Immunity, Infection and Forensics -4

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 -4

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

Mark Scheme

Q1.

Question Number	Answer	Additional guidance	Mark
	An explanation that makes reference to the following • an increase in temperature will increase the rate of { decomposition / decay } (1) • (an increase in temperature) increases enzyme activity (1) • an increase in temperature increases growth rate of {bacteria / fungi / decomposers} (1)	ALLOW converse for all points for the effects of a decrease in temperature ALLOW high temperatures may denature enzymes and decrease rate of decomposition ALLOW increases rate of multiplication	**(3)**

Q2.

Question Number	Answer	Additional Guidance	Mark
	1. idea that the temperature of the {body / core} changes (with time after death) ; 2. idea that (core) temperature depends upon the {ambient / eq} temperature ; 3. idea that {other post-death changes / muscle contraction / insect life cycles / decomposition / eq} depend on (ambient / body) temperature ;	**1 ACCEPT** cooling	**(3)**

Q3.

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)	• correct reading of temperatures (1) • after 24 hours, lowest body temperature 22 minus 5.6^{0}C (1)	22 ±5.6 Accept calculation of maximum ambient temperature <u>Example of calculation</u> 22 – 5.6 = (lower than / equal to) 16.4^{o}C	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(b)	An answer that makes reference to the following: (1) • range smaller at higher temps (1) • only the highest temperature shows no overlap		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(d)	An explanation that makes reference to the following: • rectal temperature is core temperature / it would be 37°C at time of death (1) • skin surface temperature would be more variable (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(e)	An answer that makes reference to two of the following: • rigor mortis (1) • degree of decomposition (1) • forensic entomology (1)		**(2)**

Q4.

Question Number	Answer	Mark
(i)	The only correct answer is C – polynucleotides and phospholipids *A is incorrect because phosphate is not in cellulose* *B is incorrect because polysaccharides do not contain phosphate* *D is incorrect because phosphate is not in polysaccharides*	(1)

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to three of the following • the stems contain starch or cellulose (1) • enzymes are {secreted / released} by the microorganisms (1) • which break down the glycosidic bonds (1) • which releases glucose that is used by the microorganisms in respiration (1)	ALLOW lignin ALLOW enzymes from microorganisms digest (starch / cellulose)	(3)

Q5.

Question Number	Acceptable Answer	Additional guidance	Mark
(a)	A description that makes reference to the following: • reference to PCR to include reference to {primers / DNA polymerase / nucleotides} (1) • procedure repeated {multiple times / 20 to 40 times} (1) • temperature requirements to denature and anneal (1)		**(3)**

Question Number	Acceptable Answer	Additional guidance	Mark
(b)(i)	C		**(1)**

Question Number	Acceptable Answer	Additional guidance	Mark
(b)(ii)	An explanation that makes reference to: • pattern of bands different between 1 and 3 and 2 and 4 (1) • so *Allolobophora chlorotica* not all one species (1)		**(2)**

Q6.

Question number	Answer	Additional guidance	Mark
(i)	An explanation that makes reference to two of the following: • (pre-)mRNA splicing / post-transcriptional modification (1) • different exons removed (1) • (therefore) producing different {sequences of amino acids / mRNA sequences} (1)	ALLOW the exons can be joined in different sequences ALLOW (the acetylcholinesterase) gene ismade up from several exons and introns IGNORE producing different primary structure	Choose an item. (2)

Question number	Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to three of the following: • {hormones / signal molecules / chemical signals} bind toreceptors found only in some {tissues / cells} (1) • regulating a {transcription factor / repressor molecules}(1) • {transcription factor / repressor molecule} binds to thepromotor region of the (acetylcholinesterase) gene (1) • therefore switching {on / off} transcription (1)	ALLOW epigenetic changes occur in some tissues ALLOW only act on some {tissues / cells} ALLOW {allowing / preventing} binding of RNA polymerase	Choose an item. (3)

Q7.

