Neap

Trial Examination 2022

Suggested Solutions

QCE Biology Units 3&4

Paper 1

SECTION 1 – MULTIPLE CHOICE QUESTIONS

	A	B	C	D
1.	○	○	●	○
2.	○	○	○	●
3.	○	○	○	●
4.	○	●	○	○
5.	●	○	○	○
6.	●	○	○	○
7.	○	○	○	●
8.	●	○	○	○
9.	●	○	○	○
10.	○	○	○	●
11.	○	●	○	○
12.	●	○	○	○
13.	●	○	○	○
14.	○	○	●	○
15.	●	○	○	○

	A	B	C	D
16.	●	○	○	○
17.	○	●	○	○
18.	●	○	○	○
19.	○	○	●	○
20.	○	○	●	○
21.	○	●	○	○
22.	○	○	●	○
23.	○	○	○	●
24.	●	○	○	○
25.	○	○	●	○

QUESTION 1 C

C is correct. An anticodon is found on a transfer RNA (tRNA) molecule and binds to the codon; thus, it must be complementary to the codon.

A is incorrect. If the codon and anticodon had the same sequence, the hydrogen bonds required to hold the bases together would not form.

B is incorrect. An anticodon is complementary to the codon, which is made from RNA. Therefore, the anticodon contains uracil, not thymine.

D is incorrect. Anticodons are found on tRNA molecules.

QUESTION 2 D

D is correct. Both insertion and deletion involve changing the number of bases found in an mRNA strand. Therefore, they would change the reading frame in the translation process and affect the codon sequence after the error, resulting in a frameshift mutation.

A and **C** are incorrect. Both insertion and deletion can affect the sequence.

B is incorrect. Substitution will not change the number of bases and, therefore, results in what is known as a point mutation, which only affects one amino acid.

QUESTION 3 D

D is correct. This is the only factor that will result in a decrease in population size. For example, a natural disaster that separates individuals in a population reduces genetic variability, which may lead to a decrease in population size.

A, **B** and **C** are incorrect. These factors will result in an increase in population size.

QUESTION 4 B

B is correct. Transcription is the first stage of protein synthesis, where one strand of DNA is used to produce a strand of messenger RNA (mRNA).

A is incorrect. An amino acid chain is a protein produced in the translation stage.

C and **D** are incorrect. Messenger DNA and master RNA are not real forms of DNA.

QUESTION 5 A

A is correct. In ecology, the term population refers to the number of individuals in a single species in an ecosystem.

B is incorrect. The term community refers to organisms of different species living together in the same environment.

C is incorrect. The term ecosystem refers to the location in which organisms live and the interactions between the environment and the organisms.

D is incorrect. The term habitat refers to the location in which organisms live, including the organisms' surroundings.

QUESTION 6 A

A is correct. Meiosis produces sperm or egg cells, which are called gametes.

B, **C** and **D** incorrect. These are somatic cells produced during mitosis, not meiosis.

QUESTION 7 D

D is correct. In a cross of heterozygous parents (for example, Tt × Tt), the genotypes of the offspring can be TT, Tt or tt in the ratio of 1 : 2 : 1. Tt is the heterozygous genotype and will, therefore, make up half of the possibilities.

A is incorrect. One of four offspring, on average, will be homozygous recessive.

B is incorrect. Monohybrid crosses could involve situations where the alleles present are co-dominant or incompletely dominant.

C is incorrect. The offspring of an F1 cross (the F2 generation) are not all homozygous, as shown by the ratio above.

QUESTION 8 A

A is correct. Three bases make up a codon and only one codon codes for an amino acid.

B is incorrect. Three amino acids would require nine bases in a sequence (three codons).

C is incorrect. A protein is made up of many amino acids joined together.

D is incorrect. A ribosome is where proteins are made.

QUESTION 9 A

A is correct. Gel electrophoresis uses electricity to separate particles based on charge and mass.

B is incorrect. DNA fragments are separated, not joined, by gel electrophoresis.

C is incorrect. Copies of DNA fragments are made using the polymerase chain reaction (PCR) technique.

D is incorrect. There are other uses for gel electrophoresis, such as paternity testing.

QUESTION 10 D

D is correct and **A** is incorrect. Gene flow relates to the migration of alleles from one population to another, which introduces similarities between the groups involved.

B and **C** are incorrect. Gene flow is a microevolutionary process where alleles are transferred from one population to another population through the migration of individuals.

QUESTION 11 B

B is correct. Diversity refers to the number of different types of organisms (species) living together.

A is incorrect. This option only refers to the total number of organisms, not the different types.

C and **D** are incorrect. The amount of land the ecosystem covers and the interactions between producers are not significant to ecosystem diversity as ecosystems can vary in both size and type.

QUESTION 12 A

A is correct. A polygenic trait has phenotypes that have many variations that change continuously.

B is incorrect. Polygenic traits have more than two distinct phenotypes.

C is incorrect. This option refers to epigenetics.

D is incorrect. This option refers to a type of phenotypic selection process.

