

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

Question 1 D

D is correct. Mitochondria are membrane-bound organelles that are only present in eukaryotic cells.

A is incorrect. Both prokaryotic and eukaryotic cells are surrounded by a plasma membrane.

B is incorrect. Ribosomes are not surrounded by a membrane and are found in both prokaryotic and eukaryotic cells.

C is incorrect. The fluid component of the cytosol is found in all living cells.

Question 2 C

C is correct. Cell 3 contains more mitochondria than the other cell types; therefore, as mitochondria undergo aerobic cellular respiration, cell 3 would provide more energy for muscle cell contraction.

A is incorrect. A spherical cell would not be able to readily elongate and contract as required by muscle cells.

B is incorrect. A spherical cell would have a smaller surface area to volume ratio than a flattened circular cell, so it would have a comparatively lower rate of exchange.

D is incorrect. All the cells have a nucleus, which is essential to control the contraction process.

Question 3 B

B is correct. Hydrophilic molecules are water-soluble and lipophobic, so they would not be able to pass through the phospholipid bilayer of the plasma membrane.

A is incorrect. Hydrophilic substances are not always large (for example, mineral ions) and they are not lipid-soluble.

C is incorrect. Hydrophilic substances can move both along and against the concentration gradient, but this is not the factor that limits their movement through the membrane.

D is incorrect. The only method of transport that needs energy to be provided by the cell is active uptake. The method used in this instance is facilitated diffusion, which does not require energy.

Question 4 A

A is correct. The diagram shows glucose molecules moving from a higher concentration to a lower concentration via protein channels using protein carriers. This would occur by facilitated diffusion, which does not require the energy provided by ATP.

B is incorrect. The diagram correctly shows the heads of the phospholipid molecules facing outwards and the tails towards each other.

C is incorrect. The diagram correctly shows the glucose molecules passing through the protein channel using protein carriers.

D is incorrect. The diagram correctly shows the glucose molecules moving down the concentration gradient from a higher concentration to a lower concentration.

Question 5 C

C is correct. Villi are present in the duodenum and ileum of the small intestine to increase the surface area for absorption of digested food.

A is incorrect. There are no microvilli in the stomach; the stomach is mainly involved in mechanical and chemical digestion.

B is incorrect. The oesophagus is used in the transport of food from the mouth to the stomach, not in absorption as shown in the diagram.

D is incorrect. The microvilli in the colon are used in the absorption of water and mineral ions, not glucose molecules.

Question 6 D

D is correct. A single chromosome undergoes DNA replication and then separation to either end of the bacterial cell, so each offspring cell contains the same DNA.

A is incorrect. Bacteria do not undergo the stages of mitosis (G1 and G2), so they do not carry out the cell cycle.

B is incorrect. Bacteria have no nucleus-containing chromosomes to undergo the stages of mitosis.

C is incorrect. There is no spindle formation involved in binary fission.

Question 7 A

A is correct. Metaphase would occur between the stages shown in cells X and Y. Therefore, in metaphase, there would be six chromosomes, each made up of two chromatids, as shown in cell X.

B is incorrect. Cell Y shows only two centrioles, one at each pole of the spindle fibre network.

C is incorrect. In metaphase, there would be 12 chromatids as shown in cells X and Y.

D is incorrect. In metaphase, the chromosomes align along the equator of the spindle network. Each chromosome consists of two chromatids joined by a centromere, so there would only be six centromeres.

Question 8 B

B is correct. Cell X is undergoing prophase, as shown by the chromosomes appearing as double-stranded structures. Metaphase would then occur, followed by anaphase. Anaphase is shown in cell Y by the daughter chromosomes separating to the poles.

A is incorrect. The chromosomes have already replicated before mitosis begins, so each chromosome in cell X already consists of two chromatids, as shown.

C is incorrect. Neither cell X nor Y is undergoing cytokinesis, which would occur after anaphase (shown in cell Y).

D is incorrect. The nuclear membrane breaks down during prophase (shown in cell X), so it has already disappeared before the stage shown in cell Y.

Question 9 A

A is correct. If the tumour suppressor genes (TSGs) are non-functional, inhibition of cell division, repair and apoptosis will not occur, resulting in millions of cells forming cancer tissue.

