EXAM PAPERS PRACTICE

Cell recognition and the immune system 1

Level: CIE AS 9700
Subject: Biology
Exam Board: Suitable for all boards
Topic: Cell recognition and the immune system 1
Type: Mark Scheme

To be used by all students preparing for CIE AS Biology 9700 foundation or higher tier but also suitable for students of other boards.

Mark schemes

1

(a) Virus / fungus / protozoan;

Neutral: named example

1

(b) Produces toxins;

Neutral: infects / colonises / invades cells

Damages cells / tissues / example given e.g. cell lysis;

2

(c) (i) (Antibodies) produced from a single clone of B cells / plasma cells;

Accept: hybridoma cell line instead of B cell / plasma cell
Reject: idea that antibodies are cloned

OR

(Antibodies) produced from the same B cell / plasma cell;

1

(ii) (Specific) primary structure / order of amino acids;

(Specific) tertiary / 3D structure;

(So) Only binds to / fits / complementary to one antigen;

Reject: 'active site' for either point 2. or 3. only once

3

(d) (Rapid) treatment of carriers / infected cattle / disease;

Neutral: reference to rapid identification of infected cattle

Can isolate / cull carriers / infected cattle / infected (dairy) products not sold / consumed / tracked;

Reduces spread of disease / no need to kill / prevents the death of non-infected animals;

Neutral: ethical arguments

3

[10]

2

(a) 1. Antibody has tertiary structure;
2. Complementary to binding site on protein.

2

(b) 1. Prevents false negative results;
2. (Since) shows antibody **A** has moved up strip / has not bound to any *Plasmodium* protein.

2

(c) 1. Person is infected with *Plasmodium* / has malaria;
2. Infected with (*Plasmodium*) *vivax*;
3. Coloured dye where antibody **C** present;
4. That only binds to protein from *vivax* / no reaction with antibody for *falciparum*.

Person is infected with P. vivax / Plasmodium vivax = 2 marks (MP1 and MP2)

4

[8]

3

(a)
1. Outside of virus has antigens / proteins;
2. With complementary shape to receptor / protein in membrane of cells;
3. (Receptor / protein) found only on membrane of nerve cells.

Accept converse argument

3

(b)
1. No more (nerve) cells infected / no more cold sores form;
2. (Because) virus is not replicating.

2

(c) Prevents replication of virus.

1

(d) MicroRNA binds to cell's mRNA (no mark)
1. (Binds) by specific base pairing;
2. (So) prevents mRNA being read by ribosomes;
3. (So) prevents translation / production of proteins;
4. (Proteins) that cause cell death.

4

[10]

4

(a)
1. Vaccine contains antigen from pathogen;
2. Macrophage presents antigen on its surface;
3. T cell with complementary receptor protein binds to antigen;
4. T cell stimulates B cell;
5. (With) complementary antibody on its surface;
6. B cell secretes large amounts of antibody;
7. B cell divides to form clone all secreting / producing same antibody.

5 max

(b)
1. Active involves memory cells, passive does not;
2. Active involves production of antibody by plasma cells / memory cells;
3. Passive involves antibody introduced into body from outside / named source;
4. Active long term, because antibody produced in response to antigen;
5. Passive short term, because antibody (given) is broken down;
6. Active (can) take time to develop / work, passive fast acting.

5 max

[10]

5

(a) (To diagnose AIDS, need to look for / at)
1. (AIDS-related) symptoms;
2. Number of <u>helper</u> T cells.

Neutral: 'only detects HIV antibodies' as given in the question stem

2

(b)
1. HIV antibody is not present;

Accept HIV antibodies will not bind (to antigen)

2. (So) second antibody / enzyme will not bind / is not present.

2

(c) 1. Children receive (HIV) antibodies from their mothers / maternal antibodies;
2. (So) solution will always turn blue / will always test positive (before 18 months).

Allow 1 mark for the suggestion that the child does not produce antibodies yet so test may be negative

2

(d) (Shows that)
1. Only the enzyme / nothing else is causing a colour change;
2. Washing is effective / all unbound antibody is washed away.

2

[8]

6

(a) 1. Rank all STs in ascending order;
2. Find value with same number (of people) above and below.