QUESTION 13 A

A is correct. As older fossils come from organisms that died and were buried in sediment before the fossils of newer organisms, they will be found deeper in the sediment.

B is incorrect. This option refers to newer fossils, as they come from organisms that have died more recently.

C and **D** are incorrect. Fossil age does not necessarily relate to the number of fossils that will be found in an area or the condition in which the fossils are found.

QUESTION 14 C

C is correct. Biomass refers specifically to the dry mass of organisms, which is the mass of a biological sample after the water content has been removed, usually by placing the sample in an oven.

A, **B** and **D** are incorrect. These options do not refer to dry mass.

QUESTION 15 A

A is correct. Hybrid inviability refers to two different species producing offspring together that do not survive to reproduce or are sterile.

B and **C** are incorrect. These options refer to geographic isolation mechanisms.

D is incorrect. This option refers to how speciation can occur due to geographic isolation mechanisms.

QUESTION 16 A

A is correct. Only the DNA in eukaryotic organisms can form chromosomes. Histones are proteins that DNA winds around to form chromatin within eukaryotic cells.

B, **C** and **D** are incorrect. These options are all prokaryotic organisms.

QUESTION 17 B

B is correct. Due to the presence of different transcription factors and the ability to rearrange exons, the same DNA can produce different proteins in different cells.

A is incorrect. Mutation is a random process that can change a DNA sequence; therefore, cells are not said to be mutated.

C and **D** are incorrect. The cells contain the same DNA; thus, the genome is the same if the DNA is the same.

QUESTION 18 A

A is correct and **B** is incorrect. Bones in mammal forelimbs can have similar structures and, therefore, support the theory of evolution from a common ancestor.

C and **D** are incorrect. The bones in mammal forelimbs can have many different functions. Some of these functions may be similar to structures possessed by other organisms, including some invertebrates.

QUESTION 19 C

C is correct. During the process of protein formation and before translation, DNA can form shorter and even different mRNA strands due to the removal of sections of DNA called introns and the rearrangement of sections called exons.

A is incorrect. The introns are removed from the final mRNA strand.

B is incorrect. A gene is only a section of DNA that is transcribed. The bases before the gene are transcribed if they are found in exons.

D is incorrect. The removal of the introns happens before mRNA is translated to a protein.

QUESTION 20 C

C is correct. Both extremes of the population surviving to reproduce would be an example of disruptive selection.

A is incorrect. Selection is occurring, so not all organisms will survive to breed.

B is incorrect. While humans may influence the survival of certain organisms, selective pressures can also occur naturally.

D is incorrect. Directional selection, not disruptive selection, produces offspring that favour the breeding of only one phenotype over time.

QUESTION 21 B

B is correct. DNA ligase is the enzyme responsible for joining DNA fragments together to make recombinant DNA.

A is incorrect. Restriction enzymes cleave DNA at specific sites along the strand.

C is incorrect. DNA polymerases are enzymes that create DNA molecules by joining new bases to DNA strands during the DNA replication process.

D is incorrect. DNA helicase is the enzyme responsible for unwinding the DNA strands during the DNA replication process.

QUESTION 22 C

C is correct and **B** is incorrect. Viability and fecundity refer to the ability to survive and reproduce, not just adapt.

A is incorrect. Ecology is the broader study of organisms and how they interact with their environment.

D is incorrect. Species interdependence refers to how different species rely on each other for their habitat needs, such as air, space, shelter, food or water.

QUESTION 23 D

D is correct. The leading strand is the DNA strand that is replicated in the 3′ – 5′ direction during DNA replication. Therefore, it is replicated towards the replication fork.

A is incorrect. The lagging strand is the other DNA strand involved in DNA replication. It is replicated away from the replication fork in the 5′ – 3′ direction and involves Okazaki fragments.

B and **C** are incorrect. These options relate to the lagging strand, not the leading strand.

QUESTION 24 A

A is correct. Random mating produces random populations; thus, allele frequencies will not change dramatically over time.

B is incorrect. Genetic drift causes changes in allele frequencies in a population from generation to generation due to chance events.

C is incorrect. A mutation is a change in the genetics of an organism and, hence, can upset the genetic balance of a population.

D is incorrect. Selective pressures can change and, hence, natural selection can change.

QUESTION 25 C

C is correct. Helicase is an enzyme used during the DNA replication process.

A is incorrect. An anticodon is a 3-base section found on a tRNA molecule that binds to a codon during the translation process.

B is incorrect. The transcription of DNA produces mRNA. It is what codons are made from and attached to by the anticodons during translation.

D is incorrect. An amino acid is part of a protein that is being produced during translation.

SECTION 2

QUESTION 26 (3 marks)

For example:

Possibility 1 could occur if the population recovers and increases in size due to available resources or a lack of competition.

Possibility 2 could occur if the population fluctuates in size due to the availability of resources and competition.

Possibility 3 could occur if the population becomes extinct due to a lack of genetic diversity.

[3 marks]
1 mark for explaining possibility 1.
1 mark for explaining possibility 2.
1 mark for explaining possibility 3.
Note: Responses may vary.

