Neap

Trial Examination 2023

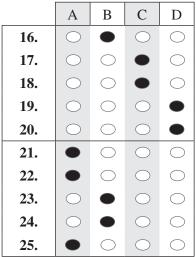# QCE Biology Units 3&4

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   A

A is correct and **D** is incorrect. When comparing r-selected species to K-selected species, r-selected species have more offspring, while K-selected species have a longer life span.

B is incorrect. K-selected species have a longer life span than r-selected species.

C is incorrect. r-selected species have more offspring.

QUESTION 2   D

D is correct and **C** is incorrect. Interspecific competition refers to different species being in competition for the same resources.

A and **B** are incorrect. Intraspecific refers to competition between individuals of the same species.

QUESTION 3   A

A is correct. A keystone species is a plant or animal that plays a unique and crucial role in the way an ecosystem functions.

B is incorrect. A dominant species usually refers to a species that has a higher abundance than other species in an ecosystem. While it may play a key role, not all dominant species are unique and crucial to their ecosystems.

C is incorrect. Not all native species are considered to be keystone species.

D is incorrect. Invasive species occur beyond their accepted normal distribution and threaten their ecosystems.

QUESTION 4   C

C is correct. Ultraviolet (UV) light can be absorbed by the DNA bases and lead to a change in the bonds between the bases; this is known as a mutation.

A and **B** are incorrect. Transcription and translation are processes involved in protein synthesis.

D is incorrect. Replication can refer to processes in which a copy of DNA or a cell is made.

QUESTION 5   B

B is correct and **A** is incorrect. Bacteria are prokaryotes, so they have circular DNA and no nuclear membrane. Eukaryotes can have unbound circular DNA in their mitochondria and chloroplasts but not in the nucleus.

C and **D** are incorrect. Bacterial DNA is not linear.

QUESTION 6   A

A is correct.

28% cytosine + 28% guanine = 56% C–G pairs

100% − 56% = 44% A–T pairs

$$\frac{44\%}{2} = 22\%\ \text{adenine} + 22\%\ \text{thymine}$$

28% cytosine + 28% guanine + 22% adenine + 22% thymine = 100%

B is incorrect. This option suggests that cytosine bases pair with thymine bases in identical percentages, when in fact cytosine bases pair with guanine bases.

C is incorrect. This is the total percentage of A–T pairs.

D is incorrect. This is the total percentage of C–G pairs.

QUESTION 7   B

B is correct. Density-dependent factors include disease, competition and predation, which have a correlation to the population size.

A, **C** and **D** are incorrect. Rainfall, cyclones and pollutants are density-independent, as the impact that they have on a population is independent of the population density.

QUESTION 8   C

C is correct. The new population number needs to consider the changes from the beginning of the year.
If a change in population size = (birth + immigration) − (death + emigration):

$$\text{new population} = 1500 \text{ (original)} + (950 + 450) - (700 + 200)$$
$$= 1500 + 1400 - 900$$
$$= 2000$$

Therefore, the population at the end of the year was 2000.

A is incorrect. This option does not consider the original 1500 in the population.

B is incorrect. This option swaps the births and immigration figures with the deaths and emigration figures.

D is incorrect. This option adds the emigration figure to the population instead of removing it.

QUESTION 9   A

A is correct and **B** is incorrect. Productivity refers to the flow of energy through the trophic levels. Phytoplankton must have higher productivity to provide energy for the next trophic level.

C is incorrect. Phytoplankton need a larger population size to provide energy to the next trophic level. A smaller biomass does not necessarily indicate a smaller population size.

D is incorrect. Energy loss decreases at each trophic level.

QUESTION 10   B

B is correct. If two populations of organisms can reproduce (in nature) and successfully interbreed to produce fertile offspring, despite a physical barrier, they are considered the same species.

A is incorrect. Two different species could not interbreed to produce fertile offspring.

C is incorrect. An indicator species can be used as a measure of environmental conditions.

D is incorrect. A flagship species is a species that can be used as a symbol for an environmental cause.

QUESTION 11   A

A is correct. Species L has a higher population size to provide energy to the predator (species M).

B is incorrect. If the species were in competition, the population of species L would increase and the population of species M would decrease.

C is incorrect. Symbiosis would see both species L and M showing a similar growth pattern, with both either increasing together or staying stable.

D is incorrect. Disease would lead to a decline in the populations of both species L and M, with the possibility of both reaching 0.

QUESTION 12   A

A is correct. The map shows that the distribution of the squirrel glider is located on the eastern coastline of Australia.

B is incorrect. Abundance numbers are not evident on the map.

C is incorrect. Vegetation data is not provided on the map and cannot be linked to distribution.

D is incorrect. Altitude data is not provided on the map and cannot be linked to distribution or abundance.

