Neap:

Trial Examination 2007

VCE Biology Unit 3

Written Examination

Question and Answer Booklet

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

Student's Name: _____

Teacher's Name: _____

Structure of Booklet

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

Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners and rulers. Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape. No calculator is allowed in this examination.

Materials supplied

Question and answer booklet of 19 pages.
Answer sheet for multiple-choice questions.

Instructions

Write your **name** and **teacher's name** on this booklet and in the space provided on the answer sheet for multiple-choice questions. All written responses should be in English.

At the end of the examination

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

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

SECTION A: MULTIPLE-CHOICE QUESTIONS

Instructions for Section A

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

Choose the response that is **correct** 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.

Question 1

The synthesis of biomolecules such as carbohydrates is often referred to as condensation polymerisation because

A. monosaccharides link together covalently.

B. water is used in the polymerisation process.

C. water is produced during the polymerisation process.

D. it is a catabolic process.

Question 2

Which of the following biomacromolecules contains the smallest number of atoms?

A. a phospholipid

B. an amino acid

C. a protein

D. a starch molecule

Question 3

Water is an important biomolecule because

A. the hydrogen bonds between adjacent molecules mean that water is a poor heat absorber.

B. it is non-polar.

C. it allows polar molecules to mix with it.

D. it is a reactant in respiration.

Question 4

Consider the piece of single-stranded DNA illustrated below.

C C A T A G G A

The DNA strand complementary to the one above is

A. G G T A T C C T.

B. C C A T A G G A.

C. G G U A U C C U.

D. C C U A U C C U.

Question 5

Bacteria that live in vents on the ocean floor (where hot magma superheats the water) have an extremely high proportion of guanine and cytosine in their DNA.

Which statement best explains why this bacterial DNA is very stable in hot temperatures?

A. The high guanine and cytosine content means the strands of bacterial DNA are less likely to be antiparallel.

B. The hydrogen bonds that allow adenine and thymine to base pair are very unstable in hot environments.

C. The covalent bonds between guanine and cytosine are too strong to be broken except by a chemical reaction.

D. Guanine and cytosine base pair with three hydrogen bonds, while the other nucleotides base pair with two hydrogen bonds.

Question 6

The side chains of amino acids that are in closest contact with the phospholipids of a membrane are best characterised as

A. hydrophobic.

B. hydrophilic.

C. polar.

D. basic.

Question 7

The proteome of an organism refers to

A. the entire set of DNA instructions located within the nucleus of a single cell of the organism.

B. all the proteins involved in anabolic reactions within any cells of the organism.

C. all the proteins involved in metabolism within any cells of the organism.

D. all the proteins and their functions within any cells of the organism.

Question 8

Consider a beaker of pure water.

If DNA was added to the pure water, what observation would be made about the resulting DNA solution in comparison to the original pure water?

A. The pH would increase.

B. The pH would remain the same.

C. The pH would decrease.

D. The resultant solution would be alkaline.

Question 9

Which of the following statements links the correct process with its cellular location?

A. Kreb's cycle occurs on the grana.

B. Calvin cycle occurs in the mitochondria.

C. Protein synthesis occurs on the ribosomes.

D. Glycolysis occurs in the stroma.

Question 10

A scientist was studying the production of a protein released by an animal cell into a culture medium. She found that the protein only appeared in the medium after she added a hormone to the cell. Before adding the hormone, she labelled the protein inside the cell with fluorescent amino acids and looked at the cell under the microscope. The fluorescent protein was seen in a network of tube-like structures throughout the cell, and in stacks of flattened sacs. After adding the hormone, the fluorescent protein was also seen as small dots clustered against the cell membrane.

Which statement most likely explains these observations?

A. The hormone triggers the synthesis of the protein in the endoplasmic reticulum and it is then secreted outside of the cell via channel proteins in the cell membrane.

B. The protein is made on parts of the cytoskeleton, is passed to the Golgi apparatus, and is secreted through hormone-stimulated exocytosis.

C. The protein is modified in the endoplasmic reticulum, is passed to the Golgi apparatus, and is secreted through hormone-stimulated exocytosis.

D. The protein is made in the Golgi apparatus, is passed to the endoplasmic reticulum, and is secreted through hormone-stimulated pinocytosis.