QUESTION 27 (5 marks)

a) **Microevolution:** small changes of allele frequencies within a species or population over time

Macroevolution: large changes in allele frequencies over time, leading to speciation

[2 marks]
1 mark for defining microevolution.
1 mark for defining macroevolution.

b) **Process A:** This process is mutation, as there is no migration or chance event that occurs and only one change of a genotype is shown.

Process B: This process is gene flow, as only migration is responsible for the changes in the genotypes shown.

Process C: This process is genetic drift, as the changes to the genotypes occur due to a chance event only.

[3 marks]
1 mark for identifying and explaining process A.
1 mark for identifying and explaining process B.
1 mark for identifying and explaining process C.

QUESTION 28 (4 marks)

Step	Description
isolation of DNA	DNA is extracted from tissue samples by breaking up the cells, filtering off the debris and breaking down the cell membranes.
cutting of DNA	Specific restriction enzymes cut DNA into fragments of varying lengths at specific base sequences.
insertion and joining of DNA fragment	Special carriers or vectors transport DNA fragments into the target cell, and enzymes known as ligases join fragments to target DNA.
amplification of recombinant DNA	Microbial cultures produce millions of copies of recombined DNA.

[4 marks]
1 mark for providing each correct description.

QUESTION 29 (9 marks)

a)

Species indices	Month 3				Month 9			
Richness	4				**4**			
Abundance	A = 24	B = 38	C = 86	D = 92	A = 99	B = **38**	C = 43	D = **8**
Percentage frequency (%)	A = 10	B = 16	C = 36	D = 38	A = **53**	B = 20	C = **23**	D = 4
Simpson's Diversity Index (SDI)	0.69				**0.63**			

$$\text{SDI} = 1 - \left(\frac{\Sigma n(n-1)}{N(N-1)} \right)$$

$$= 1 - \left(\frac{(99 \times 98) + (38 \times 37) + (43 \times 42) + (8 \times 7)}{188 \times 187} \right)$$

$$= 1 - \frac{12\,970}{35\,156}$$

$$= 0.63$$

[5 marks]
1 mark for providing the correct richness.
1 mark for providing the correct abundances (two required).
1 mark for providing the correct percentage frequencies (%) (two required).
1 mark for calculating the SDI.
1 mark for providing the correct SDI.

b) **Population A:** parasitic worms

Population D: sharks

[1 mark]
1 mark for identifying the organisms in both populations.

c) *For example:*

A predator–prey interaction can be seen between the shark (population D) and the fish (population C), as the numbers of fish decrease when the numbers of sharks increase.

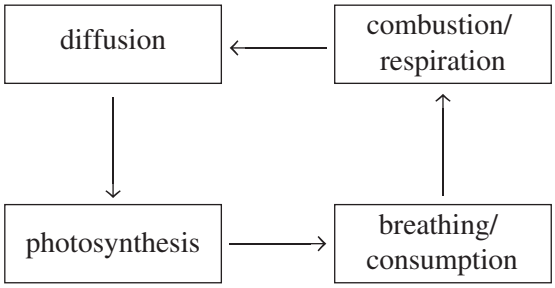
A parasite and host interaction can be seen between the parasitic worm (population A) and the fish (population C), as the numbers of parasitic worms increase when the numbers of fish increase.

An abiotic factor that could account for the differences seen in the abundances of the four populations is light, due to the month of year and the amount of algae (population B) growing.

[3 marks]
1 mark for describing one species interaction.
1 mark for describing a second species interaction.
1 mark for identifying one abiotic factor.
Note: Responses may include other appropriate species interactions and abiotic factors.

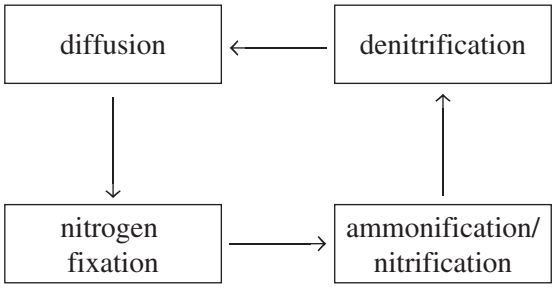
QUESTION 30 (4 marks)

Carbon cycle



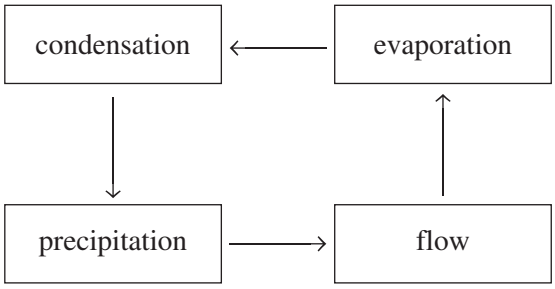
OR

Nitrogen cycle



OR

Water cycle



[4 marks]
1 mark for correctly completing each box in the flow chart.
Note: Each step of the cycle must be shown in the correct sequence, but can start and end in different boxes.