TRIUMPH PUBLICATIONS

Fortify Sample Exam A

BIOLOGY

Full Solutions

Section A

1	B	16	C	31	B
2	C	17	C	32	D
3	B	18	D	33	D
4	D	19	C	34	D
5	B	20	D	35	C
6	D	21	A	36	A
7	C	22	C	37	D
8	A	23	D	38	A
9	B	24	C	39	B
10	C	25	B	40	D
11	D	26	D		
12	A	27	A		
13	D	28	B		
14	C	29	B		
15	D	30	C		

Section B

Question 1ai.

Amino acid

Question 1aii.

All of:

- Amino acids are joined via a condensation reaction
- Water is an output
- Energy is required/is an input

Question 1b.

The ribosome reads/binds to the mRNA strand, tRNA brings specific amino acids to the mRNA. The tRNA anticodon is complementary to the mRNA codon. Amino acids are joined via condensation polymerisation to form a polypeptide chain.

Question 1c.

Any of the following three:

Organelle	Role
Mitochondria	Provides the energy required for protein export, eg. packaging of the chymase.
Golgi body/ Golgi apparatus	Modifies and packages chymase for transport out of the cell.
Rough endoplasmic reticulum	Transports chymase within the cell, including to the Golgi apparatus.
Vesicles	Carries chymase to the plasma membrane where it fuses and releases the enzyme from the cell.
Plasma membrane	Vescicles fuse with the plasma membrane where the enzymes are released via exocytosis.

Question 1d.

Chymase inhibitors would:

- Have a complementary shape to the active site of chymase enzymes.
- Prevent the substrate from binding to the enzyme.

Question 2a.

The oxygen levels decreased as oxygen was consumed for aerobic respiration.

Ethanol levels rose as ethanol is a product of anaerobic respiration.

Question 2b.

The level of carbon dioxide would be expected to increase, as carbon dioxide is a product of (one of):

- cellular respiration
- aerobic respiration
- aerobic respiration

Question 2ci.

Light-independent stage or Calvin cycle

Question 2cii.

Location in the chloroplast where this stage occurs	Stroma	
Two input molecules that are required for this stage	1. ATP	2. One of • NADPH • H^+
Two output molecules that result from this stage	1. Glucose	2. One of • $NADP^+$ • Pi • ADP

Question 3a.

Signal transduction

Question 3b.

- Enzymes such as caspases are activated inside the cell
- Digestion of cell contents occurs
- Destruction of organelles/the plasma membrane
- Cell shrinkage
- Cell blebbing
- Cell signals macrophages to phagocytose cell debris

Question 3c.

- Decreased production of caspases
- Decreased production of trigger signals, death receptor proteins or TNF2 or increase in inhibitors such as BCl-2
- A change in the functioning of a gene, leading to decreased cell death

Question 4a.

One of:

- Intact skin
- Nose lined with nasal hairs to trap pathogens
- Thick, sticky mucous in nose
- Lysozymes in saliva and tears
- Low pH stomach acid to kill pathogens

Question 4bi.

Phagocytes are a type of lymphocyte which can

- Engulf and destroy pathogens and other foreign material
- Display antigens from ingested pathogens on their surface to trigger an immune response
- Engulf antibody-antigen complex

Question 4bii.

Complement proteins are able to damage the plasma membrane of bacteria and promote inflammation, attracting other cells such as phagocytes to an infected area.

Question 4c.

- The individual's immune system detects self-cells as foreign.
- The immune system attacks these misidentified cells, resulting in autoimmune conditions such as MS.

Question 4di.

All of:

- Mast cells and damaged tissues produce histamine.
- Histamine triggers vasodilation and increased blood flow to the region, resulting in redness and heat.
- Capillaries become permeable and phagocytes move to the area resulting in increased phagocytosis and oedema.

Question 4dii.

Any realistic consequences of chronic inflammation are accepted, including:

- Chronic pain
- Reduced ability to perform activities of daily living
- Depression related to pain

Question 5a.

A dead or attenuated form of a disease-causing agent that triggers an immune response.

Question 5b.

Active immunity, as the child's immune system is producing its own antibodies and memory cells.

Question 5c.

T-helper cells release cytokines to stimulate B-cell division.

B-cells differentiate to produce plasma cells, which produce antibodies specific to the antigens.

B cells also differentiate into memory cells which provide long-term immunity.

Question 5d.

Herd immunity occurs when the majority of the population is immune to a disease, which helps protect those who are unable to be vaccinated such as babies and immunosuppressed individuals.