Question 11

Which statement about plasma membranes is correct?

A. Membrane glycoproteins usually have their carbohydrate groups facing the cytoplasm.

B. Transmembrane proteins must be orientated in specific directions in the plasma membrane to perform their functions.

C. The hydrophilic portions of phospholipids are orientated towards the inside of the phospholipid bilayer.

D. Plasma membranes containing cholesterol do not function properly.

Use the following information to answer Questions 12 and 13.

The following table gives information relating to the difference in the concentration of ions inside and outside some human cells. The cells were exposed to the ions and were allowed to acclimatise for six hours.

Ion	Extracellular concentration (mM)	Intracellular concentration (mM)	Difference in concentration between extracellular and intracellular
Na^+	140	10	14×
K^+	4	140	35×
Ca^{2+}	25	0.1	250×
Cl^-	100	4	25×

Question 12

According to the information, which ion maintains the highest concentration inside the cells?

A. Na^+

B. K^+

C. Ca^{2+}

D. Cl^-

Question 13

Which of the following statements is consistent with the information provided in the table?

A. K^+ has accumulated within the cells due to active transport.

B. Ca^{2+} has moved out of the cell due to diffusion.

C. Na^+ has moved into the cell due to active transport.

D. Cl^- has moved into the cell due to facilitated diffusion.

Question 14

Aerobic respiration is a complicated process that involves a range of inputs and outputs such as those below.

$$6CO_2 \quad C_6H_{12}O_6 \quad 36Pi \quad 6O_2 \quad 36ATP \quad 6H_2O \quad 36ADP$$

Which of the following equations is a correct depiction of this process?

A. $6CO_2 + C_6H_{12}O_6 + 36Pi \rightarrow 6O_2 + 36ATP + 6H_2O + 36ADP$

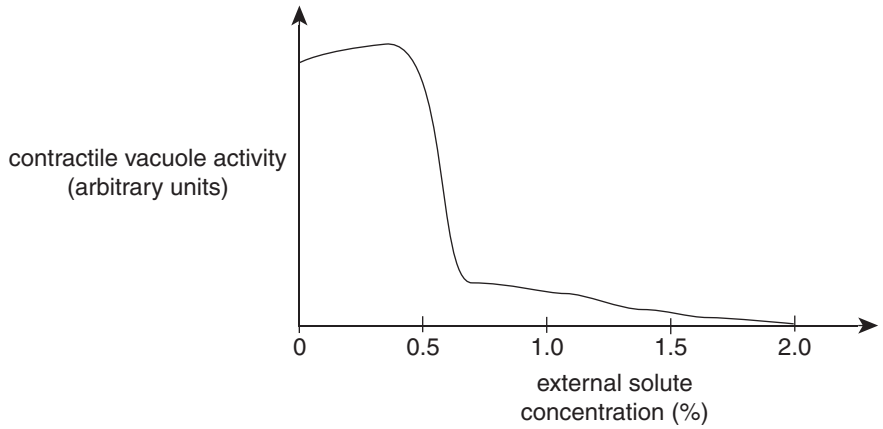
B. $C_6H_{12}O_6 + 36ADP + 36Pi + 6O_2 \rightarrow 36ATP + 6H_2O + 6CO_2$

C. $6O_2 + 6CO_2 + C_6H_{12}O_6 + 6H_2O \rightarrow 36Pi + 36ATP + 36ADP$

D. $C_6H_{12}O_6 + 36ADP + 6O_2 + 36ATP \rightarrow 36Pi + 6H_2O + 6CO_2$

Use the following information to answer Questions 15 and 16.

Single-celled freshwater protists often possess an organelle called a contractile vacuole which regulates the level of water in their cytosol. The following graph depicts the action of this organelle with changing external solute concentration.



Question 15

In what external solute concentration would the single-celled freshwater protists be able to survive most effectively?

A. 0.5%
B. 1.0%
C. 1.5%
D. 2.0%

Question 16

Which of the following statements gives a reasonable explanation for the contractile vacuole activity at a solute concentration of 2.0%?

A. The contractile vacuole is not working due to the internal concentration of solutes in the single-celled protist being isotonic to the external environment.
B. The contractile vacuole is not working to remove accumulated water because the external concentration of free water molecules is higher than the internal concentration of free water molecules.
C. The contractile vacuole is not working to remove accumulated water because the internal environment of the single-celled protist in hypertonic to the external environment.
D. The contractile vacuole has ceased functioning because the external solute concentration has exceeded the single-celled protists' tolerance to solutes.