B is incorrect. If the function of proto-oncogenes (POs) was enhanced, the result would be uncontrolled promotion of cell division, not controlled reduction.

C is incorrect. In cancer cells, there is an imbalance in the activities of the two gene types, resulting in too much cell division and too little cell death and inhibition of cell division.

D is incorrect. It is the TSGs that trigger apoptosis, so apoptosis would still occur even if the POs were no longer functioning.

Question 10 D

D is not a correct statement and is, therefore, the required response. Cancer cells are poorly differentiated; they divide so rapidly that they do not become specialised.

A, **B** and **C** are all correct statements. Cancer cells grow and divide at an abnormally rapid rate, carry out tissue invasion and avoid programmed cell death.

Question 11 B

B is correct. All stem cells are unspecialised, so they are 'neutral' in that they do not have a specific structure or function. They do have the potential to specialise.

A, C and D are incorrect. Stem cells can divide over and over many times, can be induced to specialise and can replace cells damaged by illness or injury. However, these facts do not explain why they would be called 'neutral cells'.

Question 12 C

C is correct. Pluripotent stem cells can divide and develop into all cells of the human body (three germ layers), but not into extra-embryonic tissues such as the placenta. Totipotent cells can form all cell types, including both the embryonic and extra-embryonic tissues required for development of the entire organism.

A is incorrect. Pluripotent cells form many cell types, not a limited number of types.

B is incorrect. Pluripotent cells form most cell types, not just blood and bone.

D is incorrect. The names pluripotent and totipotent are not interchangeable. They describe different types of cells with different potentials in terms of the types of cells they can differentiate into.

Question 13 D

D is correct. Although stem cells are found in most adult tissues, they are most abundant in bone marrow and can be collected later in life.

A is incorrect. Although the brain contains stem cells, they are less abundant than in bone marrow.

B is incorrect. Although the pulp inside teeth contains stem cells, they are less abundant than in bone marrow.

C is incorrect. Although the tissue at the base of finger and toe nails contain stem cells, they are less abundant than in bone marrow.

Question 14 C

C is correct. For exchange by filtration in the glomeruli/Bowman's capsules and reabsorption and secretion in the kidney tubules, it is essential that the walls consist of a single layer of flattened cells to provide a large surface area to volume ratio for exchange.

A is incorrect. The spherical shape of the Bowman's capsule would not be the best shape to fit many of them into the small kidneys. The shape provides a greater surface area to volume ratio to aid filtration efficiency.

B is incorrect. The kidney tubules are not cylindrical. They are long, convoluted and looped, providing a huge surface area for exchange.

D is incorrect. The shapes described would not play a role in protection from fluid movement.

Question 15 C

C is incorrect and is, therefore, the required response. Positive feedback results in the response produced increasing the original stimulus. This would result in body temperature being uncontrolled, rather than being thermoregulated by negative feedback and resulting in homeostasis.

A, B and D are all correct. These processes could be used to regulate body temperature.

Question 16 C

C is correct. The glands of the endocrine system are all ductless, emptying the hormones they secrete directly into the bloodstream.

A is incorrect. Hormones are mostly made of protein, with some made of lipid.

B is incorrect. Antidiuretic hormone (ADH) is produced by a receptor organ.

D is incorrect. ADH is carried in the blood, not the tissue fluid.

Question 17 B

B is correct. The plasma–ADH concentration begins to increase at 280 pmol/L, so this must be the set point for ADH secretion.

A, **C** and **D** are incorrect. These values are either before or after the set point for ADH secretion.

Question 18 D

D is correct. The measurement recorded is the ADH concentration in the blood plasma. The pituitary gland is the endocrine gland that secretes ADH into the blood.

A, **B** and **C** are incorrect. These organs are not involved in the secretion of ADH into the blood.

Question 19 C

C is correct. The increase in plasma–ADH concentration occurs before the increase in thirst intensity and will stimulate increased reabsorption of water by the kidney before Nina begins to feel thirsty.

A is incorrect. This option is the opposite of what is expected.

B is incorrect. The two processes share a direct relationship, as observed on the graph.

