Neap

Trial Examination 2020

VCE Biology Unit 2

Written Examination

Question and Answer Booklet

Reading time: 15 minutes
Writing time: 1 hour 30 minutes

Student's Name: _____

Teacher's Name: _____

Structure of booklet

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*
A	25	25	25
B	6	6	50
			Total 75

Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners and rulers.

Students are NOT permitted to bring into the examination room: blank sheets of paper and/or correction fluid/tape.

No calculator is allowed in this examination.

Materials supplied

Question and answer booklet of 22 pages

Answer sheet for multiple-choice questions

Instructions

Write your **name** and your **teacher's name** in the space provided above on this page, and on your answer sheet for multiple-choice questions.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

All written responses must be in English.

At the end of the examination

Place the answer sheet for multiple-choice questions inside the front cover of this booklet.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

SECTION A – MULTIPLE-CHOICE QUESTIONS

Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.

Choose the response that is **correct** or that **best answers** the question.

A correct answer scores 1; an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

Use the following information to answer Questions 1 and 2.

Cell reproduction is more complex in eukaryotes than in prokaryotes, as prokaryotes lack a nucleus and have only a single chromosome with no centromere.

Question 1

Prokaryotes carry out cell reproduction by the process of

A. regeneration.

B. binary fission.

C. cell fusion.

D. propagation.

Question 2

Which one of the following stages occurs in cell reproduction in eukaryotes, but not prokaryotes?

A. DNA replication

B. chromosome separation

C. mitosis

D. cytokinesis

Use the following information to answer Questions 3–5.

The sequence of events that take place from one cell division to another is called the cell cycle. Use your knowledge of the cell cycle to answer the following questions.

Question 3

This sequence of events is called a cycle because

A. the stages repeat each time the cell divides.

B. the cycle takes place in phases.

C. the cycle is a continuous process.

D. every cell produced will divide again.

Question 4

The longest stage in the cycle is

A. nuclear division, as it involves all four stages of mitosis.

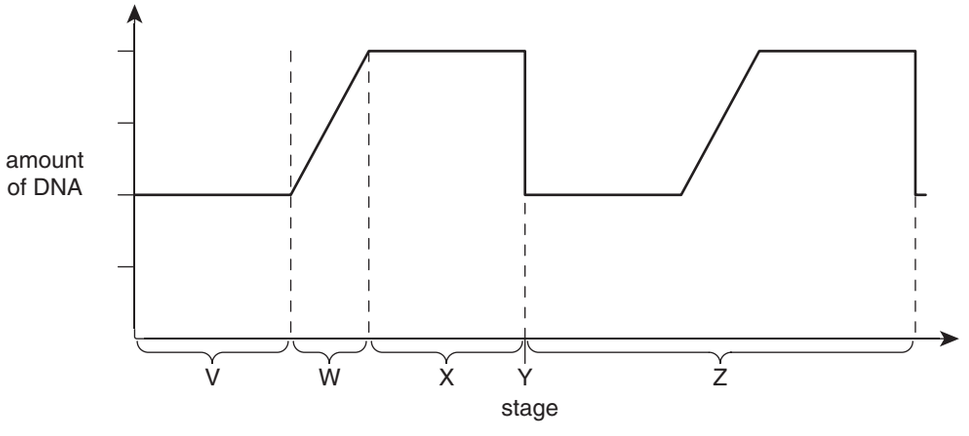
B. the synthesis phase, as exact copies of all the DNA molecules must be formed.

C. the first growth phase, as the new cell needs to produce new proteins and grow.

D. interphase, as the new cell goes through different stages ready for the next division.

Question 5

The following graph shows the changes in the amount of nuclear DNA per cell during the cell cycle. These changes reflect the different phases that occur in the cycle.



Based on the information in the graph, which one of the following statements is correct?

