

2022 VCE Biology (NHT) external assessment report

Specific information

Section A

Question	Correct answer
1	D
2	B
3	C
4	B
5	C
6	D
7	B
8	C
9	D
10	B
11	A
12	C
13	C
14	D
15	B
16	D
17	A
18	C
19	B
20	B
21	A
22	D

Question	Correct answer
23	B
24	C
25	D
26	B
27	B
28	A
29	C
30	A
31	D
32	A
33	B
34	C
35	D
36	D
37	D
38	C
39	A
40	C

Section B

Many responses were clearly organised and logically set out.

Question 1a.

Structural genes code for proteins that serve as cellular structures or enzymes, for example. Regulatory genes code for products that regulate gene expression.

Question 1bi.

All products coded for by the three structural genes are, for example, turned on or translated at the same time. This would also save energy and result in less product being produced.

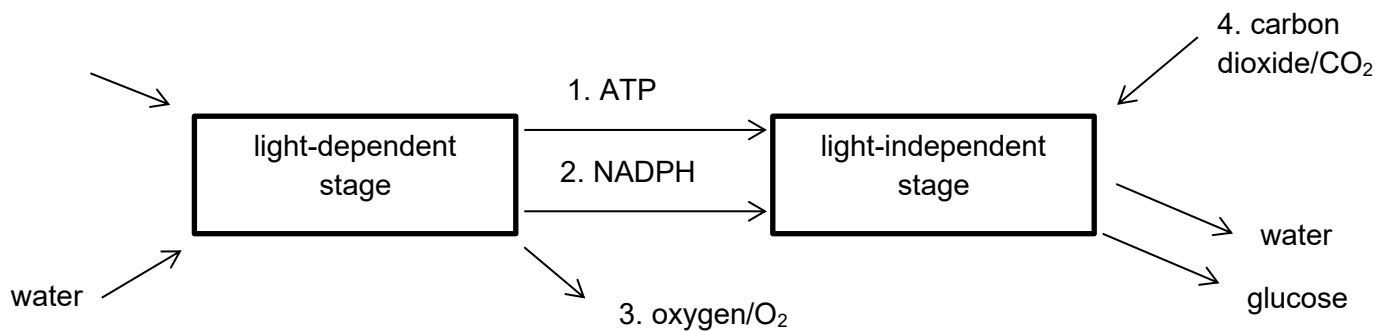
Question 1bii.

An increase in temperature would lead to decreased activity of the enzyme, and the eventual denaturation of enzymes and substrates no longer able to fit or bind to the active site of the enzyme.

Question 2a.

Photosynthesis transfers or converts light energy and $\text{CO}_2 + \text{H}_2\text{O}$ into chemical energy stored in glucose. Glucose is then used as a building block to make complex carbohydrates such as starch. This then provides energy to produce ATP, which can be used by the plant cell as a source of energy for many chemical reactions within the cell.

Question 2b.



Question 2c.

Possible responses included:

- light-dependent stage occurs in grana of chloroplast
- light-independent stage occurs in the stroma
- chlorophyll traps/transfers light energy
- $\text{ADP} + \text{P}_i \rightarrow \text{ATP}$ in light-dependent stage
- light-independent stage is a cycle known as a Calvin cycle.

Question 3a.

Peptide-based, as it binds to FasD receptor on the membrane of a cell, or it is hydrophilic and cannot cross the plasma membrane.

Question 3b.

HIV enzymes would lead to:

- increased release or less inhibiting of cytochrome c
- activation of caspase 9
- apoptosis occurring.

Question 3c.

The requirements of the experimental design for trialling this molecule would be any four of the following:

- Use a large number of HIV-positive participants.
- Have one group / experimental group given the molecule and one group given no molecule / placebo as a control group.
- Measure the effectiveness of the molecule by percentage change in T helper cell number pre- and post-trial.
- Have appropriate control variables (for example, same gender, same duration of treatment, same sample volume of thymus tested for T helper cell count).
- Repeat the trial to confirm reliability of results.

Some students incorrectly described the development and making of the molecule.

Question 4a.

First-line defences against the virus include any two of the following:

- Mucous membranes make it difficult to viruses to adhere.
- Nose hairs are a physical barrier to the virus.
- Acidic environment of the stomach.

Question 4b.

Sore and inflamed throat due to:

- the destruction of cells in the throat releasing chemicals that cause increased membrane permeability and swelling
- more immune cells moving to the site due to vasodilation
- mast cells releasing histamines, which produce inflammation.

