Neap

Trial Examination 2020

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 B

The answer is **B**, as a prokaryotic cell divides by a type of asexual reproduction in which the parent cell divides into approximately two equal cells. Regeneration is a process of renewal or growth, not reproduction; fusion is the joining of two cells; and propagation refers to reproduction of vegetative parts in plants.

Question 2 C

The answer is **C**, as eukaryotic cells possess a nucleus containing chromosomes and so carry out the process of cell reproduction, with DNA replication and chromosome separation, in the process of mitosis. Prokaryotes have no nucleus so, although their single chromosome replicates and the copies separate, there is no nuclear division called mitosis.

Question 3 A

The answer is **A**, as when a cell cycle is complete the new cells either progress to specialisation or repeat the stages of the cell cycle again. **B** and **C** occur in the cycle but this does not explain why it is called a cycle. Not all cells reproduce.

Question 4 D

The answer is **D**, as interphase involves all the stages (G_1, S and G_2 inclusive) and so is a much longer stage; whereas S and G_1 are shorter stages and mitosis is only a very short stage in comparison to the other stages.

Question 5 D

The answer is **D**, as at point Y the amount of DNA is halved during cytokinesis. All other alternatives are incorrect, as W is DNA synthesis, X is the G_2 and mitosis stage and there are two cycles shown in the graph, not one.

Question 6 C

The answer is **C**, as asexual reproduction does not involve gametes and so there is no fusion. It involves mitosis in eukaryotes but not meiosis. Asexual reproduction only involves one parent, but in sexual reproduction it can also involve only one parent if that parent is a hermaphrodite containing both male and female sex organs.

Question 7 A

The answer is **A**, as two clusters of chromosomes are visible with a new cell wall forming between them, which is characteristic of a plant cell in the final stage of mitosis (telophase). As the cell shown has a cell wall, it is not an animal cell, so **B** and **D** are incorrect. The cell has spindle fibres and two new nuclei forming so it is not a bacterial cell, as in **C**.

Question 8 B

The answer is **B**, as during metaphase the chromosomes move to line up along the equator attached to the spindle fibres made up of microtubules; during anaphase, the spindle fibres contract pulling the daughter chromosomes towards the poles. Both these stages would therefore be affected by drugs that inhibit or disrupt microtubule formation. No other phases of mitosis involve the spindle fibres.

Question 9 D

The answer is **D**, as during meiosis the homologous chromosomes line up in pairs in meiosis I; the chromatids of each chromosome separate in meiosis II. This means that each daughter cell receives one of the four chromatids and therefore one of each parental chromosome with the same gene loci. The chromosomes from the mother will have the same gene loci but most likely different alleles to those of the homologous paternal chromosome.

Question 10 A

The answer is **A**, as during meiosis two factors result in greater variation in the gametes. The first of these is the independent assortment of the homologous chromosomes and their movement to different daughter cells, which results in shuffling and therefore new combinations of alleles in different gametes. The second factor is crossing-over and recombination, but this occurs between chromatids of two homologous chromosomes, not the same one, as suggested in **C**.

Question 11 B

The answer is **B**, as each chromatid consists of one tightly coiled DNA molecule. All the autosomes and sex chromosomes in a female human chromosome set are in homologous pairs, but in the male the X and Y chromosomes are not homologous. Chromosomes can only be seen during cell division, and the DNA of the chromosomes is colourless and so cannot be seen unless stained.

Question 12 C

The answer is **C**, as inheritance of skin colour in humans is an example of many genes located on autosomes, called polygenes, that result in continuous variation due to the additive effects of the pigment coded for by the genes. A trait controlled by one gene would result in discrete groups of phenotypes or discontinuous variation. Every gene would have two or more alleles, not one.

Question 13 C

The answer is **C**, as the phenotype of an organism such as the seal point Siamese cat, is not just the outward appearance of the organism. Rather, it is the features or traits of the organism – anatomical, functional and behavioural – that are expressed by the organism, and determined both by its genotype and environmental factors.

