Mark scheme - Communicable diseases, disease prevention and the immune system - Set 1

4 1	a		mobile vector / insect, moving / flying from tree to tree AW (1)	2	
			low genetic diversity / lack of resistance (1) fungal spores carried by the wind AW (1) climate favouring fungal growth / spread of vector (1) overcrowding of trees / small distance between trees (1)		
	b		vector (1)	1	**ALLOW** carried by insects
	c		*Plasmodium* (1) Protista / Protoctista (1) Eukaryota / Eukarya (1)	3	**ALLOW** *falciparum*
			Total	**6**	

42		i	3.75 (1)(1)		2	**ALLOW** 3,750 µm or 0.375 cm for **one** mark. **ALLOW** 1 mark for correct working e.g. 3 x 1250
		ii	(with light microscope) no further resolution (at × 1250) (1)		1	**IGNORE** ref to further detail, as implied in question. **ALLOW** ref to resolution not the same as magnification.
		iii	*two from* stay keep indoors / increase ventilation / wear masks (1) measures to, exclude / not attract / kill, rats / fleas (1) strict / immediate quarantine for persons with symptoms (1)		2	**ALLOW** (longer term) measures to reduce overcrowding.
			Total		**5**	
43			A		1	**Examiner's Comments** In this question candidates needed to process quite a lot of information about pathogens. While many chose the correct option, the most common error was to think that malaria is caused by a bacterium and therefore choose the incorrect option C. This type of question is one of those that highlight popular misconceptions.
			Total		**1**	
44		i	reduced / no, genetic variation ⌉		2 max	**ALLOW** genetically identical / same genetics **ALLOW** same / similar, alleles **IGNORE** same / similar, genes

			control (more) variables ⎤ increases validity ⎤		**ALLOW** makes it valid **Examiner's Comments** Most candidates were able to refer to clones being genetically identical. Many were able to communicate that this would remove a confounding variable but few candidates used the technical term: 'validity'. Some attempted to describe validity by using the term 'fair test' or even 'reliable'. Centres are again referred to the OCR Practical Skills Handbook for help with the correct use of such terms.
		ii	*procedure* tissue culture / micropropagation ⎤ *asepsis important because* reduces, microorganisms / contamination ⎤	2	**IGNORE** cuttings / vegetative propagation **ALLOW** clear description **ALLOW** without asepsis microbes might grow **ALLOW reduces competition for**, space / nutrients / resources **IGNORE** infection / pathogens **Examiner's Comments** Around half of candidates correctly referred to micropropagation or tissue culture. Cuttings and vegetative propagation were commonly seen un-creditworthy responses. Around half of candidates also correctly suggested that asepsis would reduce microbial contamination. Many were not awarded the second mark because they said simply that infection would be reduced without mentioning microorganisms.
		iii	clone C = 952 ± 2 ⎤⎤⎤	3	**ALLOW** 2 marks for any answer between 915 and 990 *If answer is incorrect* **ALLOW** 1 mark for 700 (area of triangle) and **ALLOW 1 mark** for 252 (area of rectangle) **Examiner's Comments** Many candidates found the mathematical skills involved in calculating the area of a triangle and rectangle challenging and full

					marks were awarded for only about a quarter of answers.
		i v	0.76(16) ⌉	1	**ALLOW** 76(.2)% / 76/100 / 19/25 / 7.6 x 10⁻¹ **ALLOW** ECF for answer to part (iii) ÷ 1250 **ALLOW** e.g. 0.564 / 56% (if answer to (iii) is 700) **Examiner's Comments** A majority of candidates could divide their answer to part 1 by 1250 and were awarded this mark. However, it should be noted that the question asked for a proportion so answers presented as a ratio were not credited.
		v	(shows) total / cumulative, infection over time (of study) ⌉ *idea that* on different days the level of infection could be different ⌉ any reference Fig.18 to support ⌉	2 max	**ALLOW** descriptive or numeric reference **Examiner's Comments** Just under half of candidates scored a mark here – usually for some description of one of the first two marking points. Very few candidates referred to Fig. within their answer, despite being told to do so, so it was rare to award both the available marks. A number of candidates misinterpreted the significance of the word 'visibly', suggesting that the area under the curve could measure invisible infection. Others referred to leaves being shed and gained no credit.
		v i	light <u>intensity</u> ⌉ light duration ⌉ soil (named) mineral (content) ⌉ <u>soil</u>, water / moisture (content) ⌉ soil type ⌉ <u>soil</u> pH ⌉	2 max	Mark the first 2 answers with exception of ignored answers below. **IGNORE** temperature / wind speed / rainfall **ALLOW** day length **IGNORE** light exposure **IGNORE** nutrients / ions / solutes / nitrogen **IGNORE** water availability **IGNORE** carbon dioxide