D is incorrect. Thirst is an important sensation in osmoregulation to stimulate the need to drink.

Question 20 D

D is correct. High light intensity will correlate with an increase in temperature, which would increase the rate of transpiration from the plant through the stomata.

A is incorrect. High humidity means that the water vapour concentration in the air surrounding the plant would increase, and the concentration gradient would decrease, reducing the rate of transpiration.

B is incorrect. If there is no wind, there will be no water vapour blown away from around the leaves. This would not increase transpiration.

C is incorrect. In low temperatures, there will be a low rate of evaporation of water inside the leaves. This would not increase transpiration, as the concentration gradient to the outside of the plant would not increase.

Question 21 C

C is correct. The genome consists of all the genes in an organism, including those on both the autosomes and sex chromosomes.

A is incorrect. The genome contains all the genes; the features they code for have no impact on their inclusion.

B is incorrect. This option only refers to the genes on the autosomes and omits the genes found on the sex chromosomes.

D is incorrect. The genome contains all the genes found on both paternal and maternal chromosomes, as they have the same gene sequence.

Question 22 D

D is correct. A pair of homologous chromosomes consists of two chromosomes with the same length and centromere position. Most importantly, however, the two chromosomes have the same gene loci or gene sequence.

A is incorrect. While homologous chromosomes have the same length, this alone is not their defining feature; there may be other chromosomes in the set that have the same length.

B is incorrect. While homologous chromosomes have the same centromere position, this alone is not their defining feature.

C is incorrect. While the gene loci of two homologous chromosomes are identical, the alleles of the genes are not.

Question 23 B

B is correct. Gametes, which are haploid (n), are produced in the cells of the gonads, which are diploid ($2n$).

A is incorrect. Adult somatic cells are diploid ($2n$), not haploid (n).

C is incorrect. Meiosis occurs in the gonad cells (not in somatic cells) to produce gametes or sex cells (not zygotes).

D is incorrect. Gonad cells are diploid ($2n$) cells and are part of an organ in which meiosis occurs.

Question 24 C

C is correct. There are only 21 pairs of homologous chromosomes shown on the karyotype, as the sex chromosomes and the three copies of chromosome 18 are not homologous.

A is incorrect. Autosomes are non-sex chromosomes, so the X and Y chromosomes are not autosomes.

B is incorrect. The chromosomes numbered 1–22 are autosomes, not somatic chromosomes. Autosome is the term used for non-sex chromosomes.

D is incorrect. Chromosomes X and Y are sex chromosomes, not sex-linked. Sex-linked is a term used for genes on the sex chromosomes.

Question 25 B

B is correct. All the chromosomes are in homologous pairs, except for the sex chromosomes and autosome 18, which has one extra chromosome. Therefore, the correct notation for a karyotype of Edward's syndrome would be $2n + 1$.

A is incorrect. There is one extra chromosome, not one missing.

C is incorrect. There are two of each chromosome; therefore, the diploid number ($2n$) should be shown, not the haploid number (n).

D is incorrect. There are two of each chromosome; therefore the diploid number ($2n$) should be shown, not the haploid number (n). Additionally, there is one extra chromosome, not one missing.

Question 26 A

A is correct. The term aneuploidy refers to conditions that result from having an abnormal number of chromosomes in a haploid set due to extra or missing chromosomes. This is seen in the karyotype for Edward's syndrome, which has one extra copy of chromosome 18.

B is incorrect. The term monoploidy refers to a condition in which an individual contains only half the normal number of chromosomes.

C is incorrect. The term polyploidy refers to a condition in which there are more than two sets of chromosomes in an organism's somatic cells.

D is incorrect. The term triploidy refers to three sets of chromosomes in an organism's somatic cells (not three of one type of chromosome, which is called trisomy).

Question 27 D

D is correct. Non-disjunction in meiosis is the failure of homologous chromosomes (meiosis I) or sister chromosomes (meiosis II) to separate, resulting in gametes with one more or less of a chromosome in its haploid set. If a human gamete with an extra copy of chromosome 18 fuses with a normal gamete, the resulting offspring will have three copies of chromosome 18 and display symptoms of Edward's syndrome.

