Neap

Trial Examination 2021

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	7	7	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 the 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.

Question 1

Binary fission in prokaryotic cells can occur at a much faster rate than cell division in eukaryotic cells. This is because prokaryotic cells

A. do not contain membrane-bound organelles.
B. do not undergo DNA replication.
C. do not carry out mitosis.
D. are much smaller, which allows for faster cytokinesis.

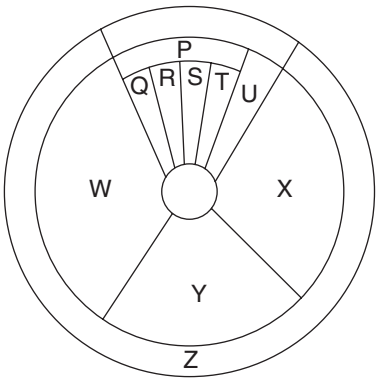
Question 2

The advantage of sexual reproduction from an evolutionary point of view is that

A. it allows plant breeders to produce genetically uniform crops.
B. all the offspring will be well-suited to the same environment as the parents.
C. dispersal into new environments is more readily achieved.
D. there is greater variation in the offspring, increasing the chances of the species' survival.

Use the following information to answer Questions 3–5.

The following diagram shows the cell cycle in eukaryotic cells.



Question 3

In the cell cycle above, two cells are produced at the end of stage

A. P.

B. U.

C. Y.

D. W.

Question 4

Interphase includes stages

A. Z and P.

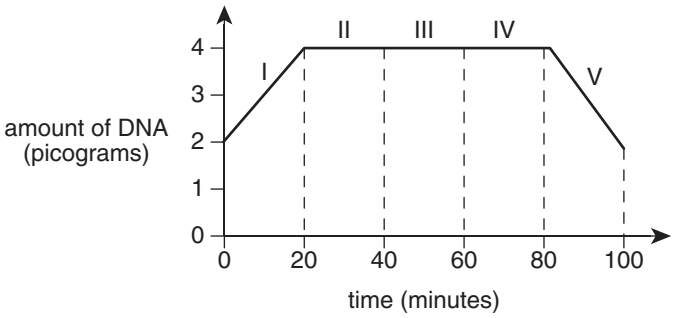
B. P and U.

C. W, Y and X.

D. Y, W and P.

Question 5

The following graph shows the changes in the amount of DNA in a cell during the cell cycle.

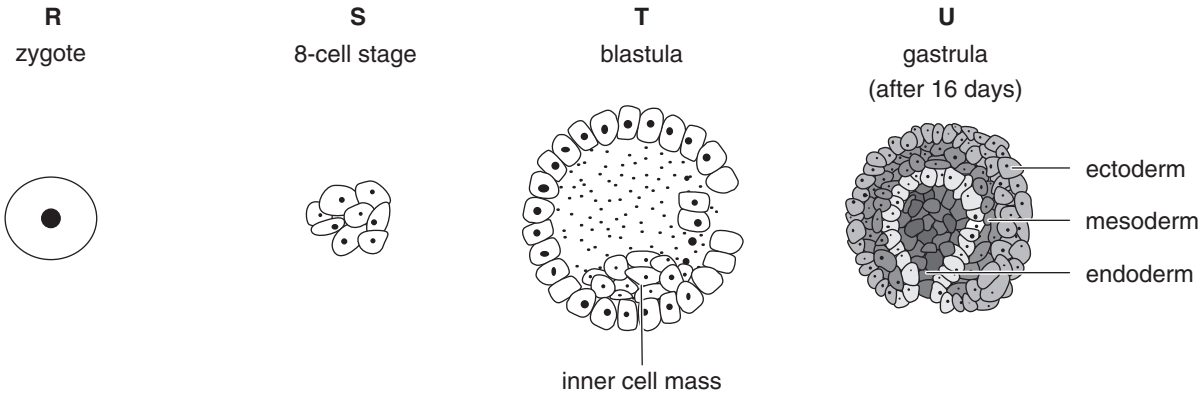


Which row correctly matches a stage of the cell cycle with the change in the amount of DNA during that stage?

