Neap:

Trial Examination 2017

VCE Biology Units 1&2

Written Examination

Question and Answer Booklet

Reading time: 15 minutes
Writing: 2 hours 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	40	40	40
B	15	15	80
			Total 120

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 36 pages.

Answer sheet for multiple-choice questions.

Instructions

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

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 and hand them in.

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** for the question.

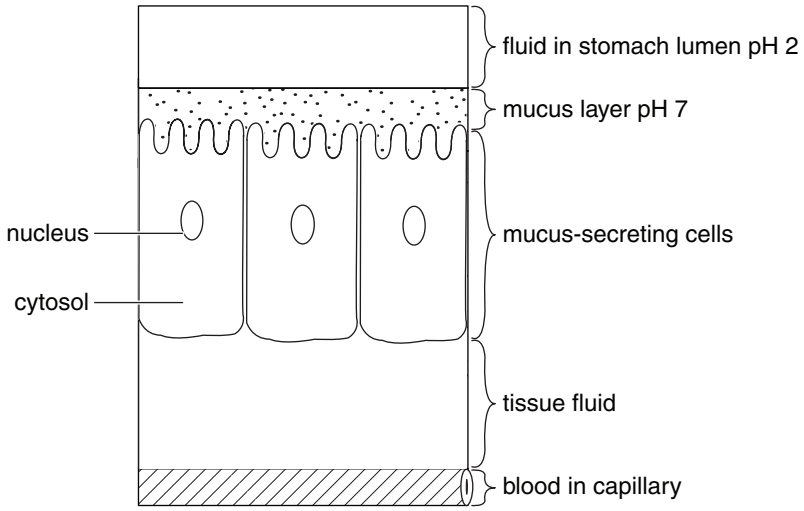
A correct answer scores 1, an incorrect answer scores 0.

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

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

Use the following information to answer Questions 1–5.

The following diagram shows some cells lining the stomach that secrete mucus (consisting of large glycoprotein molecules in a watery solution) into the cavity or lumen of the stomach.



Question 1

Which of the following organelles in these mucus-secreting cells would be involved in the secretion of the mucus?

A. ribosomes

B. vesicles

C. endoplasmic reticulum

D. lysosomes

Question 2

The process involved in the secretion of the mucus glycoprotein molecules from these cells is called

A. osmosis.

B. active transport.

C. endocytosis.

D. exocytosis.

Question 3

In the diagram of the mucus-secreting cells, the parts shown which make up the internal environment of the human body include

A. mucus.

B. stomach lumen fluid.

C. tissue fluid.

D. cytosol.

Question 4

The surface of the mucus-secreting cells facing the lumen of the stomach is shaped differently to the other three surfaces of the cells.

This is a

A. structural adaption to increase mucus absorption.

B. functional adaptation to aid food movement through the stomach.

C. structural adaptation to increase surface area.

D. physiological adaption to help keep the surface moist.

Question 5

Comparing the differences in the pH values of the various fluids in the regions shown on the diagram, it can be deduced that the mucus is important to

A. help make the stomach lining slippery to aid food movement.

B. stop the enzymes which aid food digestion from damaging the cells.

C. form a protective barrier for the cells from the acid stomach fluid.

D. neutralise the internal and external fluids.

Question 6

Most absorption occurs in the small intestine, however certain lipid-soluble substances (for example, aspirin) and 10–20% ethanol (alcohol) are absorbed in the stomach.

The absorption of alcohol into the blood capillary would be by

A. diffusion through the phospholipid bilayer of the cell membranes.

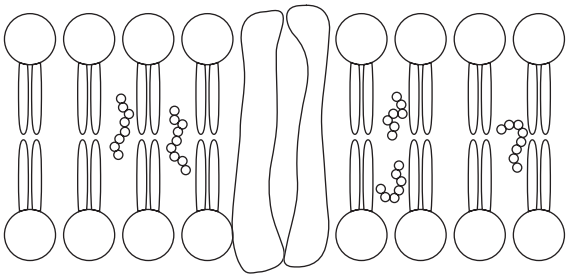
B. facilitated diffusion through protein channels of the cell membranes.

C. osmosis through the small spaces in the phospholipid bilayer.

D. active transport using protein carriers in the cell membranes.

Use the following information to answer Questions 7 and 8.

The following diagram shows the structure of the plasma membrane in cells as modelled in the fluid mosaic model.



Question 7

The hydrophilic part of the plasma membrane faces the outer and inner environments of the cell to

A. absorb water.

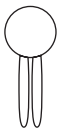
B. repel lipid-soluble substances.

C. allow lipid-soluble substances to pass through.

D. keep both surfaces moist.

Question 8

From the diagram above, what does the image below represent?



A. the phospholipid bilayer

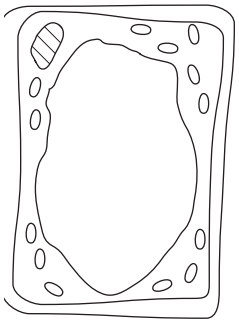
B. 2 glycerol and 1 fatty acid

C. a phospholipid molecule

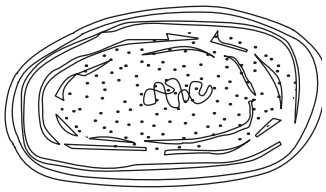
D. a triglyceride molecule

Use the following information to answer Questions 9–12.

The following two diagrams show a plant green leaf cell, cell A, and a cyanobacterial cell, cell B.



cell A (× 400)



cell B (× 30 000)

Question 9

Which of the following would not be present in both cell types?

A. cell wall

B. cell membrane

C. nucleolus

D. ribosomes

Question 10

For cell A, which pair of terms is correct?

A. heterotroph/chemosynthetic

B. heterotroph/photosynthetic

C. autotroph/chemosynthetic

D. autotroph/photosynthetic

Question 11

Cell B would not carry out aerobic cellular respiration as it

A. absorbs and uses light energy for its activities.

B. does not contain mitochondria.

C. obtains its energy from other chemical reactions.

D. does not contain chlorophyll.

Question 12

Cell A would carry out

A. photosynthesis during the day and cellular respiration at night.

B. both photosynthesis and cellular respiration during the day.

C. both photosynthesis and cellular respiration at night.

D. neither photosynthesis or cellular respiration at night.

Use the following information to answer Questions 13–17.

In the heat of the day, kangaroos spend long periods of time lying in the shade of trees. The faeces (droppings) of the kangaroos accumulate under the trees providing mineral nutrients for the trees. Red kangaroos, *Macropus rufus*, have excellent thermoregulatory abilities, including heat loss by panting, sweating and licking their fur. Kangaroos and wallabies have a network of special blood vessels near the skin of their forelegs to facilitate heat loss during licking. This is particularly well developed in *M. rufus.* Experimental data suggests that licking the fur of the forelegs provides most of the non-respiratory heat loss in red kangaroos.