QUESTION 13   D

DNA replication involves one DNA strand unzipping due to helicase and then new nucleotides moving to this copy of the strand. DNA polymerase uses each original strand to produce a copy of the DNA molecules, adding complementary nucleotides to the exposed bases.

QUESTION 14   D

Nitrogen in the air undergoes nitrogen fixation to become ammonium. The ammonium then undergoes nitrification to produce nitrites and nitrates. Nitrogen is returned to the atmosphere via denitrification. Decomposers are involved in ammonification to produce ammonium.

QUESTION 15   D

D is correct. After the DNA is isolated and cut by a restriction enzyme, it is inserted into the plasmid, which has been extracted from a bacterial cell.

A and **B** are incorrect. The bacterial plasmid is the vector that has the DNA inserted into it.

C is incorrect. Restriction enzymes are used to isolate the DNA.

QUESTION 16   B

B is correct. The resources are divided between the heron and egret to avoid competition. This is evident where the diet of herons consists of higher proportions of foods such as small reptiles and rats, while for the egrets these same food sources are low. In comparison, the egret's diet has higher proportions of fish, frogs, insects and molluscs, which are in lower proportions in the heron's diet.

A is incorrect. Competitive exclusion refers to when two species that compete for the same resource cannot coexist in the same niche. This is not the case in this scenario.

C is incorrect. These two organisms are not the same species, so intraspecific competition is not possible.

D is incorrect. The fundamental niche refers to the environmental conditions in which the species live and these conditions are not solely specific to food sources.

QUESTION 17   C

mRNA leaves the nucleus and moves to the ribosome. The ribosome reads the codons in mRNA and aligns with the anticodons on tRNA, which carries the amino acids. The amino acids join together via peptide bonds to form a polypeptide.

QUESTION 18   C

C is correct. The photosynthetic organisms (beginning with those considered anoxygenic) appeared during the Archean eon, which was approximately 2.5–4 billion years ago.

A is incorrect. The Phanerozoic eon ranges from 0.5 billion years ago to the present day.

B is incorrect. The Proterozoic eon ranged from 0.5 to 2.5 billion years ago.

D is incorrect. The Hadean eon ranged from 4 to 4.6 billion years ago.

QUESTION 19   D

D is correct. Carrying capacity is defined as the size of a population that can be supported indefinitely by the available resources and services of an ecosystem.

A, **B** and **C** are incorrect. These options do not accurately describe carrying capacity.

QUESTION 20   D

D is correct. Stabilising selection favours the intermediate phenotype over the extremes.

A is incorrect. Artificial selection refers to the selection of organisms with desirable characteristics for breeding.

B is incorrect. Disruptive selection favours the two extreme phenotypes at the expense of the intermediate phenotype.

C is incorrect. Directional selection favours one extreme trait at the cost of the other phenotypic extreme, leading to the phenotypic distribution shifting in that particular direction.

QUESTION 21   A

A is correct. *Atopodontus adriaensi* shares a more recent common ancestor with *Euchilichthys sensu*, as it has only diverged once, whereas there are two speciation events at which it shared a common ancestor with *Chiloglanis sensu.*

B is incorrect. *Euchilichthys sensu* is more closely related to *Euchilichthys dybowskii* than it is to *Chiloglanis sensu*.

C is incorrect. These species would have evolved by divergent evolution, whereby the different species have a common ancestor but have accumulated differences over time.

D is incorrect. *Atopochilus savorgnani* and *Euchilichthys dybowskii* share a common ancestor.

QUESTION 22   A

A is correct. The two examples have developed similar features despite not sharing a recent common ancestor, indicating convergent evolution. Their niches require them to catch their prey by relying on structures such as hairs and tentacles.

B is incorrect. Divergent evolution often leads to the development of homologous structures that are anatomically similar. However, these two species have analogous structures, which have a similar function but are not derived from a common ancestor.

C is incorrect. Speciation occurs when reproductive isolating mechanisms prevent two organisms from interbreeding to produce fertile offspring. These two species have not been formed as an immediate response to an isolating mechanism.

D is incorrect. The differences in these two species have not occurred due to genetic drift, which refers to a change in the gene pool as a result of chance or a random event.

QUESTION 23   B

B is correct. As Anadara preferred warmer climates, larger numbers in the fossil record indicate warmer conditions.

A and **D** are incorrect. Variations in temperature or consistent temperatures would have resulted in similar numbers of Anadara and the diatoms.

C is incorrect. Cooler conditions would have favoured the diatoms and resulted in more diatoms in the recently deposited sediments.

QUESTION 24   B

B is correct.

$$N = \frac{M \times n}{m}$$
$$= \frac{20 \times 20}{8}$$
$$= 50 \text{ geckos}$$

A is incorrect. This option swaps the values for *n* and *m*.