	Stage of the cell cycle	Change in the amount of DNA
A.	R	II
B.	S	V
C.	X	I
D.	Y	III

Use the following information to answer Questions 6–8.

The following diagram shows the stages of development from a human zygote (fertilised egg) through its development (stages R–U). Five days after fertilisation, the zygote has divided into a ball of over 100 cells and formed a blastula. The outer layers of the blastula will form the placenta, while the inner mass will form the developing embryo, as shown in stage U below.



Question 6

The cells of the inner cell mass at stage T are

A. totipotent.

B. pluripotent.

C. multipotent.

D. unipotent.

Question 7

The cells at stage U

A. are already predetermined for a particular cell type.

B. can no longer divide by mitosis as they are specialised.

C. are capable of differentiation into all cell types.

D. are fully specialised.

Question 8

The cells at stage U make up three primary layers that form specialised cells, tissues and organs.

Which one of the following statements is correct?

A. Ectoderm cells will form cardiac and skeletal muscle cells.

B. Endoderm cells will produce heart and blood vessels.

C. Mesoderm cells will form the inner layers of the digestive and respiratory system.

D. Ectoderm cells will form the skin and pigment layers.

Use the following information to answer Questions 9–12.

The cell cycle is strictly controlled by checkpoints that ensure that a cell divides in an ordered manner. If the checkpoints fail, the result may be abnormal development of an embryo or cancer/tumour formation. Carcinogens are agents that can cause cancer; 90% of carcinogens are called mutagens, as they damage the DNA.

Most human cancers occur if mutations appear in:

- the proto-oncogenes, which initiate cell division and regulate normal cell development
- the tumour-suppressor genes, which switch off cell division.

Normally these genes work in balance in humans but, if mutations occur, especially in tumour-suppressor genes, cancers develop.

Question 9

In the cell cycle, there are checkpoints towards the end of the G1 phase, at the end of the G2 phase and during mitosis.

Which row correctly matches the checkpoint with its function?

	Checkpoint	Function
A.	G2	ensures that the amount of DNA has been halved
B.	mitosis	ensures that homologous chromosomes are attached to spindles
C.	G1	ensures that nutrients are sufficient and cell size and growth are normal
D.	G2	ensures that the DNA replication has produced identical chromosomes attached by the centromeres

Question 10

If a mutation appears in a tumour-suppressor gene, which one of the following would **not** occur?

A. uncontrolled cell division

B. apoptosis (cell death) of cells with DNA damage

C. unchecked cell proliferation

D. small amounts of repair to damaged DNA in cells

Question 11

Which one of the following is **not** a mutagen that can induce or increase the rate of mutations in DNA?

A. X-rays and nuclear radiation

B. some of the wavelengths of sunlight

C. some viruses such as the human papillomavirus

D. chlorine in filtered swimming pools

Question 12

Genetic predisposition means a person has an increased likelihood of developing a particular disease due to the presence of one or more gene mutations. For example, certain mutations in the BRCA1 and BRCA2 genes are involved with breast and ovarian cancer.

Which one of the following is a correct statement about these genes?

A. If a person has a mutation in this kind of gene, they will definitely develop the disease.

B. Lifestyle choices are important in cases of genetic predisposition, as they cause the disease.

C. A genetic predisposition results from specific genetic variations that are often inherited from a parent.

D. People with the genes for a genetic predisposition are less likely to develop cancers than people without the genes.

Question 13

Cell differentiation

A. involves the gain of genes during cell division.

B. results in four daughter cells from a single parent cell.

C. occurs in certain regions of all multicellular organisms.

D. occurs only in embryos to produce different types of tissues.

Question 14

A fine hair was tied around a dividing tadpole embryo at the two-cell stage, resulting in partial separation. The two cells developed into two tadpoles attached to each other.

These two tadpoles would most likely

A. have different genotypes.

B. be the same sex.

C. have the same mass.

D. have the same phenotype.

Use the following information to answer Questions 15 and 16.

In 1983, researchers observed that tumour tissue from patients with bowel cancer had less methylation than normal tissue from their other body parts.

Question 15

Genes that are methylated are usually switched off and do not express.