Question 13

The kangaroos and shade trees have a relationship called

A. mutualism.

B. parasitism.

C. amensalism.

D. commensalism.

Question 14

The kangaroos lying in the shade in the heat of the day is an example of a

A. structural adaptation.

B. functional adaptation.

C. physiological adaptation.

D. behavioral adaptation.

Question 15

The special blood vessel network in the kangaroo forelegs and the experimental results suggest that kangaroos and some wallabies lose most of their heat by

A. sweating from the skin of their forelegs.

B. evaporation of water licked onto the foreleg skin.

C. passive diffusion of water from the skin blood vessels.

D. conduction of heat from the blood in the skin blood vessels.

Question 16

The efficient cutaneous (skin) thermoregulation mechanisms of kangaroos aid in maintaining a relatively constant internal body temperature despite the environmental temperatures reaching up to 50°C during the day.

This is specifically called

A. homeostasis.

B. homeoregulation.

C. homeothermy.

D. homeobalance.

Question 17

On a very hot day, when the air temperature is well above thermoneutral levels, which of the following responses would occur as part of the negative feedback pathway in the kangaroo?

A. migration of the foreleg skin blood vessels closer to the surface

B. vasodilation of the foreleg skin blood vessels

C. reduction in sweat secretion from the foreleg skin sweat glands

D. decrease in loss of water vapour by panting

Question 18

Almost 40% of mammalian extinction that has occurred globally in the last 200 years has been in Australia.

Which of the following is **not** a major factor that has caused this?

A. planned and organised management of the land

B. habitat destruction and modification

C. expansion of invasive introduced species

D. alteration of fire patterns with more frequent, hotter wild fires

Use the following information to answer Questions 19–20.

The following photograph is of a greater bilby, a nocturnal marsupial that feeds on fruits, seeds, bulbs and insects. It has powerful forelimbs and strong claws for digging. Its senses of smell and hearing are excellent, but it has poor vision. Bilbies do not need to drink.

Bilbies live in deep burrows in the arid grasslands and woodlands of Australia's sandy deserts. Their distribution once covered 70% of mainland Australia, but since European settlement and the introduction of foxes, rabbits and feral cats, the species is classified as vulnerable. As such, it is only found in small areas of western and central Australia. Dingoes, pythons, birds of prey and monitor lizards also eat bilbies. At times when rabbit populations increase dramatically, so too do the number of foxes. However, when the rabbit population collapses, the foxes then prey on the native species, including bilbies. Feral camel populations also are a threat to bilby populations as they trample the suitable grassland with their hard hooves.

Question 19

The reduction in distribution and size of bilby populations in Australia has been due to

A. competition with monitor lizards for food.

B. predation by foxes and dingoes.

C. death from disease introduced by Europeans.

D. emigration to areas of more fertile grassland.

Question 20

Fire is an important natural component of the ecology of many Australian terrestrial ecosystems. Bilbies rely heavily on plants that bloom after occasional burning for their food. Indigenous Australians traditionally used fire to aid hunting and promote plant regeneration. This would have provided bilbies with an abundant and varied food source.

From this information, an appropriate strategy to promote an increase in bilby population numbers would be to

A. kill all feral cats and camels.

B. establish greater areas of grassland.

C. move all bilbies to sanctuaries to save them.

D. introduce regulated fire management of arid grasslands.

Question 21

The cell cycle is useful to show the production of new cells from pre-existing cells by DNA replication, mitosis and cytokinesis.

The cell cycle could **not** be used to illustrate

A. yeast cells reproducing by budding.

B. the production of blood stem cells in bone marrow.

C. bacteria dividing by binary fission.

D. plant root cells dividing for growth and replacement.

Question 22

When bacteria divide by binary fission,

A. it is a slow process as their DNA is free in the cytosol.

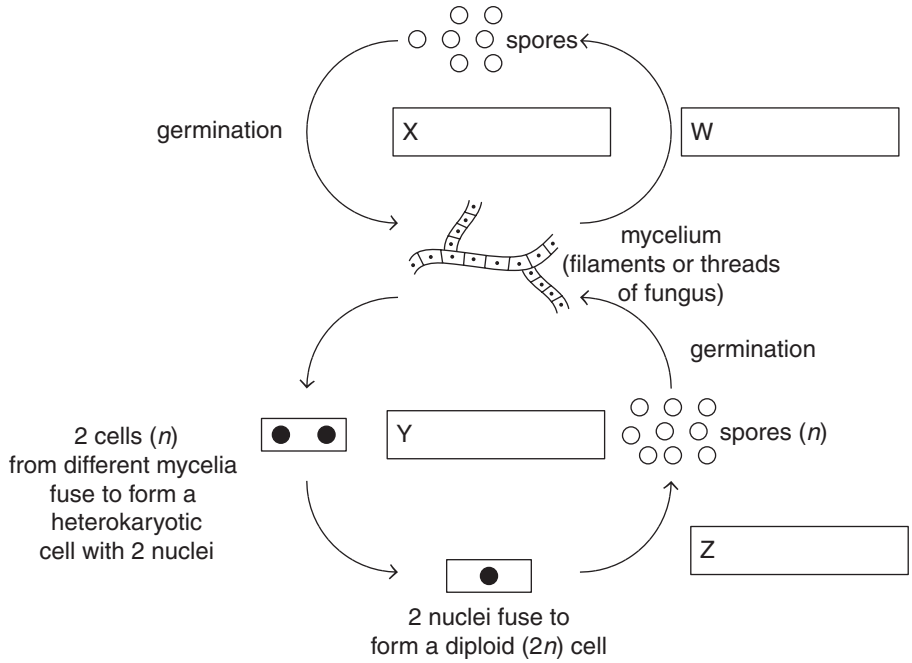
B. no spindle fibres form as there are no centrioles present in the cell.

C. the two daughter cells produced will be identical in size and genetic make-up.

D. it is biologically advantageous as it results in offspring with great genetic diversity.

Use the following information to answer Questions 23 and 24.

Fungi can reproduce asexually by fragmentation, budding or producing spores, or sexually in response to adverse environmental conditions. In both types of reproduction spores can be produced, as shown in the diagram of the life cycle of fungus below.



Question 23

Which of the following is the correct label to complete one of the boxes labelled W–Z on the diagram?

A. W; budding

B. X; fertilisation

C. Y; fragmentation

D. Z; meiosis

Question 24

Fungal spores produced by both asexual and sexual reproduction disperse from the parent plant by either floating in the wind or being carried by animals.

