TSFX TRIAL EXAMINATION 2019

VCE BIOLOGY – UNIT 3 & 4

SOLUTIONS

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SECTION A – MULTIPLE CHOICE QUESTIONS

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

SECTION B – SHORT ANSWER QUESTIONS

QUESTION 1 (7 marks)

a. **i.** $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

$36\ ADP + 36\ P_i \rightarrow 36\ ATP$

(Correct if student writes: 36-38ADP+ 36-38P_i ⟶ 36-38 ATP instead of 36 ATP)

1 mark for all correct

ii. 100 m Sprint: Anaerobic cellular respiration results in 2 ATP/glucose.
Marathon runner: Aerobic respiration 36-38 ATP/glucose.

1 mark for all correct

iii. 100 m runner: Lactic acid. (1)
Yeast: CO_2 and ethanol. (1) 2 marks

b. Increasing temperature increases rate of cellular respiration as shown by increasing oxygen consumption (1) and this is due to enzyme and substrate molecules moving faster and complexing (colliding) more often (1) so faster reaction occurs.

2 marks

c. Any one of:

Both mitochondria and bacteria contain

- circular DNA.
- similar membrane structure surrounding them.
- divide by similar process.
- have ribosomes.

1 mark

QUESTION 2 (12 marks)

a. **i.** Different or alternative forms of a specific gene (different nucleotide sequences). 1 mark

ii. Proteins. 1 mark

iii. Ribosome. 1 mark

iv. Translation 3 marks

- Ribosome attaches to mRNA and reads one codon at a time. (1)
- tRNA with the complementary anticodon to the codon carries a specific amino acid to the ribosome. (1)
- as more amino acids are added, they are joined by peptide bonds in sequence to form the polypeptide dystrophin. (1)

b. **i.** A section within a gene that codes for amino acids. 1 mark

ii. A large deletion mutation resulting in Becks DMD only produces a mild form of Duchenne Muscular Dystrophy whereas a mutation in the reading frame like DMD produces severe Duchenne Muscular Dystrophy. 1 mark

This suggests a reading frame mutation is more significant than a deletion mutation, even if it is a large deletion, as it produces a very different (non-functioning) protein, compared to the deletion mutation producing a protein that still functions. 1 mark

iii. A single base change in a DNA triplet. 1 mark

iv. TAC ACA ATG GGG AGA GGT GTC AGA 1 mark

v. No. The genetic code is said to be redundant (degenerate) as it is possible for more than one codon/triplet to code for one specific amino acid. This would mean a different base sequence would still code for the same amino acid sequence. 1 mark

QUESTION 3 (9 marks)

a. A hormone is a signalling molecule secreted by cells that is transported around the organism and causes a response in specific target cells. 1 mark

b. Only the kidney target cells have the specific shaped receptors that are complementary in shape to the shape of the hormone (ADH) molecule. 1 mark

c. Reception: ADH consists of water-soluble protein molecules which attach to specific receptors on the external membrane of the target kidney cells. (1)

Transduction: Secondary messenger molecules are activated and a series /cascade of enzymes are activated that transfer and amplify the signal inside the target cell. (1)

Cellular Response: Final reaction in the cascade causes increase in the membrane permeability of the kidney cells. (1)

3 marks

d. **i.** Intrinsic example – Any one of:

DNA damage, virus infection, enzymes not functioning, mitochondria release signalling molecules (1)

Extrinsic example – Any one of:

Removal of unwanted cells such as webbing between digits, removal of excess cells after immune response by cytokine signalling, destruction of underdeveloped cells such as excess brain cells during foetal development (1)

2 marks

ii. Caspase enzymes activated and cleave specific proteins in the cytoplasm and/or nucleus resulting in the breakdown of organelles/ nucleus/ cytoskeleton.(1)

Cell shrinks, blebbing of membrane occurs and apoptotic bodies develop as cell breaks apart. (1)

2 marks

QUESTION 4 (9 marks)

a. In an autoimmune disease, the host's cells detect functioning (healthy) cells as non-self and trigger an immune response that attacks and destroys the host tissue. 1 mark

b. Experiment design:

- 2 groups of 20 mice with induced type 1 diabetes – one group: given the drug (IV) (experimental group), one group: given no drug but given a placebo treatment (control group).
- Keep all other variables constant for both groups (CV) – for example, type and amount of food, amount of water, temperature, type of enclosure.
  (Need to mention at least 2 controlled variables).
- Observe the mice daily and test for onset of diabetes symptoms (for example, measure blood glucose levels). (DV)
- Repeat the same experiment many times to check consistency of results.

