A-Level Biology

HIV

Mark Scheme

Time available: 66 minutes
Marks available: 51 marks

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1.

(a) 1. A = Attachment protein;

Accept gp41 /gp140 /gp120/CD4/ glycoprotein

Accept antigen

Ignore receptor protein

2. B = Capsid

OR

Capsomere

OR

Protein;

2

(b) 1. Attachment proteins attach to receptors on helper T cell/lymphocyte;

2. Nucleic acid/RNA enters cell;

3. Reverse transcriptase converts RNA to DNA;

4. Viral protein/capsid/enzymes produced;

5. Virus (particles) assembled and released (from cell);

4 max

[6]

2.

(a) 1. RNA converted into DNA using reverse transcriptase;

Reject 'messenger' or 'm' before RNA

2. DNA incorporated/inserted into (helper T cell) DNA/chromosome/genome/nucleus;

3. DNA transcribed into (HIV m)RNA;

Accept descriptions of transcription

4. (HIV mRNA) translated into (new) HIV/viral proteins (for assembly into viral particles);

Accept descriptions of translation

Accept named viral protein, eg capsid

Reject viral cells

4

(b) For

1. (There appears to be) no virus/ HIV(-1)/RNA/DNA, so could be a cure/effective;
   Max 4 for reasons for or against
   Ignore virus is killed

2. No CCR5/receptor, so not get HIV(-1) in the future

OR

No CCR5/receptor, so nothing for HIV(-1) to bind to;
   Reject less CCR5/less HIV(-1) bind

3. Only one transplant/BSCT needed (shown by patient **Q**)

4. Would not need (daily) ART (16 months after BSCT);

Against

5. Don't know if chemotherapy/radiotherapy is needed

OR

Do not know if BSCT alone would be effective;

OR

Do not know which treatment is having the effect

OR

Could be due to chemotherapy/radiotherapy;

Accept: chemotherapy/radiotherapy is toxic/harmful/has side-effects

6. Only for HIV-1;
   Accept: Might not work in other types of HIV

7. Don't know if it would work in all people

OR

Only worked/tried in 2 cases;

8. Might not be long term

OR

Only 18 months;

9. HIV-1 may mutate and be able to bind to a different receptor (on T_H cells);

10. Might be a lack of (suitable stem cell/BSCT) donors;
Accept stem cells/BSCT (might be) rejected

5 max

[9]

3. (a) 1. Less/no antibody produced;

2. (Because HIV) destroys helper T cells;
Accept 'reduces number' for 'destroys'

3. (So) few/no B cells activated / stimulated

OR

(So) few/no B cells undergo mitosis/differentiate/form plasma cells;

3

(b) **Not effective in treating AIDS because**

1. Number of T cells < 200 at 4 months;
   Max 4 if not one of 9. or 10.
   Accept 3.5 - 5 months
   Reject day/week only once

2. (So) drug is not effective

   OR

   AIDS symptoms occur;

3. Does not remove (all) HIV (particles)

   OR

   Number of HIV (fairly) constant/stable

   OR

   (Slight) increase in HIV (over 16 months);

4. No stats test;

5. Only shows (results over) 16 months;

6. Only one person;

7. Unknown side effects (of drug);

8. No control group;

Effective in treating AIDS because

9. Number of T cells > 200 after 5 months

   OR

   Number of T cells increasing after 4 months;
   Reject day/week only once
   Accept any month after 5 months OR 'in the long term'

10. So drug is effective

    OR

    AIDS symptoms relieved/removed;

5 max

[8]

4. (a)

Accept a labelled diagram.

1. RNA (as genetic material);
   Reject nucleus/DNA/plasmids.

2. Reverse transcriptase;

3. (Protein) capsomeres/capsid;
   Reject capsule.

4. (Phospho)lipid (viral) envelope
   OR
   Envelope made of membrane;
   Reject if HIV has a cell membrane or a cell wall.

5. Attachment proteins;
   Accept gp41 and/or gp 120.
   Accept glycoprotein.
   Accept description of attachment protein.
   Ignore 'receptor protein'.
   Ignore cytoplasm.

4 max

(b) Automarked q – ☑ 106

1

(c) 1. (All) have more T helper/CD4 cells;
   Accept higher proportion of T helper/CD4 to virus particles.
   Statement must be comparative.

2. Lower viral load **to** infect/destroy helper T/CD4 cells;
   For 'infect' accept 'HIV does not reproduce in'.
   Statement must be comparative.

3. (So more/continued) activation of B cells/cytotoxic T cells/phagocytes;
   Accept 'stimulation' for 'activation'.

4. (With B cells more/continued) production of plasma cells/antibodies
   OR
   (With cytotoxic T cells more/continued) ability to kill virus infected cells;
   Ignore reference to B cells acting as phagocytes/antigen-presenting cells.

5. (More able to) destroy other microbes/pathogens
   OR
   (More able to) destroy mutated/cancer cells;

3 max

[8]

5.

(a)
1. Person (infected with HIV) has HIV DNA (in their DNA);
2. New HIV (particles) still made;
3. (AZT) inhibits reverse transcriptase;
4. (AZT) stops these (new HIV particles) from forming new HIV DNA;
   OR
   Slows / stops replication of HIV;
5. Stops destruction of more / newly infected T cells;
6. So immune system continues to work (and AIDS does not develop);

4. Context is important

4. Allow slows / stops (re)production of HIV

4. Reject (AZT) prevents DNA replication

4 max

(b)
1. Slows / stops the development of AIDS;
2. Because HIV **resistant to AZT** is damaged / destroyed / prevented from replicating (by other drugs);

OR

3. AZT continues to work as a drug;
4. Because HAART prevents the spread of AZT-resistant HIV to rest of the human population;

OR

5. No new HIV particles made;
6. Because HAART might interfere with viral protein synthesis;

Mark in pairs.

Do not mix and match.

2. Neutral HIV killed

2. Accept other drugs prevent HIV resistant to AZT from infecting new / more cells

6. Accept blocks transcription / translation / synthesis of lipid envelope / aspect of viral structure

4 max

(c)
1. (Fewer mitochondria so) less (aerobic) respiration;
2. (Muscles receive) less ATP (so waste);

1. Ignore no respiration

2. Reject less energy produced

2. Ignore no ATP is made

2

[10]

6.

(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 <u>so</u> 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]