Neap

Trial Examination 2021

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. Mitosis does not occur in binary fission of prokaryotic cells so the process of division is simpler and can be much faster than eukaryotic cell division. **A** and **D** are incorrect. The presence of membrane-bound organelles and the size of the cells do not affect the speed of the division of prokaryotic cells. **B** is incorrect. Prokaryotic cells undergo DNA replication.

Question 2 D

D is correct. Due to processes that occur during meiosis, sexual reproduction results in greater variation in the gametes produced, and therefore greater variation in the offspring. **A** is incorrect. Offspring produced by sexual reproduction are genetically different to the parents. **B** is incorrect. As offspring produced by sexual reproduction are different to the parents, they may not be suited to the same environment as the parents, or may be better suited to other environments. **C** is incorrect. Offspring produced by sexual reproduction are not necessarily more easily dispersed.

Question 3 B

B is correct. Two new cells are not produced until after cytokinesis, which is stage U. **A**, **C** and **D** are incorrect. Although the DNA in the cell replicates in stage Y and the cell grows in stage W, it is not until after stage P is completed and stage Y occurs that the two cells are produced.

Question 4 C

C is correct. Interphase is the longest stage of the cell cycle and continues from the end of cytokinesis to the beginning of mitosis. It includes stage X (G1: growth), stage Y (S: DNA synthesis) and stage W (G2: growth and organelle duplication). **A**, **B** and **D** are incorrect. Interphase does not include stage P (mitosis) or stage U (cytokinesis).

Question 5 C

A is correct. Stage R is the metaphase stage of mitosis in which the chromosomes line up along the equator, but the amount of DNA remains constant at four picograms, as is shown in section II in the graph. **B** is incorrect. In stage S, the chromatids separate to the poles in anaphase of mitosis, and the amount of DNA remains constant; it does not halve as shown in stage V. **C** is incorrect. In stage X, the amount of DNA stays constant and does not double. **D** is incorrect. In stage Y, the amount of DNA doubles and does not remain constant.

Question 6 B

B is correct. The inner cell mass of the blastula consists of cells that are the developing embryo, which are pluripotent at this early stage as they can develop into most cell types in the three germ layers of the embryo. **A** is incorrect. Totipotent cells can develop into all cell types, including the outer cell layer that forms the placenta. **C** is incorrect. Multipotent cells can only develop into a limited number of cell types. **D** is incorrect. Unipotent is not a type of potency in stem cells.

Question 7 A

A is correct. The cells are already 'tagged' to produce specific cell types. **B**, **C** and **D** are incorrect. The cells can still undergo mitosis as they are not yet fully specialised, but they cannot differentiate into all cell types.

Question 8 D

D is correct. 'Ecto' means outside; ectoderm layers form skin and pigment layers, nail, hair, eye lens and other outer parts of organs. **A** is incorrect. Ectoderm cells will not form interior cells such as cardiac or skeletal muscle cells. **B** is incorrect. The heart and blood vessels are formed by the mesoderm. **C** is incorrect. The inner layers of the digestive and respiratory systems will be formed by endoderm cells.

Question 9 C

C is correct. The G1 checkpoint is near the end of the first growth phase, so it is important that cell size and adequate nutrient availability is determined. **A** is incorrect. At the G2 checkpoint, the amount of DNA is checked to ensure that it has doubled, not halved. **B** is incorrect. Since the cell cycle involves mitosis, not meiosis, there will be no homologous pairing of chromosomes or attachment to spindle fibres. **D** is incorrect. The structures checked at the G2 checkpoint are made up of two chromatids, not two chromosomes.

Question 10 B

B is correct. If there is a mutation in a tumour-suppressor gene, it will not trigger apoptosis of cells with damaged DNA, so they will not be removed and will develop into cancer cells. **A**, **C** and **D** are incorrect. Rapid cell division, unchecked cell proliferation and small amounts of repair to cells with damaged DNA will still occur if a mutation appears in a tumour-suppressor gene.

Question 11 D

D is correct. The measured quantities of chlorine added to the water of swimming pools does not induce or increase the rate of mutations, so is not a mutagen. **A**, **B** and **C** are incorrect. Mutagens do include X-rays, nuclear radiation, some wavelengths in sunlight (such as ultraviolet rays) and some viruses (such as the human papillomavirus).

