

QCE Biology Units 3&4

Paper 1

SECTION 1 – MULTIPLE-CHOICE QUESTIONS

	A	B	C	D
1.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
2.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
5.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
6.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
7.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
8.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
9.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
12.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
13.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
14.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
15.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

	A	B	C	D
16.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
17.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
18.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
19.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20.	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
21.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
24.	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
25.	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

QUESTION 1 D

D is correct. A changing environment means that different phenotypes will be selected for and against. **A** is incorrect. Natural selection acts on the phenotypes of populations, not individuals in populations. **B** is incorrect. Variation exists in a population to begin with, and specific phenotypes are selected for and against. **C** is incorrect. This option relates to Lamarckian inheritance, not natural selection.

QUESTION 2 A

A is correct. Nucleotides are added to the 3' end of the non-template strand. **B** is incorrect. This option gives the 5' end of the non-template strand. **C** is incorrect. This option gives the 3' end of the template strand. **D** is incorrect. This option gives the 5' end of the template strand.

QUESTION 3 A

A is correct. This option shows the correct anticodons that are complementary to the codons. **B** and **D** are incorrect. These options show thymine and not uracil, which is incorrect for RNA. **C** is incorrect. The antisense strand is shown and this option assumes that the sense strand is shown.

QUESTION 4 D

D is correct. The interactions between the side groups of amino acids determine the tertiary structure of a protein. **A** is incorrect. Prosthetic groups are not a part of the tertiary structure of a protein. **B** is incorrect. Hydrogen bonds are important in the tertiary structure of proteins, but the interactions between the side groups of amino acids are more important. **C** is incorrect. The sequence of amino acids gives the primary structure of a protein, not the tertiary structure.

QUESTION 5 C

C is correct. Sperm carry either an X or Y chromosome and, in the case of the swamp wallaby, there are two Y chromosomes. **A**, **B** and **D** are incorrect. Sperm carry either X or Y chromosomes, not both.

QUESTION 6 D

D is correct. In a case where the allele only causes death at an advanced age, the individual can have already reproduced and passed on the allele to its offspring. **A** is incorrect. In different populations, recessive phenotypes may be more common than dominant phenotypes. **B** is incorrect. Only one parent is required to have one allele for the condition to produce children with the condition. **C** is incorrect. For dominant characteristics, a person that carries the allele expresses the trait, so they are not a carrier.

QUESTION 7 D

D is correct. In prokaryotes and eukaryotes, gene expression occurs in a ribosome. **A** is incorrect. Transcription occurs in the nucleus in eukaryotic cells only. **B** is incorrect. mRNA processing removes introns, not exons. **C** is incorrect. Translation occurs in the cytosol.

QUESTION 8 B

B is correct. Crossing over and recombination occur during meiosis, the process that produces gametes. **A** is incorrect. Mutations are only passed on if they occur in gametes. **C** is incorrect. Geographical variation is not the main cause of genetic variation. **D** is incorrect. Environmental effects may influence natural selection, but it is not the main cause of genetic variation in sexually reproducing species.

QUESTION 9 A

A is correct. Allopatric speciation is due to geographic isolation, which came about when the land bridges connecting the Australian mainland, Tasmania and New Guinea were destroyed by the rise in sea level.

B is incorrect. Although variation in the climate of physical environments can lead to speciation, the question asked specifically about allopatric speciation. **C** is incorrect. There are not enormous differences between organisms across the Australian mainland, Tasmania and New Guinea.

D is incorrect. Although frequent mutations may lead to speciation, this question specifically asked about allopatric speciation.

QUESTION 10 B

B is correct. In this option, an offspring was produced, so a zygote was formed and developed, but the offspring was stillborn. **A** is incorrect. This option describes a prezygotic mechanism to prevent orchid species from interbreeding. **C** is incorrect. This option describes a behaviour that prevents different species of bowerbirds from interbreeding. **D** is incorrect. The 'lock and key' fit of sexual organs prevents interbreeding between different species.

QUESTION 11 B

B is correct. There are more individuals from species 2 across the area of site I than any of the other species. **A**, **C** and **D** are incorrect. There are fewer individuals from these species across site I.

QUESTION 12 D

D is correct. There is only one individual at site I and two individuals at site II, and large-growing trees require large amounts of space between them. **A**, **B** and **C** are incorrect. Based on the scale of the sites, none of these species are likely to be large-growing trees.