Question 17

A typical animal hormone has different actions on different tissues because

A. the various target cells have different genes.
B. hormones are directed to specific targets by the circulatory system.
C. the receptors on different target cells are linked to different cell mechanisms.
D. each different response is connected to a different receptor for the same hormone.

Question 18

Plants bend toward a unidirectional light source as a result of

A. the increased amount of glucose synthesised by their leaves.

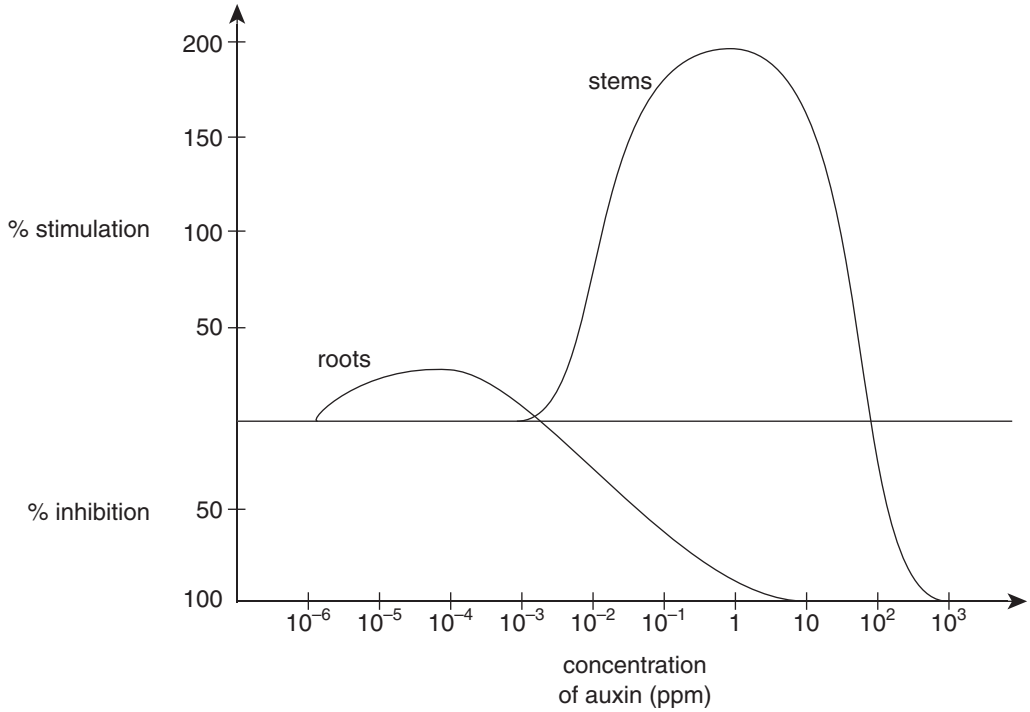
B. an unequal auxin distribution in their stems.

C. their need for light for photosynthesis.

D. an inability to synthesise chemical regulators.

Question 19

The diagram below shows the effect of varying auxin concentration on the growth of the shoots and roots of *Plantago lanceolata*, a common broad-leaved lawn weed.



Which of the following statements is the best explanation of how auxin sprays can be used to control *Plantago* on lawns?

A. Auxin at 10^{-1} ppm has the same effect on both roots and stems.

B. At concentrations above 10^{-3} ppm, auxin slows the growth of stems and reduces the size of the weeds.

C. At concentrations above 10^{-3} ppm, auxin causes stem growth to outstrip the ability of the roots to supply water so the plant wilts.

D. Increasing auxin concentration causes root growth to outstrip the ability of the stems to supply glucose for active uptake.

Question 20

The speed of a nerve impulse along the neuron of a squid is maximised when

A. the axon is wider and a myelin sheath is present.

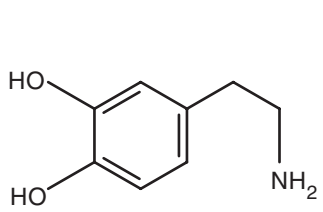
B. the axon is narrower and a myelin sheath is present.