			humidity ⎤ air pollution ⎤		**Examiner's Comments** Many candidates gained full marks here. Frequent responses that did not gain credit often lacked precision. Examples of this included: 'pH' rather than 'soil pH'; 'soil nutrients' rather than 'soil minerals' or 'amount of light' rather than 'light intensity'. Many candidates suggested atmospheric CO_2 concentration and were not credited as it is unrealistic to suppose that this factor would vary significantly between non-adjacent fields. A small minority of candidates suggested biotic factors.
			Total	**12**	
4 5			For answers marked by levels of response: Read through the whole answer from start to finish, concentrating on features that make it a stronger or weaker answer using the indicative scientific content as guidance. The indicative scientific content indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the science content of the answer, first decide which set of level descriptors, **Level 1, Level 2 or Level 3, best describes the overall quality** of the answer using the guidelines described in the level descriptors in the mark scheme. Once the level is located, award the higher or lower mark. **The higher mark** should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met. **The lower mark** should be awarded	**6**	**For Level 3** **need discussion of more than one correct factor related to information in rubric of question** **AND** **a plausible suggestion of an action that could be taken to address one of these factors.** **IGNORE** climate change (as not mentioned in information given) **IGNORE** repetition of bullet points and suggestions that are simply reverse action (e.g. don't live close together). **Indicative scientific points may include:** **F1** • *Factor and discussion*: lack of trained health professionals **so** lack of, vaccination / treatment lack of understanding of the way in which pathogen is, spread / transmission • Possible action: increase trained health staff by sending trained health professionals into the area better access to, hospitals / clinics train up more health professionals locally educate

			where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.
			
			In summary:
			
			   • **The science content determines the level.**
			   • **The communication statement determines the mark within a level.**
			
			Level 3 (5–6 marks)
			Scientific discussion expanding on that given in the bullet point on page 12 of the exam paper of more than one correct factor that affect the spread of communicable diseases in humans
			and
			a plausible suggestion of an action that could be taken to address one of these factors.
			
			There is a well- developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.
			
			Level 2 (3–4 marks)
			Scientific discussion expanding on that given in the bullet point on page 12 of the exam paper of one correct factor that affects the spread of communicable diseases in humans
			and
			a plausible suggestion of an action that could be taken to address any factor mentioned in the passage.
			OR
			scientific discussion expanding on that given in the bullet point on page 12 of the exam paper of more than one factor that affects the spread of communicable diseases in humans
			OR
			plausible suggestions of more than one action that could be put in place to address factor(s) mentioned in the passage.
					the population (esp children) so that they can take necessary precautions educate the population about the risk of sexual transmission
					
					F2
					
					   • *Factor and discussion*:
					the ill cared for by family members **so** family exposed to the pathogen as lack of safe nursing techniques e.g. use of protective clothing / surgical gloves / hand washing / isolation
					pathogens can be spread more easily, by droplet (infection) / coughing / sneezing
					   • *Possible action*: restrict care to trained health professionals better access to, hospitals / clinics training in barrier nursing techniques provide isolation wards / quarantine
					
					F3
					
					   • *Factor and discussion:*
					overcrowded living conditions / living in close proximity **so** pathogens can be spread more easily, by droplet (infection) / coughing / sneezing / within the community
					
					   • *Possible action*:
					accommodation with, larger / less sharing of, rooms improve ventilation
					
					F4
					
					   • *Factor and discussion:*
					poor disposal of waste / poor sanitation **so** easy to pick up pathogen from, faeces / lack of hand washing

			There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.		• *Possible action:* make people aware by, putting up public warnings / education projects improve / proper, sewage disposal use of (antibacterial) handwashing gels

There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.

