Neap

Trial Examination 2022

VCE Biology Unit 2

Written Examination

Suggested Solutions

SECTION A – MULTIPLE-CHOICE QUESTIONS

1	A	B	**C**	D
2	A	B	C	**D**
3	A	B	C	**D**
4	A	**B**	C	D
5	A	B	**C**	D
6	A	**B**	C	D
7	**A**	B	C	D
8	A	B	C	**D**
9	A	B	**C**	D
10	**A**	B	C	D
11	A	B	**C**	D
12	A	B	C	**D**
13	**A**	B	C	D

14	A	**B**	C	D
15	A	B	C	**D**
16	A	B	C	**D**
17	A	**B**	C	D
18	A	B	C	**D**
19	A	B	**C**	D
20	A	**B**	C	D
21	**A**	B	C	D
22	**A**	B	C	D
23	A	B	**C**	D
24	A	B	C	**D**
25	A	**B**	C	D

Question 1 C

C is correct. The genome consists of all the genes in an organism, including those on both the autosomes and sex chromosomes.

A is incorrect. The genome contains all the genes; the features they code for have no impact on their inclusion.

B is incorrect. This option only refers to the genes on the autosomes and omits the genes found on the sex chromosomes.

D is incorrect. The genome contains all the genes found on both paternal and maternal chromosomes, as they have the same gene sequence.

Question 2 D

D is correct. A pair of homologous chromosomes consists of two chromosomes with the same length and centromere position. Most importantly, however, the two chromosomes have the same gene loci or gene sequence.

A is incorrect. While homologous chromosomes have the same length, this alone is not their defining feature; there may be other chromosomes in the set that have the same length.

B is incorrect. While homologous chromosomes have the same centromere position, this alone is not their defining feature.

C is incorrect. While the gene loci of two homologous chromosomes are identical, the alleles of the genes are not.

Question 3 D

D is correct. Each chromosome consists of two strands of nucleotide units that make up the DNA molecule.

A is incorrect. The DNA molecule is a double chain of nucleotides in a single strand of the DNA helix.

B is incorrect. The subunits of DNA are nucleotides, not nitrogenous bases. Nitrogenous bases are one part of a nucleotide.

C is incorrect. The bases that pair up are complementary to each other, not identical.

Question 4 B

B is correct. Gametes, which that are haploid (n), are produced in the cells of the gonads, which are diploid ($2n$).

A is incorrect. Adult somatic cells are diploid ($2n$), not haploid (n).

C is incorrect. Meiosis occurs in the gonad cells (not in somatic cells) to produce gametes or sex cells (not zygotes).

D is incorrect. Gonad cells are diploid ($2n$) cells and are part of an organ in which meiosis occurs.

Question 5 C

C is correct. There are only 21 pairs of homologous chromosomes shown on the karyotype, as the sex chromosomes and the three copies of chromosome 18 are not homologous.

A is incorrect. Autosomes are non-sex chromosomes, so the X and Y chromosomes are not autosomes.

B is incorrect. The chromosomes numbered 1–22 are autosomes, not somatic chromosomes. Autosome is the term used for non-sex chromosomes.

D is incorrect. Chromosomes X and Y are sex chromosomes, not sex-linked. Sex-linked is a term used for genes on the sex chromosomes.

Question 6 B

B is correct. All the chromosomes are in homologous pairs, except for the sex chromosomes and autosome 18, which has one extra chromosome. Therefore, the correct notation for a karyotype of Edward's syndrome would be $2n + 1$.

A is incorrect. There is one extra chromosome, not one missing.

C is incorrect. There are two of each chromosome; therefore, the diploid number ($2n$) should be shown, not the haploid number (n).

D is incorrect. There are two of each chromosome; therefore the diploid number ($2n$) should be shown, not the haploid number (n). Additionally, there is one extra chromosome, not one missing.

Question 7 A

A is correct. The term aneuploidy refers to conditions that result from having an abnormal number of chromosomes in a haploid set due to extra or missing chromosomes. This is seen in the karyotype for Edward's syndrome, which has one extra copy of chromosome 18.

B is incorrect. The term monoploidy refers to a condition in which an individual contains only half the normal number of chromosomes.

C is incorrect. The term polyploidy refers to a condition in which there are more than two sets of chromosomes in an organism's somatic cells.

D is incorrect. The term triploidy refers to three sets of chromosomes in an organism's somatic cells (not three of one type of chromosome, which is called trisomy).