C. the axon is narrower and the myelin sheath is absent.

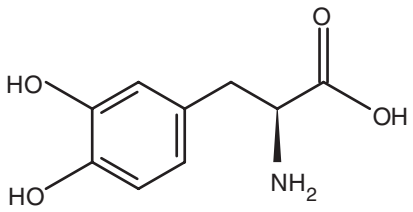
D. the axon is wider and the myelin sheath is absent.

Question 21

Parkinson's disease is a degenerative disorder of the central nervous system. The primary symptoms are excessive muscle contraction, impaired speech, memory loss and attention deficit, normally caused by the insufficient formation and action of dopamine, a neurotransmitter in the brain. The most widely used form of treatment is levodopa (L-dopa) which is administered orally.



dopamine



levodopa

Which of the following statements is most likely to be correct?

A. Because of its molecular similarity to dopamine, levodopa diffuses into neurons in the brain so that the speed of nerve impulses is increased.

B. Levodopa passes from the blood into the brain, where it is converted by an enzyme into dopamine, restoring normal neurotransmitter function.

C. Levodopa binds to dopamine, preventing it from occupying dopamine receptors on neurons.

D. Because of its molecular similarity to dopamine, levodopa binds to dopamine receptors on neurons in the brain so that impulse transmission is inhibited.

Question 22

Body temperature in humans is normally controlled by homeostatic feedback mechanisms. A fever is a condition where the body temperature is higher than normal, usually during a bacterial or viral infection.

Which of the following is the most likely causal mechanism of a fever?

A. An increase in temperature due to the heat produced by rapidly multiplying pathogens.

B. The body's thermostat is reset to a higher temperature.

C. A decrease in the ability to cool, for example, by increasing sweating.

D. An increase in the delay between a rise in body temperature and its detection in the brain.

Question 23

Consider the following statements about antibiotics and antibiotic drug use.

(i) Most antibiotics are non-specific, also killing beneficial bacteria that normally occur in the body.

(ii) Antibiotics can be used to immunise children against diseases such as tuberculosis.

(iii) Antibiotic-resistant bacteria can spread from one treated person to other persons who live in close proximity (for example, among family members).

(iv) Antibiotics can inhibit bacterial growth by disrupting protein synthesis and cell wall formation.

Which of the statements are correct?

A. (i), (iii) and (iv) only

B. (i), (ii) and (iv) only

C. (i), (ii) and (iii) only

D. (ii), (iii) and (iv) only

Question 24

Autoimmune diseases result from a breakdown in the body's ability to

A. produce interferons.
B. produce memory cells.
C. destroy major histocompatibility complex (MHC) proteins.
D. distinguish 'self' from 'non-self'.

Question 25

A doctor discovers her patient can resist many bacterial infections by producing appropriate antibodies, but the patient is highly susceptible to viral infections.

The most likely diagnosis is a disorder of the patient's

A. T cells.
B. macrophages.
C. plasma cells.
D. B cells.

SECTION B: SHORT-ANSWER QUESTIONS

Instructions for Section B

Answer this section in **pen**.

Answer all questions in the spaces provided.

Question 1

The enhanced greenhouse effect is a significant political issue in Australia. One of the strategies that may counter this issue is to reduce greenhouse gases such as carbon dioxide. However, carbon dioxide can be beneficial for some organisms.

a. **i.** What process in plants has carbon dioxide as a substrate?

_____

ii. Write the balanced chemical equation for the process mentioned in **a.i.**

_____

iii. Explain how having a higher level of carbon dioxide in the atmosphere could be beneficial to plants.