Accept find middle value

2

(b) Not ethical to fail to treat cancer.

1

(c) Yes since with ipilimumab:

1. Median ST increased by 2.1 months;
2. Percentage of patients showing reduction in tumours increased from 10.3% to 15.2%;

No because:
3. No standard errors shown / no (Student) t- test / no statistical test carried out;
4. (So) not able to tell if differences are (statistically) significant / due to chance (alone);
5. Improvement might only be evident in some patients / no improvement in some patients;
6. Quality of (extra) time alive not reported;

If answers relate only to 'Yes' or 'No', award 2 marks max

4 max

(d) 1. Faulty protein recognised as an antigen / as a 'foreign' protein;
2. T cells will bind to faulty protein / to (this) 'foreign' protein;
3. (Sensitised) T cells will stimulate clonal selection of B cells;
4. (Resulting in) release of antibodies against faulty protein.

3 max

[10]

7

(a)
1. Vaccine/it contains antigen (from HPV);

   Term 'antigen' may be first mentioned with point 2
2. Displayed on antigen-presenting cells;

   Accept named example, e.g. macrophage/phagocyte/B cells
3. Specific helper T cell (detects antigen and) stimulates specific B cell;

   Accept 'helper T cell with receptor on surface' for 'specific' and B cells with receptor/antibody on surface that bind to antigen for 'specific'
4. B cell divides/goes through mitosis/forms clone to give plasma cells;
5. B cell/plasma cell produces antibody;

4 max

(b)
1. Two (doses) because got more antibody;

   Accept more effective in producing antibody
2. With three doses, second dose/dose at 1 month doesn't lead to production of any more antibody (than the two-dose group)/get same/similar response;
3. Three doses would be more expensive/less popular with parents/girls (and serves no purpose);

   Accept 'less painful'

2 max

(c) t-test, because comparing two means;

Mark for correct test and explanation correct

Accept 'comparing the mean'

Reject 'to show that the results/means are significant'

1

(d)
1. Compare (base sequences of) DNA;
2. Look for mutations/named mutations (that change the base sequence);
3. Compare (base sequences of) (m)RNA;

   1 and 3 accept triplet/codon sequences for comparisons

   Ignore references to 'introns/non-coding DNA'

2 max

[9]

8

(a)

Feature	Bacterium	Human immunodeficiency virus (HIV) particle
RNA	✓	✓
Cell wall	✓	
Enzyme molecules	✓	✓
Capsid		✓

1 mark for each correct vertical column

2

(b) 1. (Complementary) nucleotides/bases pair
OR
A to T **and** C to G;

Ignore '(DNA polymerase) forms base pairs/nucleotide pairs'

2. DNA polymerase;
3. Nucleotides join together (to form new strand)/phosphodiester bonds form;

Ignore '(DNA polymerase) forms base pairs/nucleotide pairs'

*If clearly writing rote answer about DNA replication **2 max** e.g. helicase or separating strands*

3

(c) 1. DNA double stranded/double helix **and** mRNA single-stranded;

Contrast requires both parts of the statement

2. DNA (very) long **and** RNA short;

*Accept 'RNA short**er**' or 'DNA bigg**er**/long**er**'*

3. Thymine/T in DNA **and** uracil/U in RNA;
4. Deoxyribose in DNA **and** ribose in RNA;

***R** Deoxyribonucleic/ ribonucleic acid*

***Ignore** ref. to histones*

***Ignore** ref. to helix and straight chain alone*

5. DNA has base pairing **and** mRNA doesn't/ DNA has hydrogen bonding and mRNA doesn't;
6. DNA has introns/non-coding sequences **and** mRNA doesn't;

***Ignore** ref to splicing*

3 max

[8]

9

(a) 1. Virus can't bind (to receptor)/ can't enter cells;
2. So can't be replicated/ multiply;

Accept can't reproduce

3. So, doesn't damage cell(s)/tissues (and cause symptoms);

Accept no toxins released

2 max

(b) 1. Antigen/glycoprotein on Ebola binds to/stimulates (a specific) B cell;

Accept correct reference to stimulation of B cells by T cells

2. (Binding causes) replication/cloning of B cell;

Accept replication/cloning of plasma cell;