Question Number	Answer	Additional Guidance	Mark
(a)	1. proteins consist of amino acids joined together by peptide bonds; 2. credit reference to named bonds (between R groups) involved in holding {3D structure / eq} ; 3. carbohydrates consist of {monsaccharides / glucose / eq} ; 4. reference to glycosidic {bonds / eq} between (adjacent) {glucose / eq} molecules ;		(3)

Question Number	Answer	Additional Guidance	Mark
(b)	1. idea that the drugs could {bind to / alter shape of} {glycoproteins / gp120} ; 2. idea that drugs bind to {receptors / antigens} on membrane / eq ; 3. called CD4 (antigen / molecules) ; 4. preventing virus attaching to T (helper / $CD4^+$) cells / eq ;		(3)

Question Number	Answer	Additional Guidance	Mark
*(c)	(QWC – spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. reference to reverse transcriptase ; 2. idea of formation of (viral) DNA ; 3. from (viral) RNA ; 4. reference to integrase ; 5. idea of integration of (viral) DNA into (host) DNA ; 6. idea that {T helper cells / eq} would be {destroyed / killed / burst / eq} (by virus particles leaving cell) ; 7. idea that more T (helper) cells would become infected ;	**QWC focussing on clarity of expression** 2. reject idea that RNA is {turned into / converted into} DNA 5. ACCEPT idea of {latency / formation of provirus / eq}	**(5)**

Q8.

Question Number	Answer	Mark
(a)(i)	C T helper cells ;	**(1)**

Question Number	Answer	Mark
(a)(ii)	D reverse transcriptase ;	**(1)**

Question Number	Answer	Additional guidance	Mark
(b)(i)	1. reference to glycoprotein ; 2. credit detail of structure e.g. specific (3D) shape, L and H regions, Y-shape, 4 (peptide) chains, disulphide bridges between peptides, hinge region ; 3. reference to {antigen-binding site / variable region / Fab (region) / eq }; 4. idea of antibodies have a {similar / constant / Fc / eq } region; 5. produced by plasma cells / present on B cells ; 6. role of antibody described e.g. opsonisation, immobilisation, agglutination, lysis ;	**1. Accept** protein, chains of amino acids **2. Ignore** active site **Accept** a Y-shaped drawing **3. Accept** references to {binding to specific antigen / antigen-specific / antigen receptors} **5. Accept** present on B effector cells	**(2)**

Question Number	Answer	Additional guidance	Mark
***(b)(ii)**	(QWC – answer must be organised in a clear, logical sequence) 1. reference to artificial (active) immunity ; 2. reference to {vaccine / vaccination } ; 3. containing {synthetic molecule / (synthetic) antigen / (synthetic) glycoprotein } ; 4. ref to stimulation of the {specific / humoral} immune response (to the synthetic antigen) ; 5. credit detail of process of producing effector B cells e.g. clonal expansion of B cells, involvement of cytokines, T helper cells activate B cells ; 6. reference to (production of B) memory cells ; 7. idea that (2G12) antibodies are produced {faster / in greater concentration} on {reinfection / eq} ;	Mps are awarded if the statements are clearly expressed **5. Ignore** references to production of activated T killer cells **6. Ignore** references to production of T memory cells **7. Accept** ref to secondary immune response	**(5)**

Question Number	Answer	Additional guidance	Mark
(c)	1. idea that HIV infection does not always produce symptoms ; 2. reference to {provirus / latency } ; 3. reference to test needed to detect (symptomless) HIV ; 4. idea that only people who suspect they may have contracted HIV would have a test ; 5. idea that {some people would not want to be tested / impossible to test everyone} ; 6. idea that symptoms are common to other diseases ; 7. {new cases arising/ patients dying} all the time / eq ; 8. idea of new strains of virus arising ;	**2. Accept** virus is dormant	**(2)**

Q9.

