



EXAM PAPERS PRACTICE

Immunity, Infection and Forensics -1

Name: _____

Class: _____

Date: _____

Time:

Total Marks Available:

Total Marks Archived:

Level: Edexcel A level Biology

Subject: Biology

Exam Board: Pearson Edexcel Level 3 GCE AS and A level Biology A (Salters-Nuffield) and also Pearsons Edexcel AS and A Level Biology B (9BI0) - Is however suitable for use by AS and A level Biology Students of other Boards

Topic: Immunity, Infection and Forensics -1

Type: Mark Scheme

To be used by all students preparing for Edexcel AS and A level Biology A and Biology B - Students of other Boards may also find this useful



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Mark Scheme

Q1.



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Question Number	Answer	Additional guidance	Mark
(a)(i)	<ol style="list-style-type: none">1. idea that interferon involved in viral infections, lysozyme affects bacteria;2. idea of interferon produced by infected cells, lysozyme present in {secretions / phagocytes / neutrophils / macrophages / eq };3. interferon {inhibits / eq} {replication / eq} of viruses, lysozyme {kills / destroys} bacteria;	<p>Piece together throughout Accept lysosome throughout Ignore pathogen throughout</p> <p>2. Accept named secretion {produced / released}</p> <p>3. Accept a reference to lysozyme destroying cell walls</p>	(3)

Question Number	Answer	Additional guidance	Mark
(a)(ii)	<ol style="list-style-type: none">1. reference to (lysozyme) is an enzyme ;2. idea that {proteins / active sites / enzymes} have a specific shape ;3. idea that lysozyme acts on cell wall ;4. of bacteria ;	<p>Accept lysosome in this context</p>	(4)



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Question Number	Answer	Additional guidance	Mark
(a)(ii)	<ol style="list-style-type: none">1. reference to (lysozyme) is an enzyme ;2. idea that {proteins / active sites / enzymes} have a specific shape ;3. idea that lysozyme acts on cell wall ;4. of bacteria ;	Accept lysosome in this context	(4)

Question Number	Answer	Additional guidance	Mark
(b)(i)	<ol style="list-style-type: none">1. reference to histamine released as a result of damaged {tissue / cells} ;2. (histamine released from) {basophils / mast cells / platelets} ;3. detail of effect of histamine e.g arterioles dilate, vasodilation, increased blood flow, capillaries more permeable ;4. named effect of inflammation e.g. {oedema / swelling /redness / heat / pain / eq} ;	2. Accept white blood cells, macrophages and neutrophils 4. Accept raises temperature	(3)



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Question Number	Answer	Additional guidance	Mark
(b)(ii)	<ol style="list-style-type: none">1. idea of (only) {a local reaction produced / histamines produced around bite area} ;2. idea that cream {has been applied to actual site of production of histamine } ;3. idea of {effect / treatment / relief / eq} {more rapid / immediate / eq };4. idea of higher concentration of antihistamine at site ;5. idea that the antihistamines will not be {digested (by enzymes) / destroyed (by acid / enzymes) / eq} ;6. idea that tablets may lower immune response generally / lead to side-effects ;	2-6 Accept converse	(3)

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Q2.

Question Number	Answer	Additional guidance	Mark
(a)(i)	<ol style="list-style-type: none">1. reference to {polymerase chain reaction / PCR} ;2. polymerase (enzyme) {added / eq };3. idea of need for primers and nucleotides ;4. {90-98} (°C) → {50-65} (°C) → {70-75} (°C) ;5. idea that cycle needs to be repeated {several times / to make several copies of DNA / eq};	1. Accept as a ref to PCR machine	(4)

Question Number	Answer	Additional guidance	Mark
(a)(ii)	(DNA) {profiling / fingerprinting / (gel) electrophoresis} ;	Ignore Southern blotting, PCR Accept DNA profile / DNA fingerprint	(1)