A. Stage W involves cell growth.

B. Stage V is mitosis.

C. The graph shows one cell cycle.

D. Stage Y is cytokinesis.

Question 6

Asexual reproduction is the only type of reproduction that involves

A. a single parent to produce offspring.

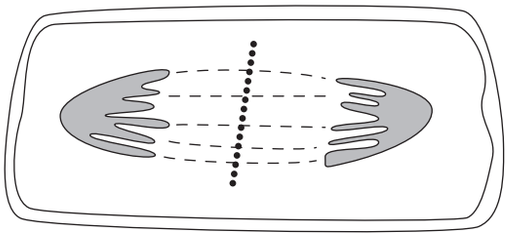
B. the processes of meiosis and mitosis.

C. no fusion of gametes.

D. gametes of one type only.

Question 7

The diagram below shows a cell undergoing mitosis.



Which one of the following conclusions can be drawn about its location and stage of mitosis?

A. This is a plant cell at telophase, as a new cell wall can be seen forming.

B. This is an animal cell at anaphase, as it shows two groups of chromosomes pulling apart.

C. No cell membrane or other organelles can be seen, so this is a bacterial cell at telophase.

D. Only the remnants of spindle fibres can be seen, so this is an animal cell at late anaphase.

Question 8

Various drugs, such as vincristine, are important chemotherapeutic agents in the treatment of some types of cancer. They are called mitotic inhibitors as they disrupt the formation of microtubules in cells, which are needed to move chromosomes around the cell.

Which one of the following contains the two stages of mitosis that would be interrupted by these drugs?

A. interphase and prophase

B. metaphase and anaphase

C. anaphase and telophase

D. prophase and metaphase

Question 9

Daughter cells produced in meiosis contain

A. the same amount of DNA as the parent cell, as DNA doubles during meiosis.

B. double the number of chromosomes, as each parental chromosome consists of two chromatids.

C. chromosomes with the same alleles at each gene locus as the parent cell.

D. one of each parental chromosome with the same gene loci as the original chromosome.

Question 10

During meiosis, several factors occur that result in increased variation in the gametes produced, which can lead to greater variation in the offspring produced after mating.

Which one of the following is one of these factors?

A. Homologous chromosomes pair up and move to different daughter cells, independent of each other.

B. Any male gamete fuses at random with any female gamete.

C. The two chromatids of one of the homologous chromosomes cross over and undergo recombination.

D. All maternal chromosomes move to one pole and all paternal chromosomes move to the other pole.

Question 11

Which one of the following statements is correct?

A. All human chromosomes exist in homologous pairs.

B. Each chromatid of a human chromosome contains one DNA molecule.

C. Human chromosomes are normally visible in all cells at all times.

D. Human chromosomes do not require staining to be clearly observed.

Question 12

Skin colour in humans depends on the amount of pigment present in their cells and shows a wide range of possible densities, ranging from high to low levels.

This is an example of a human trait that shows continuous variation, in which

A. one main gene controls skin colour.

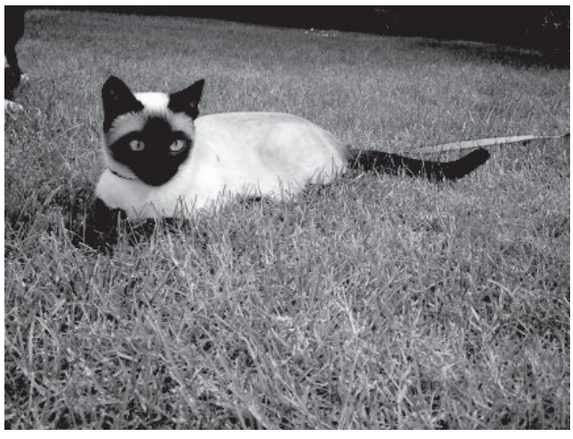
B. each skin colour gene has only one allele.

C. polygenes on autosomes control skin colour.

D. the resulting skin colours will consist of a few discrete groups.

Question 13

The following photograph is of a seal point Siamese cat.