Question 4c.

The virus is transmitted by disease-containing water droplets that are spread through coughing, sneezing, sharing food or close contact.

Prevention methods include not sharing food, wearing a mask in enclosed areas and using hand sanitiser.

Question 4d.

The immune response includes:

- viral antigen identified as non-self
- B/T memory cells, previously produced, become active
- plasma cells produced
- antibodies rapidly produced or already present
- virus is neutralised or agglutinated and unable to infect cells.

Question 5a.

Increased average temperature could have:

- changed food availability that suited smaller birds, providing a selective advantage
- changed nesting area availability to suited smaller birds, who survived and reproduced
- advantaged birds with a larger SA:Vol, allowing greater heat loss.

Question 5b.

Agree. 15 000 birds is a large sample size, making this a reliable study.

Question 5c.

The benefits of using non-migratory birds are:

- can be used as a control to compare against other data to make it a valid experiment
- there would be limited gene flow between populations of birds
- the composition of the gene pool would have changed due to mutations, not gene flow, over the 40 years of study.

Most students understood the benefits of using non-migratory birds; however, they were unable to explain the consequences to the gene pool.

Question 5d.

For the bird species to evolve:

- there is genetic variation in body size / wing length of the bird species population
- environmental change occurs as the climate becomes hotter
- those birds with a smaller body size / longer wing length have a selective advantage
- birds with smaller body size / longer wing length interbreed and produce offspring with the same characteristics
- over several generations / time, a decrease in body size / increase in wing length is observed in the population of birds.

Question 6

The BMP4 gene is responsible for pre-bone or cartilage protein laid down in embryo.

Mutations such as repeats in BMP4 increase the duration of expression, leading to more or less bone being laid down. This leads to variation in the length and breadth of the jaw, thus new phenotypes (for example, short, broad jaw and long, narrow jaw). These new phenotypes can exploit new food resources in African lakes and so persist and may allow speciation.

Question 7a.

Advantages of bipedalism are that it:

- enabled them to walk greater distances and migrate
- allowed hands to remain free for carrying and manipulating objects
- enabled greater vision of predators.

Question 7b.

Skeletal feature of hominin	Skeletal feature of ape-like hominin
<i>arched foot</i>	<i>flat foot</i>
S-shaped/curved spine/lordosis	C-shaped/straight spine
shallow wide / bowl-shaped pelvis	narrow, long pelvis
smaller arm : leg length ratio	longer arm : leg length ratio
toes in line	toes still opposable
femurs angled	femurs vertical

Features that related to skull structure could not be awarded marks as the fossil skeleton found did not include the skull.

Question 7c.

Fossil B is the correct response because when compared to Fossil A, it has:

- a smaller cranium or smaller brain case
- more prominent brow ridges
- a forehead that slopes back more / face more sloped
- prominent upper cheekbone and jawbone, suggesting a larger jaw
- a squarer, U-shaped, less-parabolic jaw.

Question 8a.

Suitable responses included:

- reduce the number of male chicks that are killed, since this causes pain and suffering to chicks
- reduce the cost of determining the sex of hatched chickens or incubating unwanted chickens, which reduces costs for farmers and increases their quality of life.

Question 8b.

Suitable responses included:

- transgenic, as there has been an addition of genetic material from another species
- genetically modified, as its DNA is altered.

Question 9a.

Some valid reasons included the following.

- Individual with HIV
 - lack of T-helper cells
 - inability to generate antibodies or adaptive response not fast enough
- Immunocompromised cancer patient or patients receiving chemotherapy
 - weakened immune system
 - inability to generate antibodies or adaptive response not fast enough
- Elderly
 - weakened immune system
 - inability to generate antibodies or adaptive response not fast enough
- Newborn baby
 - lack of fully developed immune system
 - inability to generate own antibodies or adaptive response

Question 9b.

Suitable responses included:

- Tuberculosis (TB) is caused by bacterial infection.
- Antivirals are used to treat viral pathogens or diseases.

No marks could be awarded for antibiotics.

Question 9c.

Epidemics are restricted to specific regions or countries, while pandemics spread across international borders and affect multiple countries. TB should therefore be classified as a pandemic.

OR

The incidence of TB has globally decreased. The majority of growth in TB cases is restricted to specific countries. TB is appropriately classified as an epidemic.

Question 9d.

TB is decreasing by 2% per year.

As there were 10 million people affected in 2020, the infection rate will not be zero by 2030.