The advantage of this to the fungus is to

A. colonise new environments.

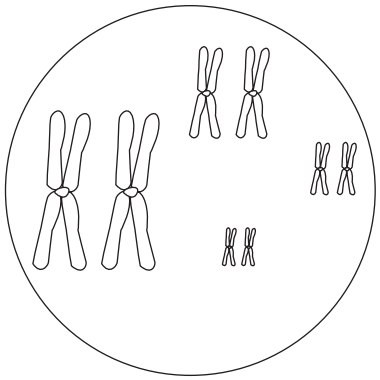
B. decrease species diversity.

C. maintain their distribution in a limited area.

D. provide food for bees and other insects.

Use the following information to answer Questions 25–28.

The fruit fly, *Drosophila melanogaster*, is commonly used in genetics experiments. The following diagram is of a cell from a fruit fly undergoing cell division.



Question 25

The cell shown in the diagram would be found in a male fruit fly in a

A. damaged wing.

B. growing antenna.

C. mature testis.

D. developing bristle.

Question 26

The cell is shown at

A. prophase 1 of meiosis.

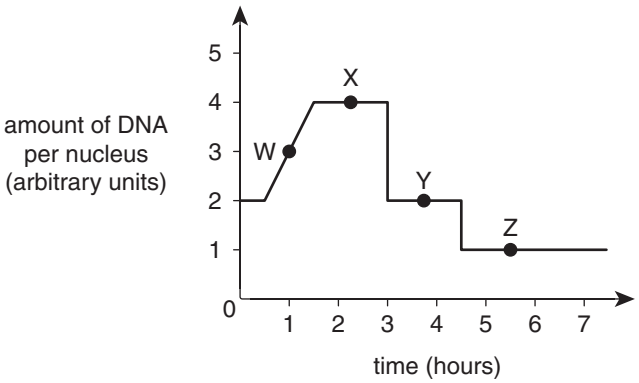
B. metaphase 1 of mitosis.

C. anaphase 1 of mitosis.

D. metaphase 2 of meiosis.

Question 27

The following graph shows the amount of DNA in this dividing fruit fly cell.



The cell shown in the diagram on the previous page would most likely be represented by which point on the graph?

A. W

B. X

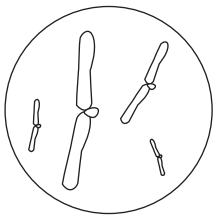
C. Y

D. Z

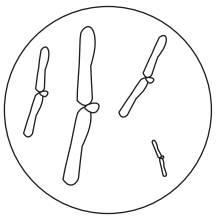
Question 28

Which of the following diagrams shows one of the cells that would be found at the end of the type of cell division discussed in **Questions 5–8**?

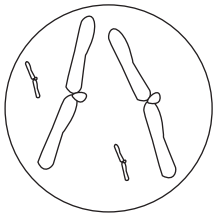
A.



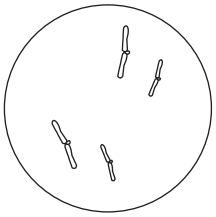
B.



C.



D.



Question 29

Except for identical twins, several offspring produced by two unrelated parents will have a unique genetic identity, but may be very similar in their phenotypic characteristics.

The unique genetic identity of the offspring is due to

A. the fusion of two different gametes produced by mitosis.

B. crossing over of chromatids between homologous chromosomes in prophase 2.

C. non-separation of homologous pairs of chromosomes in anaphase 1.

D. random fertilisation of sperm and eggs produced by the two parents.

Question 30

Which of the following is **not** a mutagen?

A. ultraviolet radiation

B. X-rays

C. white light rays

D. gamma radiation

Question 31

As interest in the possible relationship between diet and cancer has increased in recent years, so have attempts to determine whether chemical carcinogenic substances may be present in foods consumed. Reports from experimental evidence indicate that beef steaks cooked over a charcoal fire and therefore exposed to smoke have higher levels of polycyclic aromatic hydrocarbon (PAH) chemicals, as do other smoked foods, and even roasted coffee.

If these PAH chemicals are carcinogenic, they will cause changes to a cell's

A. plasma membrane.

B. chromosomal DNA.

C. extracellular enzymes.

D. nucleolar RNA.

Question 32

In the 1950s and 1960s, thalidomide was given to pregnant women to ease 'morning sickness' (nausea). Unfortunately the drug had not been fully tested and its use resulted in severe defects in some children, including severely stunted arms and legs, as well as deformed eyes, hearts and other internal organs.

These limb defects and other symptoms were due to

A. a genetic predisposition.

B. underuse of certain muscles.

C. uncontrolled cell division.

D. an abnormal embryonic development.

Question 33

The genome of an organism is the sum total of the organism's DNA, measured by the

A. total number of G, C, A and U bases in its cells.

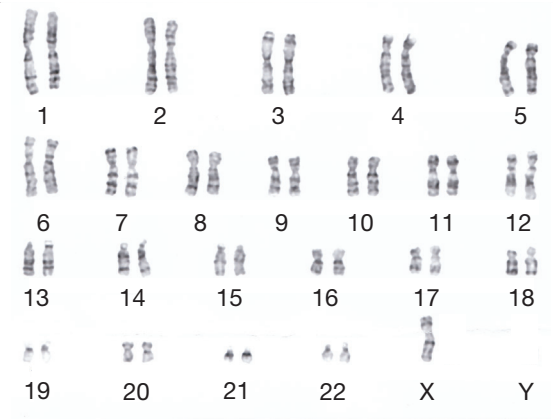
B. number of base pairs in a haploid set of chromosomes.

C. total number of chromosomes in a diploid cell.

D. number of autosomes in a somatic cell.

Question 34

Examine the following image.



The image shown would be representative of a cell from a

A. normal male.

B. female with Down syndrome.

C. male with Klinefelter's syndrome.

D. female with Turner's syndrome.

Question 35

Histones are proteins that DNA wraps around so chromosomes are very tightly coiled and fit inside cells. If histones squeeze the DNA tightly, the DNA cannot be 'read' by the cells.

This is called an epigenetic change as it alters

A. the DNA sequence of the genes.

B. how the cells 'read' the genes.

C. the number of genes in the cell.

D. the type of genes in the cell.

Use the following information to answer Questions 36 and 37.

A plant which has been extensively studied by geneticists is the tomato, *Lycopersicum esculentum*. Three of the genes that are monogenic and code for particular traits, together with their alleles and appropriate allele symbols, are shown below.

Gene	Alleles and allele symbols
plant height	tall (T), short (t)
fruit shape	round (R), oval (r)
stem texture	hairy stem (H), hairless stem (h)

Question 36

Which of the following would be considered a test cross in tomato plants?

A. TtRr × ttrr

B. TtRr × TtRr

C. TtRr × TTRR

D. TTRr × TtRR

Question 37

During meiosis in one type of tomato plant, the chromatids of two of the homologous chromosomes – on which two of the listed genes were located – crossed over, and recombination occurred.