QUESTION 13 C

C is correct. There are six individuals from species 3 at site I and eighteen individuals at site II.

A is incorrect. Site II and site I have a similar density of individuals from species 1. **B** is incorrect. There are thirty individuals from species 2 at site I, whereas at site II there are twelve individuals.

D is incorrect. Site II has twice the density of individuals from species 4 than does site I.

QUESTION 14 B

B is correct. Of the fish caught, 40% are two years old in the heavily fished population, whereas 40% of the catch are seven years old in the lightly fished population. **A** is incorrect. The lightly fished population has fish caught that are seven and eight years old, which are not the ages found in the fish caught in the heavily fished population. **C** is incorrect. The age proportion of fish over five years old is very different between the lightly and heavily fished populations. **D** is incorrect. The graphs give no indication that a higher percentage of fish are caught in either the lightly or heavily fished populations.

QUESTION 15 B

B is correct. Most fish caught from the heavily fished population are two years of age (40%). **A**, **C** and **D** are incorrect. The evidence from the graphs does not support any of these ages as being the most common age for the heavily fished group.

QUESTION 16 B

B is correct. Both species benefit from the symbiotic relationship. **A** is incorrect. In a parasite/host relationship, both species would not benefit from the relationship. **C** is incorrect. The bacteria are not acting as a decomposer. **D** is incorrect. Both species benefit from each other, rather than compete with each other.

QUESTION 17 B

B is correct. Blackbirds consume ladybugs, which consume aphids, which consume the rosebush. **A** is incorrect. The ladybug is a second-order consumer, as it consumes aphids, which have in turn consumed the rosebush. **C** is incorrect. Aphids consume the rosebush, making them first-order consumers. **D** is incorrect. Caterpillars consume both the rosebush and the grapevine, making them first-order consumers.

QUESTION 18 C

C is correct. The first-order carnivore must only consume another animal. **A** is incorrect. The aphid is not a carnivore. **B** is incorrect. The blackbird can be a first-order consumer when it consumes the grapevine and a first-order carnivore when it consumes the caterpillar. **D** is incorrect. The hawk is, at minimum, a second-order carnivore.

QUESTION 19 A

A is correct. To be a second-order carnivore, an organism must consume an animal that has also consumed an animal. **B** is incorrect. A carnivore that ate only caterpillars would only be a first-order carnivore. **C** is incorrect. If hawks were consumed, the new predator could be a second-order or third-order carnivore depending on if the blackbird has consumed caterpillars or only grapevines. **D** is incorrect. Any organism that consumed silver eyes would be a third-order carnivore.

QUESTION 20 C

C is correct. Moving from rosebush → aphid → ladybug → silver eye → hawk, the food web has five trophic levels. **A**, **B** and **D** are incorrect. None of these options give the correct number of trophic levels.

QUESTION 21 A

A is correct. *X* shows the tolerance range, where the organism can survive; *Y* shows the optimal range, where conditions are most suitable for the organism's survival. **B** is incorrect. Death is not shown on the graph. **C** is incorrect. *X* shows the tolerance range, not the optimal range (preferred niche); *Y* shows the optimal range, not the tolerance range. **D** is incorrect. *X* shows the tolerance range, not the optimal range (preferred niche); *Y* does not show physiological stress.

QUESTION 22 A

A is correct. There are three genes, each with two alleles, whose combined effects bring about the phenotypes in this species of wheat. **B** is incorrect. Although there are multiple genes, each gene has only two alleles. **C** is incorrect. Discontinuous variation would have phenotypes that are clearly distinct from one another rather than phenotypes along a continuum. **D** is incorrect. Codominance would result in some phenotypes being striped or spotted or patches of specific colours.

QUESTION 23 B

B is correct. All possible phenotypes can be produced from these parents, as shown in the Punnett square below.

	I^B	i
I^A	$I^A I^B$ blood type: AB	$I^A i$ blood type: A
i	$I^B i$ blood type: B	ii blood type: O

A is incorrect. This combination can only result in AB or A blood groups. **C** is incorrect. This combination can only result in A or B blood groups. **D** is incorrect. This combination can only result in A or B blood groups.