Question Number	Answer	Mark
	The only correct answer is D - RNA and reverse transcriptase ***A*** *is incorrect because it is does not contain DNA* ***B*** *is incorrect because it is does not contain DNA* ***C*** *is incorrect because it does not contain DNA polymerase*	**(1)**

Q10.

Question Number	Answer	Additional Guidance	Mark
(a)	1. (structure G is {glycoprotein / gp120} ; 2. used for {attachment / eq} to CD4 (molecules / receptors /antigens) ; 3. on T helper {cells / lymphocytes} ;	1. IGNORE gp 41 and gp 160 and other wrong numbers 3. ACCEPT macrophages / dendritic cells / CD4 cells	(3)

Question Number	Answer	Additional Guidance	Mark
(b)(i)	1. they are globular proteins ; 2. it has an active site ; 3. idea of {charged R groups on outside of molecules / composed of many small R groups} ;	2. idea of active site R groups enable binding of substrate 3. idea of hydrophilic on the outside	(3)

Question Number	Answer	Additional Guidance	Mark
*(b)(ii)	(QWC – spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. idea that drugs would prevent viral replication ; 2. idea that T (helper) {cells / lymphocytes} will not be { killed / burst / destroyed}(by virus particles leaving cell) ; 3. idea of {inhibition / eq} of reverse transcriptase ; 4. idea that (viral) DNA could not be made; 5. from the (viral) RNA ; 6. idea of {inhibition / eq} of integrase ; 7. idea that (viral) DNA cannot integrate into (host) {DNA / genome} / eq ;	QWC emphasis on **clarity** of expression 1. ACCEPT description of virus formation 3. ACCEPT drugs prevent action of reverse transcriptase 4. reject idea that RNA is {turned into / converted into} DNA 6. ACCEPT drugs prevent action of integrase 7. ACCEPT idea that drugs would prevent {latency / formation of provirus / eq} ;	**(5)**

Q11.

Question number	Answer	Additional guidance	Mark
	A description that makes reference to four of the following: • stem cell is undifferentiated whereas a 'key player' is differentiated (to undertake a specific function) (1) • example of a 'key player' (1) • example of specific function of a named 'key player' cell (1) • number of divisions of a stem cell is unlimited whereas for a 'key player' the number of cell divisions is limited (1) • 'key player' has undergone differential gene expression (1)	ALLOW unspecialised and specialised e.g. B cells / plasma cells / phagocytes / lymphocytes e.g. (B cells) produce antibodies ALLOW Hayflick limit for 'key players' but not for stem cells	Expert (4)

Q12.

Question Number	Answer	Additional guidance	Mark
(i)	A description that makes reference to three of the following: • {glycoproteins / GP120} on the (surface of the) virus(1) • bind to (CD4) receptors on the (surface of the) T (helper) cells(1) • viral envelope fuses with cell membrane of T helper cell (1) • viral RNA enters the cell (1)	ALLOW GP130 IGNORE capsid	(3)

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to the following • (lack of T helper cells) reduces cytokine production (1) • therefore reducing { cloning / activation } of B cells (1) • reducing antibody production (1) • there is an increased risk of opportunistic infections (1)	ALLOW reduced production of {B effector cells/plasma cells} ALLOW example eg TB	(4)

Q13.

Question Number	Answer	Mark
	The only correct answer is C - preventing the multiplication of bacteria ***A*** *is not correct because bacteriostatic antibiotics do not destroy bacteria* ***B*** *is not correct because antibiotics are not effective against viruses* ***D*** *is not correct because antibiotics do not prevent the development of antibiotic resistance*	**(1)**

Q14.

