malaria / example using Fig. 5.2 **;**
e.g. (although, Anopheles / vector, shown as present),
no / few, cases (of malaria) in, North America / Europe
(although, *Anopheles* / vector, occurs elsewhere) malaria, only / mainly, in subtropical and tropical areas **;**

explanations:
Plasmodium / parasite / pathogen, not present in all areas where *Anopheles* is located / AW **;**
conditions (where *Anopheles* located) not always suitable for life cycle of, *Plasmodium* / parasite / pathogen **;**
some, areas / countries, have eradicated the disease (but still have the vector) **;**
AVP **;** e.g. some countries have better prevention methods against malaria
AVP **;** some countries have effective treatment for malaria
I vaccination [max 3]

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(c) (ii) *assume ref. to A. gambiae unless stated otherwise*

occurrence
1 (in Africa) wide distribution / large numbers **;**
2 occurs where high density of humans **;**
3 occurs (in climate) where *Plasmodium* is, present / able to survive **;** AW **A** e.g. *idea of* Plasmodium requiring temperatures above approx. 20 °C where *A. gambiae* is also present

well adapted ***or*** *better adapted than other mosquito vectors*
4 better adapted to complete life cycle / lays eggs in large variety of habitats / can withstand (more) polluted waters / larvae able to eat a wide variety of food **;**
5 short(er) life cycle / long(er) breeding season **; A** reproduces quickly
6 withstands, dry / drier, conditions / larger temperature variation / higher temperatures **; I** better adapted to climate
7 (more) resistant to, pesticides / insecticides **; R** immune

feeding
8 feed mainly / AW, on human blood **;**
9 takes, large(r) / more frequent, blood meals **;**
10 takes blood meal / bites / feeds, at night (when humans less able to notice) **;**
11 mouthparts, well adapted for feeding on humans / can penetrate clothing**;**

as host for Plasmodium
12 good host for / very susceptible to, parasite / *Plasmodium* **;**

AVP **;** e.g. able to migrate to find hosts
quick to adapt to changing human habitation
better adapted to find (human) hosts
females live for longer
A. gambiae present in Africa, where, malaria control is difficult

[max 3]

(d) (i) large egret / yellow winged bat / eastern green mamba **;** [1]

(ii) **1** insufficient numbers of bats **;**
2 (so) not enough energy / energy available is low (to sustain needs) **;**
3 energy loss at each level / progressively less energy transferred / inefficient / transfer of energy / AW **;**
4 example of energy loss from bat intake **;** *in context of mamba feeding* e.g. inedible parts / named indigestible parts / faeces / egestion
5 example of energy loss in food chain (to bat) **;**
e.g. death but not eaten
excretion
respiration
heat loss, in movement / digestion
allow either point below if not awarded for mp 4
inedible parts / named examples
indigestible parts / faeces / egestion [max 3]

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(iii) use biological control **;**
introduce / increase numbers of / AW, predators (of mosquito) / named e.g. guppy / dragonfly / yellow winged bats **;**
to eat / consume / reduce number of, mosquitoes **;**
grow crops other than sweet potato / grow less sweet potato **;**
A do not grow sweet potato
numbers (of mosquito) reduce so fewer, act as vectors / feed on humans **;**
AVP **;** e.g. use genetic modification to produce sweet potato crop with toxin against mosquito [max 2]

(e) nectar / nectaries / flowers / phloem (tissue) **/** (phloem) sap / sieve tubes / vascular bundles / stem / leaf **;**
I *ref. to*, source / sink
R if includes, roots / 'potatoes' / xylem, *for this mp only, then for mp 2 allow explanation for the other stated part that is correct*

explanation **;**
e.g. fluid feeders / piercing and sucking mouthparts / proboscis for feeding
(fluids provide) source of carbon / energy / sugar / sucrose
A glucose / fructose
(fluids provide) source of, nitrogen / amino acids
near to, vascular bundles / phloem *for, stem / leaf*
for phloem sap / AW *for vascular bundles* [2]

[Total: 18]

192. 9700_w20_ms_21 Q: 3

(a)(i)	blood, travels through the heart twice for every one complete, circuit (of the body) / circulation **or** blood, travels through the heart twice and through pulmonary and systemic, circulations / systems / circuits ; **A** description of both circulations	**1**
(a)(ii)	chordae tendineae / tendinous cords ; **A** tendons / 'heart strings' *any **two** from:* *idea that* (atrioventricular) valve, held in position / prevented from inverting, during ventricular, systole / contraction ; **A** AV valve *for atrioventricular valve* connect the papillary muscle to the (atrioventricular / AV), valve ; *ref. to* tension, in the chordae tendineae / AW, (during ventricular contraction) ; (allows valve to) prevent backflow of blood into atrium / ensure one way blood flow (through the heart) ; *ecf max 2 marks for function if structure A is a correctly named valve (atrioventricular / tricuspid / bicuspid)*	**3**
(b)(i)	*idea of* using both antibiotics makes sure all bacteria are killed ; if, resistance against one antibiotic occurs then, the other antibiotic will be effective / bacteria still susceptible to the other antibiotic **or** if, some bacteria are less susceptible to one antibiotic, then, the other antibiotic will be effective / bacteria still susceptible to the other antibiotic ; *any **one** from:* antibiotics / gentamicin and penicillin G, have different sites of action / AW ; **A** suggestion of how the antibiotics have different ways of killing *ref. to* mutations, qualified ; e.g. need two mutations to occur to be resistant to both antibiotics probability / AW, of these two mutations occurring in the same bacterium is very small mutations must be in different genes	**2**
(b)(ii)	*any **three** from:* course of antibiotic is not completed ; less susceptible bacteria survive ; **A** not all bacteria destroyed replication / population growth, increases chance of mutation ; *ref. to* random mutation, ref to gene / allele, for resistance to gentamicin ; suggestion of outcome of different mutations ; e.g. changed ribosome structure so gentamicin cannot bind enzyme to breakdown gentamicin *ref. to* transmission of allele for resistance ; e.g. vertical transmission / described horizontal transmission / described (conjugation / transformation) e.g. frequency of allele for resistance increases in the population ; *when antibiotic next prescribed* antibiotic in the environment is the selection pressure / resistant bacteria selected for / susceptible bacteria selected against ;	**3**

193. 9700_w20_ms_22 Q: 2

(a)	*any* ***four*** *from:* **1** (in combination treatment) antibiotics (in Table 2.1), act at different targets / have different modes of action / AW ; **A** comparison of any two antibiotics from Table 2.1 **A** suggestion of how two antibiotics have different ways of killing **2** *idea that* if resistance / mutation, occurs / exists, unlikely to be against all antibiotics / other antibiotics should still be effective ; **3** (in combination treatment) if resistance / mutation, occurs / exists, all bacteria will (still) be, killed / destroyed / AW ; **A** no bacteria remain to develop resistance / no reservoir of resistant bacteria **4** antibiotic resistance, not / less likely to be, spread to affect people because no bacteria surviving (with combination treatment) ; AW **5** long treatment time / 6 months, with, combination treatment / AW, increases chance of killing all bacteria **or** long treatment time with a single antibiotic not effective in killing all bacteria if, resistance develops / a mutation occurs ; **6** AVP ; e.g. combination treatment (is likely to) eliminate bacteria more quickly (so less chance of resistance occurring) resistance to different antibiotics involves more <u>genes</u> so less chance of resistance occurring <u>gene</u> for antibiotic resistance has more chance of being passed on if using single antibiotic (and not all killed) ora if using single antibiotic (and not all killed) more chance of being passed on (to other bacteria) by horizontal / vertical / AW, transmission ora	**4**

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(b)(i)	transcription ;	**1**
(b)(ii)	*any **three** from:* **I** stops transcription **1** alters shape of / blocks, active site ; **R** enters / fits into, active site *as it is <u>not</u> competitive* **R** *ref. to* choice of competitive or non-competitive **A** alters shape of enzyme *only if mp2 gained* **2** substrate / nucleotides, cannot, bind to / enter, active site ; **A** fewer / no, enzyme-substrate complexes / ESCs, form *allow ecf from mp1 if rifampicin described as, competitive / enters active site* **3** complementary (base) pairs / (complementary) base pairs, cannot form / form less easily (between DNA and RNA nucleotides) ; **4, 5, 6** *(in context of rifampicin binding to RNA polymerase)* prevents / AW, unwinding of DNA (double helix) ; **A** uncoiling **I** unzipping prevents / AW, attachment to DNA (strand) **A** prevents / AW, attachment to promoter prevents / AW, movement along DNA (strand) ; prevents / AW, elongation (of polynucleotide) / formation of polynucleotide /nucleotides being joined ; prevents / AW, phosphodiester bond formation ; prevents / AW, proof reading ; **7** AVP ; e.g. prevents / AW, tRNA / rRNA, formation	**3**
(c)(i)	Phe Tyr ; *one mark for both correct*	**1**
(c)(ii)	**B D F G** ; *in any order*	**1**
(c)(iii)	*resistance* **1** shape / tertiary structure, of, β-subunit / enzyme, altered / AW ; **I** active site changes shape **A** quaternary structure of enzyme altered **2** rifampicin / antibiotic, cannot / does not, bind (as well) ; AW **R** *if context is binding to active site* *different levels of resistances* *any **two** from:* **3** (because) other mutations are involved ; AW **A** described from Table 2.1 e.g. **C** has 2 (other) mutations and **D** and **E** have 3 **4** mutations may result in different changes to, structure / shape of, β-subunit / enzyme, and result in different, effects / levels of resistance ; **5** data from Table 2.2 to support mp 4 ; *must be linked to concept of mp4* **6** AVP ; e.g. *ref. to* different binding abilities (of rifampicin to enzyme) some (of the other) mutations may cause more of a change to binding site for rifampicin mutation(s) may make it harder to bind lower resistance = binds, more strongly / for longer time lower resistance = higher proportion of transcription events hindered e.g. idea that mutations still, produce functioning enzyme / allow catalysis to occur	**3**

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194. 9700_w20_ms_23 Q: 4

(a)(i) **X – R**
and
Y – P ; — **1**

(a)(ii) *any **two** from:* — **2**

mp1** = resistance with ref. to **P / Q / R
Y, is resistant to **Q** / has no resistance to **P ;**
A Y has some resistance to (antibiotic) **R**