The decrease in methylation in the cells in the bowel would have resulted in

A. an alteration of the structure of the DNA in the chromatin.

B. changes in the nucleotide sequences in the DNA.

C. an increased action of tumour-suppressor genes.

D. less chance of cancer occurring.

Question 16

This research is an example of the effect of

A. genotype on the organism's phenotype.

B. epigenetics on the organism's genotype.

C. phenotype on the organism's genotype.

D. epigenetics on the organism's phenotype.

Question 17

Ichthyosis, a form of skin disease, is caused by the hereditary deficiency of a steroid hormone and is due to deletion mutations in the STS gene. It affects one in 2000–6000 males, whereas far fewer females have the condition.

This is because

A. females would only have one copy of the ichthyosis gene in their genotype.

B. females alter their genotype with the use of creams to moisturise their skin.

C. the pattern of inheritance is Y-linked dominant.

D. the ichthyosis gene is sex-linked on the X chromosome.

Question 18

'Hair colour, like skin colour, is an example of polygenic inheritance.'

Which one of the following examples correctly supports this statement?

A. Chromosomes 3, 6, 10 and 18 have genes coding for the dark pigment in hair called melanin.

B. The greater the number of alleles for melanin in a person's genotype, the darker their hair.

C. Pheomelanins are the red hair pigments that determine one of the two phenotypes.

D. Hair colour is the result of many chromosomes coding for redness or darkness.

Use the following information to answer Questions 19 and 20.

In cattle, a single autosomal gene determines whether an animal is polled (meaning hornless) or horned. Polled is the dominant trait.

Question 19

A polled bull whose mother was horned was mated with a herd of heterozygous polled cows.

What is the probability of polled offspring being heterozygous?

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

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

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

D. 1

Question 20

A farmer wanted to determine if a bull was homozygous polled or heterozygous polled.

Which one of the following could be used to determine this information?

	Type of cross	Type of cow to mate the bull with
A.	test cross	horned cow
B.	reciprocal cross	horned cow
C.	test cross	polled cow
D.	back cross	polled cow

Question 21

Red-green colour blindness is a sex-linked recessive characteristic. A woman with red-green colour blindness had children with a man who was not red-green colour blind.

The most likely outcome is that

A. all of their children would be red-green colour blind.

B. none of their children would be red-green colour blind.

C. half of their daughters would be red-green colour blind.

D. all of their sons would be red-green colour blind.

Use the following information to answer Questions 22–25.

The vinegar fly, *Drosophila melanogaster*, has four pairs of chromosomes. Genetic studies have mapped the genes of many of the traits of this species. The loci of some of the genes are shown in the following table.

Name of trait	Allele symbol	Description	Chromosome number	Dominant (D) or recessive (R) trait	Locus
arc wings	a	wings curved down	2	R	99.2
bar eyes	B	reduced eye shape	1	D	57.0
bent wings	bt	wings bent up	4	R	1.4
bobbed bristles	bb	short bristles	1	R	66.0
brown eyes	bw	brown eye colour	2	R	104.5
javelin bristles	jvl	cylindrical bristles	3	R	56.7
wrinkled wings	W	wrinkled wings	3	D	46.0
sparkling eyes	spa	rough, bulging eyes	4	R	3.0
vermillion eyes	v	vermillion eye colour	1	R	33.0
vestigial wings	vg	reduced wing size	2	R	67.0

Question 22

Using the information in the table above, what is the genotype of a male fly with wrinkled wings and short bristles?

A. Wwbbbb

B. WWbb

C. wwbbbb

D. WwBbBb

Question 23

Flies heterozygous for wrinkled wings and unaffected eye colour were crossed with flies with unaffected wings and vermillion eyes.

Which row gives the expected ratio of traits that would be seen in their offspring?

	Unaffected wings and unaffected eyes	Unaffected wings and vermillion eyes	Wrinkled wings and unaffected eyes	Wrinkled wings and vermillion eyes
A.	1	1	few	few
B.	1	1	1	1
C.	9	3	3	1
D.	2	1	2	1

Question 24

The two traits that would illustrate linkage with the highest percentage of crossing-over would be

A. bent wings and sparkling eyes.

B. bobbed bristles and vermillion eyes.

C. wrinkled wings and javelin bristles.

D. brown eyes and vestigial wings.

Question 25

Crossing-over is important as it

A. reduces the likelihood that daughter cells that form gametes will contain different genetic material.

B. mixes up the alleles between the two chromatids of one of the homologous chromosomes.

C. increases genetic variation in the daughter cells and ultimately the offspring that are produced.

D. changes the alleles of the genes, which increases genetic diversity.

SECTION B

Instructions for Section B

Answer **all** questions in the spaces provided.