Question 14 A

The answer is **A**, as epigenetic factors, such as histone modification, do not alter the sequence of the DNA or their inheritance in the gametes. They do modify the expression of the genes, and this can lead to a change in the organism's phenotype.

Question 15 C

The answer is **C**, as the genome of an organism is defined as the total of an organism's DNA measured in the number of base pairs contained in a haploid set of chromosomes. Since the total number of base pairs in the diploid set of the koala is 3.4 billion, the genome of the koala would be half of that – 1.7 billion base pairs.

Question 16 A

The answer is **A**, as a female baby koala would inherit a haploid set of eight chromosomes from her mother – seven autosomes and one X chromosome. The other eight chromosomes would be from the father – seven autosomes and another X chromosome. This would result in the diploid number of sixteen, with fourteen autosomes and two sex chromosomes (XX for female baby koala).

Question 17 C

The answer is **C**. Identical twins have the same genotype as they are the result of one fertilised egg or an early embryo, which separates into two to form two babies. Non-identical twins result from the release of two eggs, which are fertilised by two sperm. They have different genotypes and are no more similar than brothers and sisters. Although all koalas would have the same gene loci on their chromosomes, as they are the same species, they would have different combinations of base paris for the same gene loci, so **A** is incorrect.

Question 18 A

The answer is **A**, as studying genetic relationships between species is helpful in other cases, but while koalas are commonly called koala bears, they are marsupials. There are no bears in Australia; thus, a study of the relationships between koalas and bears would not be beneficial in the conservation of koalas. Genetic information on their diet, disease susceptibility and genetic diversity would all be useful in trying to preserve the koala species.

Question 19 B

The answer is **B**, as a Y-linked trait is passed on to the father's male offspring only, as they inherit the Y chromosome from their father. These male offspring would then pass it on to their male children; the grandsons ultimately inherit the trait from their grandfather. Daughters do not inherit a Y chromosome from their father. Mothers with an X-linked dominant trait could be heterozygous, so their male offspring may not inherit the trait.

Question 20 B

The answer is **B**, as the male with Klinefelter syndrome has three sex chromosomes, which cannot pair up in prophase I of meiosis, so the process cannot take place and no gametes can be produced by him. No autosomes are missing from his genotype and both SRY and Sox9 genes are present in his genotype, along with an extra X chromosome.

Question 21 D

The answer is **D**, as the gene for each blood group type is located on a different autosome and, as autosomes are in pairs, a person can only have two alleles of each gene in their genotype. The genes for the three blood groups are not linked. Each gene has two alleles except the ABO blood group gene, which has three alleles.

Question 22 C

The answer is **C**, as a man and a woman heterozygous for Rh positive blood group (Dd × Dd) have a 75% chance of having an Rh positive child, but one-third of those would be predicted to have the genotype DD and two-thirds would be predicted to be Dd, heterozygous for Rh positive blood group. As each birth is an independent event, each child born to this couple would have the same two-thirds chance of being heterozygous for Rh positive.

Question 23 A

The answer is **A**, as the gene controlling production of salivary amylase is on chromosome 1, and thus is autosomal; the production of no salivary amylase is inherited as the recessive trait. Therefore, the pattern of inheritance of no salivary amylase is autosomal recessive as shown in pedigree A, in which two parents who could produce amylase produced a child/daughter who could not produce it. The trait of lack of production of salivary amylase appears in both male and female offspring, supporting an autosomal pattern of inheritance and not a sex-linked pattern of inheritance.

Question 24 B

The answer is **B**, as rabbit Z, which shows the dominant trait of production of salivary amylase, could have the genotype AA or Aa. By crossing rabbit Z with a homozygous recessive rabbit in a test cross, the results in the genotypes of the offspring would help to determine the genotype of rabbit Z. If all the offspring can produce salivary amylase, rabbit Z is most likely AA. If several of the offspring cannot produce salivary amylase, rabbit Z is most likely Aa genotype.