A is incorrect. Mutations/errors in the DNA of the gene may occur during DNA replication but would not result in the loss or gain of chromosomes.

B is incorrect. Errors in chromosome structure may occur during crossing-over and recombination as pieces of chromosomes are added, deleted, or exchanged incorrectly. However, the loss or gain of whole chromosomes would not occur.

C is incorrect. Although independent assortment occurs at the same time as non-disjunction, it does not cause the gain or loss of chromosomes.

Question 28 C

C is correct. Epigenetic factors alter gene expression (how a cell reads a DNA sequence), not the nucleotide sequence of the DNA of the gene.

A is incorrect. Alterations in gene expression due to epigenetic factors will result in changes in the phenotypic characteristics between individuals.

B is incorrect. Unlike genetic changes, epigenetic changes are reversible.

D is incorrect. Environment and behaviours, such as diet and exercise, can result in epigenetic changes.

Question 29 A

A is correct. One of the ways that epigenetic changes affect gene expression is DNA methylation, which works by adding a chemical group to DNA that blocks the proteins required to 'read' the gene. If higher levels of DNA methylation were observed for both genes in binge and heavy drinkers, this would support the hypothesis.

B is incorrect. DNA nucleotide sequences in the two genes would not be caused by epigenetic factors.

C is incorrect. Changes in the functioning of the two genes would support the hypothesis that excessive alcohol consumption is an epigenetic factor. If no change in function occurred, the hypothesis would not be supported.

D is incorrect. If there was no difference between the results of the three groups of drinkers, the hypothesis would not be supported.

Question 30 C

C is correct. In all four different blood grouping systems listed, the gene locus is located on an autosome, not a sex chromosome, so the pattern of inheritance is called autosomal inheritance.

A is incorrect. Codominance occurs when both alleles are expressed equally and appear in the phenotype of the offspring. This is only shown by the phenotype AB in ABO blood grouping, and phenotype MN in MN blood grouping.

B is incorrect. Incomplete dominance occurs when neither allele expresses completely in the offspring and the resulting phenotype is a blend of the two parents. This occurs in none of the four blood grouping systems shown.

D is incorrect. None of the gene loci for the four blood grouping systems shown is on a sex chromosome

Question 31 D

D is correct. For the child to have a blood group O, Rh–, both parents would have to have genotypes with at least one *i* allele and one Rh– allele. Parents in the cross $I^A I^B \times ii$ could not produce a baby with blood group O (which would require a genotype of *ii*).

A, B and C are incorrect. The parents in these crosses have the required alleles for an O, Rh– baby.

Question 32 A

A is correct. In a cross of $I^A I^B MN \times I^A I^A NN$, the chance of producing an $I^A I^A$ offspring is $\frac{1}{2}$ and the chance of producing an NN offspring is $\frac{1}{2}$. Therefore, the chance of an offspring with blood groups A and N is $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$.

B, C and D are incorrect. These predictions are not possible from the parental genotypes specified.

Question 33 B

B is correct. Both the gene loci for the Rh and Duffy blood grouping systems are linked on chromosome 1, so the correct notation for linkage must be used together with the correct allele symbols for heterozygosity.

The chromosome inherited from his mother would be Fyb Rh– and the chromosome inherited from his father would be Fya Rh+; therefore, his genotype would be written $\frac{Fya Rh-}{Fyb Rh+}$.

A and D are incorrect. Both alleles of each blood group would not be inherited by the same offspring, so they should not be shown on the same line.

C is incorrect. This genotype shows the man as Rh+ Rh+. As he is heterozygous, this should be Rh+ Rh–.

Question 34 D

D is correct. Both the gene loci are linked but not close together, as one is on the short arm of chromosome 1 and one is on the long arm. In this test cross between a parent heterozygous for both gene loci and a parent homozygous recessive for both gene loci, if some crossing-over and recombination occurred, the resultant ratio in a large group of offspring would be 1 : few : few : 1, with the groups of a few being the recombinant offspring.

A is incorrect. This option is the expected ratio for a dihybrid cross in which the parents have the same genotypes, as shown in the question. However, the two relevant gene loci are not linked.