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

Question 1 (6 marks)

As part of their study of asexual reproduction, Biology students were shown the following two diagrams and asked to complete a table with information about the diagrams.

Diagram 1

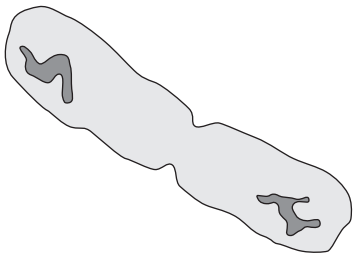
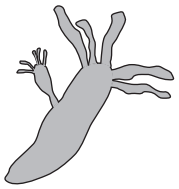


Diagram 2



a. One student wrote their responses in the table as shown below. They did not complete every cell of the table and some of the information that they included was incorrect.

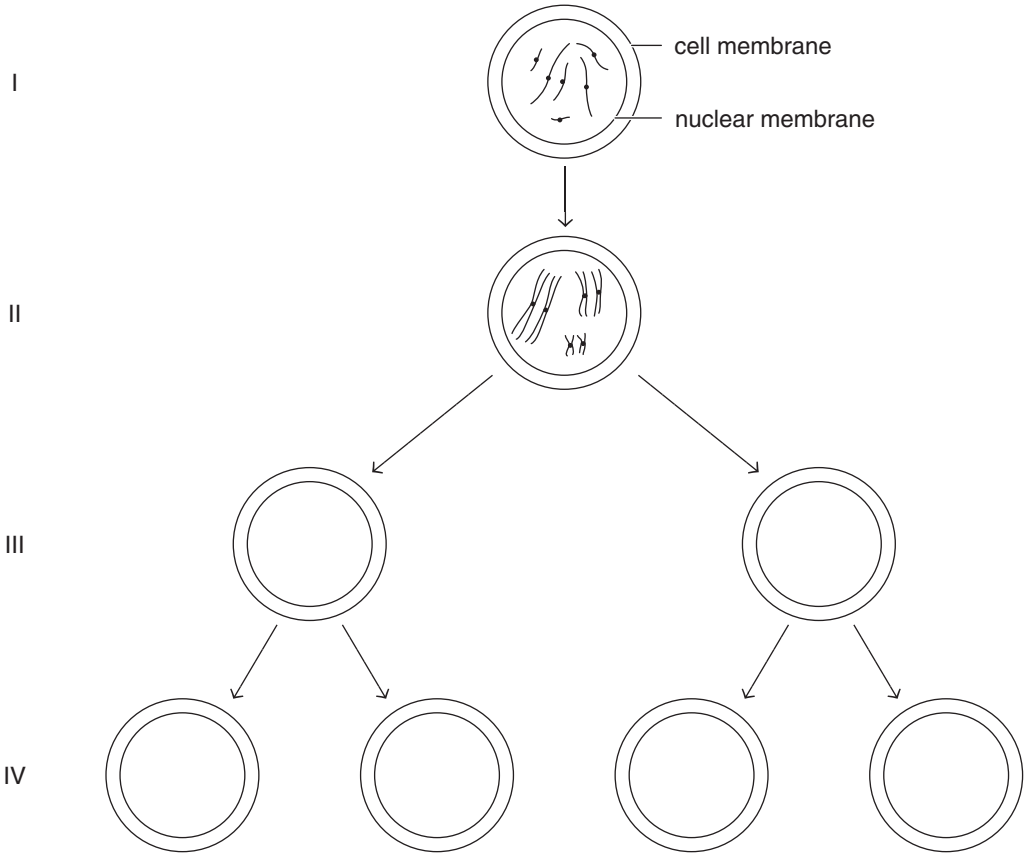
Complete the table below by filling in the two empty cells with the correct information. 2 marks

