



TSFX TRIAL EXAMINATION 2020

VCE BIOLOGY – UNIT 3 & 4

SOLUTIONS

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SECTION A – MULTIPLE CHOICE QUESTIONS

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

SECTION B – SHORT ANSWER QUESTIONS

QUESTION 1 (11 marks)

- a. i. Salt ions of sodium carbonate and sodium chloride pass through the protein channels (1 mark).
- Even though they are small, they are polar/charged and water soluble/hydrophilic, so they cannot pass through the phospholipid bilayer (1 mark).
- ii. No, carbon dioxide molecules are small enough to pass through the small pores in the phospholipid bilayer.

OR

Through the spaces between the molecules in the phospholipid bilayer (1 mark).

- b. Hypersaline: Water would tend to move continuously out of the cells by osmosis resulting in dehydration and subsequent breakdown of cell functioning (1 mark).
- Hyperalkaline: With a pH well above 7, the enzymes in the cells may be denatured, resulting in a decrease or cessation of cell functions (1 mark).
- c. i. Light independent stage (1 mark).
- ii. ATP (1 mark) and NADPH (1 mark).

AND

These coenzymes come from the light dependent stage (1 mark).

- iii. Due to algal blooms, reduced light intensity would be another limiting factor (1 mark).

Resulting in reduced splitting of water molecules into hydrogen ions and oxygen (1 mark).

QUESTION 2 (10 marks)

- a. i. In the Genetic code table, 'stop' means no amino acid will be added to the polypeptide (1 mark).
- ii. These three boxes should be left blank as the codons do not code for any amino acid (1 mark).
- b. i. Group of 3 letters in the DNA of the gene is called a triplet (1 mark).
- ii. Gly, Glu, Ser, Pro, Ser, Gly, Met (1 mark).
- iii. As there are two different codons that code for the same amino acid, Gly, this illustrates that the Genetic code is 'redundant' or 'degenerate' (1 mark).
- iv. CAACTTTCAGGAAGGCCTCA (1 mark).

- c. i. Introns are removed (1 mark)

AND

They are non-coding segments for this specific gene; that is, they do not code for any amino acids (1 mark).

- ii. RNA polymerase is an enzyme essential for transcription (1 mark)

AND

As it moves along the DNA strand, RNA polymerase aligns the mRNA codon with the complementary tRNA anticodon (1 mark).

QUESTION 3 (7 marks)

- a. i. Structure W is an operon (1 mark)

- ii. Gene lac 1 is a regulator gene that codes for a repressor protein which will inhibit transcription if produced (1 mark).

AND

Lac genes are structural genes that code for production of lactase enzymes (1 mark).

- b. Gene expression OR Protein synthesis (1 mark).

- c. i. In step Y, the lac repressor protein binds to the operator region, preventing RNA polymerase from moving along from the promoter region of the gene and starting transcription (1 mark).

- ii. When no lactose is present in the cell, the structural genes will not be expressed to produce lactase enzyme (1 mark).

AND

This will prevent the cell wasting resources and energy by making more lactase enzyme when it is not needed (1 mark).

QUESTION 4 (5 marks)

- a. Steroid OR Sex hormone OR Testosterone/progesterone/oestrogen (1 mark).

It binds to a receptor in the cytosol, so must be lipophilic, as it can pass through the phospholipid bilayer (1 mark).

- b. Signal transduction does occur in this cell as the signal is transferred from the receptor, via a receptor/signal complex into the nucleus, where the response occurs (1 mark),

- c. The response is initially within the nucleus when the gene(s) is activated (1 mark).
A protein, such as an enzyme, will be produced (1 mark).

QUESTION 5 (12 marks)

- a. The foreign invader can be recognised as 'non-self' either from antigen markers expressed on the surface of cells or as molecules freely floating in body fluids, such as toxins (1 mark).
- b. i. Thinner, delicate skin is more likely to be broken, allowing entry of microbes (1 mark).
- ii. A shrinking thymus gland results in reduced maturation of T lymphocytes, so there will be fewer available to act in the immune system (1 mark).
- c. i. IgG antibodies from the mother's blood pass across the placenta into the foetus's blood (1 mark).
- ii. In the newborn in the first 2 months, the mother's IgG antibodies in the foetal blood are breaking down and the baby has not yet been exposed to the whooping cough antigen to begin manufacturing its own antibodies (1 mark).
- iii. The baby is vaccinated at 2, 4 and 6 months resulting in production of its own whooping cough antibodies in increasing amounts at each vaccination, as it had also produced B memory cells at each vaccination (1 mark).
- d. i. Innate/ Passive/Natural (1 mark).
- As antibodies are passed on from the mother and not made by the foetus itself (1 mark).
- ii. Adaptive/Active/ Induced (1 mark).
- As vaccination with the whooping cough antigen will result in the baby's body producing both antibodies and B memory cells against whooping cough (1 mark)
- e. Herd immunity means the greater percentage of individuals vaccinated, preferably 95% or higher, then the lower the chance of the disease-causing pathogen spreading (1 mark).
- It is important for protection of individuals who cannot be vaccinated against the pathogen (such as very young children, old people, immune deficient people), so they are not exposed to the pathogen and do not develop the disease (1 mark).

QUESTION 6 (7 marks)

- a. Endemic diseases would be those localised in Australia; and no pandemic diseases, as in the early 1800s there was no regular global/international travel to bring diseases from other countries (1 mark).
- b. i. Koalas were hunted and killed at random and in large numbers for their skins, resulting in a huge decrease in population numbers with markedly reduced genetic diversity. Even when the numbers started to increase again once they were protected, the genetic diversity in the population remained low (1 mark).