B is incorrect. This option is the expected ratio for a dihybrid cross in which both parents were heterozygous for both genes, and the two gene loci were not linked.

C is incorrect. This option is not the expected ratio for a dihybrid cross in which both parents were heterozygous for both genes, and the two gene loci were not linked.

Question 35 B

B is correct. If the small cuttlefish carry out the behaviour of flattening their bodies to appear bigger than they are, the predator may be frightened away.

A is incorrect. Colour-changing skin is a physiological adaptation, not a structural adaptation. It is beneficial to cuttlefish of all ages and, rather than frightening predators, it allows the cuttlefish to hide from predators.

C is incorrect. The beak is a structural adaptation, not a physiological adaptation.

D is incorrect. The hollow cuttlebone assists with buoyancy; it could not be used for an attack as it is not located on the outside of the cuttlefish's body.

Question 36 D

D is correct. Using muscle contraction to change the cuttlefish's colour for camouflage is a physiological adaptation. It would be important during daylight hours when the cuttlefish is more obvious to predators.

A is incorrect. Changing its buoyancy helps the cuttlefish float or move up and down, but this movement would be too slow to move towards a mate and not useful for sideways movement. It would not be important during daylight hours.

B is incorrect. The beak is a structural adaptation for subduing prey and attacking predators and rivals, not attracting mates. It would not be important during daylight hours.

C is incorrect. Mass migration occurs in the breeding season, but it is a behavioural, not physiological, adaptation. It would not be important during daylight hours.

Question 37 A

A is correct. The donor DNA must contain the complete genome of the organism to be cloned. The required diploid number of chromosomes would be found in a somatic/body cell.

B is incorrect. Although ovary cells are diploid cells, the donor egg is usually not from the same female as the somatic cell.

C and **D** are incorrect. Egg and sperm cells only contain half the genetic material required as they are haploid cells.

Question 38 C

C is correct. The embryo must be implanted into a surrogate mother that is the same species as the embryo.

A is incorrect. The original female donor used was Willa, who died years ago.

B is incorrect. The surrogate cannot be a different species, as the embryo would probably be aborted.

D is incorrect. A female egg donor cannot act as a surrogate if it is a different species.

Question 39 D

D is correct. Reproductive cloning does not alter the genome of an organism, it just produces offspring with an identical genome to the one donor parent organism.

A is incorrect. The regeneration of extinct species could be useful. If extinct species were returned to ecosystems, they could perform important functions or jobs that they once performed and were lost when they became extinct.

B is incorrect. Aiding threatened species to increase their chances of survival would be beneficial.

C is incorrect. Increasing genetic diversity in a species increases their chances of survival in a changing environment.

Question 40 B

B is correct. Clearing land for the development of farms, factories and housing has resulted in much of the bandicoot's bushland habitat being cleared away.

A is incorrect. Although bandicoots may have been a food source in the past, they are not commonly hunted for food today.

C is incorrect. Bandicoots are now a protected marsupial species.

D is incorrect. Feral goats mostly eat hay, weeds and blackberry plants. This would not have caused the decline in bandicoot numbers, as they do not eat bandicoots.

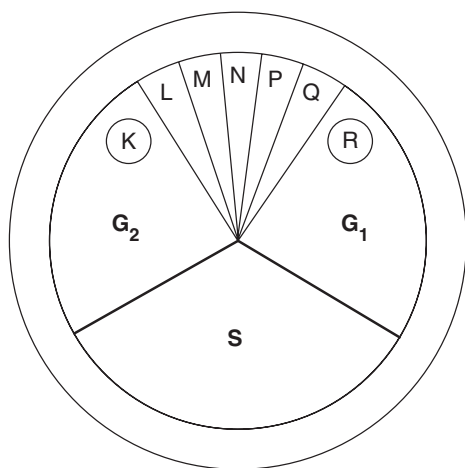
SECTION B

Question 1 (5 marks)

- a. i. cells 1 mark
- ii. The cells contain no membrane-bound nucleus or organelles. 1 mark
- b. i. chlorophyll (*or another pigment that can absorb light*) 1 mark
- ii. oxygen 1 mark
- iii. The process is diffusion. The gas will diffuse from a high concentration in the cells to a lower concentration in the water, then in the air. 1 mark

Question 2 (11 marks)

a.

