Neap

Trial Examination 2020

# VCE Biology Units 1&2

Written Examination

## Suggested Solutions

### SECTION A – MULTIPLE-CHOICE QUESTIONS

| | | | | |
|---|---|---|---|---|
| 1 | **A** | B | C | D |
| 2 | A | B | C | **D** |
| 3 | A | **B** | C | D |
| 4 | A | B | C | **D** |
| 5 | **A** | B | C | D |
| 6 | A | B | **C** | D |
| 7 | **A** | B | C | D |
| 8 | **A** | B | C | D |
| 9 | A | **B** | C | D |
| 10 | A | B | **C** | D |
| 11 | A | B | C | **D** |
| 12 | A | B | **C** | D |
| 13 | A | **B** | C | D |
| 14 | A | B | **C** | D |

| | | | | |
|---|---|---|---|---|
| 15 | A | B | C | **D** |
| 16 | A | B | **C** | D |
| 17 | A | **B** | C | D |
| 18 | A | **B** | C | D |
| 19 | A | B | **C** | D |
| 20 | A | B | C | **D** |
| 21 | **A** | B | C | D |
| 22 | A | B | C | **D** |
| 23 | A | B | C | **D** |
| 24 | A | B | **C** | D |
| 25 | **A** | B | C | D |
| 26 | A | **B** | C | D |
| 27 | A | B | C | **D** |
| 28 | A | B | **C** | D |

| | | | | |
|---|---|---|---|---|
| 29 | **A** | B | C | D |
| 30 | A | B | **C** | D |
| 31 | **A** | B | C | D |
| 32 | A | B | **C** | D |
| 33 | **A** | B | C | D |
| 34 | A | **B** | C | D |
| 35 | A | **B** | C | D |
| 36 | A | B | C | **D** |
| 37 | A | B | **C** | D |
| 38 | **A** | B | C | D |
| 39 | A | **B** | C | D |
| 40 | A | B | C | **D** |

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**Question 1 A**

**A** is correct, as many lysosomes are found in phagocytes (special white blood cells) and they contain digestive enzymes to destroy ingested bacteria. For **B** to be correct, it would have to specify rough endoplasmic reticulum, as smooth endoplasmic reticulum is for lipid synthesis and transport, not protein. **C** is incorrect as bone cells do contain nuclei and require regulation. **D** is incorrect because Golgi bodies are essential to modify and package the enzyme for secretion out of the cells into the duct before reaching the mouth.

**Question 2 D**

**D** is correct, as the biconcave shape and the extremely small size of the mature red blood cells means that they have a much larger surface area to volume ratio for exchange of inputs and outputs than any of the other three cell types.

**Question 3 B**

**B** is correct, as one of the main functions of the plasma membrane is to control the movement of substances in and out of the cells. It is found in both eukaryotic and prokaryotic cells, thus **A** is incorrect. The plasma membrane is fluid in nature, not fixed, and cholesterol makes it more stable, not less.

**Question 4 D**

**D** is correct, as water moves from a higher concentration to a lower concentration in the gut through osmosis and is a passive process. All other choices contain incorrect phrases; in **A**, low to high concentration is not diffusion; in **B**, facilitated diffusion does not use energy; in **C**, movement down the concentration gradient is passive, not active transport.

**Question 5 A**

**A** is correct, as separated internal organelles/compartments means different cellular processes can occur in each compartment as different enzymes can be active in each. Different biological processes need different enzymes and environments, so **D** is incorrect. Prokaryotes have no membrane-bound organelles, and so no such compartments. The organelle membranes are similar in structure to the plasma membrane, consisting of proteins and phospholipids.

**Question 6 C**

**C** is correct, as the eyespots would detect the light needed for photosynthesis so the *Chlamydomonas* can move towards light for more efficient photosynthesis. They would also require mitochondria for aerobic respiration to break down the glucose synthesised in photosynthesis, so **A** is incorrect. They would move towards shallower water for more light during the day. Nuclei are present in their cells but are not seen, as they are colourless and obscured by the large chloroplast.