Question 25 D

The answer is **D**. As genes D and A are both located on chromosome 1, they are linked genes. During meiosis, crossing over and recombination can produce recombinant gametes. If the cross in the question was carried out (a test cross), the predicted ratio in the offspring would be:

1 parental phenotype	:	few recombinant phenotype	:	few recombinant phenotype	:	1 parental phenotype
Rh +, amylase +		Rh +, amylase –		Rh –, amylase +		Rh –, amylase –

If the first child is Rh positive but unable to make amylase, as this is the genotype of one of the two types of recombinant offspring, the chance of that child resulting from the given cross would be less than 25%.

SECTION B

Question 1 (8 marks)

a. **i.** fission **OR** fragmentation 1 mark

ii. Offspring are genetically identical to each other and the parent. 1 mark

iii. Human identical twins result from the fusion of gametes, followed by separation of the zygote or an early stage embryo. 1 mark

Fission in sea anemones involves no gametes and the separation of one parent into two organisms. 1 mark

b. **i.** In the sexual method of reproduction, there would be greater genetic diversity in the offspring which ensures greater survival chance of the species in changing environmental conditions. 1 mark

In the asexual method of reproduction, all the offspring would be genetically identical and therefore there would be less chance of the survival of the species. 1 mark

ii. Another advantage of the sexual method of reproduction described would be the dispersal of individuals to other areas to reduce crowding and competition for food, as the sexual method has a larval stage that swims through the water. 1 mark

Note: Other appropriate advantages are acceptable.

c. The lack of genetic diversity may mean the crops are susceptible to disease or pest attack. 1 mark

Note: Other appropriate problems are acceptable.

Question 2 (5 marks)

a. The checkpoint at G_1 is necessary, as it checks that DNA that is already damaged or mutated is removed by cell death and not replicated in the next S stage, which would waste cell energy and resources. 1 mark

b. The checkpoint at G_2 is important, as it checks that all DNA has been replicated correctly in the S stage with no damage or mutations. 1 mark

c. cancer 1 mark

d. **i.** mutagens 1 mark

ii. *For example, any one of:*

- DDT
- tobacco
- nicotine
- thalidomide

1 mark

Question 3 (7 marks)

a. The common features of stem cells are that they can self-renew, 1 mark
and they can also differentiate into other types of cells. 1 mark

b. **i.** totipotent 1 mark

ii. Type I cells can differentiate into all cell types to produce a whole organism, whereas types III and IV can only produce several different types of cells. 1 mark

c. *For example, any one of:*

- Some people believe that the use of stem cells destroys life.
- Some people consider the use of stem cells to interfere with the course of nature or to be 'playing God'.

1 mark

d. **i.** Type II cells would be the best for generating skin tissue, as these cells can divide into many different types of cells, including the skin cells that were needed. 1 mark

ii. If the skin was generated from embryonic cells and not from the person's own body cells, the skin would probably be rejected by the person's immune system. 1 mark

Question 4 (15 marks)

a. **i.** process: meiosis 1 mark

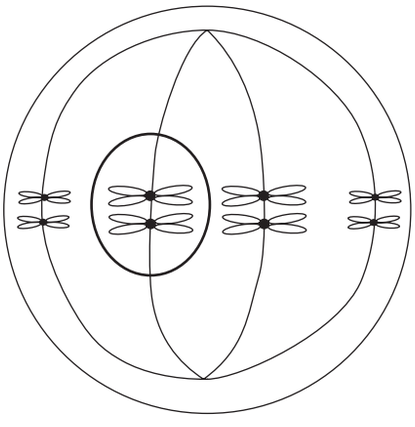
location: testes **OR** ovaries 1 mark

ii. X: Metaphase I; Y: Metaphase II 1 mark

iii. Metaphase is used because the chromosomes attached to the spindle fibres line up along the equator of the cell. 1 mark

iv. In metaphase I, homologous pairs of chromosomes line up along the equator, whereas in metaphase II only single chromosomes line up. 1 mark

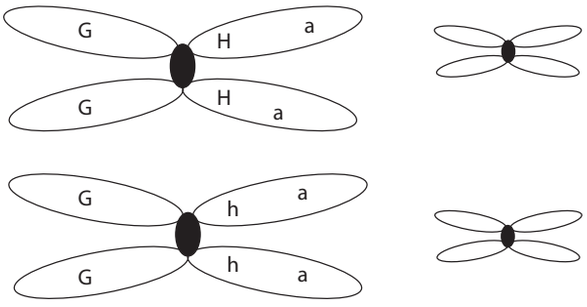
b. **i.** Homologous chromosomes have the same gene loci or the same genes at the same positions. 1 mark