3. Plasma cells/B cells release/produce antibodies;

2 max

(c) 1. Lots of antibodies (against Ebola) in recovered patient;
2. Transfusion/plasma contains antibodies;

Ignore reference to cells

3. Antibodies (specific so) will bind with (Ebola) antigen;
4. (In recipient) virus destroyed/cannot enter cell;

Antigen destroyed is insufficient

3 max

(d) 1. (High mutation rate leads to) antigens change/antigenic variability;

Accept (high mutation rate leads to) changes in base sequence coding for antigen;

2. Vaccine contains specific antigen;
3. Antibodies not complementary to (changed) antigen / won't bind to (changed) antigens;

3

[10]

10

(a) 1. Antigen stimulates immune response / activates B/T cells;
2. B/T cells divide OR antibodies produced;
3. Antibodies/T cells attack myelin sheaths;

Ignore references to antigen binding to myelin

3

(b) 1. Fewer cristae/smaller surface area (of cristae);
2. So less electron transport/oxidative phosphorylation;
3. (So) not enough ATP produced

OR

Not enough energy to keep neurones alive;

1. Accept 'inner membrane' as 'cristae'

2. Accept fewer ATP synthase enzymes

2. Accept lower rate of electron transfer/oxidative phosphorylation

3. Accept less use/stimulation of neurone leads to death of cell

3. Accept no/less ATP produced/no energy to keep neurones alive

3. Ignore references to glycolysis/ Krebs cycle

3

(c) (i) (Transmission) electron (microscope) – **no mark**

Need high resolution (to see structure of mitochondria)

Accept 'scanning electron microscope' /TEM/SEM

Accept – optical microscope not high enough resolution

1

(ii) 1. Took photographs/areas at random;
2. Counted total number (of normal) and number of unusual mitochondria;
3. Divided number of unusual mitochondria by total number and multiplied by 100;

1. Accept (very) large number of areas/photos/samples

MP 3 = 2 marks (includes MP2)

3

[10]

11

(a) 1. (Releases) toxins;
2. Kills cells / tissues.

2. Accept any reference to cell / tissue damage

Ignore infecting / invading cells

2

(b) 1. Water potential in (bacterial) cells higher (than in honey) / water potential in honey lower (than in bacterial cells);

Q candidates must express themselves clearly

1. Must be comparative e.g. high WP in cell and low WP in honey

2. Water leaves bacteria / cells by osmosis;
3. (Loss of water) stops (metabolic) reactions.

3. Needs a reason why lack of water kills the cell

3

[5]

12

(a) Any **two** from:
1. (Decrease linked to) few(er) cases of whooping cough;
2. (Decrease linked to) risk of / fear of side effects;
3. Insufficient vaccine available / too expensive to produce / distribute.

3. Too expensive unqualified is insufficient for mark

2 max

(b) 1. Vaccination rate increases;
2. Fewer people to spread the disease / whooping cough / more people immune / fewer susceptible.

2. Neutral − greater herd effect

2. Allow description of immune

***Q** Reject 'resistant'.*

2

(c) 1. More people are immune / fewer people carry the pathogen;

If neither point 1 or 2 awarded

Herd immunity = 1 mark

Unvaccinated does not mean infected

*1. **Q** Do not accept disease for pathogen*

2. So susceptible / unvaccinated people less likely to contact infected people.

2

[6]

13 (a) Regulator protein.

Accept regulator protein antigen

Reject regulator protein receptor

Ignore regular protein

1

(b) 1. Lipid soluble / hydrophobic

2. Enters through (phospholipid) bilayer

OR

3. (Protein part of) LDL attaches to receptor

4. Goes through carrier / channel protein.

4. Accept by facilitated diffusion or active transport

4. Reject active transport through channel protein

2

(c) Any **two** from:

1. (Monoclonal antibody) has a specific tertiary structure / variable region / is complementary to regulator protein

Do not award MP1 if reference to active site.