No marks could be awarded for 'not achievable'.

Question 10a.

PCR = polymerase chain reaction

Question 10b.

The scientist would need the nucleotide sequence on both strands of DNA either side of the target DNA sequence.

The target DNA sequence is unique and can be determined.

The scientist would make a complementary strand of nucleotides that can attach just before and just after the target DNA sequence.

Primers can attach to the ends and provide a region for Taq polymerase to join.

Question 10c.

Lane 1 is the correct response, as this sample has travelled farther than the other samples through the gel. Smaller pieces of DNA can move through the gel more quickly and so travel farther in the same time.

Question 10d.

Factor 1: incorrect temperatures.

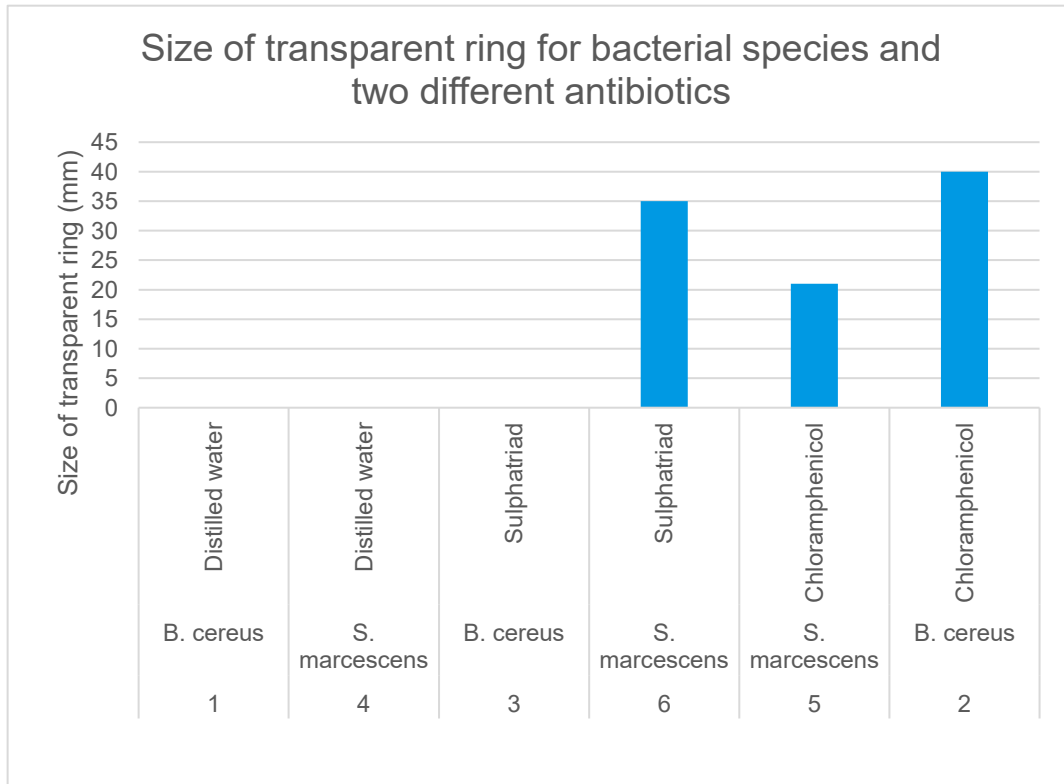
Explanation: primers may not have annealed if the temperature was incorrect or DNA polymerase may have been denatured if the temperature was too high.

Factor 2: timing of each stage.

Explanation: if the time was too short for annealing, the primers would not bind or if the denaturation time was too long, the DNA may degrade. If the extension time was too short, it would be insufficient time for complete DNA replication.

This question required students to discuss factors that would affect the process of PCR, not the process of gel electrophoresis.

Question 11a.



Students were required to put labels on the x and y axes, and include a heading.

The graph was to be a bar or point graph, not a line graph, as the data is discrete and not related.

A suitable scale and key or suitable labels to identify the results should have been included.

Question 11b.

Suitable conclusions included:

- Chloramphenicol is effective on both species.
- *B. cereus* is resistant to the antibiotic sulphatriad.
- Chloramphenicol is more effective against *B. cereus* than *S. marcescens*.
- Sulphatriad is the most effective antibiotic for *S. marcescens*.

Question 11c.

Sources of random error included:

- different concentrations of antibiotics used
- inaccurate measurement of diameter
- disc not firmly touching agar
- different spread of bacteria on the plates.