QUESTION 24 A

A is correct. If the habitat had dramatically changed, then selection pressures acting on the crocodile would have changed, leading to different characteristics. **B** is incorrect. Adaptions are selected for and against. **C** is incorrect. Natural selection acts on all individuals regardless of lifespan. **D** is incorrect. Crocodiles are not dinosaurs.

QUESTION 25 B

B is correct. The insect and frog have TGA, which corresponds with the common ancestor, and insects are positioned furthest from the vertebrates (the frog, mouse and cockatoo). **A**, **C** and **D** are incorrect. These phylogenetic trees do not accurately represent how the species are related.

SECTION 2

QUESTION 26 (5 marks)

Some varieties of bacteria are more resistant than others. [1 mark]

Antibiotic resistance can be inherited, with the alleles for resistance being passed from one cell to another by exchange of plasmids/conjugation. [1 mark]

As bacteria reproduce very rapidly and have a high mutation rate, evolution can occur rapidly. [1 mark]

Increased exposure to antibiotics is the environmental change that selects for resistant varieties; for example, in hospitals, animal feed or prescriptions that are inappropriate or not completed. [1 mark]

Bacteria without resistance die, and resistant bacteria survive and pass on genes to the next generation. This results in a change in the overall genetic makeup of the population. [1 mark]

QUESTION 27 (5 marks)

a) A population is a group of organisms of the same species living in a place at a time. [1 mark]

b) When water flea numbers are low, the numbers of trout decrease drastically; when high, the trout population increases. [1 mark]

c) Water fleas are not the only food source for trout. When their numbers are low, trout could feed on another type of food, such as algae or another insect. [1 mark]

d) second trophic level [1 mark]

e) *For example:*

Use a one-litre container to take many random samples of lake surface water.
Count the number of water fleas in each sample and average the results. [1 mark]

QUESTION 28 (6 marks)

a) *Any two of:*

- *P. gonocephala* is found over a greater range of temperatures than *P. montenegrina*.
- *P. gonocephala* is found between 16.5–23.0 °C, whereas *P. montenegrina* is not.
- *P. gonocephala* is found at a higher temperature than *P. montenegrina*.
- Both flatworms are found in temperatures between 6.5–16.5 °C.

[2 marks]

Note: Responses must clearly compare or contrast to be awarded marks.

b) *For example:*

A realised niche is one that an organism occupies. [1 mark]

The presence of a competitive species such as *P. gonocephala* narrows the niche for *P. montenegrina*. [1 mark]

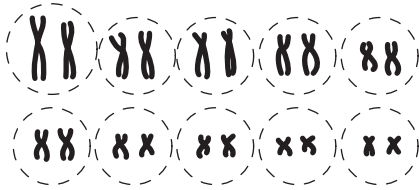
Note: Responses may also mention that a realised niche is limited by competition/competitive exclusion, or that the realised niche is colder/a smaller range in the presence of P. gonocephala.

c) No. [1 mark]

If there were a high degree of niche overlap, then one species would end up outcompeting the others. [1 mark]

QUESTION 29 (5 marks)

a) For example:



[1 mark]

Note: Accept responses that circle any pair of homologous chromosomes, as shown by dashed circles.

b) The two chromosomes would have the same gene sequence or same gene loci.

[1 mark]

Note: Same length, size, shape or centromere position are resultant from the gene sequence/loci and are not specific enough answers for this question.

c)

Species	Species A (<i>Neobatrachus fulvus</i>)	Species B (<i>Neobatrachus kunapalari</i>)
Karyotype		
Number of chromosomes	$2n = 22$	$4n = 48$

[2 marks]

d) Non-disjunction (non-separation) of chromosomes during meiosis could result in diploid gametes. Fusion of two diploid gametes would produce a tetraploid offspring.

[1 mark]

QUESTION 30 (4 marks)

a) The sample is from a north Atlantic population, and whale meat must be from the Southern Hemisphere to be sold in Japan.

[1 mark]

b) Denaturation: A DNA sample is denatured by heating, so it becomes single-stranded at approximately 94°C for two minutes.

[1 mark]

Attachment of primers: Short segments of single-stranded DNA known as primers are added. These primers pair with regions at either end of the DNA sample at approximately 55°C for two minutes.

[1 mark]

Extension: The polymerase enzyme uses the primers as a starting point and extends them so that two complete double strands are formed. Extra nucleotides are added at approximately 72°C.

[1 mark]