Question Number	Answer	Additional guidance	Mark
(b)	<ol style="list-style-type: none">1. idea of work appearing in a (Scientific) journal or being presented at a conference ;2. idea that validity or reliability is considered ;3. by other scientists / ref to peer review ;	1. Accept publishing a paper, scientific meeting	(2)



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Question Number	Answer	Additional guidance	Mark
(c)(i)	<ol style="list-style-type: none">1. reference to different {conditions / environments /eq} (in each region) ;2. idea of different selection pressures ;3. idea of {restricted gene flow / separate gene pools} ;4. reference to reproductive isolation;	<p>1. Accept appropriate named factor e.g. temperature</p> <p>3. Ignore different allele frequency</p>	(2)

Question Number	Answer	Additional guidance	Mark
(c)(ii)	<ol style="list-style-type: none">1. idea of different {alleles/ gene pool} ;2. idea that this leads to {new / different} phenotypes ;3. idea of new {allele / gene} can be {advantage / disadvantage} ;4. reference to (advantageous) {(mutated) gene / (new) allele} passed onto offspring ;	<p>1. Ignore allele frequency</p> <p>2. Accept traits / characteristics / features</p>	(2)



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Q3.

Question Number	Answer	Additional guidance	Mark
(i)	<ul style="list-style-type: none">• using carbon (14) dating	ALLOW the deeper the layer in the peat, the older it is	graduate (1)

Question Number	Answer	Additional guidance	Mark
(ii)	<p>An explanation that makes reference to three of the following</p> <ul style="list-style-type: none">• conditions are anaerobic (1)• therefore less (aerobic) respiration by decomposers (1)• acidic conditions {inhibit /denature} enzymes (1)• therefore (enzymes) cannot {digest / break down} organic material (1)	<p>ALLOW (waterlogging) reduces the oxygen content</p> <p>ALLOW microorganisms / named decomposers ALLOW decomposers respiring anaerobically</p> <p>ALLOW description of denaturing eg change in shape of active site</p> <p>ALLOW break down plants / animals /peat</p>	Expert (3)



Q4.

Question Number	Acceptable Answer	Additional guidance	Mark
	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none">• it was assumed that one gene makes one protein (so there should be 100 000 genes but there are 25 000 genes) (1)• the diagram shows that one gene can make more than one mRNA (1)• one gene can code for several proteins (1)• due to removal of different exons (1)• reference to post-transcriptional change (1)		(5)



Q5.

Question Number	Acceptable Answer	Additional guidance	Mark
(a)(i)	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none">• (small pieces) provides large surface area to volume ratio (1)• (use of ethanol for a long time means) the antibacterial substance is soluble in ethanol and more will be extracted (1)		(2)

Question Number	Acceptable Answer	Additional guidance	Mark
(a)(ii)	<p>$\pi 2.15^2$ (1)</p> <p>14.5 cm² (1)</p>		(2)



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Question Number	Acceptable Answer	Additional guidance	Mark
(b)(i)	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none">the t-test assess the significance of the difference between the means of the two treatments (1)Chi squared not appropriate because there are no expected values (1)correlation coefficient not appropriate because the independent variable is discontinuous / not continuous (1)		(3)

Question Number	Acceptable Answer	Additional guidance	Mark
(b)(ii)	$2.37^2 \div 9 = 0.62$ and $3.60^2 \div 9 = 1.44$ (1) $\sqrt{(0.62 + 1.44)} = 1.44$ (1) $(27 - 25) \div 1.44 = t = 1.39$ (1)	Correct answer gains full marks	(3)

Question Number	Acceptable Answer	Additional guidance	Mark
(b)(iii)	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none">there is no significant difference between the clear area caused by garlic compared with that caused by chloramphenicol (1)$p > 0.05$ (1)difference due to chance (1)therefore accept null hypothesis (1)	Allow marking points for the calculated value of t from the candidate	(4)