Question 8 D

D is correct. Non-disjunction in meiosis is the failure of homologous chromosomes (meiosis I) or sister chromosomes (meiosis II) to separate, resulting in gametes with one more or less of a chromosome in its haploid set. If a human gamete with an extra copy of chromosome 18 fuses with a normal gamete, the resulting offspring will have three copies of chromosome 18 and display symptoms of Edward's syndrome.

A is incorrect. Mutations/errors in the DNA of the gene may occur during DNA replication but would not result in the loss or gain of chromosomes.

B is incorrect. Errors in chromosome structure may occur during crossing-over and recombination as pieces of chromosomes are added, deleted, or exchanged incorrectly. However, the loss or gain of whole chromosomes would not occur.

C is incorrect. Although independent assortment occurs at the same time as non-disjunction, it does not cause the gain or loss of chromosomes.

Question 9 C

C is correct. Epigenetic factors alter gene expression (how a cell reads a DNA sequence), not the nucleotide sequence of the DNA of the gene.

A is incorrect. Alterations in gene expression due to epigenetic factors will result in changes in the phenotypic characteristics between individuals.

B is incorrect. Unlike genetic changes, epigenetic changes are reversible.

D is incorrect. Environment and behaviours, such as diet and exercise, can result in epigenetic changes.

Question 10 A

A is correct. One of the ways that epigenetic changes affect gene expression is DNA methylation, which works by adding a chemical group to DNA that blocks the proteins required to 'read' the gene. If higher levels of DNA methylation were observed for both genes in binge and heavy drinkers, this would support the hypothesis.

B is incorrect. DNA nucleotide sequences in the two genes would not be caused by epigenetic factors.

C is incorrect. Changes in the functioning of the two genes would support the hypothesis that excessive alcohol consumption is an epigenetic factor. If no change in function occurred, the hypothesis would not be supported.

D is incorrect. If there was no difference between the results of the three groups of drinkers, the hypothesis would not be supported.

Question 11 C

C is correct. In all four different blood grouping systems listed, the gene locus is located on an autosome, not a sex chromosome, so the pattern of inheritance is called autosomal inheritance.

A is incorrect. Codominance occurs when both alleles are expressed equally and appear in the phenotype of the offspring. This is only shown by the phenotype AB in ABO blood grouping, and phenotype MN in MN blood grouping.

B is incorrect. Incomplete dominance occurs when neither allele expresses completely in the offspring and the resulting phenotype is a blend of the two parents. This occurs in none of the four blood grouping systems shown.

D is incorrect. None of the gene loci for the four blood grouping systems shown is on a sex chromosome

Question 12 D

D is correct. For the child to have a blood group O, Rh–, both parents would have to have genotypes with at least one i allele and one Rh– allele. Parents in the cross $I^AI^B \times$ ii could not produce a baby with blood group O (which would require a genotype of ii).

A, **B** and **C** are incorrect. The parents in these crosses have the required alleles for an O, Rh– baby.

Question 13 A

A is correct. In a cross of I^AI^B MN × I^AI^A NN, the chance of producing an I^AI^A offspring is $\frac{1}{2}$ and the chance of producing an NN offspring is $\frac{1}{2}$. Therefore, the chance of an offspring with blood groups A and N is $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$.

B, **C** and **D** are incorrect. These predictions are not possible from the parental genotypes specified.

Question 14 B

B is correct. Both the gene loci for the Rh and Duffy blood grouping systems are linked on chromosome 1, so the correct notation for linkage must be used together with the correct allele symbols for heterozygosity. The chromosome inherited from his mother would be Fyb Rh– and the chromosome inherited from his father would be Fya Rh+; therefore, his genotype would be written $\frac{\text{Fya Rh–}}{\text{Fyb Rh+}}$.

A and **D** are incorrect. Both alleles of each blood group would not be inherited by the same offspring, so they should not be shown on the same line.

C is incorrect. This genotype shows the man as Rh+ Rh+. As he is heterozygous, this should be Rh+ Rh–.

Question 15 D

D is correct. Both the gene loci are linked but not close together, as one is on the short arm of chromosome 1 and one is on the long arm. In this test cross between a parent heterozygous for both gene loci and a parent homozygous recessive for both gene loci, if some crossing-over and recombination occurred, the resultant ratio in a large group of offspring would be 1 : few : few : 1, with the groups of a few being the recombinant offspring.