Question Number	Answer	Mark
(i)	**B** - plasma cell *The only correct answer is **B*** ***A** is not correct because macrophage does not produce antibodies* ***C** is not correct because red blood cells do not produce antibodies* ***D** is not correct because T cells do not produce antibodies.*	**(1)**

Question Number	Answer	Mark
(ii)	**D** – natural passive immunity - the immunity is provided by components of the mother's milk produced as part of a natural immune response. The baby has not produced these components so the immunity is passive. *The only correct answer is **D*** ***A** is not correct because the baby has not produced the immunity gained from the mother's milk so it is not active immunity* ***B** is not correct because the immunity from the mother was not generated by artificial exposure to antigens (e.g. immunisation) so it is not artificial immunity* ***C** is not correct because the baby has not produced the immunity gained from the mother's milk so it is not active immunity*	**(1)**

Q15.

Question Number	Answer	Additional Guidance	Mark
(a)	1. bacteria are cells, viruses are {not / particles} ; 2. idea of bacteria surrounded by {cell wall / slime / capsule } , viruses surrounded by {protein / capsids / envelope} ; 3. bacteria have { plasmids / ribosomes / other named structure} , viruses do not have {plasmids / ribosomes / other named structure } ; 4. bacteria (genome) are DNA, viruses can be DNA or RNA ; 5. bacterial DNA is double-stranded, viral genetic material is single (or double) stranded / eq ; 6. idea that bacteria have {circular / eq} genetic material, viruses have {linear / straight} genetic material ;	**NB** piece answers together throughout **Accept** only matched structures **2. Accept** for envelope: membrane / phospholipid layer / eq **3. Accept** bacteria have membranes, flagella cytoplasm, glycogen, lipid droplets **6. Not** in context of plasmid	(3)

Question Number	Answer	Additional Guidance	Mark
(b)(i)	1. reference to humoral (immune) response ; 2. reference to {phagocytosis / eq} by {phagocytes /named phagocyte} ; 3. reference to macrophages as { antigen-presenting cells / APCs} (to T helper cells) ; 4. reference to B cells as { antigen-presenting cells / APCs} (to itself) ; 5. idea that T helper cells release cytokines for B cell {activation / stimulation} ; 6. idea of B cells {forming clones / dividing /eq} (to form B effector cells) ; 7. reference to {differentiation of B cells into plasma cells / formation of plasma cells from B cells} (subsequent to cloning) ;	 **2. Accept** dendritic cells / Langerhans cells / B cells **3 Accept** dendritic cells / Langerhans cells 4. **Accept** antigen binds to B cells **6. Not** to form plasma cells	**(4)**

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	1. reference to {opsonisation / antibodies bind to bacteria / eq} ; 2. (as a result) enhancing phagocytosis / eq ; 3. reference to {immobilisation / agglutination / eq } (of bacteria) ; 4. idea of antibodies neutralising toxins / eq ;	**1. Not** reference to killing bacteria **2. Accept** easier, better	**(2)**

Question Number	Answer	Additional Guidance	Mark
(b)(iii)	1. idea that the immune response will be weaker ; 2. person may not recover from this infection / eq ; 3. idea of {other (opportunistic) infection / cancer} ; 4. reference to cytokines released from {T helper / CD4 } cells ; 5. idea that cytokines are involved in {activation / division } of {B cells / T killer cells} ; 6. credit consequence of impaired B cell function ; 7. credit consequence of impaired T killer cell function ;	**1. Accept** in context of either humoral or cell-mediated immune response **6. Accept** e.g. no antibody produced by plasma cells **7. Accept** e.g. infected cells not destroyed	**(4)**

Q16.

Question number	Answer	Additional guidance	Mark
	An explanation that makes reference to four of the following: • (cytokines / histamine) increases permeability of the capillaries (1) • (cytokines / histamine) cause vasodilation (1) • increasing blood flow to site of inflammation (1) • allowing white blood cells to { migrate / move } from the blood into the tissue space (1) • cytokines attract white blood cells (1)	ALLOW cause arterioles to dilate MP4 and 5 ALLOW immune cells / phagocytes / macrophages / monocytes ALLOW chemicals in place of cytokines	**(4)**

Q17.