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Question Number	Acceptable Answer	Additional guidance	Mark
(c)(i)	An explanation that makes reference to the following: <ul style="list-style-type: none">• suggests cedar wood oil has no anti-microbial effect on <i>E. coli</i> and all other oils do (1)• quoting at least two values from: rosemary 2%, geranium 0.5%, garlic 0.125% / manipulation of data to show relative effects (1)		(2)

Question Number	Acceptable Answer	Additional guidance	Mark
(c)(ii)	An answer that makes reference to the following: <ul style="list-style-type: none">• for cedar wood oil try concentrations above 4% (1)• for all the others, try concentrations below 0.0625% (1)		(2)

Question Number	Acceptable Answer	Additional guidance	Mark
(c)(iii)	A description that makes reference to the following: <ul style="list-style-type: none">• only one tray per species – need repeated measurements (1)• species – only used one species of bacteria / only used extracts from four plant species (1)		(2)



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Q6.

Question Number	Answer	Additional Guidance	Mark
	<p>An explanation that makes reference to three of the following:</p> <ul style="list-style-type: none">antibiotics reduce the number of other (species of) bacteria (1)antibiotics that attack cell walls {cause lysis / are bactericidal } (1)antibiotics that attack protein synthesis (machinery) {prevent growth / are bacteriostatic} (1)this reduces interspecific competition from other bacteria for limited resources (1)	ALLOW attack ribosomes	(3)

Q7.

Question Number	Answer	Additional guidance	Mark
(i)	<p>An explanation that makes reference to three of the following</p> <ul style="list-style-type: none">ribosome shape is altered (1)mRNA is prevented from binding (to the ribosome) / causing change in tRNA binding (1)therefore translation cannot occur (1){ protein / polypeptide } is not synthesised (1)	ALLOW translation is affected / reduced / altered ALLOW faulty protein produced	(3)



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Question Number	Answer	Additional guidance	Mark
(ii)	<p>An answer that makes reference to two of the following</p> <ul style="list-style-type: none">• bacteria have not been exposed to new antibiotics before /bacteria do not have mechanisms to make them resistant to the new antibiotics (1)• bacteria have developed resistance (to other antibiotics) by { evolving / natural selection } (1)• therefore there has been {no advantage to possessing a mutation to bypass the new antibiotic / no mutation present to give resistance } (1)		(2)

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Question Number	Answer	Mark
(iii)	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p>Indicative content</p> <ul style="list-style-type: none">• prepare agar plates with bacterial cultures / bacterial lawn / seeded with bacteria –use bacteria that are resistant to other antibiotics• prepare solutions of new antibiotic and penicillin• place onto paper discs / into wells in the agar / prepare mast rings• control time and temperature of incubation• same concentration and volume of both antibiotics• measure the area of inhibition• repeat for effective antibiotics• description of serial dilution of each antibiotic• range of dilutions on each plate-one antibiotic per plate• statistical test to determine which is the most effective• repeat with different strains of resistant bacteria	(6)



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Level	Marks		Additional Guidance
0	0	No awardable content	
1	1-2	<p>An explanation of how the investigation should be modified may be attempted but with limited analysis, interpretation and/or evaluation of the scientific information. Generalised comments made.</p> <p>The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.</p>	<p>Preparation of agar plates Method of adding antibiotic</p> <p>Use of new antibiotic and penicillin Measure zone of inhibition</p>
2	3-4	<p>An explanation of how the investigation should be modified will be given with occasional evidence of analysis, interpretation and/or evaluation of the scientific information.</p> <p>The explanation shows some linkages and lines of scientific reasoning with some structure.</p>	<p>Incubated for stated time 24-72 hours Incubated at stated temperature 25-37°C Method of culturing bacteria on agar plates/preparing a lawn</p> <p>Repeats to calculate the mean Larger zone of inhibition-more effective antibiotic</p>
3	5-6	<p>An explanation of how the investigation should be modified is given which is supported throughout by evidence from the analysis, interpretation and/or evaluation of the scientific information.</p> <p>The explanation shows a well-developed and sustained line of scientific reasoning which is clear, coherent and logically structured.</p>	<p>Strain of bacteria known to be resistant to penicillin/other antibiotics Same volume/concentration of both antibiotics</p> <p>Several strains of resistant bacteria tested with new antibiotic Preparation of serial dilutions for both antibiotics Range of concentrations give minimum effective dose Named statistical test eg T-test</p>



Q8.