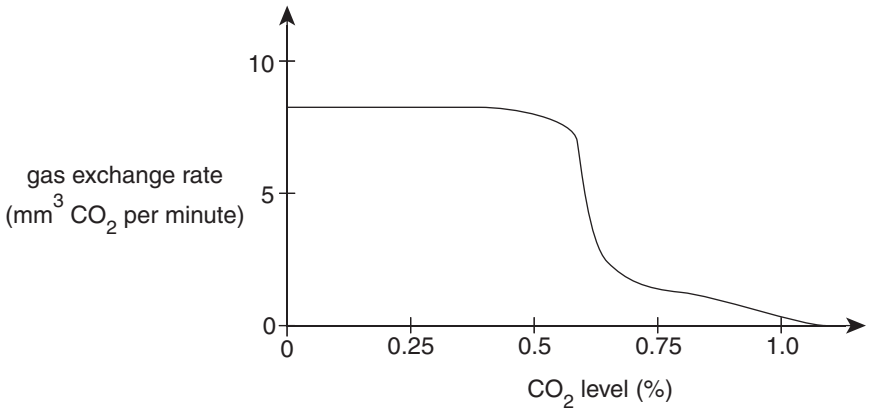
_____

_____

_____

1 + 2 + 2 = 5 marks

b. High carbon dioxide levels can have other effects on the survival of various organisms. The graph below illustrates the relationship between carbon dioxide levels in the air and the rate of gas exchange in some terrestrial plants.



i. Describe the relationship between carbon dioxide levels and the rate of gas exchange between 0.5 and 1.0% carbon dioxide.

_____

ii. What is the rate of gas exchange when the carbon dioxide levels are 0.75%?

_____

iii. Name two factors that would need to be kept constant when gathering data such as that used to construct the graph above.

_____

1 + 1 + 1 = 3 marks

Total 8 marks

Question 2

Starch is a polysaccharide that forms a blue–black complex with iodine solution. Iodine solution is a red–brown colour.

Amylase is an enzyme which catalyses the breakdown of starch to maltose (a disaccharide).

a. i. Name the bond that must be broken by this enzyme.

_____

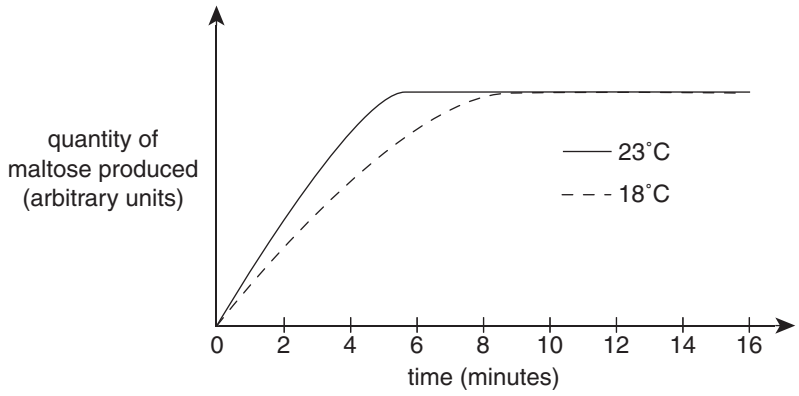
ii. State the colour you would expect to see if you carried out the test before and after adding amylase to a dilute solution of starch.

_____

_____

1 + 1 = 2 marks

In an investigation into the action of amylase, equal volumes of enzyme solution and starch solution were mixed. The quantity of maltose produced was measured during the course of two separate experiments, one carried out at 18°C and the other at 23°C. The results are shown below.



b. i. Explain why the quantity of maltose produced eventually became constant at both temperatures.

_____

_____

ii. Explain why, after exactly four minutes, more maltose had been produced at 23°C than at 18°C.

_____

_____

_____

_____

1 + 2 = 3 marks

c. The experiment was repeated with the same volume and concentration of amylase, but with a higher concentration of starch solution.

Sketch, on the graph above, the curve you would expect to obtain if the experiment were repeated at 23°C with an increased starch concentration.

1 mark

d. Explain why an enzyme that catalyses the conversion of starch to maltose is unable to catalyse the conversion of a protein into amino acids.

_____

_____

_____

_____

_____

2 marks
Total 8 marks

Question 3

The enzyme tyrosine kinase in a normal healthy person helps regulate cell growth and cell division. In some cancer patients the primary structure for the enzyme tyrosine kinase is different (and is subsequently referred to as the CML enzyme) causing huge numbers of white blood cells leading to a type of cancer referred to as chronic myeloid leukaemia (CML).

a. i. What is meant by "the primary structure for the enzyme"?

_____

_____

ii. Using your understanding of DNA structure and function, explain how a different primary structure for the CML enzyme could occur.

_____

_____

_____

1 + 2 = 3 marks

The CML enzyme has a shape that allows a 'cancer protein' to bind to it as well as ATP. The cancer protein subsequently becomes activated which leads to chronic myeloid leukaemia.

b. i. What role does the CML enzyme play in the reaction described above?