Question number	Answer	Additional guidance	Mark
	An explanation that makes reference to three of the following: • {chemical mediators / histamine} released (1) • increasing blood flow / increasing capillary permeability / causing oedema (1) • {increasing number of / activating / recruiting} white blood cells (in the area of inflammation) (1) • (stimulating) the release of (catabolic) enzymes / increasing phagocytosis (of damaged tissue) (1)	ALLOW activating T killer cells / activating phagocytes / activating macrophages ALLOW tissues destroyed by {macrophages / phagocytes / T killer cells}	Expert (3)

Q18.

Question Number	Answer
*	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. 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. • standardisation of composition of compost heaps • identification of species • abundance of each species of organism in the sample • determination of C:N / set up compost heaps with different C:N ratios • time e.g. days / intervals / repetition of sampling • other factors to monitor or control e.g. water / gases / humidity / temperature / aeration / mass • sampling technique e.g. location of sample within compost heap / repetition of sampling

Level	Mark	Descriptor	
0	Marks	No awardable content	
Level 1	1-2	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. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.	Measure / set up compost heaps with different C:N ratios Observe species present over time
Level 2	3-4	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. The explanation shows some linkages and lines of scientific reasoning with some structure.	Recording species present / numbers of each species / measuring C:N ratio Monitoring changes over time Control of relevant factors
Level 3	5-6	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. The explanation shows a well-developed and sustained line of scientific reasoning which is clear, coherent and logically structured.	Description of a suitable sampling technique Linking species present or species density to C:N measurements Use of a statistical test to compare changes of time / C:N ratio Use information on numbers of species and population sizes to demonstrate succession

Q19.

Question Number	Answer	Additional guidance	Mark
(i)	An calculation that shows the following • selection of correct data from table and difference calculated (1) • calculation of percentage to three significant figures (1)	Example of calculation 1855-135 = 1720 92.7 (%) Correct answer with no working gains full marks.	graduate (2)

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to the following • as the vaccination rate increases the number of cases of measles decreases (in some years) (1) • example from data to show why the conclusion is valid (1) • (the effects of changes in percentage vaccination are seen in the following year) because it takes time for {antibodies / memory cells} to be produced (1) • time taken for herd immunity to develop (1)	ALLOW reference to data from specific years such as 2013 to 2014, 2014 to 2015	Expert (4)

Q20.

Question Number	Answer	Mark
(i)	The only correct answer is B *produced when B cells are activated to become plasma cells* A is not correct because B cells do not become killer cells C is not correct because macrophages do not become B cells D is not correct because plasma cells do not become memory cells	Computer (1)

Question Number	Answer	Mark
(ii)	The only correct answer is A *active artificial immunity* B is not correct because immunity due to vaccination is not natural immunity C is not correct because passive immunity does not lead to the production of antibodies D is not correct because immunity due to vaccination is not natural immunity and passive immunity does not lead to the production of antibodies	Computer (1)

Question Number	Answer	Additional guidance	Mark
(iii)	An explanation that makes reference to three of the following • due to a loss of memory cells there is no secondary immune response (1) • therefore antibodies cannot be produced quickly (1) • therefore there is less immunity (to diseases previously vaccinated against) (1) • need to repeat vaccinations to produce more memory cells (1)	ALLOW converse for repeat vaccination ALLOW converse for repeat vaccination ALLOW diseases can be contracted that children were previously immune to	Expert (3)

Q21.

Question Number	Answer	Additional guidance	Mark
	An explanation that makes reference to the following • flora in the gut and skin are better adapted to the conditions (1) • therefore they can outcompete pathogenic organisms (1) • bacteria in the gut secrete {chemicals /lactic acid} which help to destroy pathogens (1)	ALLOW details of competition for space or nutrients ALLOW enzymes	(3)

Q22.