- ii. The genetic diversity in the gene pool of the koalas was decreased markedly, making the species susceptible to becoming endangered or extinct, if there was a change in the environment (1 mark).
- c. Not natural selection, as it does not involve survival and reproduction of the better suited individuals, just the ones that were lucky enough to be in a tree that was not burnt (1 mark).

AND

Koalas cannot move quickly away from bushfires and are hurt or killed at random (1 mark).

- d. i. Gene flow (1 mark).
- ii. Reduced genetic diversity in the southern populations compared to northern populations, so concern that no or few individuals will carry genes for resistance to infectious diseases, such as chlamydia, and may all be wiped out (1 mark).

QUESTION 7 (7 marks)

- a. Histone IV is the most highly conserved (1 mark).

AND

It has the lowest rate of genetic divergence, and therefore the lowest rate of accumulated mutations of the three proteins shown on the graph (1 mark).

- b. i. Electron transport chain (1 mark).
- ii. It is important that the genes for cytochrome c are highly conserved, so they function to produce the cytochrome enzymes needed to catalyse the electron transport chain as it is the major energy-producing step in cellular aerobic respiration (1 mark).
- c. i. The genome is the sum total of an organism's DNA measured by the number of base pairs contained in a haploid set of chromosomes (1 mark).
- ii. Ribosomal DNA is a structural component that makes up the ribosomes, the sites of protein synthesis (1 mark).

Transfer DNA is a functional molecule that transports an amino acid to the ribosome when its anticodon binds to a complementary mRNA codon during translation (1 mark).

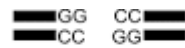
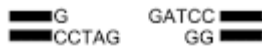
QUESTION 8 (11 marks)

a. i. DNA (1 mark).

ii. Recognition site (1 mark).

iii. Sticky ends (1 mark)

Blunt ends (1 mark)



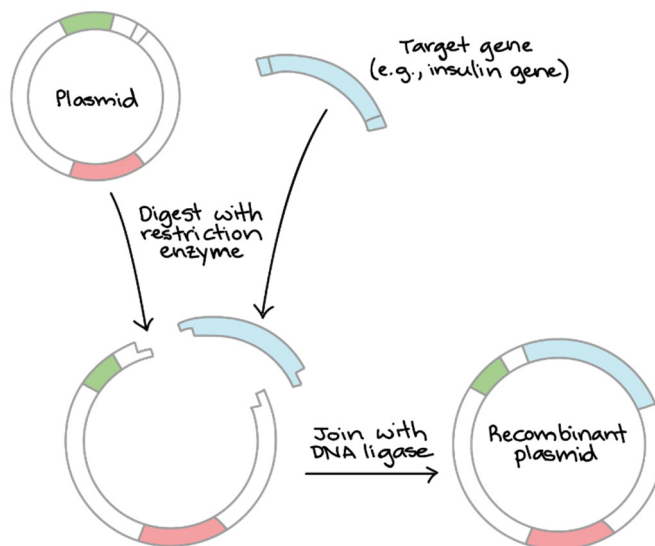
b. i. 'Cloning a gene' means making many genetically identical copies of the gene from one original gene (1 mark).

ii. Vector = Plasmid

Cut plasmid

Gene of interest

Recombinant Plasmid (1 mark)



Using ligase enzyme (1 mark) to join cut plasmid and gene of interest.
Drawing (1 mark).

c. i. Transgenic organisms are those that contain one or more genes that have been added to their genetic material by genetic engineering techniques. However, genes can also be left in the genetic material and switched off or silenced. So not all genetically modified organisms (GMOs) are transgenic (TGOs) (1 mark).

ii. One similarity between genetic engineering and selective breeding is that they both result in organisms with more desirable traits for human purposes (1 mark)

iii. Both result in a reduction in the genetic diversity in the gene pool of the species, which could result in a decrease in the numbers of organisms if there was a change in the environment; or could result in species extinction (1 mark).

QUESTION 9 (4 marks)

- a. The footprint is evidence of an organism that once lived on the Earth's surface (1 mark).
- b. After death of the bird and some of the soft tissue being eaten by scavengers or decomposed, the bones must have been rapidly buried by sediment, thereby eliminating oxygen and further decomposition (1 mark).

More layers of sediment would have been laid sequentially and, with pressure and dehydration, sedimentary rock with the bones embedded in it would have formed the fossil (1 mark).

- c. Radiocarbon dating is only useful for fossils up to 50,000 years old. After that, there is not enough radioisotope of carbon 14 left, so a radioisotope with a much longer half-life must be used, such as calcium (1 mark).

QUESTION 10 (6 marks)

- a. All the fossils at the Java site were humans or human ancestors and therefore classified in the genus *Homo* and called the hominins (1 mark).

AND

They were not called the hominoids as that group includes both the hominins and the great apes (1 mark).

- b. Very prominent brow ridges (1 mark).

AND

Protruding face (1 mark).

OR

Any other acceptable differences (1 mark).

- c.
 - i. There were several periods of interbreeding which would allow exchange of genetic material due to sexual reproduction (1 mark).
 - ii. Denisovans, Neanderthals and *Homo sapiens* cannot be classified as separate species, as they were able to interbreed under natural conditions to produce fertile viable offspring (1 mark).

END OF SUGGESTED SOLUTIONS