Source: Racheal E Watson Wikimedia Commons (2018) CC BY-SA 3.0. Accessed August 2020. http://commons.wikimedia.org/wiki/FIle:Mimbi1.jpg

Owners of these cats have sometimes noticed that in winter the darker patches get bigger and then reduce in size again in summer. One owner reported a similar situation with a cat that had to be shaved around his abdomen for an operation. It was a very cold winter and when the hair grew back it was a shade darker. As the temperature became warmer in spring then summer, the abdomen hair became lighter again.

Based on your knowledge and this example, it can be concluded that

A. the phenotype of an organism is always its outward appearance.

B. environmental factors are more important than genotype in determining phenotype.

C. the phenotype of an organism is determined by its genotype and environmental factors.

D. the genotypes of all seal point Siamese cats are the same, but their phenotypes are different.

Question 14

An example of an epigenetic factor that can have an effect on the phenotype of an organism is histone modification. Histones are proteins that DNA wraps around so that the DNA is tightly coiled up and can fit inside the nucleus of the cell. If histones squeeze too tightly, however, the cell cannot 'read' the DNA.

Histone modification can be described as an epigenetic factor, which

A. modifies the expression of genes.

B. alters the sequence of the DNA molecule.

C. cannot be inherited even if it occurs in the gametes.

D. turns genes on permanently.

Use the following information to answer Questions 15–18.

In 2018, after five years of research by Australian and international scientists, it was announced that the first full sequencing of the koala genome had been completed. The Australian-led team, consisting of scientists from seven different countries, sequenced 3.4 billion base pairs in the DNA of the koala cells. They make up more than 26 000 genes, making it slightly larger than the human genome. Koalas have sixteen large chromosomes per somatic cell and a similar sex-determining chromosome system to humans and most other mammals.

Question 15

The genome of a koala would consist of

A. sixteen chromosomes.

B. eight chromosomes.

C. 1.7 billion base pairs.

D. 26 000 genes.

Question 16

Which one of the following sets of autosomes and chromosomes would a female baby koala inherit from its mother?

A. seven autosomes and one X chromosome

B. seven autosomes and two X chromosomes

C. eight autosomes and one X chromosome

D. fourteen autosomes and two X chromosomes

Question 17

Which one of the following can be drawn from studying the information provided from the Koala and Human Genome Projects?

A. The sequence of base pairs in the DNA would be the same in all members of the koala species, as they have the same gene loci on their chromosomes.

B. Koalas are more complex than humans, as they have a higher number of base pairs in their DNA than humans.

C. Identical human twins would have no differences in their genome, compared to many differences in non-identical twins.

D. The greater number of base pairs in the koala genome results in a higher diploid number.

Question 18

The Koala Genome Project will be helpful in many ways to support the conservation and preservation of koalas in Australia.

How would the project **not** be helpful for the conservation and preservation of koalas?

A. studying the relationship between the koala and other bears

B. providing knowledge about disease susceptibility and resistance in koalas

C. comparing current genetic diversity with koalas collected in the past

D. supplying information on the unusual and highly specialised diet of koalas

Use the following information to answer Questions 19 and 20.

The X chromosome in humans is significantly longer than the Y chromosome, as it has approximately 1098 genes compared to only 26 genes on the Y chromosome. Sixteen of the genes on the Y chromosome are for cell maintenance; nine are for sperm production and one is for male sexual traits. The single gene determining maleness is called the SRY gene. It is responsible for triggering the activation and regulation of another gene, the Sox9 gene, found on a non-sex chromosome. This Sox9 gene triggers the development of gonads into testes instead of ovaries, therefore determining the potential to be male. The SRY gene is called a Y-linked gene.

Question 19

Based on your knowledge of sex determination in humans and the information above, which one of the following statements is correct?