**Question 7 A**

**A** is correct, as they can use their eyespots to detect the stimulus (light) and swim using their effector (the flagella) towards it in a stimulus-response model. This will not make the light go away, so there is no feedback, but it will increase their efficiency in photosynthesis and therefore their survival. This is not regulated as there is no coordinating centre, and it is not an example of homeostasis.


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**Question 8 A**

**A** is correct, as there will be competition for between *Chlamydomonas*, *Volvox* and *Euglena* for resources, such as light, carbon dioxide and even space. All the other alternatives involve the three species helping each other in some way to the benefit of all species.

**Question 9 B**

**B** is correct, as the organisms are all photosynthetic and act as producers to provide food for the food web, thus forming the first trophic level. They are not zooplankton, which is part of the second trophic level that feeds on the producers. They are not decomposers, and there is no such term as second order producers.

**Question 10 C**

**C** is correct, as aerobic cellular respiration generates more ATP per glucose molecule than anaerobic cellular respiration. Aerobic cellular respiration is complete breakdown of glucose producing water and carbon dioxide as wastes. It occurs all the time in living cells, not just during daylight hours.

**Question 11 D**

**D** is correct, as chlorophyll pigments are essential for absorption of light for photosynthesis in all the organisms listed. **B** is incorrect, as there are no chloroplasts in the prokaryotic cells of cyanobacteria. Photosynthesis does not occur in mitochondria and uses the external energy source of light.

**Question 12 C**

**C** is correct, as the internal environment consists of all the body fluids bathing the cells – the tissue/extracellular/interstitial fluid, the blood and the lymph. The cells themselves are not included, nor are the blood vessels. The lung air sacs would be considered part of the external environment, together with the inside of the respiratory, digestive and excretory systems and the surroundings of the organism.

**Question 13 B**

**B** is correct, as increased cellular metabolism produces more energy in the form of ATP and heat. All other alternatives would increase heat loss or reduce heat loss and are not involved in generating more heat.

**Question 14 C**

**C** is correct, as the otter is behaving in a way to aid its survival by reducing heat loss and fixing itself in a more permanent position during sleep, and thus is a behavioural adaptation. The other three alternatives are structural adaptations.

**Question 15 D**

**D** is correct, as the otter is the predator, catching and eating the sea urchin, its prey. The otter and sea urchin do not compete with each other, and there is no parasitism involved where one organism benefits and the other is harmed.

**Question 16 C**

**C** is correct, as if nearly all the otters were killed or died, the sea urchin numbers would rapidly increase. The large numbers of sea urchins would eat the kelp, resulting in the loss of the large kelp forests. This would ultimately affect all the organisms in the ecosystem, resulting in its collapse. All other three alternatives refer to increases in populations of other organisms, regeneration and a flourishing reef, all of which would not occur if otter numbers declined drastically.

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**Question 17 B**

**B** is correct, as keystone species have a disproportionately large effect on the other organisms in the ecosystem. They play an important role in keeping the ecosystem well maintained and developing in a positive direction, despite not being the most abundant species. All of the other terms are inappropriate for the otters in the kelp forest ecosystem.

**Question 18 B**

**B** is correct, as a hypothesis is a proposed explanation to explain previous observations that can be tested through study and experimentation. It is more than just a suggestion, as it must be logical and sensible. It may result in a prediction or ultimately a theory after many further tests are carried out to see if they support the hypothesis.

**Question 19 C**

**C** is correct, as these are all controlled variables that need to be kept the same for all repetitions to show that it is the independent variable being altered that has caused the results, and not one of these other factors. This is different to the control group, in which the independent variable is not altered so it can be used as a comparison to the experimental group.

**Question 20 D**

**D** is correct, as the dependent variable is the factor being observed or measured in the experiment. In this case, it was the volume of carbon dioxide being given off every twenty seconds, not the total volume after five minutes. The temperature of the solution, either 25°C or 15°C, was the independent variable, and the amount of yeast was kept the same in each experiment and thus was a controlled variable.