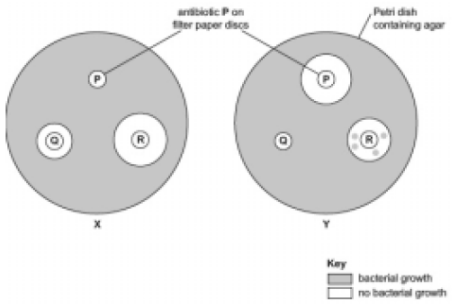
***mp2** = antibiotics used at different concentrations*
(antibiotic) **R** may, have different concentration / be less effective, compared with **P ;**

***mp3** = reason for resistance*
ref. to gene(s) for resistance (on plasmids)
or
Y has, cell wall / cell membrane, that prevents entry of antibiotic **Q**
or
Y has enzyme that breaks down, **Q / R ;**

***mp4** = action of antibiotics*
idea that antibiotics have, different / specific, target(s) / AW **;**

A any example of process inhibited by antibiotic, e.g.
cell wall synthesis
transcription
translation
DNA replication
cell surface membrane function
synthesis of folic acid

(a)(ii) ***mp5** = AVP ;*
e.g. *idea that* **P** may be bacteriocidal / (antibiotic) **R** is bacteriostatic
e.g. *idea that* gene for resistance to antibiotic **R** passed by, vertical / horizontal, transmission



(b) *any **three** from:* — **3**
*to award the MP1 to MP5 you **must be able to see a difference** between the two stated clearly*

	vaccines		*antibiotics*
1	(generally) are preventative / are not a treatment / are not a cure **or** use before a person, has an infection / is ill	**v**	are (generally) not preventative / are a treatment / are a cure **or** used when a person, has an infection / is ill **;**
2	effective against bacteria and viruses (in context of different vaccines)	**v**	not effective against viruses / only effect against bacteria **;**
3	*idea of* indirect effect on pathogens	**v**	*idea of* direct effect on pathogens **;** **A** example of effect
4	not given as a course / give once or a few times (or with boosters)	**v**	given as a course / over many days / AW **;**
5	specific for particular, pathogen	**v**	(most) antibiotics act on a range of pathogens **;**
6	stimulate an <u>immune response</u>	**or**	do not stimulate an <u>immune response</u> **;**
7	detail e.g. stimulate, (B- / T-) lymphocytes / production of antibodies **A** stimulates production of memory cells	**or**	do not stimulate, (B- / T-) lymphocytes / production of antibodies **;** **A** no stimulation of memory cells
8	provide long-term, protection / immunity	**or**	do not provide long-term, protection / immunity **;**
9	does not lead to resistance	**or**	may lead to resistance **;**
10	time delay before being effective / AW	**or**	have effect, faster / sooner / AW **;**

195. 9700_s17_ms_21 Q: 6

(a)(i)	*Vibrio cholerae* ;	**1**
(a)(ii)	faecal-oral route ;; *description of faecal / oral route* *infected person* faeces / sewage / stool, contaminating (drinking) water **R** (human) waste unqualified **or** poor hygiene so transferring, faecal material / sewage, onto utensils / food / AW **or** defaecating / putting sewage, onto vegetable plots ; **or** flies in contact with contaminated faeces landing on food and contaminating / AW *uninfected person* eating contaminated food / using contaminated utensils **or** drinking contaminated water ;	**max 2**
(b)	1 ganglioside is the receptor for choleragen ; 2 choleragen is complementary to ganglioside ; 3 any interaction between molecules ; e.g. (hydrogen / ionic) bonding	**max 2**
(c)	endocytosis ; **A** phagocytosis / pinocytosis	**1**
(d)	1 loss of water / dehydration ; 2 by osmosis ; 3 (water moves out) down water potential gradient / from high to low water potential / high Ψ to low Ψ ; 4 Loss of cations / positively-charged ions (as well as chloride ions) ; 5 change in potential (difference) / change in charge across membrane ; 6 AVP ; e.g. disruption of absorption (of products of digestion / vitamins / mineral ions) disruption of digestion	**max 2**
(e)	1 rehydration therapy, is effective / can treat cholera / reduces death rate ; 2 any detail ; e.g. solution of glucose and salts 3 antibiotic is a selection pressure / described ; 4 *ref. to*, antibiotic / tetracycline, resistance ; 5 *ref. to*, vertical transmission / horizontal transmission, of resistance ; **A** described, **A** transfer for transmission 6 antibiotics will become, ineffective / less effective / AW ; 7 keep antibiotics for use 'as last resort' ; AW 8 *ref. to* cost ; 9 antibiotics kill gut bacteria ; 10 *idea that* disrupts functions of digestive system ; 11 AVP ; e.g. antibiotics going into the environment / food chain antibiotics can cause mutation decreases need to develop new drugs prevents development of active immunity *idea of* transmission between bacterial species plasmids with resistance genes	**max 3**

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196. 9700_s17_ms_23 Q: 3

(a)	*Mycobacterium tuberculosis* / *Mycobacterium bovis* ; *correct spelling*	**1**
(b)	**1** deaths decrease to zero / new cases fall to 4 per 100 000, (in 2010) ; **A** other values that confirm decrease *(after introduction of antibiotics)* **2** deaths relatively constant / approx. 52 per 100 000, until 1943–6 (*accept any in range*) ; **A** for a few years **A** *idea that* rate of decrease not improved **3** number of new cases initially stops increasing / plateaus ; **4** (overall) number of new cases increases before decreases ; **5** data to support mp 3 or 4 ; e.g. 88–90 per 100 000 (1940–44) rises to / drops from, 104 per 100 000 in 1946 ; *(after introduction of vaccination)* **6** no change in trend of decrease in deaths / deaths continue to decrease ; **7** decrease from 36–40 per 100 000 (in 1948) ; **8** short plateau / 100 per 100 000 (until 1950), in new cases, then decreases ; **9** antibiotics may not have been in widespread use at first ; **ora** **10** vaccine, reduces spread / gives (herd) immunity ; **11** *ref. to* decrease less steep initially as time needed to build up herd immunity ; **12** AVP ; e.g. suggestion why increase in new cases after introduction of antibiotics suggestion why cases have not decreased to zero not possible to tell relative effect of vaccine v antibiotic	**max 5**
(c)(i)	some people who are HIV+ will have developed HIV / AIDS ; HIV / AIDS weakens immune, system / response ; **ora** *allow* ***ecf*** *for HIV+ people* detail of why immune response weakened ; people with HIV / AIDS, prone to opportunistic diseases ; **A** TB is an opportunistic disease **A** more susceptible to, diseases / TB (Table 3.1 shows that) a greater proportion / AW, people die of TB if they are HIV+ ; AW e.g. greater chance of dying from TB if HIV+ dormant TB more likely to become the active form in, HIV+ people / people with HIV / AIDS ; AW AVP ; a high proportion of deaths from HIV / AIDs is due to TB mortality HIV+ people do not respond well to treatment for life-threatening diseases inability to pay for treatment for all conditions for HIV+ people	**max 3**
	Total:	**9**

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197. 9700_s16_ms_23 Q: 5

(a) *0 marks if another mode of transmission given (e.g. faecal-oral / contact / sexual)*
I in unpasteurised milk / contaminated meat (*M. bovis*)

1 aerosol / droplet, infection ;
only need to have one of 'infected' / 'uninfected' to gain mp2 and mp3
2 infected / AW, person, coughs / breathes / spits / talks / sneezes ;
3 uninfected / AW, person, inhales / inspires / breathes in, droplets ;

allow one mark if mp2 and mp3 given with no reference to, infected / uninfected
4 organism / pathogen / bacteria / *M. tuberculosis*, in, airborne droplets / droplets in air ; **A** without 'airborne ' or 'in air' if mp2 gained [max 2]

(b) **1** incomplete treatment / dose not finished ;
2 not all bacteria killed / some bacteria survive ; **R** TB for bacteria
3 mutation ; **R** mutation to give immunity
4 further detail of mutation ;
5 selection of resistant bacteria / resistant bacteria selected for ;
6 resistant bacteria reproduce / vertical resistance ;
7 death of, susceptible / non-resistant, bacteria ;
8 AVP ; e.g. horizontal resistance / described [max 4]

(c) **(i)** making / synthesis of, (m)RNA ;
from a DNA, template / sequence of bases / sequence of nucleotides ;
A from a gene [2]

(ii) *idea that* pathogen and human RNA polymerase are (slightly) different ; e.g. (slightly) different shaped active sites
A rifampicin unable to, cross cell surface membrane / enter nucleus / cross nuclear envelope [1]

(d) *points can be general or TB specific*
1 prescribing / take, antibiotics, only when (absolutely) necessary ;
2 ensure, correct / effective, antibiotic(s) prescribed / used ;
3 complete course / follow instructions for use, of antibiotics ; **A** *ref. to* DOTS
4 patients to, use only antibiotics prescribed / not use leftover antibiotics at a later date / AW ;
5 *ref. to* monitoring situation to check if antibiotic is effective ;
6 use other antibacterials ;
7 develop new, drugs / antibiotics ;
8 ensure / improve, knowledge of, healthcare professionals / public ; AW
9 reduce / control, antibiotics in, agriculture / animals used for food ;
10 reporting patterns of antibiotic resistance / AW ;
11 *ref. to* breaking transmission cycle / described example ; e.g. vaccines good hygiene in hospitals
12 break transmission cycle of resistant bacteria ; e.g. quarantine
13 AVP ; e.g. WHO Global Plan Stop TB
14 *further detail of mp1 or mp2* ; e.g. only prescribe wide-spectrum antibiotics when narrow spectrum not known [max 3]

(e) *idea that* antibiotics act at a cell structure not possessed by a virus ;
e.g. viruses, do not have, a cell wall / a cell surface membrane / ribosomes

suggestion that viruses, are inside host cells / not within reach(of antibiotics) ;
antibiotics act only on, living / growing, cells (viruses do not grow) ;
A can prevent metabolic processes not occurring in viruses
antibiotics do not act on, protein coat / capsid / capsomeres / viral envelope ; [max 2]

[Total: 14]

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198. 9700_w16_ms_21 Q: 4

(a) (i) *Vibrio cholerae* ; [1]

(ii) **R** if other modes of transmission listed

ref. to 'infected' and 'uninfected' not required (as in question) but statements must be in correct context

I polluted water

one mark for infected person
passed in, faeces / stools / sewage ; **R** waste, unqualified

one mark for uninfected person
ingests / eats, contaminated, food / crops
or
drinks / ingests, contaminated, water / liquids ;
A uses utensils washed in contaminated water / AW

if above 2 mps not gained, one mark for
idea of (infected person) sharing drinking bottles / utensils (with uninfected person)

two marks for
faecal-oral, route / transmission ;; [2]