A. All daughters and sons of a male with a Y-linked trait will inherit the trait.

B. All grandsons of a male with a Y-linked trait will inherit the trait.

C. All male offspring of a mother with an X-linked dominant will must inherit the trait.

D. All sons of a father who has an X-linked dominant trait will inherit the trait.

Question 20

Males with Klinefelter syndrome have a diploid number of 47 due to having the sex chromosomes XXY. Symptoms include some breast development, abnormally big hips, tall height, infertility, and small testicles.

These males are infertile, as

A. they do not have the SRY and Fox9 genes needed for male development.

B. they cannot produce gametes because they cannot undergo prophase 1 of meiosis in their testes.

C. there are two copies of the X-linked sex genes, which switches off the Y-linked genes.

D. the SRY gene cannot activate the Sox9 gene, as the autosome on which the Sox9 gene is located is absent from their chromosome set.

Use the following information to answer Questions 21–25.

There are many different genes that control blood types in humans by determining the protein antigen that is on the surface of the red blood cells. The features of three of these genes are shown in the table below.

Function of gene	Locus of gene	Alleles of gene
controlling Rhesus (Rh) blood type	chromosome number 1	D = Rh positive; d = Rh negative
controlling MN blood type	chromosome number 4	L^M = antigen produced; L^N = antigen not produced
controlling ABO blood type	chromosome number 9	I^A =antigen A; I^B = antigen B; i = neither antigen

Another gene located on chromosome number 1 is the gene controlling production of salivary amylase, the AMY gene, that has the alleles A = amylase produced and a = no amylase produced.

Question 21

The genes for the three types of blood groups shown above

A. could be described as linked genes, as they are all functioning in a similar manner for antigen production.

B. all have two alternative forms of the gene.

C. would all be inherited at two gene loci on one chromosome.

D. could only have two alleles of each gene present in the cells of a normal person.

Question 22

If a man and a woman, both heterozygous for the Rh positive blood type, had three children and all were Rh positive, the chance that the second child was heterozygous Rh positive would be

A. $\frac{1}{3}$

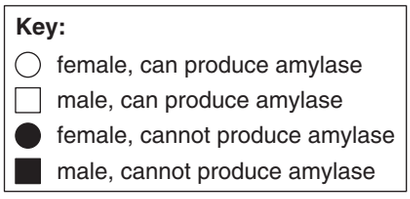
B. $\frac{1}{2}$

C. $\frac{2}{3}$

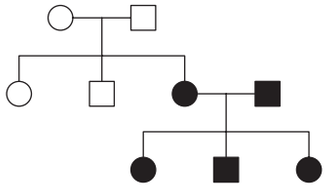
D. $\frac{3}{4}$

Question 23

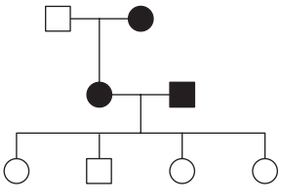
Which one of the following pedigrees shows the pattern of inheritance for the AMY gene?



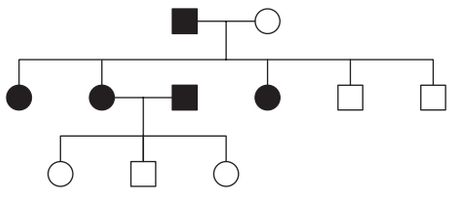
A.



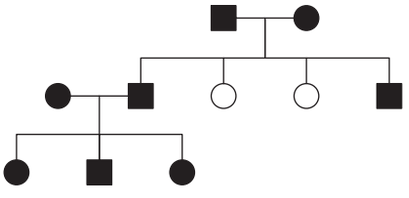
B.



C.



D.



Question 24

Carnivores such as cats do not produce salivary amylase, but herbivores such as rabbits or cows do.

What cross could be carried out to determine the genotype of rabbit Z,which can produce salivary amylase, assuming the pattern of inheritance is the same for rabbits as in humans?