2. Binds to / forms complex with (regulator protein)

"It" refers to monoclonal antibody in MP1 and MP2

3. (So regulator protein) would not fit / bind to the receptor / is not complementary to receptor

3. Reject receptor on LDL

2 max

(d) 1. Injection with salt solution

1. Accept inject placebo in salt solution

2. Otherwise treated the same.

2

[7]

14 (a) *QWC*

1. (Phagocyte engulfs) to form vacuole / vesicle / phagosome;
   Accept surrounds bacteria with membrane
2. Lysosome empties contents into vacuole / vesicle / phagosome;
   Accept joins / fuses
3. (Releasing) enzymes that digest / hydrolyse bacteria;
   Ignore breakdown / destroy / lytic enzymes

3

(b) Two suitable structures;;

Examples,

1. Cell wall;
2. Capsule / slime layer;
3. Circular DNA;
   Reject "circular chromosome"
4. Naked DNA / DNA without histones;
5. Flagellum;
6. Plasmid;
7. Pilus;
8. 70s / smaller ribosomes;
9. Mesosome;

2 max

[5]

15 (a) (i) 1. (Tumour suppressor) gene inactivated / not able to control / slow down cell division;
Ignore: references to growth

2. Rate of cell division too fast / out of control.
1 and 2 Accept: mitosis
1 and 2 Reject: meiosis

2

(ii) 1. (Genetic) code degenerate;

Accept: codon for triplet

Accept description of degenerate code, e.g. another triplet codes for the same amino acid

2. Mutation in intron.

Accept: mutation in non-coding DNA

1 max

(b) 1. Antibody has specific tertiary structure / binding site / variable region;

Do not accept explanations involving undefined antigen

2. Complementary (shape / fit) to receptor protein / GF / binds to receptor protein / to GF;

Ignore: same shape as receptor protein / GF

3. Prevents GF binding (to receptor).

3

[6]

16 (a) (i) **(Whole-cell vaccine),**

Accept converse statements for other vaccine

Reject references to the vaccine being alive or the disease reproducing etc

1. Heat(ing) supposed to kill bacteria;

2. Some might be alive / active / viable;

Accept active pathogens present

3. (If so) bacteria could reproduce;

4. Bacterium makes or contains toxin;

5. Toxin might not be affected / all destroyed by heat;

6. Bacteria or toxins attacking / killing person's cells;

3 max

(ii) **(Whole-cell vaccine),**

Ignore references to more / greater antigens unqualified. It is the variety of antigens that matters

1. (Contains) many different / greater range of antigens;

2. Each antigen causes its own immune response / production of / has a specific (type of) antibody;

2

(b) 1. Only patients who had whooping cough have toxin / antibody / immune response;

Accept converse e.g. those without antibody had another disease

2. Toxin is an antigen and is (only) produced by this bacterium;

3. Leading to presence of specific antibody / only 4% had this antibody / 13% did not have antibody;

3

(c) 1. There may not be large rises;

2. Might be the result of wrong diagnosis / reference to difference in figures / 13% diagnosed with whooping cough didn't have it;

Ignore reference to new strains or antigenic variability

2

[10]

17 (a) (i) 1. (Scientists) can't show bias / influence / may have a vested interest / work for the company developing the vaccine;

Relates to the scientists

2. (Volunteers) can't show psychological / mental effects / 'placebo effect' / expectations;

Relates to the volunteers

Accept: reduces the 'Hawthorne effect' / demand characteristics

Neutral: so they have no idea what they are taking

2

(ii) Any **two** suitable suggestions, eg

Neutral: refs. to age and health

1. Amount of nicotine in cigarettes;
   Neutral: different types of cigarette / different ways / frequency of smoking
2. Amount inhaled / absorbed / time since last cigarette;
   Neutral: absorption by gut / digestion
   Accept: absorption by mouth
3. (Different) amounts excreted / metabolism / rate of binding (of nicotine) to protein;
   Accept: broken down (differently)
4. (Different) blood volumes;
   Neutral: different body masses
5. Nicotine from passive smoking / other smokers / other sources;
6. Some volunteers received the vaccine / placebo;
   Accept: some volunteers would have / would not have the antibodies

2 max

(b) (i)

1. Antibodies to nicotine produced / antibodies bind to nicotine;
   Q *Reject: vaccine contains / produces antibodies*
   Q *Neutral: antibodies digest / kill / fight nicotine*
2. (So) nicotine does not bind to protein / does not reach the brain;
   Q *Reject: any reference to 'active site'*
   Neutral: idea that the antibodies bind to the protein
3. (So) cigarettes / smoking does not satisfy addiction / reward smokers / release (reward) chemicals;