(iii) **A** poor sanitation *once only for mp 1 or 3*
two from
1 damage to, sewers / drains / foul water systems ;
2 (so) mixing of sewage and drinking water ;
3 (contaminated) water supplies cannot be treated ;
A water (for drinking) from untreated (contaminated) sources
4 *ref. to* spread by flies exposed to, contaminated faeces / untreated sewage ;

5 *idea of* people in high density temporary accommodation facilitating spread ;
6 unable to practice good hygiene ; **A** examples e.g. lack of soap
restrictions on (treated) water for cleaning
7 unable to thoroughly cook foods ;
8 need to share (contaminated) water containers / cooking pots / AW ;

9 disruption to health care facilities / AW ; **A** example
e.g. lack of ORT (so higher proportion of infected people)

10 AVP ; e.g. increased risk of malnutrition linked to increased risk of disease [2]

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(b) (i) *two from*
different mRNA codon (formed during transcription) ;
A triplet / triplet of bases / triplet code / 3-base code
R codons
idea that, each codon specifies a particular amino acid / a different codon specifies a different amino acid ; **A**

(different) tRNA with different amino acid binds to, ribosome / mRNA ; [2]

(ii) *two from*
change in, tertiary / quaternary, structure (of enzyme) ;
A change in polypeptide, folding / coiling ;

(enzyme) binding site for antibiotic, lost / changes shape ;
R active site *unless clear that substrate binding and catalytic site remains unchanged*

antibiotic / nalidixic acid, cannot bind (so enzyme remains active) ;
allow ecf for active site [2]

(c) *four from*
1 risk of, further spread / wider epidemic, (from people still infected) ; AW
2 reduces chance of succesful treatment / higher death rates ;
3 increased, treatment / hospitalisation times ; **A** takes longer to treat
A more complex treatment
4 increased costs of treatment / strain on health budget / AW ;

5 risk of, further resistance / resistance to all antibiotics ;
6 fewer antibiotics left that are effective ;
A risk that no antibiotics will be left to successfully treat

7 need to find, new antibiotics / alternative treatment ;
A difficulty in finding new treatments / AW
8 (so) cost of research ; *allow cost once*

9 AVP ; e.g. strain on, resources / health personnel, to treat other diseases
need to identify type of resistance so that effective treatment is given
education, qualified [4]

[Total: 13]

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199. 9700_w16_ms_23 Q: 2

(a) *two from*
- **1** provide an alternative pathway ;
- **2** brings reactants close together (in active site / to form ESC) ;
- **3** put a strain on the reactant(s) ;
- **4** so bonds, break / form, more easily ;
- **5** transfer of, charges / groups ;
- **6** AVP ; e.g. involvement of R groups [2]

(b) (i) *quoting figures with no qualitative description = **mp4** only*

four from
- **1** as time increases the concentration of PABA increases ;
- **2** increasing the concentration of inhibitor, decreases concentration of PABA / slows the reaction ;
- **3** from 0 to 2 / 2.5 / 3 minutes, no difference in concentration of PABA produced / same rate, for all concentrations of inhibitor ;
- **4** use of data ; *from plotted points or from curves*
  e.g. concentrations of PABA at different times for any one inhibitor
  e.g. concentrations of PABA at same time for two different inhibitor concentrations
  e.g. concentration of PABA = 2 – 3.5 μM at a specific time
- **5** AVP ;
  e.g. for all concentrations of inhibitor, rate becomes less steep after approximately 5 minutes
  e.g. for last 20 minutes rate of reaction is linear (for all or any one concentrations of inhibitor)
  e.g. little difference, in rate / final [PABA], between 0 and 1 μM
  e.g. greater difference, in rate / final [PABA], between 1 μM and 3 μM [4]

(ii) *three from*
- **1** carry out / AW, with different concentrations of substrate ;
  A use a low concentration and a high concentration of substrate *if a number of different concentrations of substrate without any reference to high and low this must be a minimum of 5*
- **2** with and without inhibitor ;
- **3** all other variables constant ;
  A one key variable, e.g. enzyme concentration / temperature / pH
- **4** interpretation of results ;
  e.g. draw a graph to see change to, K_m / V_{max}
  e.g. *idea that* if the effect of the inhibitor decreases with an increase in substrate concentration then inhibitor is competitive **ora**
  e.g. competitive: increase in K_m / no change in V_{max}
  e.g. non-competitive: no change in K_m / decrease in V_{max} [3]

(iii) *one from*
bacteria, cannot make / make less, folic acid, so they die / cannot grow / cannot reproduce / cannot multiply ;
inhibitor targets only bacterial cells ;
inhibitor will not harm human cells ; [1]

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(iv) *allow drugs for antibiotics throughout*

two from
1 *idea that* there are few targets for drugs ;
A e.g. virus has no, cell wall / cell membrane / ribosomes
2 no / few, enzymes ;
3 antibiotics only work on, growing / living, cells ;
A viruses have no, metabolism / growth
4 viruses are inside (host) cells / not within reach of antibiotics ;
R if antibodies
5 antibiotics do not work on, protein coat / capsid / viral envelope ;
I capsule [2]

(c) *two from*
do not use for viral infections ;
do not use as preventative medicine ;
antibiotics should only be used (for treatment) when necessary ;

carry out antibiotic sensitivity test ;
ensure, correct / effective, antibiotic, prescribed / used ; AW
ensure people take the correct dose ;
ensure people complete the course of their antibiotic ; **A** ensure people follow the instructions
ensure people do not use, left-over / other people's, antibiotics ;
only supply on prescription / not over the counter / AW ;

only use, wide / broad, spectrum antibiotic when pathogen not known ; **A ora** use narrow spectrum antibiotic when pathogen is known
use more than one antibiotic (at the same time) ; **A** mixture of antibiotics / antibiotics in combination
monitor antibiotics to check that they are effective ;
report cases of antibiotic resistance ;
reporting patterns of antibiotic resistance (temporal and geographical) ;

rotate antibiotics so not used all the time ;
keep some antibiotics to use as a last resort ;
do not use the same antibiotics for animals as for humans ;
reduce use of antibiotics in, food production / (livestock) agriculture ;

use other antimicrobial drugs ;
develop new, types of antibiotics / drugs, to kill bacteria ;
ensure / improve, knowledge of, healthcare professionals / public ; **A** *ref. to* education about awareness of antibiotic resistance
ref. to breaking transmission cycle / described example of a method ; e.g. vaccines / good hygiene in hospitals
break transmission cycle of resistant bacteria / described example ; e.g. quarantine [2]

[Total: 14]

Q1.

2 (a)

*Award one mark per column. No penalisation for complete lack of **all** crosses (or **all** ticks) unless mixture of x and ✓ missing as agreed*

statement	emphysema	tuberculosis	obesity	rickets	smallpox
eliminated by vaccination	x	x	x	x	✓
a worldwide infectious disease	x	✓	x	x	✓ or x
a form of malnutrition	x	x	✓	✓	x
a deficiency disease	x	x	x	✓	x
involves degeneration of lung tissue	✓	✓ or x	x	x	x

[Total 5]

Q2.

(d) variable region;
binding region to antigen;
shape is specific to, choleragen / antigen;
complementary;
ref to R groups on amino acids (in polypeptide / protein);
different, sequences of amino acids / primary structures;
ref to, folding of the molecule / secondary structure / tertiary structure; **[max 3]**

(e) poor sanitation / no treatment of faecal waste;
contamination of (drinking) water supply;
poverty / poor living conditions / poor hygiene / poor (health) education;

ref to natural disasters; e.g. assistance / aid / medical help / AW, cannot arrive in time

no rehydration therapy available (at time when needed);
no (effective) vaccine;
further detail; (bacteria live in gut, where immune system is not effective) **[max 3]**

Q3.

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5 **(a)** female *Anopheles* mosquito ;
either takes blood meal / AW, from infected person *or* parasites enter mosquito in blood meal from infected person ;

takes blood meal / AW, from uninfected person ;
parasite / pathogen / plasmodia, transferred in mosquito's, saliva / anticoagulant ;
ref. to transfusion malaria / congenital or mother-foetus malaria / needle sharing / needle stick injury for max 1 ; [3 max]

(b) **(i)** (protein is) antigen ;

following vaccination
(clonal) selection for, appropriate / corresponding / specific, B cell ;
clonal expansion / divide (by mitosis) (to form B cell clone) ;
memory cells ;

on infection by parasite
(B cells / plasma cells) secrete antibody ; **A** immunoglobulin / Ig
secondary response (qualified) / higher levels of antibody / rapid production of antibody ;
ref. to antigen-antibody specificity ;
antibody attaches to, surface protein / antigen, on parasite ;
prevents attachment to red blood cell ; **A** prevents entry into red blood cell [4 max]

(ii) genetic complexity of *Plasmodium* ; **A** ref to *Plasmodium*, being eukaryotic / having many genes
many antigens ;
many stages in life cycle (within human) ;
antigens change / antigenic variation, in different stages ;
Plasmodium / parasite, lives within cells ; **A** antigenic concealment
A only briefly free in the blood stream
antibodies cannot work against stages within cells ; [2 max]

(c) *use only one mark scheme as appropriate*

drug is either
competitive inhibitor / effect described in terms of competition ;
drug molecule has, same / similar / shape, as, substrate / surface protein ;
A complementary shape to active site
R same / similar, structure, as substrate
drug molecule fits into active site ;
blocks access to active site / prevents formation of ES complex ;

or
non-competitive inhibitor / described in terms of not competing ;
drug molecule fits into, another site (not the active site) / allosteric site ;
active site changes shape so cannot accept, substrate / surface protein ;
permanent (irreversible) / reversible ;

or
combines permanently with active site ;
e.g. by covalent bonding ;
blocks access to active site / prevents formation of ES complex ;
increasing, substrate / surface protein, has no effect ; [3 max]

[Total: 12]

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Q4.