A. Cross rabbit Z with another rabbit that could produce salivary amylase.

B. Cross rabbit Z with a rabbit that that could not produce salivary amylase.

C. Cross rabbit Z with a rabbit that was heterozygous for amylase production.

D. Cross rabbit Z with a rabbit that was homozygous for amylase production.

Question 25

A man who was heterozygous for Rh blood type and heterozygous for production of amylase married a woman who was Rh negative and could not produce salivary amylase. They had four children.

Based on your knowledge and the information given, what is the probability that their first child was Rh positive but unable to produce salivery amylase?

A. 75%

B. 25%

C. more than 75%

D. less than 25%

END OF SECTION A

SECTION B

Instructions for Section B

Answer **all** questions in the spaces provided. Write using blue or black pen.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

Question 1 (8 marks)

The photograph below is of a sea anemone, a marine predatory animal, often found attached to rocks or hard surfaces. A typical sea anemone is a single polyp, with its body consisting of an elongated sac with one opening at the top. This 'mouth' is surrounded by tentacles used to catch prey in the water.

Source: Kaori Hayama Unsplash (2018). Accessed July 2020.http://unsplash.com/photos/upDzVKYjS2c

Sea anemones breed by releasing sperm and eggs through their mouth into the sea water, either from one hermaphroditic parent or two parents of different sexes. The fertilised eggs develop into larvae that eventually settle on the seabed and develop into young polyps. Sea anemones also breed by breaking into smaller pieces that regenerate into polyps. When sea anemones split into two by longitudinal or transverse fission, they are essentially 'producing identical twins from a single specimen'.

a. **i.** What is the specific name given to the type of reproduction by sea anemones that is **not** through the fertilisation of eggs by sperm? 1 mark

_____

ii. Why is the tpe of redroduction names in **part a.i.** often called 'cloning'? 1 mark

_____

_____

iii. How is the type of reproduction named in **part a.i.** different to the production of identical twins in humans and other mammals? 2 marks

_____

_____

_____

_____

Sea anemones will reproduce sexually for much of their mature lifetime, but especially when food is in low availability or the survival of the sea anemone is jeopardised by some other adverse factor.

b. **i.** Explain **one** of the main biological advantages of this sexual method of reproduction compared to the asexual method of splitting into smaller pieces. 2 marks

_____

_____

_____

_____

ii. Using the information given, suggest another advantage of sexual reproduction in sea anemones. 1 mark

_____

_____

Cloning has also been used extensively and successfully in plant horticulture to grow economically important crops, including vegetables (such as potatoes) and fruits (such as bananas, strawberries and dates). This agricultural practice can result in a reduction in the number of crop species grown, or even result in monocultures where only one species is grown.

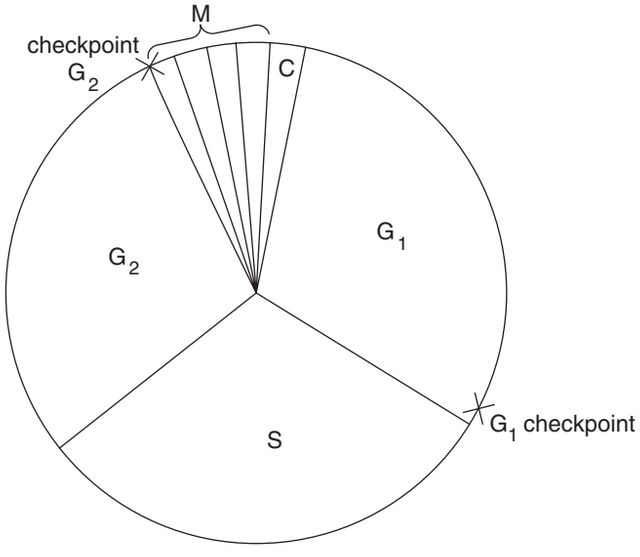
c. Comment on a major problem that could arise if such monoculture crops are grown, even when the climatic environmental conditions are relatively stable. 1 mark

_____

_____

Question 2 (5 marks)

The DNA molecule contains all the information needed for the structure and functioning of the cells. Every time DNA replicates in the cell cycle, there is a chance that an error or mutation could occur. To ensure that any mutations in the DNA are repaired before the final cell division at the end of the cell cycle, there are checkpoints in the cycle. If there is DNA damage or some other problem, a group of chemicals called CDK inhibitors will inhibit and stop the cell cycle. CDK promoters will allow the cycle to progress if no damage or other problems are detected. These checkpoints are shown on the simplified cell cycle diagram below.