If a test cross was carried out, which of the following phenotypic ratios of offspring would support that the two genes were closely linked?

A. 9 : 3 : 3 : 1

B. > 1 : 1 : 1 : < 1

C. 1 : 1 : 1 : 1

D. < 1 : 1 : 1 : < 1

Question 38

Which of the following statements is correct with respect to Y-linkage in humans?

A. As the Y chromosome is small it mainly has Y-linked genes, not genes for secondary sexual characteristics.

B. Y-linked traits are passed from a father to half his sons and none of his daughters.

C. Y-linked traits will be passed on to offspring with no genetic recombination.

D. Y-linked traits, especially Y-linked diseases, are common.

Use the following information to answer Questions 39 and 40.

The genome of the tomato has been decoded and found to have 31 760 genes – some 7000 more genes than a human. Plant geneticists from 14 countries spent 9 years decoding the tomato genome of Heinz 1706, which is used to make tomato sauce; and the tomato's closest wild relative, *Solanum pimpinellifolium*, found in the highlands of Peru where the tomato's ancestors originated. The genome of the potato has also been decoded and it was found to have 92% of the same DNA as the tomato. The potato family, *Solanaceae*, also includes tobacco, pepper and eggplants.

Question 39

Decoding the genes of tomatoes, potatoes and humans all involve the process of

A. DNA sequencing.

B. RNA analysis.

C. DNA micrographing.

D. RNA transcription.

Question 40

If tomatoes have approximately 7000 more genes than humans, they must

A. be more complex in their cell functioning than humans.

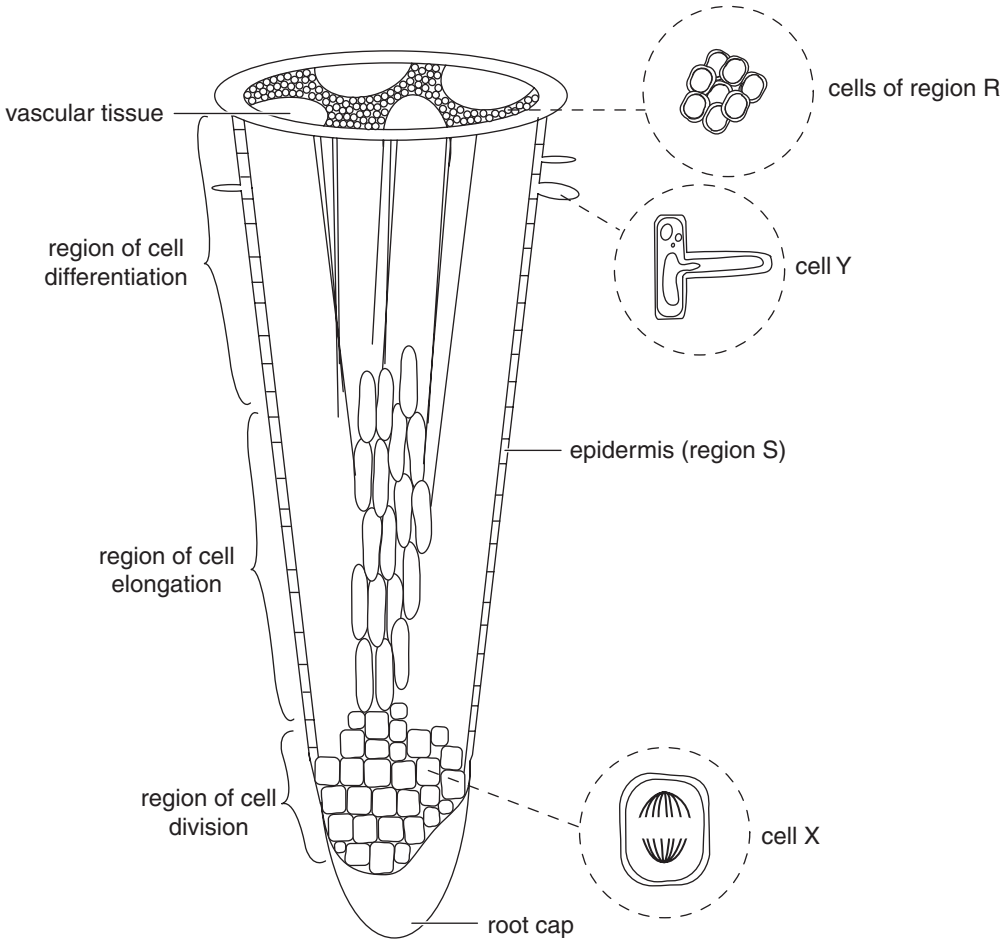
B. produce a greater number of proteins in their cells.

C. have more DNA in their nuclear chromosomes.

D. have the same DNA structure in all their chromosomes.

SECTION B – SHORT-ANSWER QUESTIONS

Question 1 (7 marks)
The following diagram shows a three-dimensional representation of a root of a vascular plant showing some specific regions and cell types.



a. For each of the cells X and Y, describe a structural feature of the cell that aids in its specialised function.

i. cell X 1 mark

ii. cell Y 1 mark

b. **i.** Cells in region S are similar in size, shape and function.
What is the general term given to such groups of similar cells? 1 mark

_____

ii. What is the specific name given to the group of cells in region R that carry water and mineral salts from the roots up to the stems and leaves? 1 mark

_____

iii. What is **one** major difference between the cells in region R and those in region S? 1 mark

_____

_____

The concentration of sodium ions in the soil water surrounding the roots of a plant growing in normal soil was measured at 2 mM, whereas in the cytosol of the root cells, it was measured at 8–10 mM.

c. **i.** By what process would sodium ions enter the root cells in this plant? 1 mark

_____

ii. Name **one** essential organelle or structure that would be necessary in the root cells for the process named in part **c.i.** to occur, and explain why it is essential. 1 mark