1 **(a)** **(i)** (*nuclear envelope*) drawn with two membranes and a space and at least one nuclear pore ;
(*mitochondrion*) two membranes with at least one crista attached or unattached ;
mitochondrion drawn smaller than nucleus ; ora

if wrongly labelled or both labels omitted, penalise once [3]

(ii) (to nearest <u>whole</u> number) (x) 2857 ;; **A** 2829 – 2886

allow one mark for correct working if answer incorrect / not to whole number / no answer
length of scale bar in mm × 1000, divided by actual size
e.g. 100 mm × 1000 / 35 *(scale bar 99–101 mm)* [2]

(b) cell / plasma / cell surface, membrane(s) ; **R** membranes
cytoplasm / cytosol ;
ribosomes / 70S ribosomes / 18nm ribosomes ; **R** 80S / 20nm / larger, ribosomes
DNA / genes ; **A** chromosome [3 max]

(c) (infected person) coughs / sneezes / spits / releases sputum / breathes <u>out</u> / exhales ;
A releases mucus **R** talks
<u>aerosol</u> / <u>droplets</u> / <u>moist</u> air, inhaled / breathed in (by uninfected person) ; [2]

(d) **(i)** <u>0.25</u> ; [1]

(ii) *suggested reasons for high fatality ratios*

poor / dense / overcrowded, housing / accommodation ;
low protein diets linked to lowered immunity ;
not, diagnosed / treated, early enough ;
DOTS / described, not used ;
lack of vaccination / vaccinations ineffective ;
antibacterial drugs / antibiotics / AW, not available / too expensive ;
medical services not available, qualified e.g. in rural areas / AW ;
idea of TB, linked to HIV/AIDS / opportunistic disease ;
MDR – TB / XDR – TB / not completing the course of antibiotic treatment increases resistance ;
no effective antibiotics to use ;
no facilities for isolating people ;
lack of, testing / treatment of, cattle / milk ; **A** unpasteurised milk
difficulty in obtaining reliable data / AW ;
ignore references to, overcrowded / poor, countries [4 max]

[Total: 15]

Q5.

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1 **(a) (i)** *Golgi body*

at least three unlinked cisternae drawn in cytoplasm ;
secretory vesicles forming at the side of the Golgi ;

exocytosis

vesicle shown fused to cell surface membrane ; **R** if add arrows pointing towards cell contents [3]

(ii) (to nearest whole micrometre) 5(μm) ;;

allow one mark for correct working if answer is incorrect / not to whole number / no answer

length of bar / 8000
e.g. $\frac{4\text{ cm}}{8000}$ $\frac{40\text{ mm}}{8000}$ $\frac{40000\mu\text{m}}{8000}$ **A** +/- 1mm on length of bar [2]

(b) capsule / slime layer ;
cell wall ; **R** cellulose / chitin, cell wall
flagellum (of flagellin) ;
DNA free in cytoplasm / loop of DNA / circular DNA / nucleoid / plasmid ;
DNA, naked / without histones ;
only, smaller / 70S / 18nm, ribosomes ; **A** only one type of ribosome
mesosome ; [3 max]

(c) 0.47 ; [1]

(d) *provide, boiled water / bottled water / sterile water ; **A** valid description of method to, remove / kill, bacteria*
*provide, oral / intravenous, rehydration therapy / ORT ; **A** ORS*
(contains) glucose and, salts / electrolytes ;
absorption of salts helps to absorb glucose ;
(absorption of salts) increases water uptake, by osmosis / AW ;
deaths usually caused by (rapid) dehydration ;
idea of rapid provision (of, ORT / medical supplies / personnel) ;
provide antibiotics (for severe cases) ;
*safe sewage disposal, qualified ; **R** sewage treatment plants* [4 max]

(e) transmission cycle is broken ;
sewage treatment plants / mains drainage ;
human faeces do not come into contact with drinking water supply ;
water treatment plants ; **A** drinking water is, chlorinated / treated, to kill bacteria ;
drinking water is piped to homes ; [2 max]

[Total: 15]

Q6.

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4 **(a)** caused by pathogen, transmissible / communicable / contagious / transferable / passed from one person to another ;
A for pathogen – microorganism / any two named types of microbe
R parasite unqualified [1]

(b) **R** virus or bacteria once in the answer
female, *Anopheles* (mosquito) ;
takes blood (meal) from an (infected) person, feeds on an (uninfected) person ;
R 'bite' unless qualified with blood
Plasmodium / parasite, transmitted in (mosquito's) saliva ;
Plasmodium / parasite, blood transfusion / shared needles / across placenta / at birth ;
[2 max]

(c) *max 3 for malaria max 3 if pathogen(s) is virus or bacterium*

1 *Anopheles* / mosquito / vector, survives / breeds / lives, within the tropics / in hot and humid areas ; ora
2 *Plasmodium* / pathogen / parasite, needs to reproduce within the mosquito (at temperatures above 20°C) ;
3 eradicated in some countries outside the tropics ;
4 ref. to LEDCs and, poor / non-existent, mosquito control programmes ;
5 mosquitoes resistant to, DDT / insecticides / pesticides ;
6 *Plasmodium* resistant to, drugs / chloroquine / other named drug ;
7 TB is transmitted, by, droplets / coughing / sneezing ; **A** in the air
8 no vector / no mosquito / no requirement for hot or humid conditions ;
9 ref. to, HIV infection / lower immunity / immunocompromised ; [4 max]

(d) 1 active immunity ;
2 vaccine contains, antigen(s) / pathogen / microorganism / named type ;
3 (primary) immune response ;
4 B lymphocytes / B cells / plasma cells, synthesise / produce / secrete / release, antibodies ;
5 ref. to T helper cells (enhancing humoral response) ;
6 clonal selection / described ;
7 specific, (T / B) lymphocytes / antibodies ; **A** 'particular' / AW
8 memory cells, remain (in circulation) / give long-term immunity / give immunological memory / AW ;
9 fast(er) second(ary) response ;
10 ref. to boosters / AW ;
11 immunised person cannot spread disease to others ;
12 herd immunity / unimmunised people are safe(r) ;
13 surveillance of population for signs of disease / when there is an outbreak ;
14 ref. to ring immunity / AW ; [5 max]

[Total: 12]

Q7.

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3 **(a)** 53 % ;; *2 marks for correct answer*

max 1 mark for correct calculation but, no/incorrect, answer or not to nearest whole number

72.4 – 33.9 = 38.5
(38.5 / 72.4) x 100 = 53.18 / 53.2 [2]

(b) **R** greater wealth unless linked to points below
any two valid reasons e.g. accept answers written as ora

1 more educated population ; *in context of health*
2 better/greater access to, health care/AW ;
3 higher level of preventive medicine ; e.g. immunisation programmes
4 better diet ; **A** ref. to less malnourished
A ref. to access to food supplies
5 greater access to, therapeutic medicines/drugs ; **A** antibiotics
6 better/less overcrowded, housing/living conditions ;
7 better, sanitation/sewage treatment ;
8 greater access to uncontaminated drinking water ;
R clean water unqualified
9 fewer, fatal diseases/AW ;
10 ref. to effects of, civil war/war ;
11 ref. to natural disaster ; [2 max]

(c) **(i)** rank of % positive (of countries) is different to rank of difference in <u>decrease</u> in life expectancy ;
data quote to support ; e.g. Kenya 6th highest % positive but 3rd highest decrease in life expectancy
S. Africa 4th highest % positive but 6th highest decrease in life expectancy
countries with, similar/same, <u>decrease</u> (in life expectancy) have different % positive ;
data quote to support ; e.g.
Malawi 17.8 years decrease, 16%, cf South Africa 17.5 years, 19.9%
Kenya 20.1 years, 14%, cf Zambia 20.1 years, 20% ;

with ref. to <u>decrease</u> in life expectancy and % positive
Kenya, does not fit general trend/AW ;
South Africa, does not fit general trend/AW ;
data quote to support ; e.g.
Kenya larger <u>decrease</u> than, Malawi/South Africa, but lower % positive
Kenya 20.1 years <u>decrease</u> but only 14.0 %, compared to, Malawi 17.8 with 16.0%/ South Africa 17.5 with 19.9 % ; [2 max]

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(ii) *any two relevant factors e.g.*

1 anti HIV drug therapy/AW ;
2 ref. to treatment of AIDS-related diseases ;
3 ref. to education to prevent, transmission/spread ;
4 use/provide free, condoms/femidoms ; **A** dental dams
5 avoid promiscuity ; **A** one sexual partner
6 HIV mothers avoid breast feeding ;
7 heat treat/screen, blood (for transfusion) ;
8 needle-exchange schemes/AW ; **A** ref. to sterile syringes
9 use of sterile equipment, qualified e.g. in surgery/tattooing/piercing ;
10 testing for HIV status/contact tracing ;
11 ref. to vaccine development ; [2 max]

(d) 1 primary/immune, response ;
2 ref. specificity; *in correct context*
3 (HIV/virus) antigens ;
4 antigen presentation/antigen presenting cell/APC/described ;
5 clonal selection/described ; e.g. recognition of/binding to, antigen by, B-lymphocyte
6 sensitisation/activation/described ; e.g. cell growth or cellular changes
7 clonal proliferation/formation of clone/mitosis/cell division/AW ;
8 B-lymphocytes/B-cells/plasma cells, synthesise/produce/secrete/release, antibody ;
9 T(helper)-lymphocyte response described ; e.g. cytokine production
ignore ref. to T killer cells [5 max]

[Total: 13]

Q8.

4 **(a)** *any one correct description (1 mark) with explanation (1 mark) e.g.*

any named biological control method e.g *B. thuringiensis* ;
kills mosquito larvae ;

use of insecticides ;
kills (adult) mosquitoes ;

elimination of standing water ;
removes, mosquito breeding sites/egg-laying areas ;

use of oil on water ;
prevents maturation of/kills, mosquito larvae ; [2 max]

(b) (malarial) parasite/pathogen/*Plasmodium*, has many antigens ;
eukaryotic/many genes ;
many different stages of life cycle ;
ref. to more than one *Plasmodium* species/strain of each species ;
mutation changes antigens (over time)/antigenic shift/antigenic drift ;
parasite only vulnerable, at certain stages of life cycle/when free in plasma ;
antigenic concealment/described ;
AVP ; e.g. changes antigens which are expressed (through gene switching) [3 max]

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(c) percentage of, parasites killed/growth inhibition, increases with drug concentration for both parasites ;
effect is greater on chloroquine-resistant parasites/AW ;
chloroquine-sensitive parasites not affected until 1 µmol dm^{-3} ;
further use of data from Fig. 4.1 to illustrate ;
further detail of difference in trend(s) ; **A** descriptive or figures [3 max]

(d) **(i)** (percentage) increase in malaria is high(er) in, countries in the, south/south and east ;
ora **A** named countries **R** more malaria

ref. (percentage) increase correlates with countries where HIV incidence is higher ;
penalise once if no ref to increase

data quote ; [2 max]

(ii) HIV, infects/AW, T (helper)–lymphocytes/T-cells ;
qualified ref. to immune system ;
(HIV and) malaria may be contracted via blood transfusion ;
ref. to reduced number of workers so malaria prevention not carried out ; [2 max]

[Total: 12]

Q9.