Checkpoint G_1 is located towards the end of G_1 before DNA synthesis occurs.

a. Why would it be necessary to checkthe size of the cell and for any damage to the DNA at the G_1 checkpoint? 1 mark

Checkpoint G_2 is located at the end of G_2 after DNA synthesis and G_2 are complete.

b. Why would it be important to have a checkpoint here? 1 mark

Two types of genes play an important role in regulating the cell cycle: proto-oncogenes which stimulate cells to grow and divide, and tumour-suppressor genes, which inhibit cell division. If the activities of these two gene types are in balance, normal body cells will divide at an appropriate rate for their position in the body and their function. If a mutation occurs in one of the two gene types, a person may have a genetic predisposition that results in an increased risk of developing a disease.

c. What type of disease would be likely if there was a mutation in these genes? 1 mark

There are environmental and lifestyle factors that can induce or increase the rate of mutation in the DNA.

d. **i.** What is the name given to such factors? 1 mark

_____

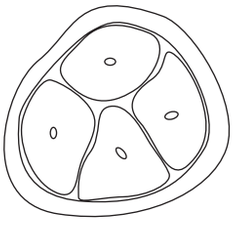
ii. Give **one** example of a factor that can induce or increase the rate of mutation in the DNA. 1 mark

_____

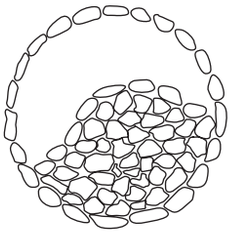
Question 3 (7 marks)

The diagrams below show four sources of stem cells which can be harvested and cultured in the laboratory.

I. four-cell embryo

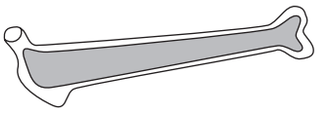


II. inner cell mass of blastocyst



III. umbilical cord blood from newborn

IV. adult bone marrow



The different sources of stem cells produce different types of stem cells.

a. What are the **two** unique features common to all four types of stem cells? 2 marks

_____

_____

b. **i.** Cell types III and IV are referred to by the term 'multipotent'.
What term is used for cell type I? 1 mark

_____

ii. Why is a different term used for type I stem cells compared to types III and IV? 1 mark

_____

_____

c. Outline **one** ethical issue that has resulted in considerable debate associated with the use of stem cells sourced from types I and II. 1 mark

_____

_____

People seriously burnt in the volcanic blast that occurred in New Zealand in late 2019 collectively needed metres of skin for skin grafts.

d. **i.** Which of the four cell types would be best for generating skin tissue? Explain why. 1 mark

_____

_____

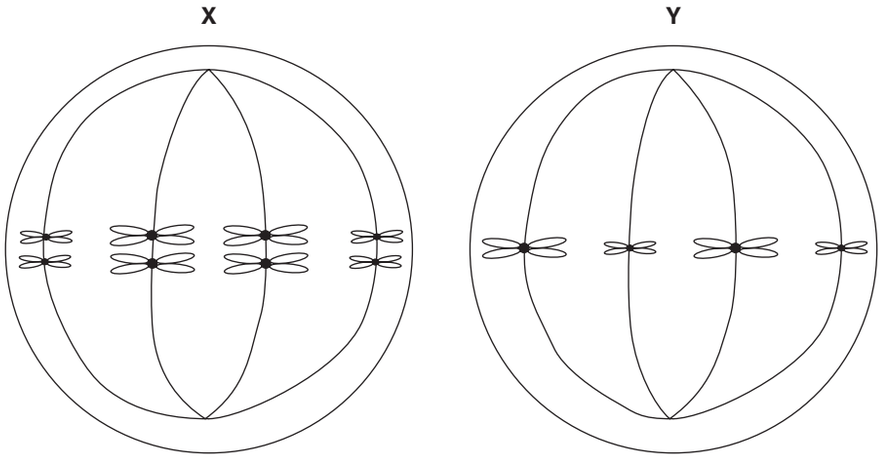
ii. What is **one** disadvantage of using stem cell-generated skin tissue that is **not** derived from the person's own cells? 1 mark