	Diagram 1	**Diagram 2**
Type of reproduction	asexual reproduction	sexual reproduction
Name of reproduction	binary fusion	
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		The species can adapt to new environments due to variation, which gives them a survival advantage.

b. The teacher told the student that they had made five errors in the cells that they had completed.
Identify **four** of the errors that the student made in the table. Justify your answers. 4 marks

Question 2 (11 marks)

Aedes aegypti is a type of mosquito that carries yellow fever. The following diagram shows the various stages of one cycle of meiosis in a female *Aedes aegypti.* Some of the cells have been left empty.



a. **i.** Identify **two** pieces of evidence in the diagram above that suggest the type of cell division is meiosis. 2 marks

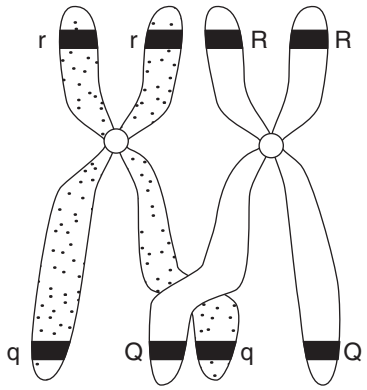
ii. Complete the diagram above with the chromosomes that would be found in the cells at stages III and IV. 2 marks

b. **i.** What is the diploid number of the cells of the *Aedes aegypti?* 1 mark

ii. Two Biology students were discussing this example. Susie said the initial ovary cell of the female mosquito in which meiosis was occurring would be called a somatic cell. Ted said it would be called a sex cell as it resulted in the production of gametes.

Which student is correct? Explain your answer using the terms 'haploid' and 'diploid'. 2 marks

c. During meiosis, the process illustrated in the diagram below could be observed.



i. What is the name of this process and in which stage(s) of meiosis would it be observed? 2 marks

Name _____

Stage(s) _____

ii. A cell containing the pair of chromosomes in the diagram above underwent meiosis to produce new cells.

State the combinations of alleles that would be present in these cells using the allele symbols in the diagram above. 1 mark

iii. Outline the significance of the process shown in the diagram above to the *Aedes aegypti*. 1 mark

Question 3 (6 marks)

Plant cloning has been used to create hybrid strains of fruit, vegetables and grains that are high-yielding, drought- and frost-tolerant and disease-resistant. The strains can be reproduced exactly over and over. The benefits of plant cloning in commercial farming are assumed to outweigh any potential negatives, but a major problem in nature could result due to its overuse.

a. **i.** What is meant by 'reproduced exactly over and over'? 1 mark

ii. Give an example of a crop that has been successfully cloned commercially. 1 mark

iii. Outline the 'major problem in nature' that could result from plant cloning. 1 mark

Many people are far more comfortable with plant cloning than animal cloning. Because identical twins are naturally occurring clones, some people believe cloning is a technological version of a natural process. This argument is often used to justify the ethics of human cloning.

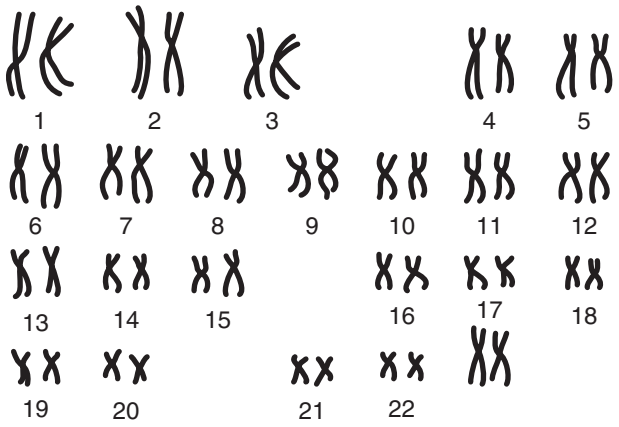
b. **i.** What is meant by 'a technological version of a natural process'? 1 mark

ii. What term would be used to describe the potency of the source of the initial cells used in animal cloning? 1 mark