6 **(a)** *assume answer refers to active immunity unless told otherwise*
accept ora if answer focuses on passive immunity

immune response ; **A** 'immune system responds'
to antigen ;
clonal selection occurs / ref to B cells *or* T cells activated ;
antibodies made ; **A** ora for passive
memory cells produced ;
long-lived / long-term effect / permanent ;
not immediate / slow ; one week minimum

passive only – antibodies removed from circulation ; [max 3]

(b) *no mark for passive immunity as in the question*

antibodies from, mother / colostrum / across placenta ; **R** 'immunity from mother'
interact with, antigen / measles antigens / virus / pathogen ;
(so) prevents an (active) immune response ; **A** no immune response

too early for immune response to occur / T cells *or* B cells not mature ;
A not immunocompetent / immune system not developed [max 2]

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(c) *idea that*
all countries with >90% of districts reporting 90% of children vaccinated have very low death rates (for children under 5 years of age) ;

ref to any percentage(s) <90% with wide variation in death rates ;

data quote, giving % and death rate(s) ; e.g. 95%, less than 50 deaths per 1000

herd immunity / described , decreases transmission ;
A description of transmission e.g. 'spread' [max 2]

[Total: 7]

Q10.

4 **(a)** *Mycobacterium, tuberculosis / bovis* ; 1

(b) **(i)** *2 marks for correct answer*
x 30 000 ;;
(image length = 60 mm) 60 000μm / 2μm **A** 59 / 61 mm (29 500 / 30 500)
1 mark if incorrect answer e.g. not converted correctly, but measurement and method correct [2]

(ii) *any 3 relevant e.g.*
DNA not surrounded by, nuclear, envelope / membrane ; AW
A no (true) nucleus
circular DNA ; **A** loop
DNA not complexed with histone proteins ; **A** naked DNA
(only) 70S / smaller / 18nm, ribosomes ; **A** ribosomes not attached to membranes
no double membrane-bound organelles; **A** no, mitochondria / chloroplasts
absence of named organelle ; e.g. Golgi apparatus, ER / RER / SER
if previous mp not given, **A** no membrane-bound organelles
capsule / slime layer ;
very small diameter / 0.5 to 5.0μm ;
cell wall of, murein / peptidoglycan ;

examples of other relevant points
pili / pilus ;
no 9+2 microtubule arrangement ;
flagellum not covered by cell surface membrane ;
presence of plasmids ; [max 3]

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(c) (i) *any 1 relevant e.g.*
ref. (BCG) vaccine / vaccination programme ;
improvements in housing conditions / less overcrowding (housing) / better ventilated homes ; **R** better standards of living *unqualified*
earlier detection / mass, chest X-ray / screening ; *i.e. in preventing spread*
improvements in diet (leading to better immune system) / AW ;
improved awareness of, transmission / AW ; **R** better education unqualified
contact tracing / explained ;
ref. testing / treating, cattle / milk ; [max 1]

(ii) *any 3 relevant e.g.*
development of antibiotic resistance (by organism) ; **A** drug resistance
R immunity
ref. impact of HIV infection ;
higher rate of immigration from countries with high incidence / AW ;
increase in tourism to countries with high incidence ;
reduced surveillance leading to undetected cases (and hence spread) ;
(detected cases, MDR) unwillingness / AW, to maintain drug regimen / AW ;
ref. to vaccination programmes no longer taking place ;
ref. to poor / overcrowded, housing (in cities) / AW ; *must be in context of developed countries* [max 3]

(d) (i) binding of tRNA prevented ;
(so) no anticodon-codon binding ;
peptide bond formation prevented ;
mRNA attachment prevented ;
inhibition of enzymes involved in translation ;
ribosome movement along mRNA, hindered / prevented ;
inhibits association of large and small subunits / AW ; [max 2]

(ii) *mammalian cell*
cell surface membrane impermeable ;
degraded, before entry into / within, the cell ;
broken down by enzymes ;
eukaryotic / 80S (22nm) / larger / different, ribosomes / ribosome structure ; [max 1]

[Total: 13]

Q11.

(d) **1** do not prescribe for viral diseases ;
2 only use when necessary / do not overprescribe ;
3 only available on prescription / not available 'over the counter' ;
4 people must, complete the course / take as instructed ;
R take a long course
5 test to find out which is most appropriate antibiotic to use ;
A use most, appropriate / effective, antibiotics
A use narrow-spectrum antibiotics
6 details of sensitivity test ;
7 rotate / AW, antibiotics / use in combination ; **R** use many antibiotics
8 do not use same antibiotics for humans and animals ; [max 2]

Q12.

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5 **(a)** *Vibrio cholerae* ; [1]

(b) **1** binding / AW, to, active site / site other than active site / allosteric site ;
2 further detail / consequence of, binding ;
if binds to active site
complementary shape to active site
similar shape to substrate **A** same shape **A** similar structure
competes with substrate for active site
if binds to other site
changes shape of active site
shape of substrate no longer complementary to active site
enzyme-substrate / ES, complex (already in active site) cannot make product
for both types of binding
3 substrate unable, to enter / bind to, active site ;
A fewer / no, enzyme-substrate / ES, complexes form
4 AVP ; e.g.
ref. to decreased enzyme activity, qualified e.g. less ATP produced / lower respiration rate
preference for, permanent / irreversible, inhibitor (to maximise effect)
correct ref. to concentration of inhibitor and effect [max 3]

(c) **(i)** 2.70 / 2.71 ;;

1 mark if answer incorrect but correct calculation
5 143 / 190 130 [2]

(ii) *max 3 if no reference to particular regions*

for differences in cases *accept ora for mark points*
1 idea of overall greater exposure to contaminated, water / food ;
2 no, safe (drinking) water sources / bottled water / water treatment plants ;
3 lack of hygiene, qualified ; e.g. hands not washed after defaecation
4 faeces / sewage, mixing with drinking water / onto crops; **A** poor sanitation
5 insufficient / poor access to, (oral cholera) vaccines ;
6 vaccine less effective in some areas ;
7 lack of education about the way cholera is transmitted ;
8 differences in effectiveness of surveillance and reporting ;
9 qualified ref. to, natural disasters / wars / refugee camps ;

for differences in fatality rates
10 increase in, antibiotic / drug, resistant strains (in some areas) ;
11 lack of, health services / drugs / antibiotics / ORT / skilled personnel ;
A lack of medicines
12 AVP ; [max 4]

[Total: 10]

Q13.

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3 **(a)** **(i)** quarternary (structure) ; [1]

(ii) alpha / α, helix ; [1]

(b) **(i)** facilitated diffusion ; [1]

(ii) osmosis ;
increasing, ion / solute, concentration in lumen (of intestine) lowers water potential ; ora
water follows, from a high(er) to a low(er) water potential / down a water potential gradient; [3]

(c) **(i)** *must have ref. to organism at least once to gain max*
bacteria / pathogen / *V. cholerae*, in faeces (of infected person) / in sewage containing faeces (from infected people) ; AW
bacteria / pathogen / *V. cholerae*, ingested / taken in orally (by uninfected person), in (contaminated) food / water ;
A faecal – oral route *for one mark if previous two mps not given* [2]

(ii) general ref. to problems associated with increased numbers of people and lack of infrastructure ;
examples ;;
e.g. problem providing, safe / uncontaminated, drinking water ;
faeces / sewage, mixing with drinking water ; **A** no / poor, sanitation
unable to practise good hygiene ; **A** example e.g. hands not washed after defaecation
infected people sharing latrines with uninfected / AW ;
lack of, medical care / treatment, leading to larger pool of infected people (at any one time)
lack of, health services / drugs / antibiotics / ORT / skilled personnel
unable to supply sufficient vaccines
lack of food / poor diet, so vaccines less effective

credit relevant examples linked to a particular type of disaster [max 2]

[Total: 10]

Q14.

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5 **(a)** 1 ref. vaccines contain antigens ;
2 antigens are (mostly), proteins / glycoproteins ;
3 antigens, denatured by heat / not denatured by radioactivity ; **A** proteins denatured *in context of antigenic proteins*
R parasite is denatured
4 detail e.g. loss of tertiary structure / bonds break ;
5 shape to be maintained for specificity of immune response / AW ;
6 AVP ; e.g. ref. to production of memory cells (for immunity) [max 3]

(b) 1 first form of, pathogen / parasite, free / exposed, in plasma ;
A not inside cells
2 second form of, pathogen / parasite, concealed / hidden, in liver / red blood cells ;

for either mp 2 or 3
3 ref. to degree of exposure to antibodies / lymphocytes

idea that
4 fewest number of parasites to destroy / earlier defence always more effective ;

5 vaccination against form leaving liver would, not protect against liver invasion / still cause liver damage ;
6 AVP ; e.g. suggestion that first form of parasite is easier to harvest [max 3]

(c) 1 primary (immune) response / artificial active response ;
2 antigen presentation / described ;
3 clonal selection / described ; e.g. **A** specificity to malarial antigen
4 clonal proliferation / B-lymphocyte division by mitosis / AW ; **A** B cell
5 detail of changes occurring from B-lymphocyte to plasma cell ;
6 B-lymphocytes / B cells / plasma cells, produce antibody ;
7 correct ref to role of T_h cells in context ; [max 5]

[Total: 11]

Q15.