Question Number	Answer	Additional Guidance	Mark
	<p>An explanation that makes reference to three of the following:</p> <ul style="list-style-type: none">• a vaccinated person will have memory T cells (1)• (memory T cells) recognise (antigens specific to) the HPV-16 virus (1)• T helper cells that activate {B cells / T killer cells} (1)• (formation of) T killer cells destroy cells infected with virus (1)	<p>ALLOW a response that begins with 'T memory cells ...' / or statement that T memory cells are already present</p> <p>ALLOW cytotoxic T cells for T killer cells</p>	3

Q9.

Question Number	Answer	Additional Guidance	Mark
(a)	<ol style="list-style-type: none">1. involves prophase, metaphase, anaphase and telophase ;2. idea that produces two nuclei ;3. idea that these are genetically identical to original ;	<ol style="list-style-type: none">1. NOT if cytokinesis or interphase included as part of mitosis2. ACCEPT produces two cells	(2)



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Question Number	Answer	Additional Guidance	Mark
(b)	<ol style="list-style-type: none">1. (SAN) is myogenic / description given ;2. electrical activity from SAN causes atria to contract / eq ;3. idea that activity of SAN can be changed by nerve impulses e.g. controlled by medulla ;4. credit detail of nervous control e.g. more impulses from accelerator increases heart rate ;		(3)

Question Number	Answer	Additional Guidance	Mark
(c)	<ol style="list-style-type: none">1. idea that lactase gene {activated / transcribed} ;2. (synthesis of) lactase / eq ;3. hydrolysis of lactose / glycosidic bonds broken ;4. to produce glucose AND galactose ;		(3)



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Question Number	Answer	Additional Guidance	Mark
(d)	<ol style="list-style-type: none">1. idea that a better model than guinea pigs or mice ;2. idea of animal rights ;3. easy to culture / eq ;4. (HeLa cells) susceptible to disease / HPV / eq ;	<ol style="list-style-type: none">1. ACCEPT reference to only HeLa {cells / DNA} are human3. ACCEPT cheaper (as continual supply)	(2)



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Question Number	Answer	Additional Guidance	Mark
*(e)	<p>(QWC – spelling of technical terms must be correct and the answer must be organised in a logical sequence)</p> <ol style="list-style-type: none">1. idea that {motor neurone / cell body / nucleus} is destroyed ;2. depolarisation does not occur in the neurone / (insufficient so) no action potential set up in the neurone ;3. detail of (depolarisation / action potential) not occurring in neurone e.g. idea Na^+ does not diffuse into neurone ;4. {neurotransmitter / named neurotransmitter} not {released / produced / eq} at junction with muscle / eq ;5. detail of lack of neurotransmitter release e.g. vesicles (containing neurotransmitter) do not {move / fuse} with {presynaptic membrane /	<p>QWC emphasis is clarity of expression</p> <ol style="list-style-type: none">1. ACCEPT idea of damage to myelin sheath / Schwann cells3. ACCEPT Na^+ / cation channels {non-functional / eq}4. ACCEPT {neurotransmitter / named neurotransmitter} not {released / produced / eq} at {motor neurone presynaptic membrane / motor end plate}	