_____

_____

_____

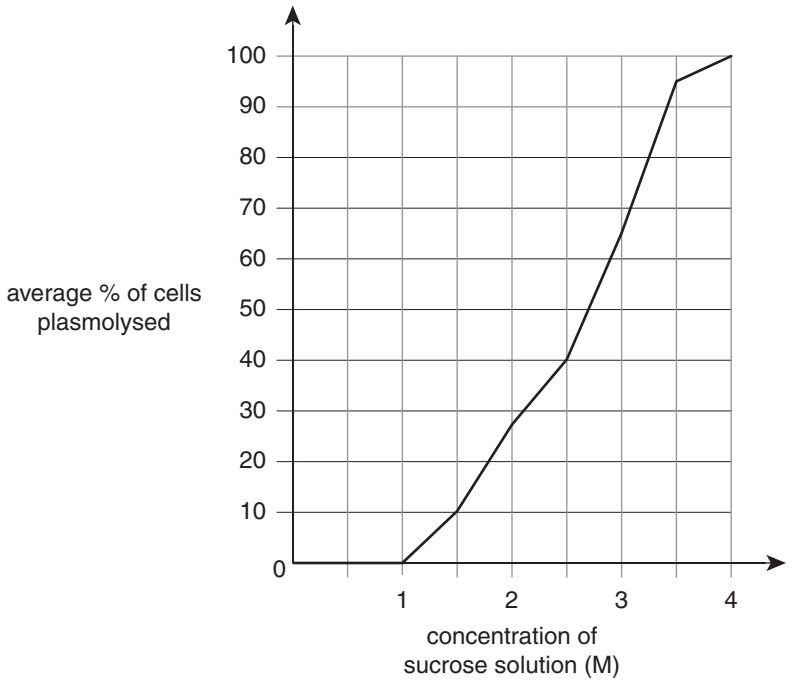
_____

_____

Question 2 (7 marks)

A Year 11 Biology student carried out an experiment to demonstrate plasmolysis (shrinkage of the cell cytoplasm in plant cells in some solutions) in the outer pink epidermal cells of the stem of rhubarb. A thin peel of these outer cells was taken and cut into one cm lengths. Several pieces were then placed in solutions of distilled water and 1 M, 2 M, 3 M and 4 M sucrose. After 30 minutes, a piece was removed from each solution and examined under a microscope to determine the percentage of cells in the field of view that were plasmolysed. This counting procedure was then repeated for two more pieces of peel from each solution and the average percentage plasmolysis in each solution was determined. This was then plotted against the concentration of each sucrose solution.

The following graph illustrates the results obtained.



a. Suggest a hypothesis proposed by the Biology student which lead to designing this experiment. 1 mark

b. **i.** What was the independent variable in this experiment? 1 mark

ii. Describe **one** strength in the experimental design of this experiment. 1 mark

c. Plasmolysis does not occur in molar solutions of sucrose which are isotonic or hypotonic to the cell sap.

Explain why for each type of solution.

i. isotonic solution 1 mark

ii. hypotonic solution 1 mark

d. From the graph, determine the concentration of sucrose at which the cells began to plasmolyse. 1 mark

e. Could this same experiment be carried out with animal cell tissue to determine the percentage plasmolysis? Explain. 1 mark

Question 3 (8 marks)

A small amount of leg muscle tissue was removed from a rat that had been running through a maze looking for food. It was then analysed for the chemical substances it contained.

a. **i.** Compared to a similar analysis of the leg muscle tissue taken from the rat in a 'rested' state, name **once** substance that would be expected to be in a much higher concentration? 1 mark

_____

_____

ii. In the space below, write a balanced chemical equation for the process that produced the two chemical substances named in part **a.i.** 2 marks

iii. In the leg muscle cells carrying out the process in part **a.ii.**, draw, name and label **one** of the organelles that would be the main site of the process. 2 marks

b. If the rat could not find any food and kept running around very vigorously searching for another two minutes, name **one** difference there would be in the chemical substances found in the muscle cells when their contents were then analysed? 1 mark

_____

_____

c. A student, Jim, who had been observing this experiment commented: "Obviously the circulatory system was the only system necessary for the process occurring in the muscle cells".

Explain whether you agree or disagree with Jim. 2 marks

_____

_____

_____

_____

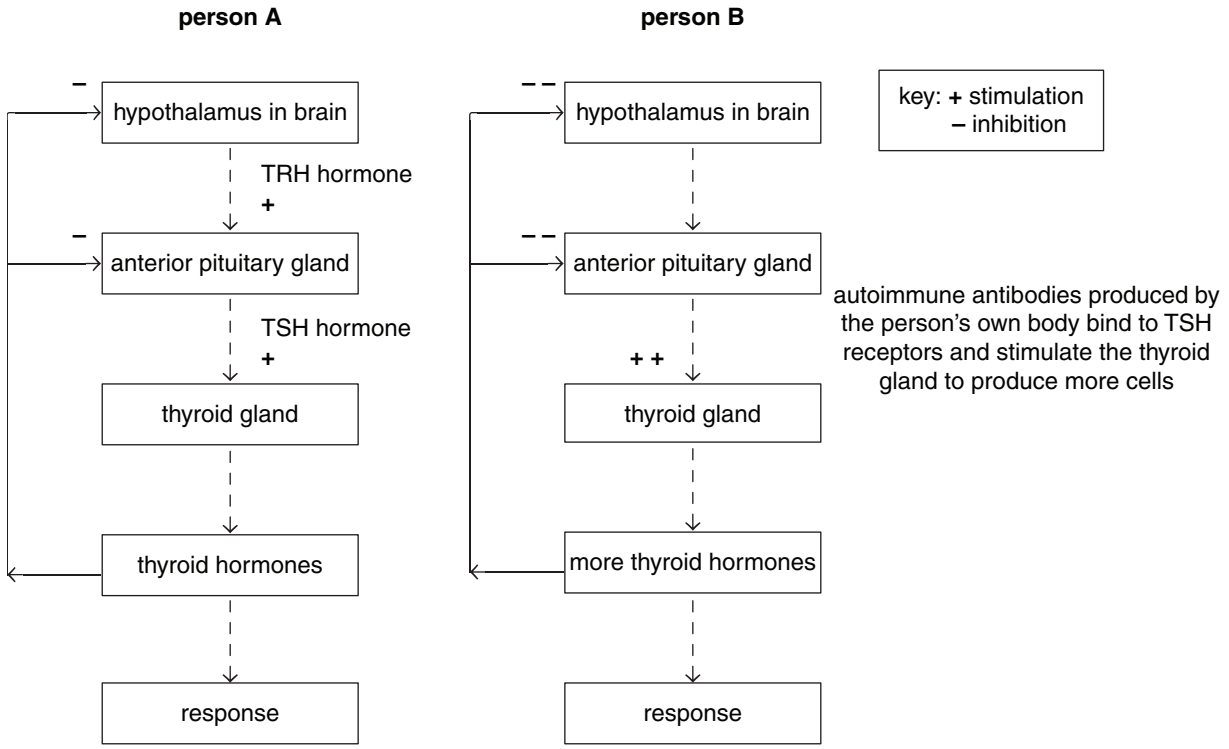
_____

Question 4 (5 marks)

The thyroid is one of the glands of the endocrine system in the human body. It produces thyroid hormones important in regulation of body temperature, metabolism and heart rate. Disorders of thyroid hormone secretion are second only to diabetes mellitus caused by lack of insulin.

The pituitary gland and hypothalamus are both involved in controlling the thyroid. When thyroid levels drop too low, the hypothalamus secretes TRH hormone, which stimulates the pituitary gland to produce TSH hormone, which in turn stimulates the thyroid gland to release thyroid hormone into the blood. An increase of thyroid hormone in the blood will result in decreased stimulation of the hypothalamus.