C is incorrect. In this option, *n* is incorrectly calculated, with the 8 marked geckos from the second capture being added to the total number of geckos in the second capture.

D is incorrect. In this option, *n* is incorrectly calculated, with the original number of geckos captured being added to the total number of geckos in the second capture.

QUESTION 25   A

A is correct. Trout is more closely related to salmon than carp and paddlefish are. Carp is more closely related to trout than paddlefish is, putting paddlefish closer to shark in the phylogenetic tree.

B, C and **D** are incorrect. While shark and salmon are appropriately placed, the positions of the other species in relation to shark and salmon do not match the table.

SECTION 2

QUESTION 26   (8 marks)

a)
$$SDI = 1 - \left(\frac{\sum n(n-1)}{N(N-1)} \right)$$

$$= 1 - \left(\frac{(23 \times 22) + (20 \times 19) + (18 \times 17) + (20 \times 19) + (12 \times 11)}{93 \times 92} \right)$$

$$= 1 - \left(\frac{506 + 380 + 306 + 380 + 132}{8556} \right)$$

$$= 1 - \left(\frac{1704}{8556} \right)$$

$$= 1 - 0.1992$$

$$= 0.801$$

[2 marks]
1 mark for showing mathematical working.
1 mark for calculating the correct SDI.

b) The increase in species diversity from 0.563 to 0.801 occurred due to an increase in species richness, with the number of species present rising from four to five. After 10 years, the site became more even due to the increase in the population count for all species (except the weed species).

[4 marks]
1 mark for referring to the increase in species diversity.
1 mark for using data to show the increase in species diversity.
1 mark for stating that the site has become more even.
1 mark for linking the increase in population count to the population becoming more even.

c) *Any one of:*

- Species diversity considers the number and abundance of different species, while ecosystem diversity considers the different habitats, communities and ecological processes within an ecosystem.

- Species diversity only contains biotic components, while ecosystem diversity contains both abiotic and biotic components.

[2 marks]
1 mark for describing a feature of species diversity or ecosystem diversity.
1 mark for describing how the other type of diversity differs.

QUESTION 27 (5 marks)

The smaller size of population B means that there is a limited gene pool. This small gene pool would lead to reduced gene flow and increase the likelihood of genetic drift, which would cause a loss of genetic diversity over time. The small population size also leads to more inbreeding, which increases its susceptibility to Devil Facial Tumour Disease (DFTD).

Breeding healthy individuals in population B with healthy individuals in population A, which is greater in population size, will introduce new alleles *(favourable characteristic or absence of mutation)* into population B.

[5 marks]
1 mark for linking population size to gene pool size.
1 mark for explaining the impact of gene pool size on gene flow.
1 mark for explaining the impact of gene pool size on the likelihood of genetic drift.
1 mark for linking the small population size to inbreeding and risk of DFTD.
1 mark for explaining how a breeding program could introduce new alleles.

QUESTION 28 (3 marks)

Due to competition for the same resources, the two species cannot exist solely in the same range (or niche). In the presence of the Speckled Damsel, the Obscure Damsel narrows the range of its niche from between −25m and 0 m to between −20 m and −5 m below sea level (or, it decreases its range from a distance of 25 m to 15 m). In this narrower range, the Obscure Damsel increased in abundance, peaking at depths from −10 m to −15 m. It decreased in abundance at greater depths due to competition with the Speckled Damsel.

[3 marks]
1 mark for identifying that the two species competed for the same resources.
1 mark for identifying that the Obscure Damsel was more successful, with an increase in abundance at shallower depths.
1 mark for identifying that the Obscure Damsel's abundance was affected by competition at greater depths.

QUESTION 29 (2 marks)

For example:

The amplification success of PCR is greater for each food source compared to the success of the conventional method of culturing samples. This is particularly evident in milk, where the culturing samples had 5% success while PCR had 35% success (seven times better).

[2 marks]
1 mark for determining that PCR was more successful.
1 mark for justifying the response by referring to the data.

QUESTION 30   (7 marks)

a)   During prophase I in stage 1, crossing over increases genetic variability. Recombination occurs when non-sister chromatids of homologous chromosomes cross over, break and rejoin. This process produces a new combination of genes of each chromosome.

[4 marks]
1 mark for identifying the stage of meiosis shown in stage 1.
1 mark for describing the process of crossing over.
1 mark for describing the process of recombination.
1 mark for describing the impact of recombination.

b)   Chromatids are produced with different combinations of alleles, such as Ab/aB. Different combinations of chromosomes 1 and 2 are produced due to independent assortment. This will result in alleles for A and B in different combinations, as would be the case with alleles D and d.

[3 marks]
1 mark for identifying the different alleles.
1 mark for linking independent assortment to different chromosome combinations.
1 mark for explaining the production of different allele combinations.