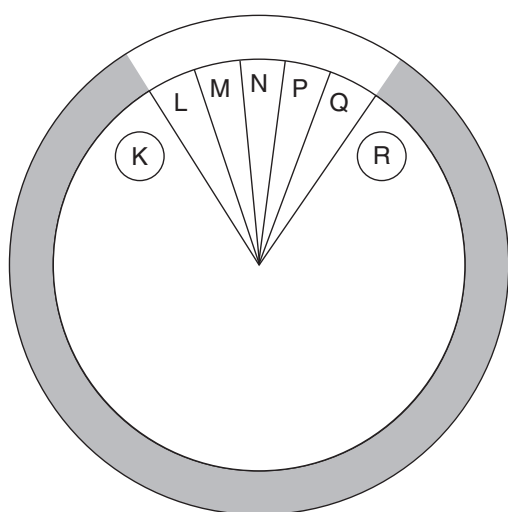


2 marks

1 mark for correct divisions.

1 mark for correct labels.

b.



1 mark

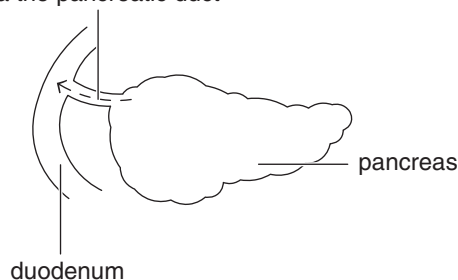
- c. 1: A cell at point R will be smaller than a cell at point K. 1 mark
- 2: A cell at point R will contain half the amount of DNA material compared to a cell at point K. 1 mark

- d. i.** It is essential to produce genetically identical daughter cells for growth, repair and replacement. 1 mark
- ii.** In animal cells, the cell will divide by constriction of the plasma membrane, which squeezes in at the centre of the cell and divides the cell into two. 1 mark
- In plant cells, a cell plate will form and then a new cell wall will form across the centre of the cell, dividing the cell into two. 1 mark
- Note: The process occurring at point Q is cytokinesis. The name of the process is not required for full marks.*
- e.** At point K, a check occurs to determine if the chromosomes have replicated correctly and that there are no errors in the DNA structure. 1 mark
- f. 1:** The damaged DNA in the cell could be repaired and the cell cycle could resume. 1 mark
- 2:** If the damage is beyond repair, apoptosis could be induced, resulting in cell death. 1 mark

Question 3 (9 marks)

- a. i.** Ribosomes are the site of synthesis of the enzyme amylase protein. 1 mark
- ii.** Any one of:
- The Golgi apparatus modifies and packages amylase protein for secretion.
 - Vesicles transport the amylase protein from the Golgi apparatus to the plasma membrane for secretion.
- 1 mark
- b.** The stomach secretes hydrochloric acid, which makes the region very acidic (pH 1–2). This denatures/destroys the amylase enzyme structure, so amylase action ceases. 1 mark
- c. 1:** Mucus protects the inner lining cells of the stomach from acid and enzyme action. 1 mark
- 2:** Protease enzyme is activated in the acidic environment to begin digestion of proteins. 1 mark

- d.** enzymes enter the duodenum via the pancreatic duct



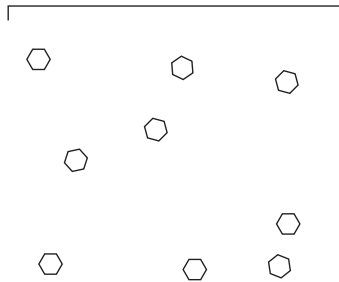
- 1 mark
- e. i.** the liver 1 mark
- ii.** Bile mechanically breaks down (emulsifies) fats/lipids from larger globules into tiny droplets. 1 mark
- Enzymes chemically break down larger, more complex molecules into small, simple, soluble molecules. 1 mark

Question 4 (6 marks)

a. i. a phospholipid molecule 1 mark

ii. This represents the two membranes of the glomerulus and Bowman's capsule, each consisting of two layers of phospholipid molecules with their tails facing inwards. 1 mark

b. fluid inside Bowman's capsule



1 mark

1 mark for indicating the presence of amino acids only using the appropriate symbol from the key.