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(b) **1** zidovudine , competitive inhibitor and efavirenz , non-competitive ;
2 zidovudine, complementary to active site ;
3 efavirenz, binds to allosteric site / reference to allostery ;
4 efavirenz changes the, shape / structure, of the active site ;
A denatures / changes tertiary structure so substrate will not fit
R changes shape unqualified
5 *either*
the effect of zidovudine is, reduced / reversed, by increasing the substrate concentration
or
the effect of efavirenz is not, reduced / reversed, by increasing the substrate concentration ; [max 4]

(c) **1** virus may be resistant to one or more of the drugs / very low chances that HIV is resistant to all of the drugs ;
R virus immune
2 (resistance due to) change to, active site / allosteric site / tertiary structure, of enzyme ;
A drug can no longer fit into active site
3 some drugs may be more effective than others / AW ;
4 reduces risk of drug resistance developing ;
5 HIV, has a high mutation rate / changes surface proteins / changes antigens ;
A antigen(ic), shift / drift
6 person may have mixture of strains of HIV ;
7 *idea that* virus will be at different stages in its, life / replication, cycle ;
8 AVP ;
e.g. more than one competitive to reduce chances of, ES complexes / AW
drugs work better in combination / synergy idea
drugs inhibiting two different enzymes, so more effective [max 2]

(d) **1** antibiotics are not effective against HIV *or* viruses / antibiotics are effective against, (named) bacteria / bacterial disease ;
A fungi / protoctists / protists / malaria
R antibiotics prevent infection
2 *idea that* viruses have no, sites / targets, where antibiotics can work ;
3 viruses have no, cell walls / ribosomes / cell membranes ;
A have different enzymes
4 viruses are within cells, *idea that* antibiotics cannot reach them ;
5 people with HIV are more susceptible to bacterial infections / reference to immune suppression / weak immune system ; [max 2]

Q16.

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3 (a) 1 caused by, a pathogen ;

2 transmissible / communicable ; **A** passed from, person / animal, to person
ignore contagious

in context of tuberculosis
3 (pathogen is) a bacterium / *Mycobacterium (tuberculosis / bovis)* / *M. tuberculosis* / *M. bovis* ;

4 mode of transmission detail ; *one from*
aerosol / droplet, infection / transmission
in droplets, from (infected) person, exhaling / AW / coughing / sneezing / talking in droplets, / inhaled / AW, by (uninfected) person
person, drinks (unpasteurized) milk / eats meat, from infected cattle
if both of these given this is also mp 2

A contaminated, milk / meat [max 3]

(b) 1 kill bacteria / bactericidal ; **A** cause bacteria to, lyse / burst **A** destroy

2 (or) bacteriostatic / prevents bacterial growth / prevents bacterial replication;
A ref. to preventing protein synthesis / inhibiting metabolic reactions

3 ref. to preventing spread (of bacteria) within body ; **A** prevents reservoir for re-infection

4 do not affect, human cells / human tissue / not toxic (to humans) ;

5 prevents death / consequences may be fatal if no antibiotic treatment / AW ;
A ref. to, alleviating symptoms / faster recovery
A restores good health / person feels well again / person cured

6 ref. to role in preventing, transmission / spread, of disease ; *do not confuse with mp 3*

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7 ref. to (antibiotic) treatment of TB ; e.g.
one of isoniazid, rifampicin (rifampin), pyrazinamide, ethambutol, streptomycin
one of 6–12 months (latent), longer for active disease, two years or more for drug-resistant forms
need combination treatment if active disease
ref. to, MDR-TB / multidrug- resistant TB *or* XDR-TB / extensively drug-resistant TB

8 part of DOTS regimen / described ;
(directly observed therapy short-course / direct observation treatment short course)
[max 4]

(c) 1 statistical, correlation / link / association, between smoking and TB ; AW
A another valid suggestion in addition to mps 2-6 suggesting link

2 where TB, cases / death rates, are high tobacco smoking is also high ;

3 in areas where there is, no overcrowding / AW, smokers have higher number of TB cases ;

4 (ref. projects) death rates from TB reduced where patients stop smoking ;

5 higher cases TB in work places where smoking occurs ;

6 higher cases of TB in children living with parents who smoke ; [max 2]

(d) 1 lack of / paralysed / AW, cilia, so mucus, not wafted away / accumulates ;

R dead cilia

2 pathogen / bacteria / *Mycobacterium*, remains in lungs / accumulates ;

3 ref. to increased opportunity / AW, for bacteria to, enter cells / infect ;

4 nutrients provided by excess mucus encourage growth ; AW

5 smoking weakens the immune system ;

6 detail ; e.g. fewer / less active / AW, phagocytes / macrophages [max 3]

(e) coronary bypass (surgery) / coronary artery bypass (graft) ;
A bypass, surgery / graft / operation
R heart bypass
heart transplant ;
angioplasty ;
stent (insertion / AW) ; [max 2]

[Total: 14]

Q17.

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6 **(a)** causes (mainly) linked to habits during life of person / AW ;
result of choices made by person / AW ;
example ;
e.g. (tobacco) smoking / exposure to asbestos at work [max 2]

(b) *pathogen* = virus ;
ignore Morbilli / measles
transmission: aerosol, infection / transmission *or* droplet, infection / transmission ;
A aerosol route described from infected to uninfeccted
ignore contact [2]

(c) (infected), visitors / immigrants / returning residents, from countries where measles occurs ;
unvaccinated people returning from travel abroad ;
reduction in vaccination rates ;
percentage cover too low ;
change in reporting pattern ;
existing vaccine no longer, effective / AW ;
AVP ;
e.g. mutation of virus produces new antigens, vaccines ineffective
increase in malnourished children, no immune response to vaccine [max 1]

[Total: 5]

18.

5 **(a)** female, *Anopheles*, mosquito sucks blood from (infected) person; R. bites
parasites / plasmodia / pathogens reproduce / multiply / form gametes (in mosquito);
injects / inserts / pumps in / (saliva) with parasites / transmits / transfers parasite as feeds / in saliva (into uninfected person); **2 max**

(b) *malarial parasite has*
nucleus / nuclear membrane / nuclear envelope;
mitochondria;
membranous organelles; R. ribosomes R. nucleolus **2 max**

(c) fewer red blood cells / number of r.b.cs. reduced;
due to bursting / rupturing of r.b.c. / parasite destroys r.b.cs.;
less haemoglobin;
less oxygen transported / reduced ability to carry oxygen;
waste excreted / toxins released (by parasite);
symptom; A. one from - anaemia / fatigue / tiredness / muscular pain / headaches / nausea / fever / high temp. and sweating / inability to control temp. / shivering **3 max**

[Total : 7]

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Q19.

Question	Expected Answers	Marks
3	*Vibrio cholerae / V. cholerae*; (correct spelling required) ignore upper case / lower case diarrhoea (phonetic spelling req); A. vomiting / 'rice water' only R. loss of fluid / loss of water and salts (contaminated) food / water; R. drinks R. cooking utensils immune response; antibodies / immunoglobulins;	[Total 5]

Q20.

4 (a) Q - cell wall; **R** cellulose cell wall

R - flagellum; **A** flagella

S - (loop/circular) DNA; **A** nucleoid

R plasmid **R** chromosome **3**

(b) nucleus/nuclear membrane/nuclear envelope/linear DNA/chromosome/ nucleolus;

mitochondrion; **A** mitochondria

lysosome(s);

endoplasmic reticulum/fixed/larger/80S, ribosomes;

Golgi (apparatus/body);

centriole(s);

R membrane based organelles **3 max**

(c) (i) *Mycobacterium*;

(**A** *M. tuberculosis*/*M. bovis*) **1**

(ii) (infected) person, sneezes/coughs/sputum/spitting/breathes out;

aerosol/droplets, in the air/moist air, inhaled/breathed in by (uninfected person); **2**

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(d) bacteria enter cells in lungs/hidden from immune system;

antibiotics kill/destroy/reduce growth/AW, of bacteria;

> 1 antibiotic used, to combat/avoid development of resistance;

makes sure that all bacteria are killed;

prevents leaving a reservoir of infection/AW; **3 max**

[Total 12]

Q21.

3 **(a)** **(i)** *2 marks for the correct answer – leeway on measurement to be decided.*

$\frac{10\text{ mm}}{100\,000}$;

100 nm. **[2]**

(ii) Good/high, resolution. **A** short wavelength **[1]**

(b) (T lymphocyte) makes viral, protein/enzyme;
Cell needs more enzymes for replicating, DNA/protein synthesis/AW;
AVP. **max [1]**

(c) Sexual intercourse;
Infected, blood/blood products;
Sharing/re-using, hypodermic needles;
Across placenta/from mother to foetus;
Breast milk;
AVP. **max [3]**

(d) No cure/no vaccine;
Drugs are expensive.

Problems with
Symptomless carriers (spreading the virus);
Testing people for HIV status;
Providing, condoms/femidoms;
Educating about risks;
Tracing contacts (of infected people);
Screening blood donations;
Treating blood to kill HIV;
AVP. **max [3]**

[Total: 10]

Q22.

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5 **(a)** **(i)** *Mycobacterium, tuberculosis / bovis* ;
A *M. tuberculosis / M. bovis* [1]

(ii) (infected person) coughs / sneezes / spitting / sputum / breathes out ;
aerosol / droplets / moist air, inhaled / breathed in by (uninfected) person ; [2]

(b) make fair / valid comparison ; **A** easier to, compare /
interpret total populations of regions are different ;
calculate, incidence / prevalence (rates) ;
so can see where impact (of TB) is greatest ; [2 max]

(c) disease of, poverty / the poor ;
people, living / sleeping, in close proximity / overcrowded conditions ;
HIV / AIDS / malnutrition, weakens immune system / AW ;
TB is opportunistic disease / described ; e.g. easily infects / increased susceptibility to TB
HIV infection rates are highest in, Africa / S-E Asia ;

control regimes / vaccination programmes for TB are better in, some countries /
regions, than others ; *ora*
ref to (WHO) DOTS scheme ;
ref to availability / combination of / length of treatment / resistance, re antibiotics / drugs ;

use of comparative data to support a statement ;
A either quote figures or calculation, e.g. percentage

AVP ; e.g. general ref to provision of health services
ref to HIV and, T cells / lymphocytes
ref to, cost / complexity, of providing treatments
ref to lack of, knowledge / education [3 max]

(d) vaccine (BCG) is not effective ;
does not always give lasting protection / effectiveness decreases with years unless exposure to TB ;
no worldwide vaccination programme (as there was for smallpox) ;
endemic all over the world ;
many, carriers / symptomless people ;
bacteria remain in the body for a long time ;
intracellular parasite / lives in lung cells ;
AVP ; e.g. lack of protein in diet means it is difficult to produce antibodies /
difficult to produce herd immunity / some ref to antigenic variation / bacteria can live in animals
[3 max]

Q23.