A is incorrect. This option is the expected ratio for a dihybrid cross in which the parents have the same genotypes, as shown in the question. However, the two relevant gene loci are not linked.

B is incorrect. This option is the expected ratio for a dihybrid cross in which both parents were heterozygous for both genes, and the two gene loci were not linked.

C is incorrect. This option is not the expected ratio for a dihybrid cross in which both parents were heterozygous for both genes, and the two gene loci were not linked.

Question 16 D

D is correct. Fragmentation increases the number of individuals in populations, especially if the environmental conditions are favourable. This allows individuals to disperse and occupy more habitats, which can increase the chances of the survival of the species.

A is incorrect. While fragmentation is an example of asexual reproduction, it is not the advantage of the method.

B is incorrect. The method of reproduction does not ensure that all members of the species will survive. Some of the individuals that grow from the fragments may be eaten by predators or die from lack of food or other resources, as could other individuals in the species.

C is incorrect. As the new individuals that grow from the fragments will be genetically identical to the original organism, there will be no change in the genetic diversity of the species.

Question 17 B

B is correct. If the small cuttlefish carry out the behaviour of flattening their bodies to appear bigger than they are, the predator may be frightened away.

A is incorrect. Colour-changing skin is a physiological adaptation, not a structural adaptation. It is beneficial to cuttlefish of all ages and, rather than frightening predators, it allows the cuttlefish to hide from predators.

C is incorrect. The beak is a structural adaptation, not a physiological adaptation.

D is incorrect. The hollow cuttlebone assists with buoyancy; it could not be used for an attack as it is not located on the outside of the cuttlefish's body.

Question 18 D

D is correct. Using muscle contraction to change the cuttlefish's colour for camouflage is a physiological adaptation. It would be important during daylight hours when the cuttlefish is more obvious to predators.

A is incorrect. Changing its buoyancy helps the cuttlefish float or move up and down, but this movement would be too slow to move towards a mate and not useful for sideways movement. It would not be important during daylight hours.

B is incorrect. The beak is a structural adaptation for subduing prey and attacking predators and rivals, not attracting mates. It would not be important during daylight hours.

C is incorrect. Mass migration occurs in the breeding season, but it is a behavioural, not physiological, adaptation. It would not be important during daylight hours.

Question 19 C

C is correct. Ferrets are a type of weasel and, like most land animals that are higher on the evolutionary scale, would be able to reproduce sexually as both males and females were found.

A is incorrect. Regeneration is a specialised regrowth used for replacing a lost or injured part, not developing an entire organism.

B is incorrect. The parent ferrets would have produced gametes that, after mating, would fuse to form the zygote and develop into the offspring. Asexual reproduction does not involve gamete production.

D is incorrect. Propagation is a term used for creating new plants, which can occur by sexual or asexual reproduction but is not used by ferrets.

Question 20 B

B is correct. Even though they reproduce sexually, there were only seven ferrets to begin the captive breeding program. All the offspring will inherit genes from this small number of parents. Therefore, they will lack genetic diversity, which decreases the chances of the species surviving.

A is incorrect. Genetic diversity would not decrease and is not a factor that affects the ferrets' ability to produce offspring.

C is incorrect. Genetic diversity and population size are not directly related; an increase in genetic diversity does not mean the population size will be high.

D is incorrect. Changes in genetic diversity affect the survival of the species, not the individual.

Question 21 A

A is correct. The wriggling tail was part of the lizard's body and its behaviour aids in the lizard's survival.

B is incorrect. This behaviour will increase the chances of the lizard's survival, not reduce it.

C is incorrect. The lizard still needs a tail and will regrow a new one.

D is incorrect. This is not an example of fragmentation. Fragmentation occurs when a parent organism breaks up into several pieces to produce new organisms; in this example, the tail has simply fallen off.

Question 22 A

A is correct. The donor DNA must contain the complete genome of the organism to be cloned. The required diploid number of chromosomes would be found in a somatic/body cell.

B is incorrect. Although ovary cells are diploid cells, the donor egg is usually not from the same female as the somatic cell.

C and **D** are incorrect. Egg and sperm cells only contain half the genetic material required as they are haploid cells.

Question 23 C

C is correct. The embryo must be implanted into a surrogate mother that is the same species as the embryo.

A is incorrect. The original female donor used was Willa, who died years ago.

B is incorrect. The surrogate cannot be a different species, as the embryo would probably be aborted.