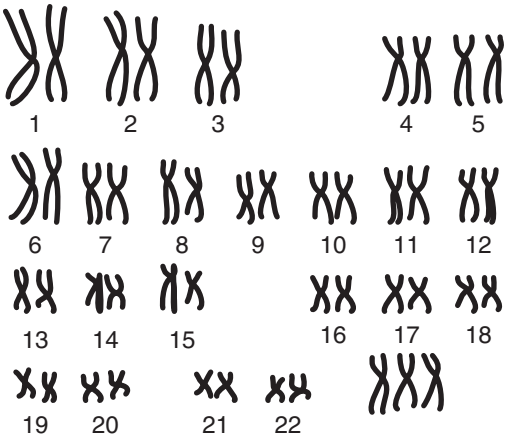
c. With reference to your answer to **part b.ii.**, what is an ethical issue that has prevented research on human cloning? 1 mark

Question 4 (7 marks)
The following karyotypes are from two different people.

Karyotype 1



Karyotype 2



a. **i.** What term is used for the numbered chromosomes? 1 mark

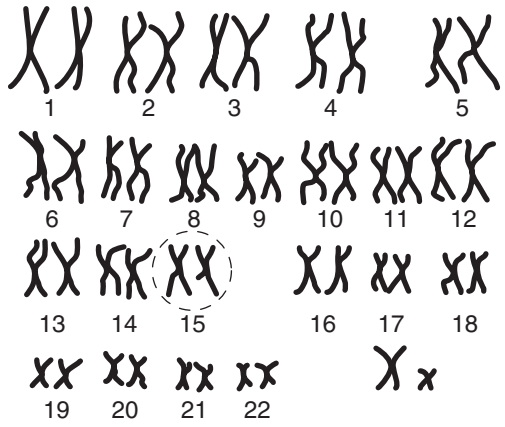
ii. How are the numbered chromosomes different to the chromosomes without numbers? 1 mark

b. **i.** How is karyotype 2 different from karyotype 1? 1 mark

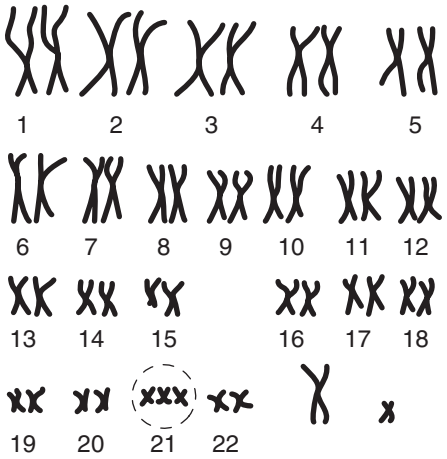
ii. Why would the difference in karyotype 2 identified in **part b.i.** affect individuals who have that karyotype? 1 mark

The following karyotypes are from another two people. In each, a chromosomal abnormality has been circled. Karyotype 3 shows Angelman syndrome and karyotype 4 shows Down's syndrome.

Karyotype 3 (Angelman syndrome)



Karyotype 4 (Down's syndrome)



c. **i.** Outline whether the circled chromosome pair in karyotype 3 could be called a homologous pair. 1 mark

ii. Are karyotypes 3 and 4 from people of the same sex as karyotypes 1 and 2? Justify your response. 1 mark

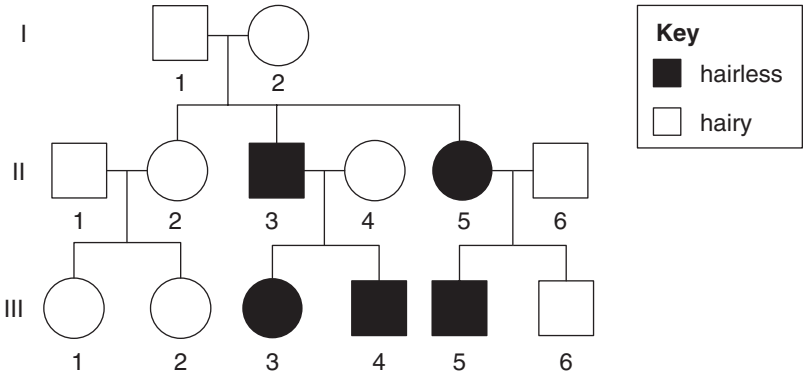
d. Angelman syndrome is caused by genes being deleted or inactivated on chromosome 15 from the mother, occurring in roughly one in 15 000 individuals. If the same defect is on the paternal chromosome, a different syndrome called Prader–Willi syndrome results. The following table lists some of the common symptoms of the two syndromes.