Level 1 (1–2 marks)
Limited scientific detail of a factor expanding on that given in the bullet points on page 12 of the exam paper
or
a plausible suggestion of an action that could be put in place to address a factor mentioned in the passage.

There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.

Level 0
No response or no response worthy of credit.

• *Possible action:*
make people aware by,
putting up public warnings /
education projects improve / proper,
sewage disposal use of
(antibacterial) handwashing gels

F5

• *Factor and discussion:*
people can, travel from / flee, places with disease
so
pathogens spread to wider area /
spread due to symptomless carriers
/ epidemic becoming pandemic
cannot be reached for,
vaccination / treatment

• *Possible action:*
travel ban
restrict travel, into / out of, infected areas
health checks at, airports / bus stations / train stations quarantine
involve, army / police, to prevent people travelling

F6

• *Factor and discussion:*
mourning and burial practices
so difficult to change deep-seated, traditions / religious practices brings people into close contact with pathogen as spread by touch and bodily fluids

					• *Possible action:* suitable alternative (e.g. cremation) involve local leaders in promoting change in practice **Examiner's Comments** The best responses made use of subject-specific terminology such as pathogen, transmission, droplet and epidemic when explaining communicable disease. Weaker answers did not distinguish between the 'disease' and its cause: the 'pathogen'. The question asked for a discussion so candidates were expected to expand on the information given in the bullet points rather than simply quoting them. Expansion points were far less common than suggested actions. Frequently suggested actions included vaccination, hand-washing, use of gloves or protective clothing and quarantine. Many gave vague suggestions such as 'train more staff' or 'improve sanitation' that reversed the information given in the question stem without adding enough detail or extra knowledge and understanding to gain credit. Some suggestions were unrealistic and impractical, e.g. massive expansion of health service infrastructure in immediate response to an acute situation. The case was not that candidates were giving incorrect information. It was more that they were failing to develop their ideas in the answer. Communication was generally good and most answers followed some logical structure.
		Total		**6**	
4 6		i	(cellulose) cell wall ✓	1 (AO1.1)	**IGNORE** cell (surface) membrane **DO NOT ALLOW** skin **Examiner's Comments** Many candidates correctly stated cell wall while others wrote 'skin'. The question was clear that entry to an individual cell was the issue.

		ii	damage / wound **or** carried by, insects / vectors / aphids ✓	1 (AO2.1)	**Examiner's Comments** Even candidates who had focused on the cell wall for (i) often veered off into histological territory with wrong answers like 'through the roots' or 'through stomata'. Candidates need to note the level of detail depicted in the question, for example whether the question context deals with organs, tissues, individual cells or with organelles or molecules within cells.
			Total	**2**	
4 7			vectors ✓ spores ✓	2(AO1.1)	**Examiner's Comments** This was answered well by the majority of candidates, but some did not realise that potato blight is a fungal disease and so did not identify the reproductive structures as spores.
			Total	**2**	
4 8	a		<table><tr><th>Pathogen</th><th>Communicable Disease</th></tr><tr><td>bacterium</td><td>tuberculosis (TB)</td></tr><tr><td>prot(oct)ist(a) ✓</td><td>potato late blight</td></tr><tr><td>prot(oct)ist(a) ✓</td><td>malaria</td></tr></table>	2 (AO1.1)	**ALLOW** fungus / fungi for potato late blight **IGNORE** *Phytophthora* **IGNORE** *Plasmodium*
	b	i	**FIRST CHECK ANSWER ON ANSWER LINE** *correct answer = 2 marks* 21 ✓ ✓ *1 mark for working stage or intermediate answer if final answer wrong:* (175 x 17 ÷ 100 or 175 x 0.17) = 29.75 / 30 ✓ or (29.75 x 70 ÷ 100 or 29.75 x 0.7) = 20.825 ✓	2 (AO2.8)	**ALLOW** 29 or 30 for 29.75 in second working step

		ii	sample size relatively small / only 175 children tested ✓ ages of children varied ✓ difficulties in interpreting the response of the dog ✓ socks could be different (in fabric) ✓ socks could have been, worn for different lengths of time / shared ✓ ref. different, soaps / washing powders, used (on feet / socks) ✓	1 max (AO3.3)	**ALLOW** different, soaps / washing powders, have different smells **Examiner's Comments** This question also provide a model for testing transferable skills. Doing the paper and going through the mark scheme could be followed up by applying the same questions and skills to new microscope drawings and descriptions of experiments.