Question 12 C

C is correct. A genetic predisposition is an increased likelihood of developing the disease based on a person's genetic makeup, which they inherit from their parents. **A** is incorrect. A genetic predisposition does not mean the individual will definitely get the disease. **B** is incorrect. Lifestyle factors may increase the likelihood of developing the disease, but do not cause the disease. **D** is incorrect. A genetic predisposition increases the likelihood that an individual will develop cancers.

Question 13 C

C is correct. Cell differentiation must occur in certain regions of all multicellular organisms so that, as the organism produce new cells for growth, repair and replacement, these cells will specialise into specific tissues. **A** is incorrect. New genes are not gained in differentiation. **B** is incorrect. This process is not related to meiosis. **D** is incorrect. Cell differentiation does occur in embryos, but also occurs in other locations.

Question 14 B

B is correct. After partial separation, the two cells will have the same genetic material, like identical twins, so the tadpoles will be the same sex. **A**, **C** and **D** are incorrect. The genotypes of the tadpoles will be the same, but their phenotypes, including their mass, may be different depending on their environment (for example, if the amount of food each tadpole receives is different).

Question 15 A

A is correct. The decrease in methylation will change the structure of the DNA that makes up the chromatin. **B** is incorrect. The decrease in methylation will not alter the nucleotide sequence of the DNA. **C** and **D** are incorrect. The decrease in methylation could result in decreased expression of tumour-suppressor genes and consequently increase the chance of bowel cancer occurring.

Question 16 D

D is correct. Factors such as methylation are called epigenetic factors, which alter gene expression by switching genes on and off, thereby altering the phenotype of the organism. **A**, **B** and **C** are incorrect. The research is not related to factors that alter the nucleotide sequence in the genes and therefore genotype is unrelated.

Question 17 D

D is correct. This genetic disorder affects far more men than women, which indicates it is caused by the ichthyosis gene being located on the X chromosome. **A** is incorrect. Females would have two copies of the gene as they have two X chromosomes. **B** is incorrect. Moisturising creams applied to the skin will not alter genetic makeup. **C** is incorrect. If the trait were Y-linked, it would not appear in females at all, as they have no Y chromosome.

Question 18 A

A is correct. Polygenic inheritance occurs when a characteristic is controlled by two or more genes. Human hair colour, for example, is controlled by genes on the four chromosomes 3, 6, 10 and 18. **B** is incorrect. A greater number of alleles for melanin does not necessarily mean that a person will have darker hair, as some of the alleles may not be expressed or may result in a lower production of melanin. **C** is incorrect. There will be a range of phenotypes, not two, depending on the contribution of each gene. **D** is incorrect. It is the genes that are expressed and code for protein pigments, not the whole chromosome.

Question 19 B

B is correct. If the alleles are H = polled and h = horned, then Hh × Hh would result in a $\frac{3}{4}$ chance of an offspring being polled. As the polled offspring would be HH or Hh, there is a $\frac{2}{3}$ chance of the offspring being heterozygous. **A**, **B** and **D** are incorrect. These options do not show the correct probability.

Question 20 A

A is correct. A polled bull could be HH or Hh. A test cross of the bull with a recessive horned cow, hh, could be used to determine the genotype of the bull. **B** and **D** are incorrect. Reciprocal and back crosses are used for other purposes. **C** is incorrect. A polled cow would not be used for a test cross as it could have the genotype HH or Hh.

Question 21 D

D is correct. If the woman is X^bX^b and the man is X^BY, any sons will be red-green colour blind as they inherit the Y chromosome from the father and the X^b from their mother. **A** and **C** are incorrect. Any daughters of the couple will not be red-green colour blind as they would be X^BX^b. **B** is incorrect. Any sons of the couple will be red-green colour blind.

Question 22 A

A is correct. Short bristles are inherited as a recessive trait with the allele symbol bobbed = bb, so a fly with short bristles would be bbbb. Wrinkled wings are inherited as a dominant trait, so a fly with wrinkled wings could be WW or Ww. Of the alternatives, the only correct possibility is Wwbbbb. **B**, **C** and **D** are incorrect. These genotypes do not represent a male with wrinkled wings and short bristles.

Question 23 B

B is correct. The gene for wrinkled wings is on chromosome 3 and the gene for vermillion eyes is on chromosome 1. Since they are not linked, a cross between WwRr × wwrr (test cross) would have a phenotypic predicted ratio of 1 : 1 : 1 : 1 of the four possible phenotypes in the offspring. **A**, **C** and **D** are incorrect. The other ratios in these options are for linked genes (1 : 1 : few : few) or heterozygous crosses.