**Question 21 A**

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

**Question 22 D**

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

**Question 23 D**

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

**Question 24 C**

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


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**Question 25 A**

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

**Question 26 B**

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

**Question 27 D**

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

**Question 28 C**

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

**Question 29 A**

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

**Question 30 C**

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

**Question 31 A**

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

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**Question 32 C**

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

**Question 33 A**

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

**Question 34 B**

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

**Question 35 B**

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

**Question 36 D**

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

**Question 37 C**

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

**Question 38 A**

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


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**Question 39 B**

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

**Question 40 D**

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

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

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

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## SECTION B

**Question 1** (7 marks)

**a.** The two cells would be considered eukaryotic cells, as the diagram shows that both the sperm and pollen grain contain membrane-bound nuclei and organelles, which are not present in prokaryotic cells. 1 mark

**b.** **i.** Sperm have a long tail (or flagellum) that allows it to swim to the egg. 1 mark

**ii.** The mid-tail cluster of mitochondria are important for providing the energy needed for movement of the sperm. 1 mark

**c.** **i.** *Any one of:*

- It could be blown by the wind to reach an egg.
- It could be carried by birds, bees or other animals to reach an egg.

1 mark

**ii.** *Any one of:*

- It is small and light.
- It has a hard outer coat so it can be carried without damage to reach the egg.
- It has a sticky outer coating to allow it to attach to pollinators.

1 mark

**d.** **i.** A tissue is a group of cells that work together to carry out a common function. 1 mark

**ii.** When mature, neither of these two cell types could be considered a tissue because they both act independently of other cells to fertilise an egg. 1 mark

**Question 2** (9 marks)

**a.** Using eight 1 $cm^3$ cubes is an example of replication and is a more efficient experimental technique than using only one cube, as it allows experimenters to check the precision of the result and to uncover any systematic errors that may effect the accuracy of the result. 1 mark

**b.** osmosis 1 mark

Osmosis is the net movement of water from a region of higher water concentration to a region of lower water concentration (or lower solute concentration to higher solute concentration) through a semipermeable membrane. 1 mark

**c.** The smaller cube (1 $cm^3$) had a greater change/increase in mass than the larger cube (2 $cm^3$). 1 mark

The smaller cube has a greater surface area to volume ratio, and therefore allows more movement of water into the potato cells. 1 mark


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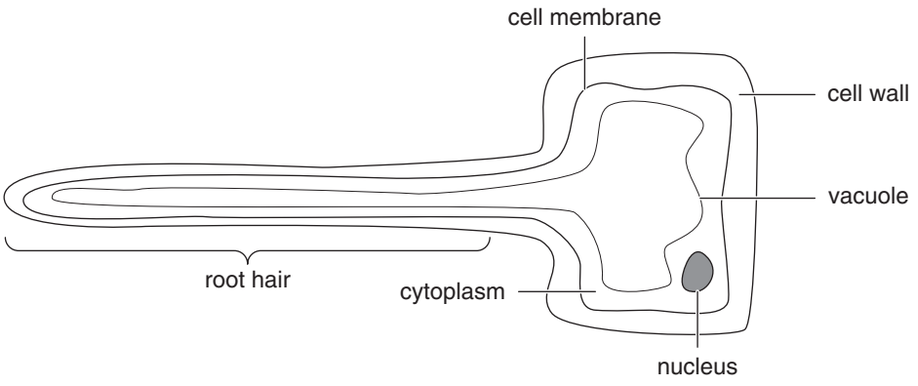
**d.**




2 marks
*1 mark for drawing.*
*1 mark for labels.*

**e.** *For example, any two of:*

- dead cells with thickened walls for support of tubes during upward pull of water
- end walls of cells broken down to form hollow tubes for effective water channels
- cell contents (nucleus and cytoplasm) absent, so form hollow tubes for transport
- walls of cellulose and lignin for adhesion with water molecules to aid in upward movement of water