No large plasma proteins (globulin) are shown in filtrate/fluid in the Bowman's capsule as, even though they are hydrophilic, they are too big to pass through any part of the membranes. Amino acids are shown as they are small, water-soluble molecules that can pass through the protein channels in both membranes.

1 mark

c. Yes, Jacob was correct. Amino acids are hydrophilic and can pass through the protein channels of the membranes in a soluble state. 1 mark

d. All the glucose filtered into the glomerular filtrate is reabsorbed in the proximal convoluted tubule. 1 mark

Question 5 (9 marks)

a. insulin 1 mark

b. i. If alloxan destroys the beta cells (cells that produce the insulin hormone) in the pancreas, then the blood-glucose concentration in the rats treated with alloxan will increase and not be regulated. 1 mark

ii. Yes. All factors except the independent variable (treatment of the rats with alloxan or water) were kept the same/constant. (*The controlled variables include the species, age, size and health of the rats and the environmental conditions.*) 1 mark

iii. Rats are mammals and more closely related to humans than chickens. They better model the effects of pancreatic damage in humans. 1 mark

- c. i. Group A. The blood glucose concentration was unregulated compared to the control group. After treatment, the blood glucose concentration of group A rose to 600mg/dL then dropped to approximately 50mg/dL before rising to over 600mg/dL again. 1 mark
- ii. hypoglycaemia 1 mark
- iii. No. The results are not deemed valid as the experiment was not reproduced and the sample size was small. (*However, there was only one independent variable and all factors, except the independent variable, were controlled.*) 1 mark
- iv. No. There was no replication/repetition and the results were not presented in a format (table) to determine the variance of the data. 1 mark
- d. The flour containing alloxan may cause damage to the pancreas of the consumer, resulting in diabetes or other related health issues. 1 mark

Question 6 (8 marks)

- a. i. There seems to be no direct relationship between genome size and chromosome number; some species with a low chromosome number have a very large genome and others have a small genome. 1 mark
- ii. Chromosomes contain many genes, which in turn are made up of DNA that consists of hundreds or thousands of base pairs.
This results in a larger genome size than chromosome number. 1 mark
- b. David is correct. The complexity of an organism does not determine its genome size. 1 mark
- c. Although corn and salamanders have the same number of chromosomes, the genes on their chromosomes are different and code for different structural and functional characteristics. 1 mark
- d. i. *Salmonella* are prokaryotes, which have no membrane-bound nucleus. Their circular chromosome and plasmids are found in the cytosol. 1 mark
- ii. In wheat plants, chromosomes are found in the nucleus, mitochondria and chloroplasts of green cells. In the animal cells of zebra fish, there are no chloroplasts, so chromosomes are only found in the nucleus and mitochondria. 1 mark
- e. i. $2n = 26$ 1 mark
- ii. $n = 25$ 1 mark

Question 7 (6 marks)

- a. i. All five offspring would be pink. 1 mark
- ii. In incomplete dominance, neither allele is completely expressed, so the offspring do not exhibit the traits of either parent. In this case, red (RR) × white (WW) results in flowers with a blend of the phenotypes of the parents. 1 mark

- b. i. All five offspring would have red and white stripes, patches or spots. 1 mark
- ii. Allele symbols: red = C^R , white = C^W
All offspring would be $C^R C^W$. 1 mark
- Note: Accept responses that assign other letters as allele symbols, given that correct notation is used.*
- c. i. test cross 1 mark
- ii. If all offspring in a large sample were red, that would indicate that the red parent was homozygous red (RR). If several or as many as half of the offspring were white, that would indicate the red parent was heterozygous red (Rr). 1 mark

Question 8 (8 marks)

- a. X^G = not affected by G6PD deficiency, X^g = affected by G6PD deficiency 1 mark
- Note: There are no alleles on the Y chromosome as the condition is X-linked. Accept responses that assign other letters as allele symbols, given that correct notation is used.*
- b. A male could not be a carrier of G6PD, as a carrier must have one allele for the dominant trait and one for the recessive trait. Since the gene for G6PD is on the X chromosome, males will only have one copy of the gene as they only have one X chromosome. 1 mark
- c. **Parental cross:** $X^G X^g \times X^g Y$ 1 mark

Gametes:

	X^g	Y
X^G	$X^G X^g$	$X^G Y$
X^g	$X^g X^g$	$X^g Y$

1 mark

Note: Accept responses that use other letters for the alleles, given that correct notation is used.