			Total	**5**	

49	a		One mark per correct row; all correct = ✓✓✓	3 (AO1.1)	**ACCEPT** any other correct examples of viral diseases in plants

Type of pathogen	Pathogen has membrane- bound organelles	Pathogen has cell wall	Example of a disease affecting plants
fungus	yes	yes	black sigatoka
bacterium	**no**	yes	ring rot
virus	no	no	**tobacco mosaic (virus) / TMV**

		b	*Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.* *In summary:* *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *Using a 'best-fit' approach based on the*	6 (AO3.3) (AO3.4)	**Indicative scientific points may include (but are not limited to):** *General experimental details to improve validity*: • a suitable range of temperatures (e.g. 0, 10, 20, 30, 40° C) • a suitable sample size or the idea of repeats (e.g. 50 plants)

science content of the answer, first decide which of the level descriptors, *Level 1, Level 2 or Level 3*, best describes the overall quality of the answer. Then, award the higher or lower mark within the level, according to the *Communication Statement (shown in italics):*

- *award the higher mark where the Communication Statement has been met.*
- *award the lower mark where aspects of the Communication Statement have been missed.*

- **The science content determines the level.**
- **The Communication Statement determines the mark within a level.**

Level 3 (5-6 marks)
A valid plan for testing the effect of temperature on callose production, including details of control variables **and** some details of callose measurement.

There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.

Level 2 (3-4 marks)
A valid plan, with some details, for testing the effect of temperature on callose production, including **either** details of control variables **or** some details of callose measurement.

There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.

Level 1 (1-2 marks)
A plan that mentions observing callose production **or** controlling variables.

There is an attempt at a logical structure

- idea of a baseline measure of callose levels before the experiment

Control variables:

- same species / size / genetics of plant (e.g. using cloned plants)
- light intensity and duration (e.g. 12 hours of light and 12 hours of dark)

- pH / nutrients / water regime (e.g. using the same soil and water supply)
- maintaining aseptic conditions and monitoring infections (and removing infected plants from the experiment)

Callose observation:

- use a microscope
- take tissue samples
- standardise the size and location of tissue samples
- take samples from different sites
- use of stain (e.g. aniline blue)
- immunofluorescence

			with a line of reasoning. The information is in the most part relevant. **0 marks** No response or no response worthy of credit.		
			Total	**9**	
50		i	prevents pathogens entering wound (1) aromatic compound is antibacterial (1)	2	
		ii	autoimmune	1	
		iii	many, plants / microorganisms, produce molecules that may have medical benefits OR many modern medicines have been developed from traditional remedies (1) many such, plants / molecules, yet to be discovered (1)	2	
			Total	**5**	
51			production / AW of, callose ⌉ release / production, of (named / toxic) chemical ⌉ leaf drop / abscission ⌉ necrosis ⌉	**2 max**	**IGNORE** cell signalling **ALLOW** formation of tylose **ALLOW** production of chemical to prevent spread **ALLOW** production of lignin **IGNORE** insecticide / antibacterial / pheromones **IGNORE** contain chemicals **CREDIT** (rapid) death of, plant / tissue (to limit spread) **IGNORE** death unqualified **Examiner's Comments** This topic was new to A Level Biology but it had clearly been taught by centres and learned by candidates. All marking points appeared regularly and many answers got two marks. Candidates are supposed to know that potato blight is not a bacterium so references to antibacterial chemicals were not credited. Some candidates described