1 mark

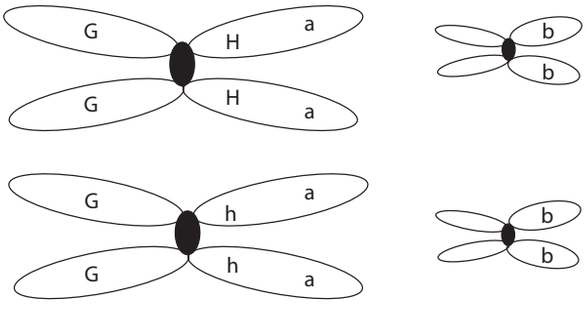
Note: Any pair of chromosomes could be circled.

ii.



3 marks
1 mark for showing all three gene loci (G, H and h) on the same chromosome pair.
1 mark for H/H and h/h.
1 mark for G/G, G/G, a/a and a/a.

c. **i.**



1 mark
*Consequential on answer to **part b.ii.***

ii. 1 parental : few recombinant : few recombinant: 1 parental 1 mark
Note: This is because gene loci G and H are linked.

iii. test cross 1 mark

iv. The predicted ratio would not be the same, as genes G and B are not linked and therefore are not inherited together. 1 mark

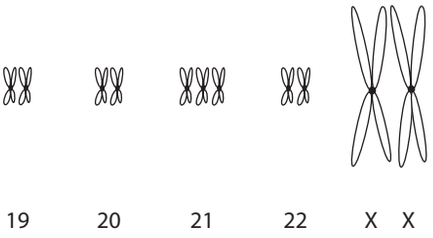
The correct ratio would be 1 : 1 : 1 : 1. 1 mark

Question 5 (11 marks)

a. Peggy meant that Down's syndrome was inherited as an autosomal disorder as the gene for the disease is located on a non-sex chromosome, 1 mark
and dominant because the condition only requires one copy of the allele to be present for the trait to be expressed. 1 mark

b. **i.** aneuploidy **OR** trisomy 1 mark

ii. diploid number: 47 1 mark



2 marks
1 mark for three of chromosome 21.
1 mark for two X chromosomes.

c. **i.** H = Huntington's disease, h = unaffected

Parents: Hh × hh

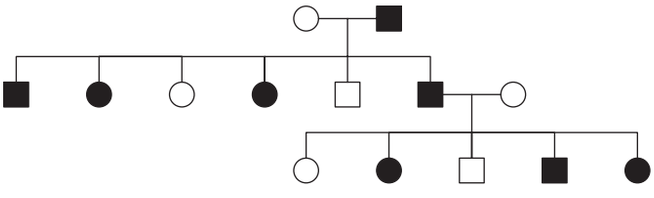
	H	**h**
h	Hh	hh
h	Hh	hh

1 mark

Probability: 50% 1 mark

ii. The heterozygous offspring could not be a carrier; as Huntington's disease is a dominant condition, heterozygotes will always develop Huntington's disease at some stage in their lives and therefore cannot be carriers. 1 mark

iii.



2 marks
1 mark for trait appearing in both males and females (autosomal).
1 mark for affected father having male and female children with the trait (autosomal dominant).
Note: Any pedigree that shows the above information is acceptable.

Question 6 (4 marks)

a. **i.** The cheek cell swab is to collect cells with nuclei from which the DNA can be extracted for testing. 1 mark

ii. The sequence of bases in the DNA of specific genes for which the test is designed is what is being analysed. 1 mark

iii. The person being tested will know if they are a carrier or heterozygous for a genetic disorder which may be passed on to future offspring. 1 mark

b. *For example, any one of:*

- the morality of taking and testing the molecule of life, DNA, from cells
- patenting and ownership of genes, genomes and DNA test results
- possible discrimination by insurance companies and employers

1 mark