Question 24 B

B is correct. The two gene loci of the traits bobbed bristles and vermillion eye colour are on the same chromosome, number 1, and the distance between the two gene loci is much further apart (33 units) than the loci of any other pair of traits. This means there is a greater chance for crossing-over to occur during meiosis I for the alleles of these two traits. **A**, **C** and **D** are incorrect. These traits would have lower percentages of crossing-over than bobbed bristles and vermillion eye colour.

Question 25 C

C is correct. In the process of crossing-over, one chromatid of each homologous chromosome crosses over with the other, breaks, and then rejoins with the other chromatid, thereby exchanging segments of alleles. This results in the production of gametes with many different combinations of alleles; that is, greater variation in the gametes. **A** is incorrect. Crossing-over increases the likelihood of gametes containing different genetic material. **B** and **D** are incorrect. The alleles are not changed during the process, nor is there a loss or gain of alleles unless an error occurs.

SECTION B

Question 1 (6 marks)

a.

	Diagram 1	Diagram 2
Type of reproduction	asexual reproduction	sexual reproduction
Name of reproduction	binary fusion	**budding**
Type of organism	eukaryote, such as bacteria	eukaryote, such as Hydra
Genetics of parent organism compared to offspring and each other	genetically identical to each other and parent	genetically different to the parent and each other
One advantage of this type of reproduction	**Only involves one parent, so no need to spend time and energy looking for a mate.** **OR** **All the offspring are genetically identical and may be well-adapted for survival in the same environment as the parent.** **OR** **A large number of offspring can be reproduced rapidly and efficiently, enabling quicker spread and colonisation of a favourable area.**	The species can adapt to new environments due to variation, which gives them a survival advantage.

2 marks

1 mark for each cell correctly completed.

b. *Any four of:*

- The type of reproduction shown in diagram 2 is a type of asexual reproduction, as it does not involve the fusion of gametes.
- The name of the reproduction shown in diagram 1 is binary fission as it involves the splitting of one individual into two, not fusion (which means joining).
- The type of organism in which the reproduction shown in diagram 1 takes place would be within a prokaryotic bacterium, not a eukaryotic cell.
- For the type of reproduction shown in diagram 2, the offspring would be genetically identical to the parent as it was formed by repeated mitotic cell divisions.
- The type of reproduction in diagram 2 is asexual, which does not lead to increased variation in the species, as all offspring are usually identical; therefore, the species does not readily adapt in changing environments.

4 marks

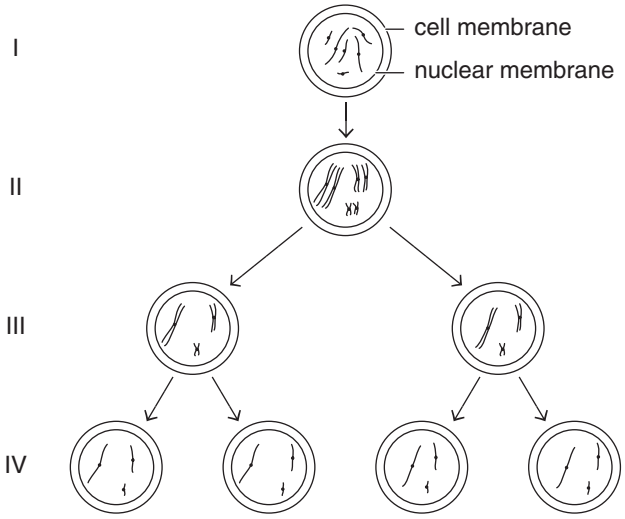
1 mark for each error identified and justified.

Question 2 (11 marks)

a. **i.** There are two divisions, which indicates meiosis and not mitosis. 1 mark

There is pairing of homologous chromosomes in cell II, which only occurs in meiosis and not in mitosis. 1 mark

ii.