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5 **(a)** transmitted by, *Anopheles* / mosquito / (insect) vector ;
P. falciparum / parasite, needs, warm / hot, temperatures / >20°C,
to complete its life cycle (in the mosquito) ;
requirement for areas of still water (ref. mosquito life cycle);
eradicated in areas outside tropics (e.g. North America) ; [2 max]

(b) **(i)** **A** 28 ;
B 14 ; [2]

(ii) reduce / halve, chromosome number ;
retain diploid number at fertilisation ;
prevent chromosome number doubling each generation ;
ref to variation ; **A** ref. to meiosis crossing over / independent assortment [2]

(c) genetic complexity of *Plasmodium* ;
A ref to *Plasmodium*, being eukaryotic / having many genes
many antigens / antigenic variation ;
many stages in life cycle (within human) ;
antigens change in different stages ;
idea that variation generated during meiosis ;
mutations / recessive alleles, are expressed in haploid stage(s) ; **ora**
Plasmodium / parasite, lives within cells ; **A** only briefly free in the blood stream
A antigenic concealment
T-lymphocyte / B-lymphocyte, receptors not stimulated ;
antibodies cannot work against stages within cells ; [4 max]

[Total: 10]

Q24.

5 **(a)** meiosis in lowest box ;
mitosis in the other two boxes ; [2]

(b) larger / 80S, ribosomes ;
mitochondria ;
Golgi (body / apparatus) ;
(smooth / rough) endoplasmic reticulum ; **A** (smooth / rough) ER
vacuole(s) / vesicle(s) / lysosomes ;
centriole / centrosome ;
A membrane-bound organelles if no examples given
R chloroplast/ chromosomes / nucleus [2 max]

(c) *ignore any other methods of transmission given*
(spores) in droplets / moist air, coughed / sneezed / breathed, out ; **A** aerosol
breathed in (by other person) ; [2 max]

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(d) **1** no (effective) vaccine ;
2 HIV has a high mutation rate ;
3 antigens change / different antigens / different strains ;
4 no cure ;
5 drugs, are expensive / not widely available / not effective / AW ;
6 vertical transmission / mother to child ;
problems with:
7 symptomless carriers (spreading the virus) ;
8 testing people for HIV status ;
9 providing, condoms / femidoms ;
10 promiscuity ;
11 educating about risks / AW ;
12 reuse of needles ;
13 tracing contacts (of infected people) ;
14 testing / screening, blood donations ;
15 treating, blood / blood products, to, destroy / inactive / 'kill', HIV ;
16 ref to cultural issues ; *accept relevant examples*
17 ref to poverty ;
18 AVP ; e.g. war / civil disturbance, out of date drugs, ref to transport links
ignore resistance of HIV [4 max]

[Total: 10]

Q25.

4 **(a)** **(i)** Vibrio cholerae ; [1]

(ii) active transport / described as movement against concentration gradient ;
A facilitated diffusion / described [1]

(iii) (bacteria) leave infected person in faeces / AW ;
(bacteria) enter water supply / AW ; **A** idea of contaminated, food / utensils
(bacteria) ingested by uninfected person ; [3]

(b) *must be in context of B-lymphocytes / B-cells / plasma cells*
max 3 if T-cells

*secondary response **A** ora*
presence of memory cells / AW (giving larger numbers) ;
ref. increased chance of, encountering antigen / antigen presentation / clonal selection ;
ref. larger numbers cells following, clonal expansion / AW (cf primary response) ;
(so) shorter duration for onset of antibody production ;
(so) higher antibody concentration ;

secondary response antibody production (by plasma cells) lasts longer ;
AVP ; e.g. faster rate, plasma cell / antibody, production, ref. longer-life of cells involved in secondary response [max 4]

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(c) **1** poor sanitation / no treatment of faecal waste / AW ;
2 contamination of (drinking) water supply ;
3 poverty, qualified / poor living conditions
4 poor hygiene ;
5 poor / lack of, (health) education about transmission ;
6 ref to natural disasters ; e.g. assistance / aid / medical help / AW, cannot arrive in time
7 ref. refugees / displaced people ;
8 lack of, water purification equipment / bottled water / AW ;
9 no rehydration therapy available (at time when needed) ;
10 no (effective) vaccine ;
11 further detail ; (bacteria live in gut, where immune system is not effective)
12 AVP ; e.g. contamination of vegetable plots with faecal waste, ref. to different strains [max 4]

[Total: 13]

Q26.

2 **(a)** communicable / transmissible / contagious / transferable / AW ;
A passed from one (infected), host / organism / one person, to another
A 'passed on'

caused by, a pathogen / microorganism / *at least* **two** named types of pathogen ;
A virus, bacterium, fungus, protoctist, worm ;
R parasite unqualified by two types [max 2]

(b) *Plasmodium, falciparum / ovale / vivax / malariae* ;
A phonetic spellings for specific name, **A** plasmodium
R if specific name first, [1]

(c) **(i)** (only) female feeds on blood / male does not feed on blood ;
female requires blood (protein) for (development of) eggs ;
(only) female carries, pathogen / disease-causing organism / *Plasmodium* / parasite ;
A (only) female transmits the disease
(only) female is vector ; ***ora ignore*** female carries, the disease / malaria [max 1]

(ii) anti-coagulant (in saliva) is passed when mosquito, sucks blood / feeds / bites / takes a blood meal ;
anti-coagulant prevents blood clotting when mosquito, sucks blood / feeds / bites / takes a blood meal ; [max 1]

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(iii) *in marking accept*
Plasmodium / pathogen / causative organism / malarial organism *where parasite is given below*

short time (in blood plasma)
for exposure to cells of the immune system / AW ;

next stage(s) of life cycle inside cells ;
A sporozoites into merozoites in liver /
merozoites into schizonts in red blood cells

parasite gains, food / energy, from cells ;
parasite, reproduces / multiplies, inside (liver / red blood) cells ;
damage to / bursting of / lysis of / impaired function of, cells ;

(antimalarial) drugs cannot penetrate (liver / red blood) cells ;
parasite, concealed / 'hides', from host immune system ;
A antigen concealment ;

no symptoms, until parasite leaves cells / while parasite is in cells ;
idea that people incubating disease are symptomless ;
A symptomless carriers
idea that treatment unlikely to prevent spread from infected person ;

AVP ; *examples*
different stages provide problems with drug / vaccine development
AVP ; mode of action of potential drugs – block attachment sites on cells
parasite in blood cells allows testing by taking blood samples
further development of any idea given above [max 2]

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(d) *if virus / bacterium / disease used instead mark to max 3*
in marking accept
Plasmodium / pathogen / causative organism / malarial organism *where parasite is given below*

distribution described for one mark

either
(mainly in) tropics / between the tropics
or
any **two** named, areas and/or countries, affected ;
e.g. *areas* (sub-Saharan) Africa, Central America, South America, South Asia, Central Asia, Middle East, Caribbean
e.g. *countries* India, Sri Lanka, China, Vietnam, Cambodia, Brazil, Kenya

discussion to max four

1 (areas where) both parasite, **and**, vector / mosquito / Anopheles, are present ;
2 Anopheles / mosquito / vector, survives / breeds / lives, in, hot and humid areas / moist tropical areas ; ***ora*** **A** standing / stagnant, water

3 parasite, needs to reproduce within the mosquito (at temperatures above 20°C) ;

4 eradicated in some countries / any e.g. (USA, Italy) ;

5 ref to LEDCs and, poor / non-existent, control programmes ;
A poor health facilities / poor drug supplies / AW

6 mosquitoes resistant to, DDT / insecticides / pesticides ;
7 parasite resistant to, chloroquine / drugs ;

8 link between human population density and *Anopheles* ;
e.g. human activity provides (lots of) breeding sites for *Anopheles*

9 occurs where named high risk group(s) exist ;
e.g. refugees, HIV-positive pregnant women (more likely to pass HIV to unborn children), (young) children
10 (outside tropics) disease spread by, travellers / tourists / migrants / refugees ;

11 AVP ;
most cases / over 90% cases, in (sub-Saharan) Africa
not, at high altitude / in deserts
different species of *Plasmodium* differ in geographical distribution / AW
misdiagnosis (so not reported)
changing pattern linked to, global warming / changes in land use / deforestation / irrigation / other relevant named
R references to sickle cell [max 4]

[Total: 11]

Q27.

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2 **(a)** *Mycobacterium tuberculosis* / *Mycobacterium bovis* ; (1)

(infected person) coughs / sneezes / spits / exhales / breathes out / aerosol (infection) / droplet (infection) / moist air (containing the pathogen) ;
(uninfected person) inhales / breathes in / inspires ;
ignore ref. to cattle
treat ref. to virus etc as neutral (2) [3]

(b) **1** ref. patient does not complete course / takes inadequate dose / stops taking when feels better ;
2 problems with continuing supply (of antibiotics) ;
3 not all bacteria killed ;
4 ref. mutation to become resistant ; **R** immune
5 likelihood of resistance increases if only one antibiotic used ;
6 ref. to changes in bacterium to enable resistance ;
7 ref. to changes in host cell (membrane structure) ;
8 AVP ; e.g. repeated exposure to different drug regimes (because of mp. 1)
exposure to bacteria with different resistance [max 2]

(c) **1** ref. to, worldwide incidence of TB / TB found worldwide ; AW
2 highest, incidence / AW, (sub-Saharan) Africa / LEDC / developing countries ;
3 problem with, vaccine / BCG, qualified ; e.g. doesn't work well, everywhere / in Africa / in Far East
doesn't work well for all ethnic groups
less efficient with age
ref. cold chain / needs to be kept cold
knowing when enough people vaccinated
ref. to cost
R vaccine doesn't work
4 difficult to identify infected people / ref. symptomless carriers / AW ;
5 difficulty with, contact tracing / described ;
6 difficult to diagnose / time to diagnose (can infect others) ;
7 ref. to transmission from animals to humans ;
8 weakened immune systems / link with HIV/AIDS / TB is opportunistic ;
9 ref. social factor ; e.g. overcrowded living conditions, poor diet, remote areas
10 coordination of, vaccine / treatment ;
11 ref. to difficulty of administering, drugs / DOTS ;
12 lack / availability, of trained personnel ;
13 ref. to political problems ; e.g. war , unstable regimes, refugees, migration
14 cost, qualified with additional relevant point ;
15 AVP ; e.g. ref. to countries (e.g. Russia) with large area / low population density,
16 AVP ;ref. to quarantine problems, travel qualified, other social factor [max 5]

[Total: 10]

Q28.