Angelman syndrome	Prader–Willi syndrome
• arm flapping • excessive laughing, even when hurt • an uneven/convulsive gait • learning difficulties	• intellectual disability • behavioural problems • short stature • constant hunger

What causes the differences in the symptoms of the two syndromes? 1 mark

Question 5 (8 marks)

Several breeds of dogs are hairless, including Mexican hairless dogs (MHD), Chinese crested dogs (CCD) and American hairless terriers (AHT). Only two types of hairless gene have been reported. The gene in the MHD and the CCD is different to the gene in the AHT, though both types are inherited in autosomal patterns. The following pedigree shows the pattern of inheritance of the hairless trait in the AHT.



a. Is the pattern of inheritance of the hairless phenotype in the AHT autosomal dominant or recessive? Justify your choice. 2 marks

Diana decided to use the allele symbols H for hairless and h for hairy when she was doing a genetics problem on the CCD. She had read about a breeding program using the CCD that reported that matings between hairless CCD resulted in both hairless and hairy male and female offspring.

b. **i.** From the symbols Diana allocated, what had she deduced? Explain your answer. 2 marks

ii. Using the allele symbols Diana allocated, determine the ratio of hairless to hairy offspring of the offspring produced by two heterozygous CCD dogs. Show your working. 2 marks

c. When carrying out breeding with heterozygous hairy CCD, the birth ratio noted in litters was 1 : 2. There were no pure-bred hairless CCD.

i. What is meant by the term 'pure breeding'? 1 mark

ii. Suggest a reason why there were no pure-bred hairless CCD in the breeding results obtained. 1 mark

Question 6 (9 marks)

Budgerigars have many genes that control feather colour. These genes combine to produce different feather colours. Light green is referred to as 'wild type', as it is the most common, but over 30 colour variations have arisen from mutations of the genes.

a. What term is used to describe this pattern of inheritance? 1 mark

The following table shows the genotypes that correspond to four different phenotypes that commonly appear in budgerigar populations.

Green	Blue	Yellow	White
BBYY, BBYy, BbYY, BbYy	BByy, Bbyy	bbYy, bbYY	bbyy

b. How many gene loci are involved in the pattern of inheritance of these four phenotypes? 1 mark

c. Two blue budgerigars with the genotype Bbyy were mated and produced offspring.

i. What is the chance that the offspring has the same genotype as its parents? Show your working. 3 marks

ii. What is the chance that the offspring has the same phenotype as its parents? 1 mark

d. Jimmy was given three green budgerigars by his parents. He wanted to know if their genotype was BBYY and not one of the other three possible genotypes. Jimmy decided to use the quickest breeding cross to find their genotypes. However, this breeding cross required another budgerigar of a different colour.

i. What were the phenotype and genotype of the budgerigar he needed for this cross? 1 mark

ii. Explain how the results of the breeding cross would indicate the genotypes of the three green budgerigars. 2 marks

Question 7 (3 marks)

Genetic screening is used to identify specific genes, often harmful ones, in gametes, developing babies, children and adults. In one technique called pre-implantation genetic diagnosis (PGD), one cell is removed from the eight-cell stage after fertilisation and the genetic material is tested for a specific gene. If the test is negative, the blastula that develops from the cells is implanted into the mother.

a. **i.** Is this type of genetic screening embryonic or foetal PGD? Justify your choice. 1 mark

_____

_____

ii. In carrying out PGD, why is the sample of genetic material tested at this early stage of development? 1 mark

_____

_____

b. This technique is most often used if the parents have a genetic disorder (for example, genetic deafness) or are both carriers of a genetic disorder (such as thalassemia, a form of anaemia). Although PGD showcases some positive applications of genetic screening, there are several ethical issues.

Outline **one** of these issues. 1 mark

_____

_____

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END OF QUESTION AND ANSWER BOOKLET