_____

_____

Question 4 (15 marks)

The two cell types shown in the diagram below are found in the same organ of a *Drosophila* fly and are two stages of the same process.



a. **i.** Name the process shown in the above diagrams **and** the organ in a fly in which it would occur. 2 marks

ii. Name the **two** different stages of the process shown in X and Y. 1 mark

iii. The names of the two stages of the process share a word in common.
What happens in the process that justifies the use of the same word in both names? 1 mark

iv. One number is different in the names of the two stages of the process.
What happens in the process that requires the use of different numbers in the two names? 1 mark

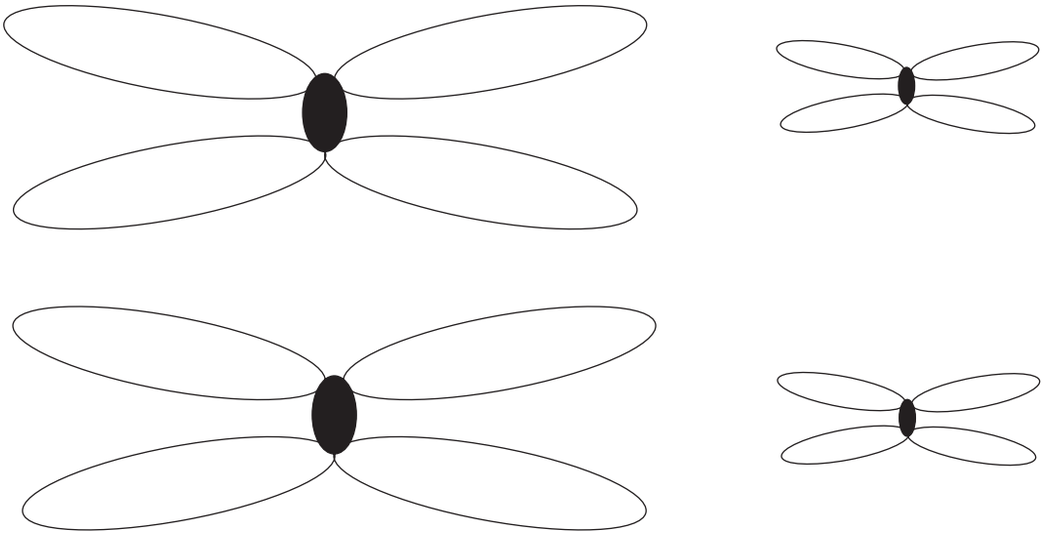
b. **i.** On the diagrams on the previous page, circle **one** pair of homologous chromosomes **and** identify why they are called homologous chromosomes. 2 marks

_____

_____

ii. The following diagram shows four chromosomes belonging to an fly that is homozygous dominant for trait G, heterozygous for trait H and homozygous recessive for trait A. G, H and A are linked genes.

On the diagram below, mark the positions of each allele on each chromatid using the letters G, H and A. 3 marks



c. The gene for the trait B, gene B, is not linked to genes G, H and A.

i. The fly is homozygous recessive for gene B.