All 4 points mentioned (3 marks), 3 points mentioned (2 marks), 2 points mentioned (1 mark)

Results:

Mice given the drug show less symptoms (lower blood glucose level) than those not given the drug. (1)

4 marks

c. 1 mark for each of the below:

Tool	**Use in Recombinant DNA Technology**
Restriction Enzyme	Enzyme found in bacteria that cuts DNA at a specific recognition sequence.
PCR	Makes many genetically identical copies (amplifies) of segment of DNA from a small sample.
Gel Electrophoresis	Separates DNA fragments based on negative charge of the DNA and size of fragments (smaller mover faster and further).
Plasmids	Small circular DNA molecules used to transfer desired genes into host cells (vectors).

4 marks

QUESTION 5 (14 marks)

a. A non-cellular or cellular infectious agent that causes disease in a host. 1 mark

b. **i.** Any physical barrier, for example: intact skin, mucus membrane, nasal hairs and explain how it works. (1)

ii. Name a plant chemical that will kill or prevent growth of microbes, for example: antibiotics in leaves, toxins in plant fluids, resins (not bitter tasting). (1)

2 marks

c. Self – cells have MHC surface markers unique to host.
Non-self – cells have foreign/antigenic markers on their surface, not those of host.

1 mark

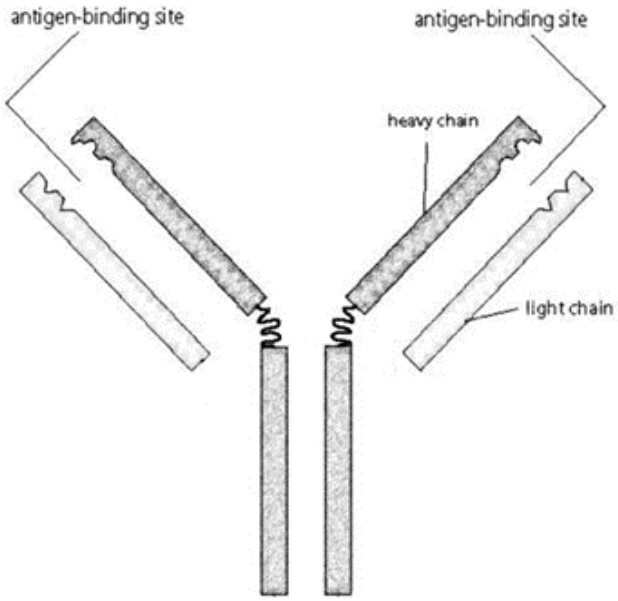
d. **i.** Neurotransmitter. 1 mark

ii. Vesicles containing neurotransmitter fuse with membrane of pre-synaptic neuron (1) releasing neurotransmitter by exocytosis. (1) 2 marks

iii. Neurotransmitter diffuses across the synaptic gap to the post synaptic neuron.

1 mark

iv. Drawing and labels: light & heavy chains (1), specific shaped antigen-binding site (1). 2 marks



e. Macrophages (that engulfed and destroyed the bacteria) present some of the antigen to the T helper cells. (1)

T helper cells release cytokines that activate specific B lymphocytes. (1)

B lymphocytes divide/clone and differentiate into plasma B cells which make specific antibodies to the antigen (1) AND into memory B cells, which remain in the lymph nodes for use for faster response if reinfection with same antigen occurs/long term immunity. (1)

4 marks

QUESTION 6 (5 marks)

a. An antibiotic is a chemical that is used to kill bacteria and the eye infections were caused by bacteria. 1 mark

b. Process: Natural selection. (1)