3

(ii) **(Agree):**

1. People choose to smoke / know the risks;
2. Should spend this money on education / preventing people from starting to smoke / treating other health problems / vaccines are expensive;

(Disagree):

3. Unethical not to treat;
4. Less money needed to treat the effects of smoking / cancer / smokers pay taxes so are entitled to treatment;

3 max

(c) 1. High antibody responders have a high % to stop smoking / are more likely to stop smoking;

'People producing a high concentration of antibodies' is equivalent to 'high antibody responders'

Accept: reference to values from the table

2. Only a few may be high antibody responders / no numbers on how many are high / medium / low antibody responders;

Neutral: not all people are high antibody responders

3. Percentage who stopped smoking is similar for placebo group and low / medium responders / some / % of placebo group (still) stopped smoking / placebo has the lowest value / % to stop smoking;

Accept: reference to values from the table

4. Large sample size / double blind **so** reliable / representative;

5. Antibody levels peak at / drop after 5 months / boosters may be needed at / after 5 months;

6. May start smoking again after 5 / 6 months / do not know the percentage who stopped smoking after 5 / 6 months;

7. Nicotine is not the only factor responsible for making people smoke;

Must mention nicotine

Do not accept: correlation does not mean causation / could be due to other factors

5 max

[15]

18 (a) (i) Substance that causes an immune response / production of antibodies;

Ignore foreign / non-self

1

(ii) 1. Not lipid soluble;

2. Too large (to diffuse through the membrane);

3. Antigens do not have the complementary shape / cannot bind to receptor / channel / carrier proteins (in membranes of other epithelial cells);

2 max

(b) 1. (Vaccine contains) antigen / attenuated / dead pathogen;

1. Reject if in context of injection of vaccine

2. T-cells activate B-cells;

3. B-cells divide / form clone / undergo mitosis;

4. Plasma cells produce antibodies;

5. Memory cells produced meaning more antibodies / antibodies produced faster in secondary response / on reinfection;

5

[8]

19 (a) 1. Infected by / susceptible to (other) pathogen(s) / named disease caused by a pathogen (from environment);

Context is where immune system cannot prevent or stop these events

Allow attack / kill

2. Pathogen(s) reproduce / cause diease (in host);

MPs not given in context of HIV

3. Damage cells / tissues / organs;

4. Release toxins;

3 max

(b) (i) 1. (HIV enters cells) before antibodies can bind to / destroy it;

Ignore SAFETY comments

1. and 2. Relate to antibodies

2. Antibodies cannot enter cells (to destroy HIV) / stay in blood;

OR

3. (Enters cells) before (secondary) immune response caused / before memory cells have time to respond;

3. and 4. Relate to virus

4. So no antibodies present (to attack HIV);

OR

5. Vaccine taken up too quickly to cause immune response;

5. and 6. Relate to vaccine

6. So no antibodies / memory cells formed;

2 max

(ii) 1. Antigen (on HIV) changes;
Accept mutates

2. (Specific) antibody / receptor no longer binds to (new) antigen;
Ignore SAFETY comments

OR

3. Many different strains of HIV / many antigens present on HIV;

4. Not possible to make a vaccine for all antigens / vaccine may not stimulate an antibody for a particular antigen;

2 max

(c) 3 suitable suggestions;;;
QWC ignore reference to HIV cells

E.g.

1. Inactive virus may become active / viral transformation;

2. Attenuated virus might become harmful;

3. Non-pathogenic virus may mutate and harm cells;

4. Genetic information / protein (from HIV) may harm cells;

5. People (may) become / test HIV positive after vaccine used;
Vaccinated people may develop disease from a different strain to that in the vaccine

6. This may affect their work / life;
May continue high risk activities and develop or pass on HIV

3 max

[10]

20 (a) (Micro)organism that causes disease / harm to body / an immune response;
Accept: named microorganism that causes disease
Allow infection

1

(b) 1. Phagocyte attracted by a substance / recognises (foreign) antigen;
Accept named substance eg chemical / antigen