On the diagram in **part b.ii.**, mark the position of the alleles of gene B. 1 mark

ii. If 100 *Drosophila* flies that were heterozygous for genes G and H were crossed with 100 flies homozygous recessive for genes G and H, what would be the predicted ratio of the four types of offspring? 1 mark

_____

_____

iii. What is the name of the type of cross described in **part c.ii.**? 1 mark

_____

iv. 100 *Drosophila* flies that were heterozygous for genes G and B were crossed with 100 flies homozygous that were recessive for genes G and B.

Is the predicted ratio the same as the ratio given in **part c.ii.**? Justify your answer. 2 marks

_____

_____

_____

_____

Question 5 (11 marks)

Two Year 11 Biology students were discussing various genetic disorders and diseases. Peggy said her neighbours had a daughter, Matilda, with Down's syndrome, and explained that Matilda inherited it as an autosomal dominant trait, as it affected features of her body. Jack disagreed with Peggy. He used inheritance of Huntington's disease as an example of an autosomal dominant disorder.

a. Explain the meaning of the phrase 'autosomal dominant trait'? 2 marks

Peggy's teacher told her she was incorrect and needed to do more research on Down's syndrome. Peggy found that Down's syndrome occurs due to a problem during meiosis in one of the parents' sex organs, resulting in one of the gametes carrying an extra chromosome.

b. **i.** What is the name given to a disorder where there is an extra chromosome in the chromosome set of a person? 1 mark

ii. Draw and label Matilda's karyotype. Show the last four pairs of autosomes, labelled with pair numbers 19, 20, 21 and 22, and her sex chromosomes, labelled appropriately. Indicate the diploid number for Matilda's cells. 3 marks

Diploid number for Matilda's cells _____

The teacher told Jack that his example was correct, as the trait for Huntington's disease is dominant. The disease has a late onset and the symptoms most commonly appear in people between 30–50 years of age. Jack decided to do a Punnet square diagram to determine the probability of an unaffected woman and a man, heterozygous for Huntington's disease but showing no symptoms at 25 years old, having a child with the potential to develop Huntington's disease.

c. **i.** Assigning appropriate symbols for the alleles, show the Punnet square diagram Jack would have drawn **and** state the probability of the child having Huntington's disease. 2 marks

Probability of the child having Huntington's disease _____

ii. Could a heterozygous offspring be a carrier? Justify your response. 1 mark

_____

_____

iii. Jack then drew a pedigree of three generations to conclusively show that the inheritance of Huntington's disease is autosomal dominant, not recessive or sex-linked.

In the following space, draw an example of this pedigree. 2 marks

Question 6 (4 marks)

In 2019, a company offered an online promotion over the Christmas period, offering up to 50% off the price of DNA home testing kits. There were a variety of kits offered, the most expensive and comprehensive being a Premium DNA Test Kit for Health (testing for the risk of common health conditions and diseases), Vitality (testing for nutrition, skin, stress, ancestry) and Family Planning. The test kit contained a code to activate an official app, the materials required to collect an inner-cheek cell swab and a package in which to return the sample.

a. **i.** Why is it necessary for the person who purchases a kit to take a swab of their inner-cheek cells? 1 mark

_____

_____

ii. The test involves complete exome sequencing technology.

What is being analysed in this process? 1 mark

_____

_____

iii. What may the sequencing result indicate that would be beneficial for family planning? 1 mark

_____

_____

b. This type of genetic screening can be carried out on embryos as well as adults. There are, however, several social and ethical implications regarding such tests.

Identify **one** of these implications. 1 mark

_____

_____

END OF QUESTION AND ANSWER BOOKLET

Neap

Trial Examination 2020

VCE Biology Unit 2

Written Examination

Multiple-choice Answer Sheet

Student's Name: _____

Teacher's Name: _____

Instructions

Use a **pencil** for **all** entries. If you make a mistake, **erase** the incorrect answer – **do not** cross it out. Marks will **not** be deducted for incorrect answers.
No mark will be given if more than **one** answer is completed for any question.

All answers must be completed like this example: A B **C** D

Use pencil only

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