Question Number	Answer	Additional guidance	Mark
(i)	A description that makes reference to the following • pre mRNA contains exons and introns (1) • introns are removed and exons are spliced together (to produce a strand of mRNA) (1)	ALLOW reference to introns and exons in the correct context i.e. exons are coding and introns are non-coding regions ALLOW 'joined together' for 'spliced'	(2)

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to the following • the {exons can be spliced together in a different order / different exons can be removed } (1) • therefore producing different sequences of amino acids (1)		(2)

Q23.

Question number	Answer	Additional guidance	Mark
	A description that makes reference to four of the following: • extract mRNA for one form of the (tau protein) (1) • copy mRNA into DNA (1) • use restriction enzymes {to create sticky ends) / cut theDNA and a vector} (1) • {ligate / insert / integrate} the TAU DNA into the vector(DNA) (1) • introduce vector into {fertilised egg / embryonic stem /zygote / cells / neural cell stem cells} (1)	IGNORE cut / remove TAU gene from a humanALLOW synthesis DNA sequence for one form e.g. use code specific for one of the tau proteins ALLOW insert gene into fertilised egg cell /embryonic stem cell ALLOW egg cell fertilised after inserting gene	Choose an item. (4)

Q24.

Question Number	Answer	Additional guidance	Mark
(i)	An answer that makes reference to two of the following: • the protein is a receptor in the cell surface membrane of Thelper cells (1) • { glycoprotein / GP120 } is unable to bind with the (CD4)receptor (on the host cell) (1) • viral RNA cannot enter the cell (1)	ALLOW the receptor that HIV binds to ALLOW HIV cannot enter the cell	(2)

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to four of the following: • stem cells (from the bone marrow) can differentiateinto specialised cells (1) • the stem cells will differentiate into T helper cells that { are resistant to HIV / have the mutated protein } (1) • T helper cells are destroyed by HIV so the patientcannot produce an immune response (1) • mutated (CD4) receptor prevents HIV entering the(replacement) T helper cells (1) • T helper cells are not destroyed therefore { HIV is notpresent in the blood / AIDS does not develop } (1)		(4)

Q25.

Question Number	Answer	Additional Guidance	Mark
(a)	1. idea that {bacteria / pathogen / virus / eq} have to be taken into macrophage / eq ; 2. idea of fusion of {phagosome / eq} with lysosome ; 3. idea that {bacteria/ pathogen / virus / eq} are {digested / broken down / eq} (by enzyme) ; 4. credit named enzyme other than lysozyme ; 5. idea that part of the {bacteria/ pathogen / virus / eq} has to be on {membrane / (outer) surface} (of the macrophage) ;	1. IGNORE phagocytosis unqualified 2. ACCEPT phagocytic vesicle 3. IGNORE destroy / killed 4. e.g. protease 5. ACCEPT antigen / protein	(4)

Question Number	Answer	Additional Guidance	Mark
(b)	1. idea of macrophage {binding/ eq} to T (helper) {cell / lymphocyte} ; 2. reference to {MHC / major histocompatibility complex } (on macrophage) ; 3. reference to CD4 (receptor on T cell) ;		(2)

Question Number	Answer	Additional Guidance	Mark
(c)	1. idea that a mutation has occurred (in the DNA) ; 2. idea that there is a change in {antigen /outer surface / cell wall / slime layer} (of bacteria) ; 3. idea that memory (T) cells will not recognise the (new) antigen ; 4. idea that another (primary) immune response needed e.g. (new) antigen needs to be presented (to the T helper cell) ; 5. to activate (another) population of T (helper) cells / eq ; 6. idea that {phagocytes / macrophages} unable to {recognise / engulf / phagocytose / digest / destroy / eq} the {*Mycobacterium tuberculosis* / bacteria} ; 7. idea that antigen presentation is not possible ;	1. NOT a mutation of the antigen	**(3)**