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	<p>eq} / eq ;</p> <p>6. Ca^{2+} not released into muscle cytoplasm ;</p> <p>7. Ca^{2+} not released from sarcoplasmic reticulum ;</p> <p>8. no Ca^{2+} to {activate / eq} troponin ;</p> <p>9. idea that muscle does not contract ;</p>	<p>6. ACCEPT Ca^{2+} not released into sarcoplasm</p>	<p>(6)</p>
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Question Number	Answer	Additional Guidance	Mark
<p>(f)</p>	<p>1. contains bases / eq ;</p> <p>2. contain phosphate (groups) ;</p> <p>3. have a pentose sugar ;</p> <p>4. reference to phosphodiester bonds ;</p> <p>5. idea of discrete strands ;</p>	<p>1. ACCEPT both have (4) bases / nucleotides</p> <p>3. ACCEPT 5C sugar</p> <p>5. ACCEPT linear</p>	<p>(3)</p>



Question Number	Answer	Additional Guidance	Mark
(g)	<p>1. smooth shown as dominant / wrinkled shown as recessive e.g. use of upper and lower case ;</p> <p>Parental generation:</p> <p>2. both types shown as homozygous ;</p> <p>F1:</p> <p>3. all shown as heterozygous ;</p> <p>F2:</p> <p>4. genetic diagram to show that 75% are smooth / 25% are wrinkled ;</p>	<p>4. Diagram should show genotypes</p>	(4)



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Question Number	Answer	Additional Guidance	Mark
(h)	<ol style="list-style-type: none">all the {DNA / eq} found in {a human / the human species / eq} ;idea of genes {on different chromosomes / different positions on same chromosome} ;	<ol style="list-style-type: none">ACCEPT population for species	(2)

Question Number	Answer	Additional Guidance	Mark
(i)	<ol style="list-style-type: none">product (of p53 gene) {stops / eq} development of tumour cells / eq <p>OR</p> <ol style="list-style-type: none">product (of p53 gene) {stops / regulates} progression {of cell cycle / towards mitosis} ;acts as an inhibitor of {transcription / protein synthesis / eq} / eq ;idea that {DNA / eq} repair ;idea that leads to apoptosis ;	<ol style="list-style-type: none">ACCEPT product stops tumour cells growing / dividing <ol style="list-style-type: none">ACCEPT product keeps it in {interphase / named mitotic stage} / product interferes with mitosis progress	(2)



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Question Number	Answer	Additional Guidance	Mark
(j)	<ol style="list-style-type: none">1. protein / glycoprotein ;2. reference to this being CD4 ;3. found on cell (surface) membrane / eq ;4. that acts as a {receptor / named receptor} for HIV / eq ;	<ol style="list-style-type: none">4. ACCEPT receptor for gp120	(2)

Question Number	Answer	Mark
(k)	200 (nucleotides) ;	(1)

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Q10.

Question Number	Answer	Additional Guidance	Mark
(i)	<p>1. (skin flora) {prevent growth of / kill} {pathogens / microorganisms / bacteria / eq} ;</p> <p>2. competition for {space / nutrients / water / minerals / eq} ;</p> <p>3. release of {chemicals / toxins / antimicrobials / lipids / enzymes / eq} ;</p>	<p>1 ACCEPT prevent colonisation</p> <p>IGNORE antigens / viruses / infections / diseases</p> <p>2 IGNORE food / resources</p> <p>3 NOT sebum / lysozymes</p>	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>B they have antimicrobial properties that inhibit the growth of bacteria</p>		(1)

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Q11.

Question Number	Answer	Additional guidance	Mark
	<p>An explanation that makes reference to two of the following</p> <ul style="list-style-type: none">• because the pH inside the stomach is too low for the enzymes of most bacteria to function (1)• bacteria that live in the stomach have adaptations that enable them to survive (1)	<p>ALLOW reference to bacterial enzymes being denatured</p> <p>ALLOW (some) bacteria have evolved specifically to withstand the conditions</p>	(2)

Q12.