2 marks

**Question 3** (6 marks)

**a.** The bacteria are autotrophs, as they can convert simple inorganic molecules into complex organic molecules using an external energy source. 1 mark

They are photosynthetic as they contain chlorophylls and other pigments that absorb light energy; thus, photosynthetic autotrophs. 1 mark

**b.** Green plants carry out a chemical process in which they capture and covert **light** energy and transform it into **chemical** energy, which is stored in complex molecules of **glucose/starch/cellulose**. In this process, the by-product **oxygen** is released. 2 marks

*Award one mark for 2–3 correct terms.*
*Note: Any one of glucose, starch or cellulose is an acceptable answer.*

**c.** **i.** A family is a higher level of classification than genus. All three genera of the purple bacteria belong to the same family. A genus is a lower level of classification in which the members are more similar. 1 mark

**ii.** Using such a classification system in research laboratories world-wide provides a universal system of naming so that all scientists can understand which organisms are being studied for better communication. 1 mark

**Question 4** (9 marks)

**a.** **i.** Aquatic means living in water, as do salmon. Terrestrial means living on land, as do bears. 1 mark

**ii.** scavengers **OR** detritivores 1 mark

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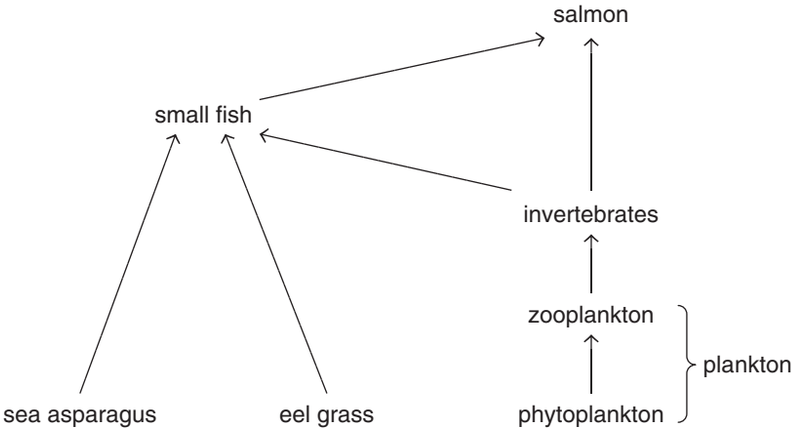
**b.** *For example, any one of:*

- Smolts may be able to excrete highly concentrated urine.
- Smolts may secrete salt from glands or ducts in their eyes.

1 mark

**c.** **i.** The main producers are phytoplankton, as abundant nutrients are available for their growth and reproduction in the water of the estuary. 1 mark

**ii.** *For example:*




2 marks
*1 mark for organisms in correct positions.*
*1 mark for all arrows pointing towards consumers.*

**iii.** The arrows show the direction of energy flow in the food web. 1 mark

**iv.** The original source of energy is the sun. 1 mark

**v.** *For example, any one of:*

- invertebrates: phytoplankton → zooplankton → invertebrates
- small fish: plankton → invertebrates → small fish

1 mark

**Question 5** (9 marks)

**a.** **i.** parasite and host 1 mark

**ii.** The fungus benefits by gaining food and a place to grow and reproduce in the fly; the fly gains no benefit and is killed by the fungus. 1 mark

**b.** The advantage of firing fungal spores that attach to other flies is to aid the dispersal of the fungus to new hosts and different areas by attaching to other flies or being carried in high wind currents. 1 mark

**c.** In the name of the fungus, *Entomophthora muscae*, the word *muscae* is the second word, which is the specific/descriptive name in the name of the species. 1 mark

In the name of the housefly, *Musca domestica*, the word *musca* is the first word, which is the genus name. 1 mark

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**d.** **i.** biomimicry 1 mark

**ii.** *For example, any one of:*

- Swimsuits based on shark skin are designed to be smooth and streamlined.
- Bullet trains based on bird beaks are designed to be aerodynamic
- Velcro based on plant seeds is designed to attach things together.