D is incorrect. A female egg donor cannot act as a surrogate if it is a different species.

Question 24 D

D is correct. Reproductive cloning does not alter the genome of an organism, it just produces offspring with an identical genome to the one donor parent organism.

A is incorrect. The regeneration of extinct species could be useful. If extinct species were returned to ecosystems, they could perform important functions or jobs that they once performed and were lost when they became extinct.

B is incorrect. Aiding threatened species to increase their chances of survival would be beneficial.

C is incorrect. Increasing genetic diversity in a species increases their chances of survival in a changing environment.

Question 25 B

B is correct. Clearing land for the development of farms, factories and housing has resulted in much of the bandicoot's bushland habitat being cleared away.

A is incorrect. Although bandicoots may have been a food source in the past, they are not commonly hunted for food today.

C is incorrect. Bandicoots are now a protected marsupial species.

D is incorrect. Feral goats mostly eat hay, weeds and blackberry plants. This would not have caused the decline in bandicoot numbers, as they do not eat bandicoots.

SECTION B

Question 1 (8 marks)

a. **i.** There seems to be no direct relationship between genome size and chromosome number; some species with a low chromosome number have a very large genome and others have a small genome. 1 mark

ii. Chromosomes contain many genes, which in turn are made up of DNA that consists of hundreds or thousands of base pairs.

This results in a larger genome size than chromosome number. 1 mark

b. David is correct. The complexity of an organism does not determine its genome size. 1 mark

c. Although corn and salamanders have the same number of chromosomes, the genes on their chromosomes are different and code for different structural and functional characteristics. 1 mark

d. **i.** *Salmonella* are prokaryotes, which have no membrane-bound nucleus. Their circular chromosome and plasmids are found in the cytosol. 1 mark

ii. In wheat plants, chromosomes are found in the nucleus, mitochondria and chloroplasts of green cells. In the animal cells of zebra fish, there are no chloroplasts, so chromosomes are only found in the nucleus and mitochondria. 1 mark

e. **i.** $2n = 26$ 1 mark

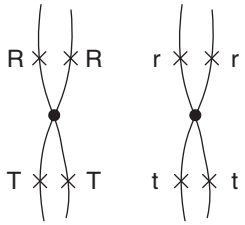
ii. $n = 25$ 1 mark

Question 2 (10 marks)

a. **i.** The parent cell undergoes two divisions. One cell first divides into two cells, which then undergo a second division, resulting in four cells. 1 mark

ii. Before meiosis begins, DNA replication occurs, meaning that each parental cell contains 12.8 pg of DNA. After the first division of meiosis, each of the two cells contains 6.4 pg. After the second division, each of the four daughter cells contains 3.2 pg. 1 mark

b.



2 marks

1 mark for drawing the chromosomes.
1 mark for labelling the correct letters at each gene locus.

c. In Figure 1, gene loci G and E are located on the same pair of homologous chromosomes. In Figure 2, gene loci G and E are located on different pairs of homologous chromosomes. 1 mark

This difference is due to linkage of gene loci G and E in Figure 1. 1 mark

d. In Figure 3, the G and e alleles are separating to one pole of the cell and alleles g and E are separating to the other. In Figure 4, the alleles G and E are separating to one pole and alleles g and e to the other. 1 mark

This difference is due to independent or random assortment. 1 mark

e. The process of independent assortment results in greater variation in the gametes produced in meiosis and, therefore, greater genetic diversity in the offspring. 1 mark

This is beneficial to a species as it increases the chances of survival and reproduction in a changing environment. 1 mark

Question 3 (6 marks)

a. i. All five offspring would be pink. 1 mark

ii. In incomplete dominance, neither allele is completely expressed, so the offspring do not exhibit the traits of either parent. In this case, red (RR) × white (WW) results in flowers with a blend of the phenotypes of the parents. 1 mark

b. i. All five offspring would have red and white stripes, patches or spots. 1 mark

ii. Allele symbols: red = C^R, white = C^W

All offspring would be C^RC^W. 1 mark

Note: Accept responses that assign other letters as allele symbols, given that correct notation is used.

c. i. test cross 1 mark

ii. If all offspring in a large sample were red, that would indicate that the red parent was homozygous red (RR). If several or as many as half of the offspring were white, that would indicate the red parent was heterozygous red (Rr). 1 mark

Question 4 (8 marks)

a. X^G = not affected by G6PD deficiency, X^g = affected by G6PD deficiency 1 mark