Hyperthyroidism, most commonly caused by Grave's disease, is an autoimmune disease in which antibodies produced by the person's own body cells stimulate more thyroid gland cells to be produced. This results in an increased release of thyroid hormone which causes markedly reduces stimulation of the hypothalamus and pituitary glands. This information is summarised in the following flow charts for person A, who is healthy, and person B, who has Grave's disease.



In a normal, healthy person, this process of regulation is important for the internal environment.

a. What makes up the internal environment of the human body? 1 mark

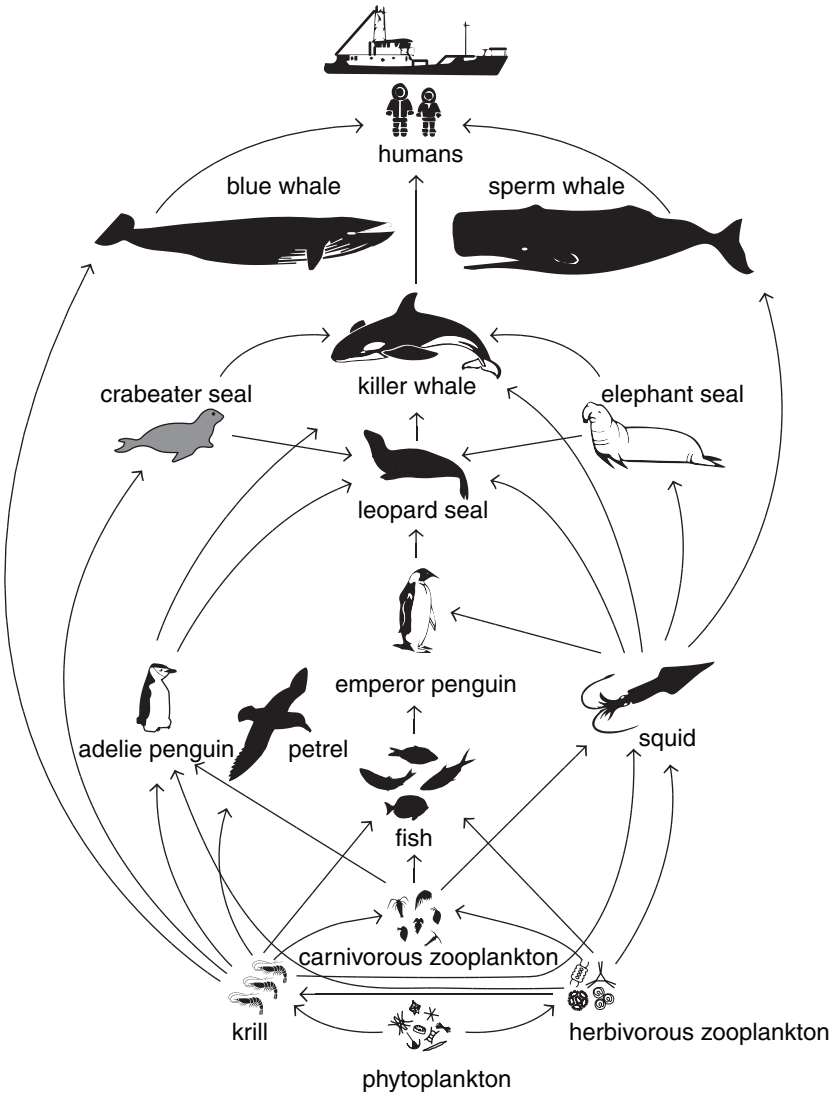
b. **i.** In both persons A and B, what is the effector in the pathway described? 1 mark

ii. For person B with Grave's disease, provide **one** physiological response and subsequent symptom the person would exhibit? 1 mark

c. In a person with Grave's disease, would this be called negative or positive feedback? Explain using the information provided. 2 marks

Question 5 (6 marks)

The following shows a diagram of a generalised food web found in an ecosystem in Antarctica.



a. What is the original source of energy for this Antarctic food web? 1 mark

_____

b. In the food web shown, most of the arrows point upwards, whereas in other food web diagrams, the arrows can point downwards or sideways.

What does the direction of the arrows actually indicate? 1 mark

_____

_____

c. A killer whale is one of the top order consumers in the Antarctic food web, but it fits into several different levels in the food web.

Explain this statement, using **two** examples to aid your explanation. 2 marks

Whale hunting for their meat and oil has been markedly reduced, however some permits for hunting of limited numbers and for scientific research are still issued and so whaling continues. At least five of the thirteen great whale species are listed as endangered, including blue whales and Sei whales.

d. **i.** Explain what impact whale hunting would have on the Antarctic ecosystem. 1 mark

ii. Blue whale numbers declined dramatically from 30 000 to 40 000 in the 1930s, to less than 5000 in 1994; Sei whale numbers however increased from 9000 in 1978, to 28 000 in 2002.

Suggest a strategy that was probably introduced which resulted in the increase in Sei whale numbers to a level where it has been suggested that Sei whales should no longer be on the endangered list. 1 mark

Question 6 (7 marks)

'Sharkskin' swimsuits received a lot of attention during the 2008 Olympic Games. When examined under an electron microscope, shark skin is made up of millions of overlapping scales (dermal denticles), each with a groove running down their length in alignment with the direction of water flow. These grooves disrupt the formation of turbulent swirls of water making the water pass by faster. The rough shape of the skin also discourages parasitic growth of algae and bacteria.

a. Why is the growth of algae and bacteria on sharks and other sea-dwelling animals referred to as parasitic? 1 mark

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Scientists have been able to replicate dermal denticles in the bottom surface of cargo hulls. This makes them more efficient, enabling faster transport and less frequent chemical cleaning of their hulls.

b. What is the term used for such copying or imitating of biological examples from nature to solve complex human problems or for technical applications? 1 mark

_____

Scientists are also applying this principle to create surfaces in hospitals that resist bacterial growth by being too rough to permit bacterial adhesion. One dangerous species of bacteria found in hospitals is *Staphylococcus aureus* which causes skin and internal organ infections. There are over thirty different types of bacteria classified as *Staphylococcus*, including *S.epidermidis*, *S. saprophyticum* and *S. schleifen*, all of which are also responsible for skin infections.

c. **i.** What international system of naming has been used for these species of bacteria? 1 mark

_____

ii. What level of classification do these four types of bacteria fall into, as indicated by their same first name? 1 mark

_____

Over the last ten years many methods have been used to analyse selected DNA for species level identification.

d. **i.** Where in a *Staphylococcus* bacterial cell would DNA be located? 1 mark

_____

ii. Consider the following four bacterial species.