1 mark

**e.** *For example, any two of:*

- Insects act as food for other higher order consumers in food webs.
- Insects are important pollinators of flowering plants.

2 marks

**Question 6** (3 marks)

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

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

**c.** cancer 1 mark

**Question 7** (7 marks)

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

**b.** **i.** totipotent 1 mark

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

**c.** *For example, any one of:*

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

1 mark

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

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

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**Question 8** (15 marks)

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

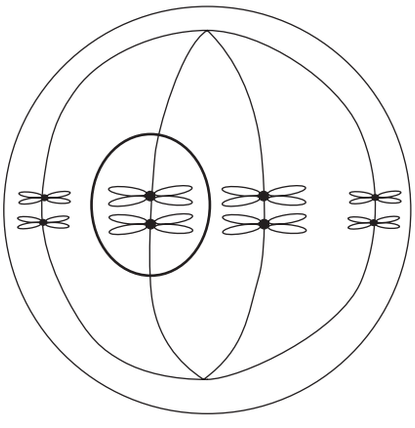
location: testes **OR** ovaries 1 mark

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

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

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

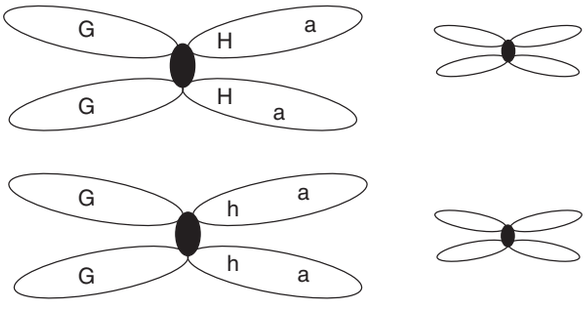
**b.** **i.** Homologous chromosomes have the same gene loci or the same genes at the same positions. 1 mark



1 mark

*Note: Any pair of chromosomes could be circled.*

**ii.**




3 marks

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

*1 mark for H/H and h/h.*

*1 mark for G/G, G/G, a/a and a/a.*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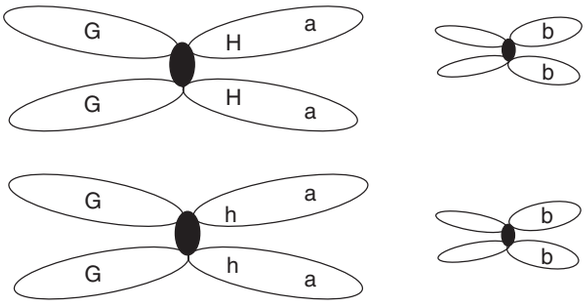
**c.** **i.**




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

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

**iii.** test cross 1 mark

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

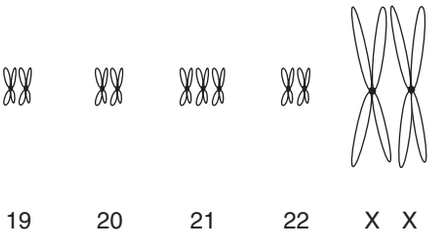
The correct ratio would be 1 : 1 : 1 : 1. 1 mark

**Question 9** (11 marks)

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

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

**ii.** diploid number: 47 1 mark




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

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

Parents: Hh × hh

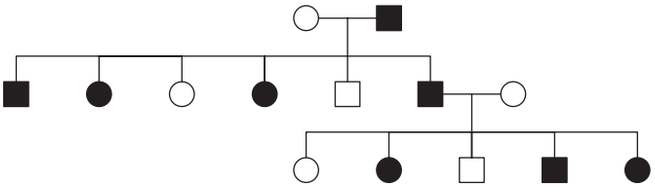
| | **H** | **h** |
|---|---|---|
| **h** | Hh | hh |
| **h** | Hh | hh |

1 mark

Probability: 50% 1 mark

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

**iii.**



2 marks

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

**Question 10** (4 marks)

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

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

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

**b.** *For example, any one of:*

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

1 mark

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