2. (Pathogen)engulfed / ingested;
Accept: description

3. Enclosed in vacuole / vesicle / phagosome;

4. (Vacuole) fuses / joins with lysosome;

5. Lysosome contains enzymes;
Accept named example of enzyme

6. Pathogen digested / molecules hydrolysed;
Neutral: Destroyed

4 max

(c) 1. Antigens (on pathogen) are a specific shape / have specific tertiary / 3D structure;
1 / 3 Structure alone is insufficient

2. Antibody fits / binds / is complementary to antigen / antibody-antigen complex forms;
Reject - active site

OR

3. Antibodies are a specific shape / have specific tertiary / 3D structure;

4. Antigens (on pathogen) fit / bind / are complementary to antibody / antibody-antigen complex forms;

2

[7]

21 (a) Hydrolysis (reaction);
Accept phonetic spelling

1

(b) 1. Too big / wrong shape;
Wrong charge - neutral
Accept insoluble

2. To fit / bind / pass through (membrane / into cell / through carrier / channel protein);

3. Carrier / channel protein;
Accept carrier / channel protein not present

3

(c) Foreign / (act as) antigen / non-self;
Reject foreign cells

1

(d) 1. Dose to be given;

Accept: interaction with other drugs

2. No (serious) side effects;

3. How effective;

4. Cost of drug;

2 max

[7]

22 (a) Has more than one / four polypeptide chains / made up of polypeptide chains;

1

(b) 1. Antibody / variable region has specific amino acid sequence / primary structure;

2. The shape / tertiary structure of the binding site is complementary to / fits / binds with these antigens;

2. Do not accept active site for this point.

3. Forms complex between antigen and antibody;

3

[4]

23 1. Vaccines contain antigens / dead / weakened pathogens / antigens dead / weakened pathogens are injected;

Ignore references to T or B cells.

2. Memory cells made;

3. On second exposure memory cells produce antibodies / become active / recognise pathogens;

3. Idea of memory cells responding.

4. Rapidly produce antibodies / produces more antibodies;

4. Production of antibodies must be qualified for mark. Underlined ideas essential.

5. Antibodies destroy pathogens;

5. Accept bacteria / viruses etc but not disease

[5]

24 (a) Nitrification;

Accept nitrifying.

Do not accept nitrogen fixing.

1

(b) 1. Uptake (by roots) involves active transport;

Reject all references to bacteria

2. Requires ATP / aerobic respiration;

2

(c) (i) 1. Not enough time / fast flow washes bacteria away;

"Not enough time for bacteria to convert all the ammonia to nitrate" gains 2 marks

2. (Not all / less) ammonia converted to nitrate / less nitrification;

2

(ii) 1. Algal bloom / increase in algae blocks light / plants / algae die;

2. Decomposers / saprobionts / bacteria break down dead plant materials;

3. Bacteria / decomposers / saprobionts use up oxygen in respiration / increase BOD causing fish to die;

3. Accept alternatives such as microbes / saprophytes.

3

[8]

25 (a) (i) Protein on (surface of) chlamydia;

That initiates an immune response (in mice) / causes antibody production;

Neutral "foreign protein"

Do not accept glycoprotein.

2. Accept description of initiating immune response.

2

(ii) 1. Antibodies / memory cells against chlamydia (protein / antigen) are present;

2. Protein on heart (muscle) similar to chlamydia protein / antigen so T cells / antibodies (attack heart muscle cells);

2. Look for idea that both proteins are similar

2. Detail of what is attacking the heart muscle cells

2

(b) **FOR**

1. Prevents / reduces heart disease / attacks;

2. Cheaper to vaccinate than treat heart disease;

AGAINST

3. Vaccination costly;

4. Don't know frequency of chlamydia infection;

5. Research in mice might not be replicated in humans / humans might have a different protein;

6. Vaccine could cause heart disease or immune response against heart (muscle);

2 max for arguments against

Accept other valid answers

3 max

[7]

26 (a) (i) Antibiotics kill other bacteria / *Clostridium* is resistant;

Less / no competition so (*Clostridium*)
reproduces / replicates / multiplies / increases in number;

Reference to bacteria being 'immune' negates first marking point.

Reference to mitosis negates second marking point.

2

(ii) Immune system less effective / more likely to have other infections / been in hospital;

Accept: 'Weak / lower' immune system'.