A. *Streptococcus oralis*

B. *Staphylococcus epidermidis*

C. *Streptococcus pneumoniae*

D. *Saccharomonospora viridis*

Which **two** of the following bacterial species would show the least variation in the sequence of the sodA gene which is often used in DNA analysis? Give the letters of the two bacterial species chosen and explain your choice. 2 marks

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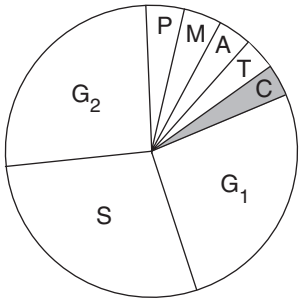
Question 7 (7 marks)
The following diagram shows the cell cycle, with letters representing the various stages in the cycle.



a. If this was the cell cycle occurring in an animal cell, draw and label a cell showing the arrangement of its chromosomal material seen

i. at stage M. 1 mark

ii. early in stage C. 1 mark

iii. late in stage S. 1 mark

b. Comment on a major difference if the cell drawn in part **a. ii.** was from a plant. 1 mark

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_____

c. Some chemical substances block various processes occurring during the cell cycle. Two such substances and their effects are given below.

Complete the table by giving the letter representing the stage in the cell cycle where the chemical substance would have an effect and describe the result in the cell. 2 marks

Chemical substance and its effect	Letter representing stage affected by substance	Result in the cell
colchicine prevents spindle formation		
methotrexate prevents successful DNA replication		

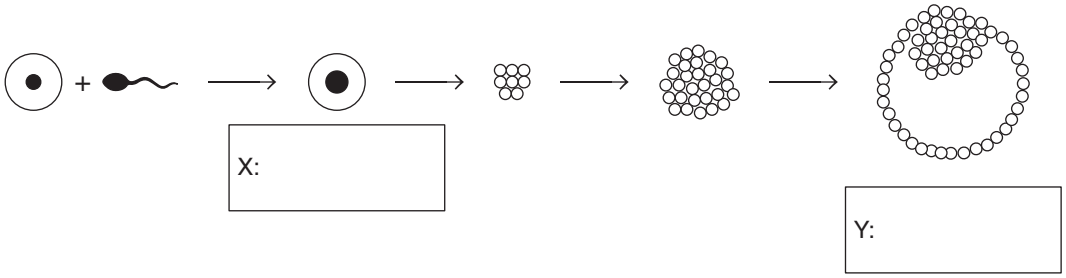
d. Some drugs used in cancer treatment (Paclitaxel and Docetaxel) work in similar ways to the chemical substances given in the table in part **c.**

How would these drugs be effective to reduce cancer in a person? 1 mark

Question 8 (8 marks)

After an egg fuses with a sperm during fertilisation, the fertilised egg then divides by mitosis into a ball of approximately 100 cells. The outer layer of cells in the ball will form the placenta and the inner mass will form the embryo. When this ball of cells is implanting into the uterine wall, the inner cell mass undergoes changes that result in three layers of cells, called primary germ layers. These layers will differentiate into all the tissues and organs of the developing baby.

a. Use this information and your knowledge to complete the following sequence by filling in the boxes labelled X and Y. 2 marks



b. Complete the following table by naming the three primary germ layers that correspond with the tissues or organs that they will form. 1 mark

Name of germ layer	Some of the tissues and/or organs the germ layer will form
	muscle, bone, blood, cartilage
	skin, epidermis, hair, nails, teeth enamel
	lining of gut, bladder, lungs, liver, pancreas

c. **i.** At how many weeks of development is an embryo called a foetus? 1 mark

_____

ii. What are the distinguishing features that allow this change in terminology from embryo to foetus? 1 mark

_____

_____

d. **i.** On the diagram in part **a.**, clearly circle an area that could provide embryonic stem cells which could be used for research or therapy. 1 mark

ii. Suggest **one** significant ethical issue related to the use of embryonic stem cells for research or therapy. 1 mark

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_____

_____

iii. What is **one** major disadvantage of using modified cells from a donated, unused IVF embryo for therapy, rather than cells from the patient who is to be treated? 1 mark

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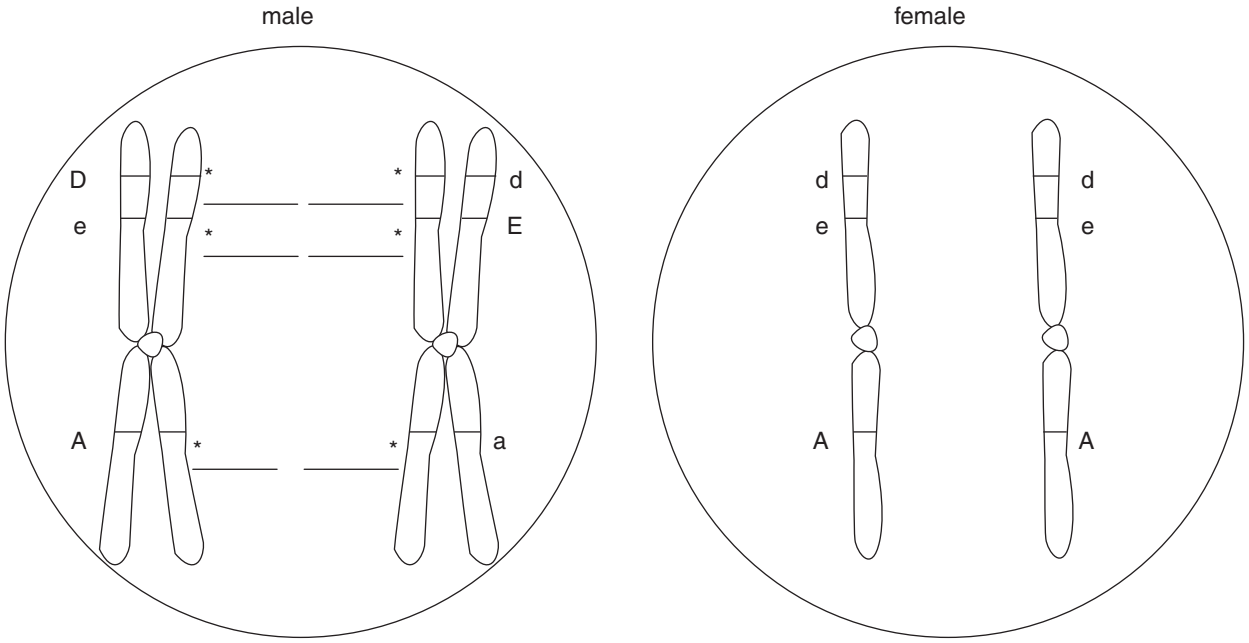
Question 9 (7 marks)

The following diagrams show both copies of chromosome 1 in both the female and the male of a married couple. The diagram for the male shows a cell undergoing meiosis, whereas the diagram for the female shows a cell before chromosome replication has occurred. Letters representing the positions of three genes and their alleles in each individual are shown on the diagrams. They are identified in the table below.