Question number	Answer	Additional guidance	Mark
	<ul style="list-style-type: none">• surface area of virus (1)• surface area of one spike protein (1)• correct whole number (1)	<p>Example of calculation</p> $4 \times \pi \times 120^2 = 180955.7 \text{ (nm}^2\text{) ALLOW } 180864 / 181028.6$ $(22.4 \times 20) \div 2 = 224 \text{ (nm}^2\text{)}$ $180955.74 \div 224 = 808$ <p>ALLOW 807</p> <p>ECF for one incorrect area values For a maximum of 2 marks</p> <p>Correct answer with no working gains full marks.</p>	<p>Expert</p> <p>(3)</p>



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Q13.

Question Number	Acceptable Answer	Additional guidance	Mark
(a)	C		(1)

Question Number	Acceptable Answer	Additional guidance	Mark
(b)	B		(1)

Question Number	Acceptable Answer	Additional guidance	Mark
(c)	B		(1)

Question Number	Acceptable Answer	Additional guidance	Mark
(d)	<p>An answer that makes reference to one of the following points:</p> <ul style="list-style-type: none">• virus has a non-cellular structure whereas bacteria has a cellular structure (1)• a virus has a protein capsid whereas a bacterium has a polysaccharide cell wall (1)• viruses have one type of nucleic acid whereas a bacterium has two (1)		(1)



Q14.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to two of the following: <ul style="list-style-type: none">• (70S) ribosome (1)• larger and smaller subunits (1)• containing protein and rRNA (1)		(2)

Q15.

Question Number	Answer	Additional Guidance	Mark
	respiration / decomposition / eq ;	ACCEPT description NOT photosynthesis	(1)

Q16.

Question Number	Answer	Additional Guidance	Mark
(i)	Correct answer gains both marks {332 + 23 + 444 / 799 } and {338 + 450 / 788 } ; (799 - 788) = 11 (au) ;	CE applies	(2)



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Question Number	Answer	Additional Guidance	Mark
(ii)	<ol style="list-style-type: none">1. idea that rate of production of carbon dioxide is greater than rate of removal of carbon dioxide ;2. idea of using of {fossil fuels / named fossil fuel / forests / eq} {releasing / producing} carbon dioxide ;3. idea that this carbon (in fossil fuels / forests) was {locked up / removed from the air } years ago ;4. idea of deforestation resulting in less {photosynthesis / carbon fixation / light independent reaction / eq} ;	<p>1 ACCEPT carbon dioxide {production / release} is greater than used in photosynthesis</p> <p>3 ACCEPT ref to carbon sink</p> <p>4 ACCEPT less carbon dioxide used for photosynthesis</p>	(3)



Q17.

Question Number	Answer	Additional Guidance	Mark
	<ol style="list-style-type: none">1. idea that we can only {make predictions about the future / extrapolate data / work on correlations / eq } ;2. idea that {scientists / industry / eq} are presenting {different views / insufficient evidence / eq} about global warming ;3. idea that some people surveyed did not {understand / know about} global warming ;4. idea that some people do not believe in {global warming / harmful effects of global warming} because they do not want it to affect their { lifestyle / named lifestyle / eq } ;5. idea that some people think that a solution to global warming will be found ;6. idea that some people do not want to think about the future ;	<p>NB just a reference to do not believe is too vague 1 ACCEPT it is due to natural cycle / normal fluctuations</p>	<p>(3)</p>



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Q18.

Question number	Answer	Additional guidance	Mark
	<p>An explanation that makes reference to three of the following:</p> <ul style="list-style-type: none">• the same bacteria causes human plague and sylvatic plague (1)• antigens in the (human plague) vaccine are processed and presented to lymphocytes (in the black-footed ferret) (1)• therefore stimulating active immunity (to sylvatic plague) (1)• and producing memory cells (to these antigens) (1)	<p>ALLOW the bacteria causing human plague and sylvatic plague have the same antigens</p> <p>ALLOW enabling a secondary immune response</p>	(3)

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Q19.