						aspects of an animal immune response and were not credited.
			Total		**2**	
5 2		i	*any two from:* **1** virus / foreign, <u>RNA</u> recognised (as incorrect) ✓ **2** virus / foreign, RNA / genome, cut / destroyed ✓ **3** virus, replication / reproduction, stopped ✓		2 (AO2.5 x3)	**ALLOW** viral for 'virus' throughout **ALLOW** will not recognise, virus / foreign, RNA as correct **DO NOT ALLOW** DNA / viral mRNA **DO NOT ALLOW** DNA / viral mRNA, but ecf from 1 **IGNORE** viral RNA, will not survive / attacked **Examiner's Comments** In this type of question candidates need to use the information given but add some insight to it to make a deduction. Hence just repeating the question stem information ('they recognise and destroy mRNA') will not score marks. Candidates needed to make the link that the viral RNA will be recognised by this mechanism as different to the cell's correct mRNA, so this viral RNA (not the whole virus) will be destroyed.
		ii	phospho(di)ester ✓		1 (AO2.1)	**Examiner's Comments** Wrong bond names included peptide and hydrogen as frequently as the correct answer, phosphodiester.
		iii	faulty / incorrect, (m) RNA destroyed ✓ faulty / wrong, proteins not made **or** prevents errors in protein synthesis ✓		2 (AO2. 5 x2)	**ALLOW** mutated for 'faulty' e.g. stop wrong amino acid sequence forming / stop wrong primary structure **Examiner's Comments** Many candidates did not read the question carefully enough and missed the point that the cell was a non- infected cell. They wrote about a cell resisting re-infection. Only a few candidates referred to the idea that this mechanism removes faulty proteins produced as a result of mutations.
			Total		**5**	

53		i	C and F and I and J ✓	1 AO1.2	**ALLOW** the correct terms written instead of letters
		ii	I and J ✓	1 AO1.1	**ALLOW** the correct terms written instead of letters
		iii	A and E and G and H ✓	1 AO1.2	**ALLOW** the correct terms written instead of letters
		iv	F ✓ one / few , types of cell performing a function ✓	2 AO2.1 AO1.1	**ALLOW** mucous membrane **IGNORE** J **ALLOW** examples of cells involved if one or few types is implied **ALLOW** similar cells doing the same job
			Total	**5**	
54		i	**FIRST CHECK ANSWER ON ANSWER LINE** *correct answer = 2 marks* 1,000,000 / 1 x 10^6 ✓ ✓ *1 mark for working if final answer wrong:* 40 x 500 = (20, 000cm3) ✓ or 20 ms is 20/1000 = 0.02 s ✓	2 (AO2.4)	**ALLOW** calculation combined with wrong time figure e.g. 40 x 500 x 3 = 60, 000 **ALLOW** (1s ÷ 0.02 s / 1000 ms ÷ 20 ms) = 50
		ii	(more) infections / irritation / coughing ✓	1 (AO2.1)	**ALLOW** bronchitis / pneumonia / bacterial disease / viral disease
			Total	**3**	
55			**1** goblet cells, secrete / release / make / produce / form, mucus ✓ **2** mucus traps, pathogens / microorganisms / bacteria ✓ **3** ref. phagocytes / neutrophils / macrophages / lysozyme ✓ **4** cilia / ciliated cells / ciliated epithelium, sweep / brush / waft / move / AW, mucus ✓ 5 cytoskeleton / microtubules / tubulin, move(s) / make(s) up, the cilia ✓	4 max	**IGNORE** excrete **ALLOW** named example of a lung pathogen **IGNORE** cilia trap, pathogens / microorganisms **ALLOW** 'cillia' / other spelling that looks and sounds same **DO NOT ALLOW** cilia cells **Examiner's Comments** Most candidates scored one or more marks. High ability responses showed correct and precise use of biological terms such as

						goblet cells, mucus, cilia and pathogens. Lower ability responses did not distinguish between the roles of two sorts of epithelial cells, goblet cells and ciliated cells. The commonest error was to say that cilia trap pathogens.
			Total		**4**	
5 6			D		1	**Examiner's Comments** Some candidates confused 'primary defence mechanism' with 'primary response' and suggested various actions of the immune system rather than blood clotting.
			Total		**1**	
5 7			mosquito mouthparts pierce skin / AW (1) pathogen injected (directly) into blood (1)		2	
			Total		**2**	
5 8		i	(opsonin) binds to antigen on pathogen and, assists binding / binds, to phagocyte		1	
		ii	*any one:* well-developed cytoskeleton (1) many lysosomes (1) many mitochondria (1) lobed nucleus (1)		1	
			Total		**2**	
5 9	a		opsonins ✓ phagosome ✓ lysosomes ✓		3	
	b	i	*A because* nuclei (of white blood cells) are lobed ✓		1	Mark is for the explanation
		ii	(x) 1300 ✓✓		2	If answer is incorrect **ALLOW** 1 mark for evidence of 0.02 (m) / 0.000015 (m) or equivalent numbers in alternate units
			Total		**6**	
6 0			*cytokines* attract / AW , (named) phagocytes ✓		2 AO1.2	**IGNORE** increase phagocytosis without reference to movement