Variation of resistance to the antibiotic K existed in the original bacterial population. (1)

With the introduction of the antibiotic K, the resistant bacteria survived and reproduced passing on the genes for resistance to offspring. Those bacteria not resistant died. (1)

Over time, most of the bacteria in the population were resistant to antibiotic K and so the antibiotic K was no longer effective against the bacterial strain. (1)

4 marks

QUESTION 7 (6 marks)

a. Divergent evolution. 1 mark

b. Samples of DNA are extracted from the cells of each species. The DNA samples are then heated to a high temperature to separate the DNA into single-stranded DNA. The two samples are mixed and allowed to cool to form double-stranded hybrid DNA. (1) These newly bonded strands of hybrid DNA are then heated to separate them. The higher the temperature needed, the greater the percentage of complementary base pairs and therefore the greater the similarity between the two species. (1)

2 marks

c. One of: The presence of homologous structures OR any comparative molecular homology evidence – for example, mtDNA or amino acid sequencing. 1 mark

d. The tiger and cheetah are more closely related as they share a more recent common ancestor. (1)

There has been less time for mutations and natural selection to occur for them to become more different compared to the cougar. (1)

2 marks

QUESTION 8 (5 marks)

a. Any one of:

Saves energy OR saves resources OR prevents accumulation of products 1 mark

b. The repressor protein determines whether the genes of the *lac* operon will be expressed or not by controlling whether transcription will or will not occur. (1)

Then a brief explanation:

When the repressor protein attaches to the operator region of the operon, mRNA is prevented from attaching to the promoter region, therefore transcription of the genes of the operon is prevented (genes are repressed/turned off)

OR

When the repressor protein is changed in shape, it cannot bind to the operator and so the mRNA can bind to the promoter region allowing transcription to begin (genes are expressed/turned on) (1)

2 marks

c. The master gene BPM4 regulates the expression of other genes and therefore the levels of BPM4 protein produced which determine the size and shape of the jaws(1) Higher levels of BPM4 result in a short robust jaw while lower levels produce a thin elongated jaw. (1)

2 marks

QUESTION 9 (8 marks)

a. If members of each group (6 & 7) can interbreed under natural conditions and produce fertile offspring, they belong to the same species. 1 mark

b. The original (ancestral) population of parrots became separated into several geographically separated populations with no gene flow-for example, by the desert. (1)

Due to different environmental selection pressures acting on the separated populations, they accumulated genetic differences due to mutations and natural selection. (1)

Over time the populations became so genetically different that they could no longer interbreed to produce fertile offspring and had evolved into different species. (1)

3 marks

c. Gene flow refers to the movement of alleles into or out of populations due to migration and reproduction. 1 mark

d. If the size of the population is severely reduced by some chance event (founder effect or bottleneck), the resulting group may have a gene pool with allele frequencies very different from the original population. (1)

This random change in allele frequencies may result in the elimination of a particular allele and this impacts more on smaller populations. (1)

2 marks

e. Genetic drift impacts on the gene pool by reducing variation in the population and could lead to extinction. 1 mark

QUESTION 10 (5 marks)

a. Any one of:

Absence of significant brow ridge

OR

Flatter/more vertical face

OR

Less protruding narrow jaw rather than deep protruding jaw

OR

Relatively even teeth

OR

Any other structural feature of the skull for *Homo sapiens*. 1 mark

b. Carbon-14 isotopic dating is used for dating fossils up to 60,000 years old.(1)
As this fossil was estimated to be 210,000 years old, there would be inadequate carbon-14 remaining in it to give a reliable and accurate age. (1)

2 marks

d. The current theory for the dispersal of *Homo sapiens* is that 150,00 years ago *Homo sapiens* left Africa and spread across Europe and into Asia. This theory is based on the fact that any fossil remains from these areas are more recent than *Homo sapiens* fossils found in Africa. (1)

The finding of this fossil in Greece leads to having to rethink the current theory as perhaps *Homo sapiens* left Africa earlier or evolution of *Homo sapiens* occurred in several places in the world, not just in Africa as previously thought. (1)

2 marks

END OF SUGGESTED SOLUTIONS