2 marks

1 mark for drawing the correct chromosomes in the cells at stage III.
1 mark for drawing the correct chromosomes in the cells at stage IV.

b. **i.** $2n = 6$ 1 mark

ii. Susie was correct, as the cell of the ovary (gonad) in which meiosis takes place is diploid; therefore, it is a somatic or non-sex cell. 1 mark

A sex cell is produced as a result of meiosis and it is haploid; therefore, it cannot be the initial ovary cell that divides. 1 mark

c. **i.** **Name:** crossing-over 1 mark

Stage: prophase I 1 mark

ii. RQ, Rq, rQ, rq 1 mark

iii. Crossing-over is important to the survival of the species as it produces greater diversity by producing new combinations of genes (in the gametes and, subsequently, in the offspring). 1 mark

Question 3 (6 marks)

a. **i.** In cloning, the offspring produced in each generation are genetically identical to the parents of the previous generation. 1 mark

ii. *For example, any one of:*

- rice
- wheat
- corn
- sorghum

1 mark

iii. Plant cloning in nature will result in no variation and all the offspring may be susceptible to disease or other environmental factors (including drought, higher soil salt concentrations or waterlogged soil). 1 mark

b. **i.** Clones occur naturally in humans and other mammals (when a fertilised egg splits in two and results in two offspring). Animal cloning can be carried out in the same way using embryo splitting (technology that separates the fertilised egg into two cells). 1 mark

ii. totipotent 1 mark

c. Totipotent cells used for human cloning are harvested from the very early stages of human embryonic development, which is a controversial issue when it comes to considerations of the destruction of human life. 1 mark

Note: Consequential on answer to ***part b.ii.***

Question 4 (7 marks)

a. **i.** autosomes 1 mark

ii. Autosomes contain genes that control the inheritance of all of an organism's characteristics but not genes that control its sex; sex chromomes contain the genes that determine sex, as well as a few that determine other body features. 1 mark

b. **i.** There are three X chromosomes in karyotype 2 compared to two X chromosomes in karyotype 1. 1 mark

ii. *Any one of:*

- As there are three copies of the X chromosome, the female would have three copies of the sex genes, which would affect her sex characteristics.
- As there are three copies of the X chromosome, the female would have three copies of each X-linked gene, which would affect her body phenotype.

1 mark

c. **i.** They could not be called homologous chromosomes as, although they would have had the same gene loci, one chromatid is missing a large segment of genes. 1 mark

ii. No. Karyotypes 1 and 2 have only X chromosomes (female), whereas karyotypes 3 and 4 have both an X and Y chromosome (male). 1 mark

d. The alleles of the genes are different on the paternal and maternal chromosomes, so depending on which chromosome was missing the segment of genes, different symptoms would be shown. 1 mark

Question 5 (8 marks)

a. The trait is autosomal recessive. 1 mark

Two hairy dogs (I1 and I2) have two hairless offspring (male II3 and female II5). 1 mark

b. **i.** Diana had deduced that the gene for the hairless trait was located on a non-sex chromosome (autosomal), as both hairy and hairless male and female offspring were produced in the breeding experiments. 1 mark

The hairless characteristic was dominant to hairy, as when the hairless parents were mated, they produced both hairless and hairy offspring. 1 mark

ii. H = hairless, h = hairy

Parents: hairless × hairy

	H	**h**
H	HH	Hh
h	Hh	hh

1 mark

The offspring would be in a 3 hairless : 1 hairy ratio. 1 mark

c. i. Pure breeding means that parents with a particular phenotype will produce offspring with the same phenotype (as parents are homozygous for the trait). 1 mark

ii. *For example, any one of:*

- The homozygous genotype (HH) was lethal.
- All carriers of this genotype died.
- All carriers of this genotype were never born.

1 mark

Question 6 (9 marks)

a. polygenic inheritance 1 mark

b. two 1 mark

c. i. Parents: Bbyy × Bbyy 1 mark

	H	**h**
H	HH	Hh
h	Hh	hh

1 mark

50% chance of genotype the same as the parents 1 mark

ii. 75% chance of same phenotype as parents 1 mark

d. i. bbyy; a white budgerigar 1 mark

ii. If all the offspring from the breeding crosses were green, Jimmy would know his three budgerigars were BBYY. 1 mark

However, if there were any that were white, yellow, or blue, he would know his budgerigars were not homozygous at both gene loci. 1 mark

Question 7 (3 marks)

a. i. The technique is embryonic pre-implantation genetic diagnosis (PGD), as it is carried out at the eight-cell stage (the term embryo is used until the eight-week mark, after which the developing baby is referred to as a foetus). 1 mark

ii. The sample of genetic material is tested early so that cell removal is possible before cell differentiation begins, and the removal will not affect the embryonic/foetal growth. 1 mark

b. PGD is a form of selective reproduction, as the embryos that have cells that test positive for a specific gene will not be used for implantation and will be destroyed. This is an ethical issue regarding the destruction of human life. 1 mark