			opsonins bind to / AW , pathogens / foreign cells / antigens , and increase phagocytosis / recognition by phagocytes ✓		
			Total	**2**	
6 1		i	(stage) **2** (should say), non-self / not self / foreign ✓ (stage) **5** (should be) before **4** / **4** (should be) **after 5** ✓	2	**ALLOW** quote to replace stage number **2**, e.g. *'phagocytes recognise pathogens as non-self* *'phagocytes do **not** recognise pathogens as **self*** **IGNORE** non-body **ALLOW 4** and **5** are in wrong order / should be reversed / need swapping / should be the other way round / AW **ALLOW** quote to replace stage numbers, e.g. *'phagosome combines with a lysosome* ***before** stage 4'* *'enzymes from lysosomes digest pathogens* ***after** stage 5'* *'forms a phagolysosome and THEN destroys the pathogen'* *'phagosome and lysosome do not combine AFTER the pathogen is destroyed'* **Examiner's Comments** Most candidates recognised the problem with stage 2 (which should have said non-self or equivalent) but fewer recognised that stages 4 and 5 were in the wrong order.
		ii	minimum of one light chain drawn on outside of heavy chain **and**	1	**GUIDELINES for drawing:** Light chain should start at tip of arm of Y and be 25–50% the length of the heavy chain.

			label to, light (polypeptide) chain / variable region / antigen-binding site ✓		**ALLOW** label line not touching if label written near correct region **Examiner's Comments** Many candidates missed this out. Candidates who attempted it often drew light chains that were too long, in the wrong place or unrecognisable. Where at least one light chain was drawn correctly there was usually one correct label such as 'variable region' or 'light chain'.
			Total	**3**	
62			B	1	**Examiner's Comments** Some candidates were unable to distinguish between the various white blood cells, although a few did suggest the erythrocyte.
			Total	**1**	
63		i	*three from* B cells / lymphocytes, have, antigen receptor / carry antibody, on surface, specific / complementary to, only one antigen (1) selected / activated, B cell, proliferates / clones / divides by mitosis (1) forms / differentiates into, plasma / effector, cells (1) which secrete antibodies specific / complementary, to antigen (1)	3	
		ii	*two from* (helper T cells) stimulated by antigen-presenting cells (1) release, cytokines / interleukin 2 (1) stimulate B-cell, proliferation / mitosis / clonal expansion (1)	2	
			Total	**5**	
64			* **Level 3 (5–6 marks)** A full explanation of why strains are immunologically distinct **AND** a description of more than one method of action of the immune system. *There is a well-developed line of*	6	**Relevant points include:** **immunologically distinct** • toxins produced by each strain will be (slightly) different • each (botulinum) toxin will have different, 3D shape / amino acid

			reasoning which is clear and logically structured. The information presented is relevant and substantiated. **Level 2 (3–4 marks)** A full explanation of why strains are immunologically distinct **AND** an attempt to describe a method of action of the immune system. **OR** A description of more than one method of action of the immune system **AND** an attempt to explain why strains are immunologically distinct. *There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.* **Level 1 (1–2 marks)** An attempt to explain why strains are immunologically distinct **AND** an attempt to describe a method of action of the immune system. *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* **0 marks** No response or no response worthy of credit.		sequence / DNA nucleotide coding sequence • toxin, acts as / is, antigen • immune response determined by shape of antigen • different compounds will have different shapes **immune system** • antigen presenting cells ingest antigen and display antigen on their surfaces • interaction between APCs and T-helper cells causes production of interleukins • B cells activated by T-helper cells • clonal selection and clonal expansion • B cells differentiate into plasma cells • plasma cells produce, antibodies / immunoglobulins • by protein synthesis antibodies bind to and neutralise toxins.
			Total	**6**	
6 5		i	*idea* of greater susceptibility to, infection / pathogens ✓ no / fewer, plasma cells / effector cells / antibodies ✓	2	e.g. immune deficiency/ slower immune response/weakened immune system / longer time to recover from infection **IGNORE** ref to illness / disease / immunological memory **ALLOW** 'fewer lymphocytes to produce antibodies' **Examiner's Comments** This question was generally well answered,