Chance of male child with G6PD: $\frac{1}{2}$ (or 50%)

1 mark

- d. A female symptomatic for G6PD would have the genotype $X^g X^g$. 1 mark
- The conditions required to express symptoms include if she ate fava beans, was affected by stress, consumed one of the medications or foods, or had an infection that triggered the G6PD deficiency symptoms. 1 mark
- e. These factors could not be called epigenetic factors as they do not act on the expression of the G6PD gene. (They affect the protein that has been produced from the gene coding.) 1 mark

Question 9 (12 marks)**a.**

Organism/Species	Adaptation and adaptive advantage	Type of adaptation
great white shark	<i>For example, any one of:</i> - gills for gaseous exchange of oxygen and carbon dioxide - pointed long teeth for grabbing and eating prey	structural
blue shark	They migrate in a long, looping patterns to the tropical Indian Ocean then return to the Great Australian Bight to forage for food each year.	behavioural
southern bluefin tuna and mackerel	They are 'warm-blooded' and can regulate their body temperature by endothermy, retaining the body heat they generate when swimming.	physiological
shrimp	<i>For example, any one of:</i> - hard outer shell/exoskeleton for body support and the protection of soft internal organs - long antennae to detect prey and other objects - jointed legs for movement in water and on rocks	structural

4 marks

1 mark for each correct cell of the table.

Note: There are a range of acceptable responses for adaptation and adaptive advantage; accept any reasonable response.

b. i. top or apex predators

1 mark

ii. A keystone species has a disproportionately large effect on other species in the ecosystem relative to their population size and play a crucial role in the maintenance of stability in the ecosystem.

1 mark

If great white sharks were absent in the ecosystem of the Great Australian Bight, the ecosystem may become unstable and potentially collapse. (Alternatively, it could result in an invasive species moving into the area and shifting the ecosystem in a new direction.)

1 mark

- c. i. Great white sharks reproduce sexually. Even though they are ovoviviparous, offspring is formed through the fusion of a female egg/gamete with a male sperm/gamete. 1 mark
- ii. Sexual reproduction would be more advantageous to the survival of the species as sexual reproduction results in greater genetic diversity in the members of the species. 1 mark
- Greater genetic diversity would give the species a greater chance of survival in a changing environment. 1 mark
- d. i. parthenogenesis 1 mark
- ii. $n = 36$ 1 mark

Question 10 (6 marks)

- a. i. The greater the flowering of stringybark gums, the greater the availability of eels as a food resource (*a direct relationship*). 1 mark
- ii. The small hole would allow the younger short-fin eels to pass through the end of the eel trap so they could survive and produce the next generation, therefore maintaining the long-term survival of the species. 1 mark
- iii. Roza is correct. This is an interdependent relationship between the eels and the local people because the people benefit from catching and eating the eels as part of their diet, while the eels benefit from achieving a greater chance of survival of the species due to sustainable harvesting. 1 mark
- b. i. *Any one of:*
- Lignotubers/underground root systems would produce a rapidly growing shoot system soon after the fire.
 - Epicormic buds under thick bark would be protected from fire, allowing them to rapidly generate new growth after the fire.
 - Seeds with a hard, fireproof coating would survive the heat of the fire and then germinate and grow rapidly into young plants after the fire.
- 1 mark
- Note: Accept any other structural adaptation that would aid in plant survival during the fire and rapid regeneration after the fire.*
- ii. Once the fire has passed and the new growth has begun, animals would come to areas of regeneration after the fire to eat the young leaves and buds. 1 mark
- By applying their knowledge of animal behaviour, hunters could then use this opportunity to trap or hunt the animals as a food resource. 1 mark