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(b) (i) ill-health / absence of well-being / abnormal condition / AW, (affecting an organism) ;
reduced effectiveness of, functions / named function ; AW
(illness with a set of) symptoms ; AW **A** signs
poor / AW, physical, mental or social, well-being ; **A** *two out of the three*
absence of well-being for two of the three = 2 marks [max 2]

(ii) **1** stable virus / virus did not mutate (frequently) ;
2 same vaccine could be used all the time ;
3 cheap to produce / ease of production ;
4 used a, vaccinia / harmless, virus (so people could not get smallpox) ;
5 able to use a 'live' virus (for stronger immune response) ; **A** live vaccine
6 vaccine, thermostable / AW ; **A** no requirement for keeping in cold
7 vaccine easy to administer ; **A** no need for boosters [max 2]

(iii) *cholera up to max 4*
1 transmission cycle is difficult to break; **A** described with example(s)
2 ref. difficulty in administering e.g. refugee camp, displaced, disaster ;
3 poor diet, lowered immune response ;
4 more than one strain (needs more than one type of vaccine) ; **A** more than one type (that causes cholera) **R** constantly mutating
5 vaccine, only gives short-term protection / requiring boosters ;
6 antigenic concealment ;
7 qualified ; e.g. organism in intestines, difficult for antibodies to reach
8 ref. (older or newer oral) vaccine, not successful for everyone / variable (60–65% up to 90% depending on population group) protection ;
9 no requirement by health authorities (for vaccine) / vaccine not used by health authorities ; AW

sickle cell
1 no vaccine available ; **A** cannot vaccinate against sickle cell
2 not caused by pathogen / non-infectious / non-transmissible / non-communicable ;
3 genetic / inherited, disease / AW ; **A** caused by a mutation
4 affects all red blood cells so vaccine would lead to their destruction ; [max 5]

Q29.

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4 (a) (i) *(estimated) number of newly infected people*

1 increases (steeply) (from 1990) until 1996 / 1997 ;
2 peaks at, 3.5 million / any figure between 3 and 4 million / 3 to 4 million ;
3 (gradual) decrease from, 1996 / 1997 ;
4 number of new cases in 2008 is greater than in 1990 ; [max 3]

(ii) *stated precaution(s) to reduce risk of infection by*

1 using, condoms / femidoms ;
A safe(r) sex / use protection during sexual intercourse
2 abstinence / monogamy / less promiscuity ;
3 not sharing needles / using sterile needles / needle exhange ; **A** syringes
4 not breast feeding ;
5 (heat) treated blood (products) / testing potential blood donors or donated blood ;

6 ref to contact tracing ;
7 increased awareness of, precautions / risks / transmission ;
8 increased use of (antiviral) drugs reduces transmission ;
9 some strains are less infective than others ;
10 less reporting of new cases ;
11 AVP ; e.g. fewer HIV+ babies born (to HIV+ mothers)
improved, screening / detection, qualified [max 3]

(b) *idea that* estimates are subject to large uncertainty / AW ;

idea that needed for any use of the data for planning health services / AW ;

AVP ; e.g. *explanation of mp 1 rather than general statement, such as*
symptomless carriers
many new cases not diagnosed
many new cases not reported
remote areas [1]

(c) 1 increase in new infections of HIV linked to increase in deaths from HIV/AIDS ; ora
in context of time delay
A small number deaths in 1990 as few infected eight years before
2 HIV/AIDS may take several years to develop after HIV infection ;
3 peak for new infections is in 1997 and for deaths is 2005 (delay of 8/9/10 years) ;

number of deaths in always lower than number of new infections
4 comparative data quote in support of lower number of deaths than infections ;
5 not all HIV+ people die from HIV/AIDS (over period of study) ;
6 not all HIV+ people, have / develop, AIDS ;
7 many deaths of HIV+ people recorded as due to, (named) opportunistic infections ;
8 (antiviral) drugs delay, AIDS / opportunistic infections / AW ;

9 AVP ; e.g. cheaper drugs / greater availability of drugs [max 4]

[Total: 11]

Q30.

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4 (a)

name of disease	type of causative organism	name of causative organism
cholera	bacterium / bacteria	*Vibrio cholerae*
HIV / AIDS	virus	human immunodeficiency virus;
malaria	protoctist; **A** protozoa / protista **A** apicomplexa / sporozoa	*Plasmodium, vivax / ovale / falciparum / malariae;* **A** *Plasmodium (spp)*
tuberculosis (TB)	bacterium / bacteria;	*Mycobacterium tuberculosis*

[4]

(b) (i) cholera; [1]

(ii) antibiotics / antibacterials / antimicrobial and one reason;
e.g. kill / inhibit, bacteria
bacterial infection / caused by bacterium
do not kill humans
A harmless to human / AW [1]

(iii) 1 vaccinated children, are immune / AW;
ignore resistant
2 herd effect;
3 explained; e.g. sufficient / AW, vaccinated / immune, to prevent spread (to susceptible individuals)
4 example of another factor that became effective; e.g. less money spent on drugs so more for better diet
prevention method described to avoid, food / water, contamination [max 2]

(c) (i) 1 bacterial (surface) antigens / epitopes, act as, non-self / foreign antigens;
2 human cells have self antigens;
3 (antigens are), proteins / polysaccharides;
4 (non-self antigen) will trigger phagocytosis / phagocytes have receptor (only) for, bacterial / non-self, antigens / proteins; **ora** for self antigens
5 ref. to non-self and self antigens containing different sequences of amino acids / self antigens are products of body's genotype / AW;
6 *idea that* phagocytes bind to antibodies complexed with (non-self) antigens (and human cells will not have bound antibody); [max 3]

(ii) *any reasonable; e.g.*
mechanism to prevent, phagosome formation / lysosome fusion with phagocytic vacuole
able to withstand attack by (hydrolytic) enzymes
contain enzyme inhibitors
able to degrade (hydrolytic) enzymes
protective capsule [max 1]

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(iii) reduction in numbers of T (h) lymphocytes; **A** CD_4 (cells) macrophages
ref. to role of T(h) cells e.g. enhanced humoral response, increase macrophage action;
lowered immune system / poor immune response / AW; e.g. unable to produce sufficient T/B cells / insufficient stem cells available [max 2]

[Total: 14]

Q31.

2 **(a)** cholera and TB ;
ignore *any other underlined diseases* [1]

(b) *must answer in context of antibiotics, not antibodies*
look for bacteria in answer if not clear in mp 1

1 (to ensure) all bacteria are, killed / removed / eliminated / destroyed / AW ;
R virus / bacteria and virus
ignore antigen or pathogen or disease
'all' *may be implied e.g. award if gain mp 2,3,4*
2 (so) no reservoir of infection remains / AW / ora ;
3 (disease) cannot be transmitted / cannot infect others / AW e.g. spread / ora ;
4 no recurrence / disease does not return ; *in context of same person*
5 to reduce chance of / AW, (antibiotic / drug) resistance developing ;
R *idea that human becomes resistant to antibiotics*
6 ref. to mutation in context of resistance ; [max 3]

(c) **(i)** binds with / fits into / AW, active site ; **R** collides with / reacts with
complementary shape to active site / similar shape to substrate ;
A same shape as substrate / same *or* similar structure as substrate
fewer, enzyme-substrate / E – S, complexes ;
A no ESC in context of one enzyme
A fewer successful collisions between enzyme and substrate
A prevents formation of E – S complexes
reduces rate of / slows (enzyme) reaction ;
A reduced enzyme activity / **A** less product formed [max 3]

(ii) *ideas that*
(humans) do not have the enzyme for cell wall synthesis ;
A penicillin only inhibits bacterial enzymes
penicillin will not inhibit any human enzyme ;
(human cells) do not have cell walls ; [max 1]

(iii) cell wall synthesis will stop / slow / be inhibited ;
A inhibit, murein / peptidoglycan, synthesis
ref. to uptake of water by osmosis ;
cell cannot withstand osmotic stress / cell cannot withstand turgor pressure / lysis / bursting / AW ;
A cell wall weakened
bacteria die / are killed / destroyed ;
stops bacteria dividing / reproducing / 'replicating' ;
AVP ; e.g. detail of action of penicillin (e.g. prevents cross-links forming),
(penicillin) only works on growing cells [max 3]

[Total: 11]

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Q32.

3 (a) *max 1 if no ref. to TB and COPD or if correct definitions given and ref. to TB/COPD incorrect (TB is an infectious disease, COPD non-infectious)*

TB caused by, a pathogen / *Mycobacterium* / *M. tuberculosis* / *M. Bovis* ; ora *for* COPD
A microorganism / bacterium / bacteria **I** virus / fungus / protoctist
A infectious disease is caused by a pathogen ora

TB is / COPD is not, transmissible / communicable / can be passed from one organism to another ; *allow detail of TB transmission e.g. droplet infection / in contaminated milk*
A infectious disease is transmissible ora

COPD caused by, damage to / irritation of, lung tissue ; AW
accept relevant ref. to tobacco smoking [2]

Q33.

4 (a) (i) *penalise once if the term genetic material is used instead of DNA*

1 no nuclear envelope / no (true) nucleus ;
A no nuclear membrane
A no nucleus envelope
A DNA free in cytoplasm ora
A DNA as nucleoid

2 DNA, loop / circular ;
A DNA not linear

3 DNA, not in chromosomes / DNA not associated with, histones / proteins ;
A naked DNA

4 no nucleolus ;

5 (presence of) plasmids ;

6 (only) have, 70S / small / 18–20 nm, ribosomes ;

7 presence of, capsule / slime layer ;

8 ref. small (cell) size / less than 5 μm / (only) 1 μm ;
A ora for eukaryotes [max 3]

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(ii) *plant cell*
cellulose ; *treat as neutral ref. to microfibrils / fibres*

bacterial cell
murein / peptidoglycan ;
A peptoglycan / polysaccharide and amino acid [2]

(b) 1 cell contents shrink / cytoplasm shrinks ; AW
R cell shrinks *unless clear that the cell wall remains, intact / same size*

2 cell (surface) membrane / plasma membrane, peels away / AW, from cell wall ;
A plasmolysis occurs / cell becomes flaccid

3 (movement of) water out by osmosis ;

4 down water potential gradient / from high to low water potential / to lower water potential /from less negative to more negative water potential ;
A ψ for water potential [max 3]

(c) 1 (mutation involves) change in sequence of, bases / nucleotides (of DNA);
A (mutation leads to) altered, mRNA / codons
A change leads to new alleles
(genes code for, polypeptides / proteins, so)

2 different, protein structures / proteins, possible / synthesised ;
A different, primary / tertiary / 3-D, structure

3 (so) range of / different, functions possible / AW ; [max 2]

[Total: 10]

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