					with the majority of candidates achieving 1 or 2 marks. Some candidates were not credited a mark for using the term 'illness' or 'disease' rather than referring to an increased risk of infection or susceptibility to pathogens. Fewer candidates were credited the second mark point, but for those that were, the majority stated 'less plasma cells' or 'less antibodies'. Some candidates missed out on this mark by stating what they knew about B cells, but not answering the actual question. For example, only saying 'fewer B lymphocytes are present' or that 'B cells make antibodies', rather than there being fewer B cells making fewer antibodies. There was a misconception amongst a few candidates that B lymphocytes were involved in phagocytosis.
		ii	(allele is) recessive (because) ✓ healthy parents produce children with the disease ✓ 2 / 5 / 2 and 5 / mothers , heterozygous / carrier ✓ (likely to be) sex-linked / described ✓ (because) on the X chromosome / X linked ✓ only males have the disease/no females have the disease/AW ✓	4 max	**ALLOW** '3 has the disease, but 1and 2 / parents, do not ' **ALLOW** '7, or / and, 8, has the disease, but, 5 and 6 /parents, do not' **ALLOW** 'allele found on the sex chromosomes' **Examiner's Comments** Again, a well answered question with plenty of opportunities to pick up marks. The majority of candidates were credited 3 or 4 marks here. Most were able to identify that the allele was recessive, sex linked and located on the X chromosome. Marks were lost when candidates misunderstood the reasoning behind only males being affected, and linking this to the Y chromosome. Some candidates gave imprecise answers which did not gain credit e.g. '2 and 5 were carriers' or saying 'males are more likely to have the disease' rather than 'only males have the disease'.
			Total	**6**	
6 6				5	**Examiner's Comments**

		antigens ✓ interleukins ✓ mitosis ✓ plasma ✓ antibodies ✓		The majority of candidates gained full marks here. The most common incorrect response was to write 'memory' or 'killer T cell' rather than 'plasma' in the fourth space. Many wrote 'hormones', rather than 'interleukins' in the second space. Some candidates still confuse antigens and antibodies.
		Total	**5**	

6
7
		Please refer to the marking instructions on this mark scheme for guidance on how to mark this question.
		
		In summary:
		Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)
		*Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors, **Level 1, Level 2** or **Level 3**, best describes the overall quality of the answer.*
		*Then, award the higher or lower mark within the level, according to the **Communication Statement** (shown in italics):*
		
		• *award the higher mark where the Communication Statement has been met.*
		• *award the lower mark where aspects of the Communication Statement have been missed.*
		
		• **The science content determines the level.**
		• **The communication statement determines the mark within a level**.
		
		Level 3 (5-6 marks)
		Detailed explanation of variation from genes and environment, using examples.
		
		There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated
			6
			(AO2.1)
			(AO2.5)
				Indicative scientific points may include (but are not limited to):
				Genes
				
				• inherit genes that code for immune cells / antibodies (from parents)
				  examples: (B/T) lymphocytes, macrophages, etc
				• different alleles code for different versions of immune cells/antibodies
				• ref. to gene segments recombining
				• alleles code for many different variable regions
				• reference to MHC alleles
				• mutation produces new alleles (for antigens / immune cells)
				• ref to autoimmune diseases
				  examples: lupus, arthritis, allergies, SCID
				
				Environment
				
				• exposure to different pathogens determines immune response
				  examples: measles, mumps, (produce) memory cells etc.
				• vaccinations produce primary immune responses
				  examples:MMR, BCG,HPV, (produce) memory cells etc.
				• reference to environmental influence on allergies
				  examples: pollen, hayfever, asthma, etc.
				• poor diet can weaken immune system
				  examples: low levels of protein / vitamins, (reducing) antibodies

Level 2 (3-4 marks)
Explanation of variation from genes and environment, with few examples.

There is a line of reasoning with some structure. The information presented is relevant and supported by some evidence

Level 1 (1-2 marks)
Limited explanation of variation from genes or environment.

There is an attempt at a logical structure with a line of reasoning. The information is, in the most part, relevant.

0 marks
No response or no response worthy of credit.