There is a reduced number of infected individuals which means the disease does not spread to the rest of the population.

Question 6a.

Natural variation may exist in a population through mutations which create new alleles, or by different allele combinations being produced through sexual reproduction. Aneuploidy/changes in the number of chromosomes may also change the phenotypes.

Question 6b.

A diverse gene pool creates a variety of phenotypes which means there is an increased chance of survival of the population if the environment/selection pressures change.

Question 6c.

One of:

- Comparing mitochondrial DNA: evidence to support their hypothesis would be differences in the nucleotide sequence of mitochondrial DNA.
- Comparing DNA sequences: evidence to support their hypothesis would be different nucleotide sequences in nuclear DNA, or using DNA hybridisation to identify relatedness.
- Comparative genomics (comparing whole genome sequences): evidence to support their hypothesis would be differences in the gene sequences of the Kerguelen petrel compared to known members of Pterodroma.

Question 6d.

Genetic drift: The change in allele frequencies due to chance events.

Bottleneck effect: A severe reduction in the size of a population due to a catastrophic event that results in reduced genetic diversity and may alter allele frequencies.

Question 7a.

A regulatory gene codes controls the expression of other genes and a structural gene codes for a protein that creates the phenotype of an organism or becomes part of the structure or function of an organism.

Question 7b.

In the Galapagos finch: the BMP4 gene codes for a signalling protein which is responsible for the beak formation of Galapagos finches. The longer the gene is expressed in the finch embryo, the larger and wider the beak produced. This process results on diversity in the beak shape and length of beaks in finches and allowed different phenotypes for natural selection.

Question 8a.

One of:

- Stratigraphy could have been used, where the relative age of a fossil is determined by its position in the strata.
- Index fossils could have been used, where the relative age of the fossil is determined by the fossils of known age that are found nearby/in the same strata.

Question 8b.

Divergent evolution

Question 8c.

All of:

- The DNA is heated to separate the double stranded DNA/break the bonds between strands.
- A single strand from each species is mixed together and cooled, to allow the strands to bind.
- The DNA hybrid is then heated and the temperature required to separate the DNA strands is recorded.

Question 9a.

Species	Location of fossil	Condition
Homo erectus	Banks of the Java Sea	One of • Low oxygen • Rapid burial by sediment • Lack of scavengers/decomposers
Homo floresiensis	Cave on the island of Flores	One of • Protected from erosion by wind/water/sun • Constant temperature • Lack of scavengers/decomposers

Question 9b.

Any two of:

- More prominent brow ridge
- Less parabolic jaw shape
- More sloping of forehead
- Less rounded skull/less globular brain case
- Teeth are different sizes

Question 9c.

One of:

- S-shaped spine
- Shorter arm to leg ratio
- Different pelvis shape to support upright posture

Question 9d.

One of:

- Art/artefacts
- Cave paintings
- Evidence of burial rituals/burial of bodies
- Stone tools
- Shell or bone objects fashioned for use as jewellery

Question 10a.

An agent capable of transporting foreign DNA into a cell/organism.

Question 10b.

Restriction enzymes are used to cut the ends of the foreign/desired gene and plasmid so that the gene can be inserted into the plasmid.

Question 10c.

DNA ligase

Question 10d.

All of:

- Denaturation: 95 °C. The reaction is heated to separate/denature the DNA strands, providing a single-stranded DNA template.
- Annealing: 55-65 °C. The reaction is cooled and primers are added which bind to their complementary sequences on the DNA template.
- Elongation/extension: 72 °C. The reaction temperature is raised as this is the optimum temperature for Taq polymerase function. Taq polymerase extends the primers, adding DNA nucleotides to the template strand to produce a new strand of DNA.

Question 11a.

Students should provide a statement which realistically predicts the effect of temperature on photosynthetic rate, for example:

It is predicted that the rate of photosynthesis in Hydrilla (as measured by the number of oxygen bubbles produced) will be higher at a temperature of 20 °C than at temperatures of 10 °C, 30 °C, 40 °C and 50 °C.

Question 11b.

Any two of:

- Concentration of sodium bicarbonate present
- Amount of Hydrilla in each apparatus
- Volume of water
- Amount of light

Question 11c.

Dependent variable: rate of photosynthesis in Hydrilla

Independent variable: temperature

Question 11d.

Sodium bicarbonate is added as it ensures the supply of carbon dioxide is adequate for photosynthesis or ensures carbon dioxide is not a limiting factor.

Question 11e.

To establish a baseline for this experiment to increase the validity of their results.