Question Number	Answer	Additional Guidance	Mark
1(a)	1. prevents viruses attaching to {uninfected / eq} host cells / eq ; 2. by binding to receptors / eq ; 3. (therefore) preventing virus from entering cell / eq ; 4. (therefore) viruses cannot replicate and infect more cells / eq ;		**(2) XP**

Question Number	Answer	Additional Guidance	Mark
1(b)	1. idea that macrophages present antigen to T {helper / CD4} cells ; 2. idea that T helper cells are needed to activate {T killer / B} cells ; 3. idea of B cell acting as an antigen-presenting cell (to self) ; 4. idea that B cells {result in / eq} plasma cells that {produce / eq} antibody ; 5. idea of infected (host) cell presenting antigen to T killer cells ; 6. idea that T killer cells destroy infected host cells / eq ;	1. ACCEPT dendritic cells / Langerhans cells IGNORE Phagocytes 6. CCEPT APC if referring to infected host cell	**(4) XP**

Question Number	Answer	Additional Guidance	Mark
1(c)	1. idea that a mutation has occurred (in the nucleic acid) ; 2. idea of a change in {antigens / protein} (on the virus surface) ; 3. idea that a secondary immune response will not be possible ; 4. idea that memory cells will not recognise the (new) antigen ; 5. idea that another (primary) immune response needed e.g. (new) antigen needs to be presented ;		**(3) XP**

Question Number	Answer	Mark
2(a)	**A** active artificial	**(1)COMP**

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	1. antibodies appear (in blood) {immediately / on day 0 / eq} in group B but {on day 4 / after 3 days} in group A ; 2. antibodies reach higher levels in group B / eq ; 3. credit comparative manipulated data ;		**(2)EXP**

Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	1. antibodies present from the first vaccination / eq ; 2. idea of a secondary immune response ; 3. memory cells already present / eq ; 4. due to first vaccination / eq ; 5. memory cells mean that {antibodies produced immediately} / eq ; 6. on exposure to (same) antigen / eq ;		**(3)EXP**

Question Number	Answer	Additional Guidance	Mark
2(c)	1. idea that the virus will be destroyed quicker ; 2. {more / wider range of} memory cells present ; 3. so {higher levels / faster production} of antibodies ;		(2)EXP

Question Number	Answer	Additional Guidance	Mark
2(d)	**Comparisons of groups A and B** 1. not very reliable as sample size is small / eq ; 2. data for first 15 days after vaccination are reliable as error bars do not overlap ; 3. data for 30 and 60 days not reliable as error bars overlap ; **Comparisons within either of the groups** 4. there may be no change in the first fifteen days ;		(3)EXP

Question Number	Answer	Additional Guidance	Mark
3(a)	1. bacteria have DNA, viruses have DNA or RNA ; 2. idea that bacteria have {circular / eq} genetic material, viruses have {linear / straight} ; 3. bacterial DNA is double-stranded, viral {DNA / RNA} is single (or double) stranded / eq; 4. bacteria (may) have plasmids, viruses do not have plasmids / eq;	**NB** piece answers together throughout **Do not accept** in context of plasmid	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(b)(i)	1. reference to {phagocytosis /endocytosis / engulfing} ; 2. credit details of phagocytosis ; 3. reference to bacterium inside a {vacuole / vesicle / phagolysosome} ;	eg formation of {pseudopodia / membrane extensions around bacteria} / cytoplasmic streaming / binding to bacteria **Not** phagolysozyme	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(b)(ii)	1. idea that bacteria need to be accessible to antibiotics ; 2. idea of bacteria inside macrophages ; 3. reference to waxy layer of (these) bacteria ; 4. idea that (bacteriostatic) antibiotics affect dividing bacteria; 5. reference to antibiotic resistance (of these bacteria) ;	**Not** bacteriocidal antibiotics	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(b)(iii)	1. idea of {dead / attenuated / eq} {organisms / pathogen / bacterium / eq} put into person; 2. reference to (stimulation of) {specific / primary} (immune) response ; 3. credit details of T helper cell activation ; 4. credit details of B cell activation ; 5. credit details of T killer cell activation ; 6. reference to production of memory cells ;	**NB** not simply crediting ref to vaccination as in stem of question **Accept** antigen eg macrophages as APCs eg involvement of cytokines, B cells as APCs eg involvement of cytokines, infected cells as APCs	**(3)**

Question Number	Answer	Additional Guidance	Mark
3(c)	1. reference to {<u>further</u> lung damage / severe breathing problems / eq} ; 2. idea that the *Mycobacterium* get into the {blood / lymph}; 3. idea that organ failure (leads to death) ; 4. idea of {reduced / weakened} immune response (due to a loss of T cells) ; 5. credit detail of role of T (helper) cells ; 6. credit detail of effect of no T killer cells ; 7. credit detail of effect of no B cells ; 8. ref to {secondary / opportunistic / other} infections (causing death) ;	eg cannot obtain enough oxygen eg production of cytokines eg infected cells will not be destroyed eg no antibody produced	**(4)**

Question Number	Answer	Additional Guidance	Mark
4(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. Accep** for envelope: membrane / phospholipid layer / eq **3. Accep** bacteria have membranes, flagella cytoplasm, glycogen, lipid droplets **6. No** in context of plasmid	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(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. Accep** dendritic cells / Langerhans cells / B cells **3 Accept** dendritic cells / Langerhans cells 4. **Accept** antigen binds to B cells **6. No** to form plasma cells	**(4)**

Question Number	Answer	Additional Guidance	Mark
4(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. No** reference to killing bacteria **2. Accep** easier, better	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(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. Accep** in context of either humoral or cell-mediated immune response **6. Accep** e.g. no antibody produced by plasma cells **7. Acce** e.g. infected cells not destroyed	**(4)**