- reference to epigenetic changes
  examples: as a result of diet, stress, chemical exposure
- (auto)immune diseases with an environmental component / trigger
  example: AIDS

Examiner's Comments

Successful candidates produced concise, well thought responses that answered all aspects of the question. Most candidates recognised the role that genetic variation had on the production of immune system cells and antibodies. Although here again there was confusion between the terms antibody and antigen. The role of mutation in this was often referred to, although inappropriate examples of this such as haemophilia were sometimes given. Many referred to autoimmune conditions often giving arthritis or *lupus* as an example. Many lower ability candidates gave inappropriate examples of this type of condition, most commonly cystic fibrosis. Many candidates quoted previous exposure to pathogens and vaccinations as environmental factors causing variation in immune response. Some recognised the role of diet or disease, such as HIV, in affecting the immune response, but only a few referred to epigenetic changes. Many very knowledgeable responses were limited to Levels 1 and 2 due to a lack of examples quoted.

? **Misconception**

Candidates seem to confuse the two terms 'antibody' and 'antigen'. It will be useful if candidates were able to develop their own aide-memoir in order to distinguish between the two terms.

Exemplar 1

as some people may have a genetic autoimmune disease such as cystic fibrosis which would mean that their body cannot use their B and T lymphocytes effectively causing them to be more prone to having on serious symptoms of a disease. The environment can cause animals to vary in their specific immune response as it depends on whether the individual has been previously exposed to the pathogen such as for example those who have been previously exposed to the influenza virus would have a quicker secondary immune response than those who haven't and so will recover quicker. The Another environmental influence would be the whether the individual has been vaccinated. This means that some individuals who have been vaccinated will have a greater chance of not being caused serious health issues if exposed to any harmful diseases or viruses.

Genes can cause animals to vary in their specific immune responses [6]

Exemplar 1 has included environmental points (the idea of exposure to pathogens and vaccination) and a genetic point (autoimmune disease), although the example given is a genetic disease though not an example of an autoimmune disease. Examiners were looking for examples such as rheumatoid arthritis, lupus or type 1 diabetes. They have one relevant example (influenza virus, in the context of exposure). This is a good example of a comfortable Level 2 answer worth 4 marks.

Exemplar 2

The genes would vary an animals Specific immune response because a genes can control both proteins and which type of T cells and B cells that they will differentiate into by Controlling which genes are expressed or not. (e.g.) if an animal needs a higher proportion of T cells. both B If one animal needs a higher proportion of T cells the

The environment also causes physiological variation and can control the expression of genes to an extent

Exemplar 2 has mentioned that genes code for immune cells and given examples of immune cells which are coded for, but lacks any explanation of variation to the immune system caused by the environment. Therefore it is limited to a Level 1 response.

					There is an attempt at a logical structure to the answer and most of the information is relevant, and so the answer can be given 2 marks.
		Total		**6**	

68				4	**1 mark for each correct row** **Ticks and crosses must be clear –** **do not accept 'hybrids'** **If ALL CELLS BLANK then = NR** **If TICKS AND BLANKS ONLY in the table, 1 mark for each correct row as follows:** **If CROSSES AND BLANKS ONLY in the table, 1 mark for each correct row as follows:** **ACCEPT 'yes' for 'tick' and 'no' for 'cross'** **Examiner's Comments** Candidates generally knew that both B and T lymphocytes form part of the immune response (line 1) though not everyone associated T cells with memory cells (line 2). The knowledge needed to associate T cells with lysis of infected cells (line 3) and B cells with plasma cell clones (line 4) was not universal. Candidates need to be taught to fully cross out ticks that have been placed in error as 'hybrid' ticks are not acceptable either as ticks or crosses.

		Total		**4**	

			Drawn line should show: higher peak **and** steeper initial rise (1) line departs *x* axis between days 30 and		
69	i			2	Peak should be at least 40 AU. **ALLOW** if nearly vertical. **DO NOT ALLOW** if actually vertical. **ALLOW** line start at 30 or 33 days.

			33 **and** concentration at 60 days above peak of printed line (1)		
		ii	*one from* (memory cells) not acting in, first line / primary response (1) (memory cells) remained in blood after primary response (1) *one of the above linked to* so no wait for / faster, clonal selection (1)	2	
			Total	**4**	