Note: There are no alleles on the Y chromosome as the condition is X-linked. Accept responses that assign other letters as allele symbols, given that correct notation is used.

b. A male could not be a carrier of G6PD, as a carrier must have one allele for the dominant trait and one for the recessive trait. Since the gene for G6PD is on the X chromosome, males will only have one copy of the gene as they only have one X chromosome. 1 mark

c. **Parental cross:** $X^GX^g \times X^gY$ 1 mark

Gametes:

	$\mathbf{X^g}$	$\mathbf{Y}$
$\mathbf{X^G}$	X^GX^g	X^GY
$\mathbf{X^g}$	X^gX^g	X^gY

1 mark

Note: Accept responses that use other letters for the alleles, given that correct notation is used.

Chance of male child with G6PD: $\frac{1}{2}$ (or 50%) 1 mark

d. A female symptomatic for G6PD would have the genotype X^gX^g. 1 mark

The conditions required to express symptoms include if she ate fava beans, was affected by stress, consumed one of the medications or foods, or had an infection that triggered the G6PD deficiency symptoms. 1 mark

e. These factors could not be called epigenetic factors as they do not act on the expression of the G6PD gene. (*They affect the protein that has been produced from the gene coding.*) 1 mark

Question 5 (12 marks)

a.

Organism/Species	Adaptation and adaptive advantage	Type of adaptation
great white shark	***For example, any one of:*** • **gills for gaseous exchange of oxygen and carbon dioxide** • **pointed long teeth for grabbing and eating prey**	structural
blue shark	They migrate in a long, looping patterns to the tropical Indian Ocean then return to the Great Australian Bight to forage for food each year.	**behavioural**
southern bluefin tuna and mackerel	They are 'warm-blooded' and can regulate their body temperature by endothermy, retaining the body heat they generate when swimming.	**physiological**
shrimp	***For example, any one of:*** • **hard outer shell/exoskeleton for body support and the protection of soft internal organs** • **long antennae to detect prey and other objects** • **jointed legs for movement in water and on rocks**	structural

4 marks
1 mark for each correct cell of the table.
Note: There are a range of acceptable responses for adaptation and adaptive advantage; accept any reasonable response.

b. **i.** top or apex predators 1 mark

ii. A keystone species has a disproportionately large effect on other species in the ecosystem relative to their population size and play a crucial role in the maintenance of stability in the ecosystem. 1 mark

If great white sharks were absent in the ecosystem of the Great Australian Bight, the ecosystem may become unstable and potentially collapse. (*Alternatively, it could result in an invasive species moving into the area and shifting the ecosystem in a new direction.*) 1 mark

c. **i.** Great white sharks reproduce sexually. Even though they are ovoviviparous, offspring is formed through the fusion of a female egg/gamete with a male sperm/gamete. 1 mark

ii. Sexual reproduction would be more advantageous to the survival of the species as sexual reproduction results in greater genetic diversity in the members of the species. 1 mark

Greater genetic diversity would give the species a greater chance of survival in a changing environment. 1 mark

d. **i.** parthenogenesis 1 mark

ii. $n = 36$ 1 mark

Question 6 (6 marks)

a. **i.** The greater the flowering of stringybark gums, the greater the availability of eels as a food resource (*a direct relationship*). 1 mark

ii. The small hole would allow the younger short-fin eels to pass through the end of the eel trap so they could survive and produce the next generation, therefore maintaining the long-term survival of the species. 1 mark

iii. Roza is correct. This is an interdependent relationship between the eels and the local people because the people benefit from catching and eating the eels as part of their diet, while the eels benefit from achieving a greater chance of survival of the species due to sustainable harvesting. 1 mark

b. **i.** *Any one of:*

- Lignotubers/underground root systems would produce a rapidly growing shoot system soon after the fire.
- Epicormic buds under thick bark would be protected from fire, allowing them to rapidly generate new growth after the fire.
- Seeds with a hard, fireproof coating would survive the heat of the fire and then germinate and grow rapidly into young plants after the fire.

1 mark

Note: Accept any other structural adaptation that would aid in plant survival during the fire and rapid regeneration after the fire.

ii. Once the fire has passed and the new growth has begun, animals would come to areas of regeneration after the fire to eat the young leaves and buds. 1 mark

By applying their knowledge of animal behaviour, hunters could then use this opportunity to trap or hunt the animals as a food resource. 1 mark