Gene	Alleles
rhesus blood group	D = rhesus positive, d = rhesus negative
red blood cell shape	E = elliptical, e = round
production of amylase enzyme	A = present, a = absent



a. Circle the word(s) below that would be appropriate to describe the chromosomes shown for the male and female, and explain your choice(s). 1 mark

autosomes / sex chromosomes / somatic chromosomes

b. What term would be used to describe

i. the two chromosomes shown in the diagram for the female? Explain why this term is used. 2 marks

ii. the four structures shown in the diagram for the male? 1 mark

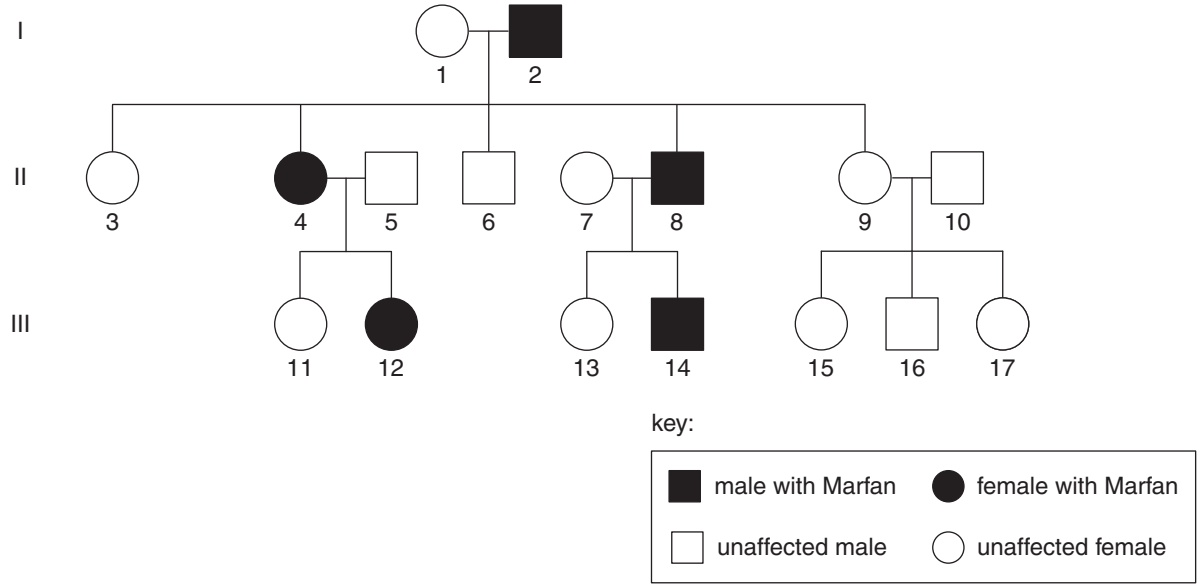
c. Complete the diagram for the male by filling in the empty lines marked with a * using appropriate letters from those given at the start of the question. 1 mark

d. The first child of this couple was rhesus positive.

What is the chance their second child will also be rhesus positive? Show your working. 2 marks

Question 10 (9 marks)

Marfan syndrome is a genetic disorder inherited as a dominant trait in humans. It is rare and affects only about 1 in 10 000–20 000 people. It causes problems with the connective tissue, especially in the eyes and heart. It results from mutations in the FBN1 gene. The following pedigree shows the inheritance of Marfan syndrome in three generations of a family.



a. **i.** Use evidence from this pedigree to show that Marfan syndrome is not inherited as a sex-linked trait. 1 mark

ii. Marfan syndrome is inherited as an autosomal trait.
What does the term 'autosomal' mean? 1 mark

b. **i.** Assign appropriate allele symbols for Marfan syndrome and non-Marfan syndrome and use these symbols to write the genotype of father 2 in generation I. 1 mark

ii. Could the father in generation I be referred to as a carrier of Marfan syndrome? Explain. 1 mark

c. **i.** Parents 7 and 8 are planning to have another child.

What is the chance that the child could be born with Marfan syndrome? Show all working using the allele symbols previously assigned in part **b. i.** 2 marks

ii. Parents 7 and 8 conceived a child but decided to have testing carried out at an early stage of the pregnancy to determine if the developing baby would be born with Marfan syndrome.

What modern test is available to determine if there is a mutation in the FBH1 gene and what would the results show if it was a positive result for Marfan syndrome? 2 marks

iii. Briefly outline **one** of the major issues that arises from the use of prenatal testing of developing babies. 1 mark

Question 11 (9 marks)

Manx cats are heterozygous for a trait that results in cats with very short or no tails. When pairs of Manx cats were mated, the litters contained approximately two Manx kittens for each long-tailed kitten rather than three-to-one, as would be expected from Mendelian genetics predictions.

a. From the information given, is the Manx trait dominant or recessive to normal long-tailed cats? Explain. 1 mark

Domestic cats exhibit a great variety of coat colours and patterns. The colours are caused by the presence of melanin which, when deposited in the hair shaft, results in a variety of colours. There are two different types of melanin, one resulting in black pigmentation and one in red/orange/yellow pigmentation. Another gene causes variation in the density of the melanin granules, from more densely packed to less densely packed or diluted.

The following table lists the commonly accepted names for the basic colours in domestic cats by genotype.

		dense D–	dilute dd
black-based colours	black B–	black	→ blue
	brown bb	→ chocolate	→ lilac
	light brown b′b′	→ cinnamon	→ fawn
red-based colours	orange oo′	red	→ cream

b. What term is used for a trait such as the pigment density of cat coat colour that is determined by a single gene locus? 1 mark

Mutations of the gene for black give rise to the colours chocolate and cinnamon, with chocolate being recessive to black and cinnamon recessive to chocolate. A mutation of the gene for dense colouration produces blue, lilac and fawn colouration, as shown in the table on the previous page.

c. **i.** Using the allele symbols listed in the table, give the possible genotype(s) for a cat with cinnamon-coloured fur. 2 marks

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_____

ii. If a black cat heterozygous for both genes for coat colour and pigment density was crossed with a chocolate cat heterozygous for pigment density, what would be the possible phenotypes in their offspring, and in what ratio? Show all working clearly. 3 marks

d. The red-based colours have much less genetic variation and are determined by a gene carried on the X chromosome (cats have the same sex-determining chromosomes as humans). Male cats can only have two genotypes with respect to the red-based gene, whereas females have three possible genotypes.

Explain why. 2 marks

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END OF QUESTION AND ANSWER BOOKLET