1

(b) Attaches to <u>active</u> <u>site</u> (of enzyme);
(Methicillin) is a competitive inhibitor / prevents monomers / substrate attaching (to enzyme);

'Competes for active site' = 2 marks.

Neutral: 'Prevents monomers joining / attaching to each other'.

Allow one mark max for answers relating to non-competitive inhibitor changing active site / preventing substrate attaching.

Do not penalise Methicillin forms an enzyme / substrate complex.

2

(c) (i) Have other illness / medical condition / 'weak' immune system / disease / infection;

Reject: Due to 'other factors', 'are smokers', 'are obese' unless related to disease or illness.

1

(ii) Increase up to 2006 / 20 (per 100 000) then decreases;

1

(iii) Correct answer in range of 52 – 59.1% = two marks;

Incorrect answer but shows change as between 4.8 – 5.2 / shows correct subtraction giving this change e.g. 14 – 9 = one mark.

2

[9]

27 (a) 1. Phagocyte attracted to bacteria by chemicals / recognise antigens on bacteria as foreign;

2. Engulf / ingest bacteria;

3. Bacteria in vacuole / vesicle;

4. Lysosome fuses with / empties enzymes into vacuole;

5. Bacteria digested / hydrolysed;

1. Accept names chemical e.g. toxin

2. Allow description of engulfing

3. Accept: bacteria in phagosome

5. Neutral: Break down

5. Accept digestive enzymes destroy bacteria

5. Do not accept "destroy bacteria" as it is in question stem

4 max

(b) 1. Microvilli provide a large / increased surface area;

2. Many mitochondria produce ATP / release or provide energy (for active transport);

3. Carrier proteins for active transport;

4. Channel / carrier proteins for facilitated diffusion;

5. Co-transport of sodium (ions) and glucose or symport / carrier protein for sodium (ions) and glucose;

6. Membrane-bound enzymes digest disaccharides / produce glucose;

1. Reject villi on epithelial cells

1. Accept brush border

2. Accept large SA:vol ratio

3. Need idea of "lots"

4. Reject: energy produced

5. Accept Na^+K^+ pump

6. Neutral: Channel proteins

7. Accept named example

6

[10]

28 (a) Straight lines point to point as not possible to predict intermediate values / values between points;

1

(b) Increases then levels / falls;
Maximum antibody production 180 units / at dose of 0.25 g per kg;

2

(c) Two marks for correct answer of 57.14 / 57.1;;
One mark for incorrect answer in which candidate clearly divides difference in antibody production / 60 by 105;

2

(d) Takes into account different masses of mice / allows comparison;

Accept different weights of mice.
Do not accept different size.

1

(e) Sheep red blood cells have antigens (on their surface);
Antigens are proteins foreign to mice / are non-self;
Stimulate B cells to produce antibodies;

3

(f) Response only observed in mice;
Disease organisms not investigated;
Not all disease caused by pathogens / cured by antibodies;

i.e. not tested on humans

2 max

[11]

29 (a) (i) To show whether immune response occured / because cats are (genetically) related to cheetahs;

Ignore reference to control.

1

(ii) To show that rejection did not normally occur / skin could (successfully) be grafted;

1

(b) (i) Rapid rejection between unrelated (domestic) cats / cats are **not** genetically similar;
Rapid rejection between (domestic) cat and cheetah / cats and cheetahs are not genetically similar;
Slow / no rejection in cheetahs / cheetahs are genetically similar;

3

(ii) Sample size small;
Time observed was short;

1 max

(iii) Similar (antigens on all cheetahs);

Accept same / not very different

1

(iv) Protein / antigen production determined by alleles / genes / base sequence on DNA;
The more similar the proteins the more similar their alleles / genes / base sequence on DNA / the more they are genetically similar;

2

[9]

30 (a) Girls are not sexually active / not likely to carry HPV / vaccine may not work if already infected / few girls sexually active (at this age);

Neutral: girls are not sexually mature

Neutral: to provide better protection

Accept: provides immunity before sexually active

*Neutral: girls are less likely to have '**it**' as could mean the vaccine from the question stem*

1

(b) Other (HPV) types have different antigens;