Question Number	Answer	Additional guidance	Mark
	<ul style="list-style-type: none">• A substance which can {inhibit the growth / prevent multiplication} of bacteria		(1)



Q20.

Question number	
*	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive, and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p>Indicative content</p> <p>Information</p> <ul style="list-style-type: none">• there are 20 000 different proteins• these proteins carryout different functions• there are a {large number of / 20} different {R groups / amino acids}• most R groups are non-polar, some are polar a few have a charge <p>Linkage to structure</p> <ul style="list-style-type: none">• R groups determine {3D shape / structure} of proteins• {large number of / 20 R groups}• many combinations of amino acids required to give wide variety of protein structures• R groups can form bonds to stabilise 3D structure (e.g. cysteine)• role of R-groups in structure of haemoglobin• role of R-groups in structure of collagen• location of cysteine allows formation of disulfide bonds <p>Linkage to function</p> <ul style="list-style-type: none">• R groups variety of protein shapes are required to allow proteins to carry out wide range of functions• examples of functions that require specific structure e.g. antibodies specific to an antigen / enzymes specific for a substrate / receptors e.g. neurotransmitters and (acetylcholine) and ion-gated channels• polar / ionic R groups increase solubility• non-polar R groups will be on outside of insoluble proteins / structural proteins / collagen / proteins inserted into membranes• role of R-groups in function of haemoglobin• role of R-groups in function of collagen <p>Linkage to location</p> <ul style="list-style-type: none">• polar R groups will be in aqueous environment /non-polar regions in a non-aqueous environment



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- | | |
|--|---|
| | <ul style="list-style-type: none">• polar /ionic R groups soluble in {plasma/ tissue fluid / cytoplasm} / line the inside of ion channels / found on the outside of soluble proteins such as hormones / transport proteins / immunoglobulins / cytokines• role of R-groups in location of haemoglobin• role of R-groups in location of collagen |
|--|---|



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Level	Marks		
0	0	No awardable content	
1	1-3	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures. The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context.	Selection of some information from the table – little or no linkage Linkage to one aspect – 2 marks Two linkages for same aspect – 3 marks
2	4-6	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts. Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows some linkages and lines of scientific reasoning with some structure.	Linkage between R groups and two aspects from structure, function and location One comment on each - 4 marks An additional comment - 5 marks An additional 2 comments – 6 marks
3	7-9	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts. Consequences are discussed which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures.	Linkage between R groups and all three aspects (structure, function and location) One comment on each - 7 marks



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		The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	An additional comment - 8 marks An additional 2 comments - 9 marks
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Q21.



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Question Number	Answer	Additional guidance	Mark
(i)	<ul style="list-style-type: none">• calculation of the number of TB patients with HIV (1)• calculation of percentage of HIV positive TB patients that died(1)	<p>Example of calculation</p> <p>15% of 9.4 million = 1.41 million</p> <p>$521\,700 \div 1\,410\,000 = 0.37 = 37\%$</p> <p>Correct answer with no working gains full marks</p>	graduate(2)

Question Number	Answer	Additional guidance	Mark
(ii)	<p>An answer that makes reference to the following</p> <ul style="list-style-type: none">• a greater percentage of patients with HIV die from TB compared with TB patients without HIV (1)• the total number of cases and deaths from TB is greater in those without HIV (1)		Expert (2)



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Question Number	Answer	Mark
(iii)	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p>indicative content</p> <ul style="list-style-type: none">• TB is more likely to develop in patients with HIV• Anti-viral drugs reduce the incidence of TB in patients with HIV• HIV binds to CD4 receptors on T-helper cells• HIV replicates inside T-helper cells then destroys the cells as it bursts out• This reduces the number of T helper cells• When a bacterium such as <i>M. tuberculosis</i> enters the body, the reduction in T helper cells means there is no immune response• The patient develops TB• Drugs that prevent viral replication means T-helper cells are not destroyed• The immune system can prevent TB developing• Therefore deaths from TB will decrease in patients with HIV• However, more deaths from TB are in patients without HIV, and therefore antiviral drugs will not reduce this number	Expert (6)



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			Additional guidance
Level 0	Marks	No awardable content	
Level 1	1-2	<p>An explanation may be attempted but with limited interpretation or analysis of the scientific information with a focus on mainly just one piece of scientific information.</p> <p>The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.</p>	<p>Data described from information provided</p> <p>e.g.</p> <ul style="list-style-type: none">• TB incidence decreases as T helper cells increase• TB bacteria multiply in body• Use of antiviral drugs increases T helper cell numbers• Basic explanation
Level 2	3-4	<p>An explanation will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information.</p> <p>The explanation shows some linkages and lines of scientific reasoning with some structure.</p>	<p>Explanation of data e.g. Overlapping error bars indicate no difference for T helper cell counts above 300 mm^{-3}</p> <p>HIV infects T helper cells HIV enters T helper cells and reduces the number of T-helper cells This reduces immune response</p> <p>Antiviral drugs prevent replication of HIV</p> <p>Immune response details</p>



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Level 3	5-6	<p>An explanation is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information.</p> <p>The explanation shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.</p>	<p>Detailed explanation as to how antiviral drugs prevent TB developing by preventing HIV replication inside cells.</p> <p>Relevant immune response detail – T helper cells activate B cells / release cytokine / result in antibody production</p> <p>Explanation that antiviral drugs will only reduce TB deaths in those also infected with HIV. No effect on others as antiviral drugs do not kill bacteria.</p>
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Q22.

Question number	Answer	Additional guidance	Mark
	<p>An explanation that makes reference to three of the following:</p> <ul style="list-style-type: none">• pig genes are transcribed and translated to produce proteins (1)• the structure of (some of) these proteins will be different from those in humans (1)• these proteins will be recognised as foreign (1)• activating lymphocytes (1)	<p>ALLOW pig genes code for antigens</p> <p>ALLOW recognised as antigens</p> <p>ALLOW trigger a specific immune response</p>	<p>Choose an item.</p> <p>(3)</p>



Q23.

Question number	Answer	Additional guidance	Mark
	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none">• {isolate / extract} RNA from (saliva) samples (1)• amplify the {RNA/DNA/nucleic acid} by PCR (1)• cut the {RNA/DNA/nucleic acid} into fragments (using restriction enzymes) (1)• (separate fragments using) gel electrophoresis (1)• more similar the {banding / profile} (of the fragments) the more closely related the strain (1)	<p>ALLOW (reverse) transcribe RNA to DNA and amplify DNA</p> <p>ALLOW sequence the virus genome</p> <p>ALLOW the fewer the number of base changes the more closely related the strains</p>	<p>Expert (4)</p>



Q24.

Question Number	Answer	Additional guidance	Mark
	<p>An answer that makes reference to three of the following</p> <p>Similarities</p> <ul style="list-style-type: none">• both contain RNA (1)• both have {a (protein) capsid / glycoproteins} (1) <p>Differences</p> <ul style="list-style-type: none">• Ebola contains one strand of RNA but HIV contains two strands of RNA (1)• HIV is spherical, Ebola virus is elongated (1)	<p>IGNORE retrovirus</p> <p>ALLOW protein coat</p> <p>ALLOW HIV is icosahedral / Ebola is filamentous</p> <p>ALLOW HIV is round</p> <p>ALLOW HIV has a lipid layer/envelope and Ebola does not (acceptable on basis of diagram provided)</p>	(3)

Q25.

Question Number	Answer	Mark
	<p>The only correct answer is B <i>non-specific response, bacteria are destroyed by phagocytes</i></p> <p>A is not correct because killer T-cells are not involved in the initial response</p> <p>C is not correct because the initial response is not the specific response</p> <p>D is not correct because the initial response is not the specific response</p>	Computer (1)