No memory cells for other types / memory cells not activated / antibodies cannot attach to antigen / correct antibodies not produced / antibodies are not complementary;

Accept: refs. to antigenic variability

Accept: B cells for memory cells

Accept: memory cells cannot recognise antigen for 'not activated'

Accept: examples of memory cell activation

2

(c) More antigen;

More memory cells;

So more antibodies produced / antibodies produced quicker (if infected);

Accept: 'many' / 'enough' instead of 'more'

Neutral: primary / secondary response

Accept: T cells / B cells / plasma cells instead of 'antibodies'

Reject: the idea that vaccines contain antibodies

***Q** Reject: antibodies 'fight' / 'antibiotics'*

2 max

(d) Cancer takes years to develop / develops later in life;

Takes time for females to become sexually active / females must become sexually active to obtain data;

Few people / only teenagers vaccinated;

Neutral: will take time to vaccinate 80% of young girls

Accept: do not develop cancer instantly

2 max

(e) (Cervical cancer) can be caused by other types of HPV / other factors / example given;

OR

(Some) women may have been infected (with HPV) before receiving the vaccine;

OR

(As a precaution) in case vaccine does not work / a way of monitoring if the vaccine has worked;

Accept: 'caused by other types of HPV' in the context of mutation

Neutral: to check for abnormal cells / that they are immune to the virus

1

(f) Virus cannot replicate / is destroyed / is not carried (in vaccinated people);

Non-vaccinated people more likely to contact vaccinated people;

Neutral: 'do not spread virus' as in question stem

Must be in context of the individual and not the population as in question stem

***Q** Do not allow 'disease is destroyed'*

Neutral: 'herd effect' as given in the question stem

2

[10]

31 (a) (yes):
Many women (with cervical cancer) have HPV 16 (18 &31);

(no):
Few women (with cervical cancer) have HPV 6 / 11;

(HPV infection does not mean causation because):
Could be caused by another factor / example given / may be due to coincidence;

No control group / did not study HPV in healthy women / did not study all HPV types / having cancer may increase susceptibility to HPV / does not add up to 100% / not all women with cancer have HPV / individual may have more than one HPV type;

Neutral: correlation between HPV (16) and cervical cancer

Reject: many women with HPV 16 (18 &31) have cervical cancer / not all women have cancer

Accept: figures from graph for 'many' and 'few'

Accept: minor errors in reading HPV frequencies from graph

Reject: does not mean HPV vaccine causes cancer;

Neutral: refs. to sample size and factors that should have been kept constant

3 max

(b) (i) Protein / glycoprotein / glycolipid / polysaccharide;

Causes immune response / antibody production;

Accept: B / T cell production

2

(ii) Memory cells produced / remain / stored (from previous infection);

Neutral: antibodies produced / remain

(When individual) comes into contact with virus / antigen (again);

Neutral: 'cell' instead of 'virus'
Reject: 'bacteria' once only

Rapid / secondary / greater response / many or more antibodies produced;

Accept: B cells / T cells

Destroys virus / antigen before it can cause harm / symptoms / cancer;

Reject: if destroys the virus / antigen in the vaccine before it can cause harm

***Q** Do not allow 'fights HPV'*

***Q** Do not allow 'memory cells remember'*

3 max

(c) HPV destroyed in males / prevents males being carriers of HPV;

Neutral: prevents males catching HPV

Prevents males passing on HPV (to unvaccinated females) / HPV may cause (other) cancers in males;

Accept: reference to herd effect protecting the population

2

[10]

32

(a) 1. Foreign protein;

Accept glycoprotein / glycolipid / polysaccharide

2. (that) stimulates an immune response / production of antibody;

2

(b) 1. A protein / immunoglobulin specific to an antigen;

2. Produced by B cells

OR

Secreted by plasma cells;

2

(c) 1750(%);

1

(d) 1. Sample 1 / before vaccination no antibody released because patients not yet encountered vaccine / antigen / virus;

Accept 'produced' for 'released'

2. (Sample 2 / primary response / after first dose) activation / clonal selection / expansion of B cells into plasma cells;

3. Plasma cells release antibodies;

4. (Sample 3 / secondary response / after second dose) memory cells produce more antibodies / produce antibodies more quickly;

4

[9]