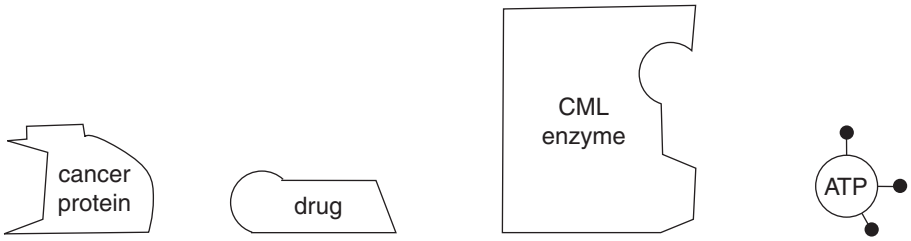
_____

ii. What role does ATP play in the reaction described above?

_____

1 + 1 = 2 marks

c. A drug was developed that competes with the ATP on the CML enzyme. This drug has been very successful in treating patients who suffer this form of cancer. The diagrams below illustrate the various molecules involved.

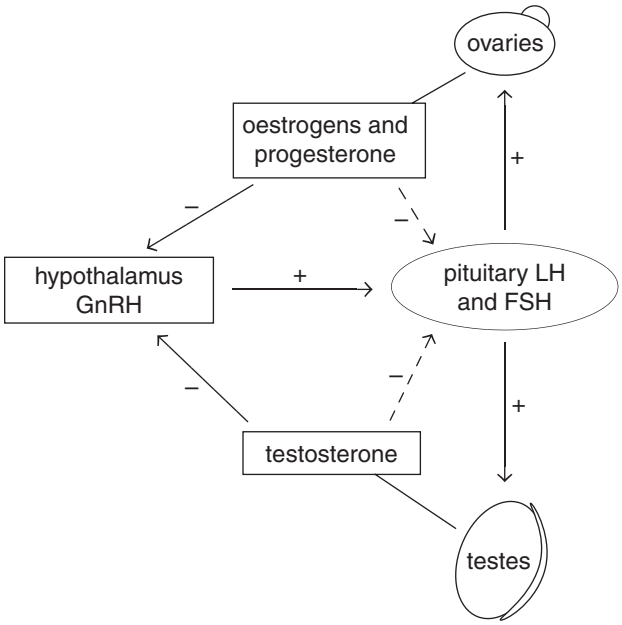


Using all the molecules from the diagram above and other relevant information from the question, explain, using a diagram, how the drug could successfully treat chronic myeloid leukaemia.

2 marks
Total 7 marks

Question 4

The following diagram represents the feedback mechanisms related to the secretion of steroid hormones such as testosterone and oestrogen in males and females. Stimulation is represented by +, and inhibition is represented by –.



LH (luteinising hormone) and FSH (follicle-stimulating hormone) secretion is triggered by GnRH (gonadotrophin-releasing hormone). GnRH is a ten amino acid peptide that is synthesised and secreted from the hypothalamus.

a. According to the feedback diagram above, what would inhibit raised GnRH secretion in females?

_____

1 mark

b. With respect only to the male, describe how raised levels of LH and FSH would eventually lead to a reduction in their secretion.

_____

_____

2 marks

In both sexes, LH stimulates secretion of sex steroid hormones from the gonads (ovaries and testes). FSH stimulates the maturation of ova and increases sperm production.

c. **i.** Name the organelle involved in the synthesis and transport of steroid hormones within a gonad cell.

_____

ii. Name the process where the steroids are secreted in small packages into the bloodstream.

_____

iii. When the steroids are in the bloodstream, why do they only target certain cells within the body?

_____

_____

1 + 1 + 1 = 3 marks

Diminished secretion of LH or FSH can result in failure of gonadal function.

d. Describe an effect that lowered levels of these hormones may have on body functioning.

_____

1 mark

e. What would occur to the LH and FSH levels in the bloodstream if the gonads were removed from either males or females?

_____

1 mark

f. Artificial manipulation of normal steroid levels is the basis for some forms of contraception.

Describe an experiment that could be conducted to test the hypothesis that "high levels of oestrogen inhibit ovulation".

_____

_____

_____

_____

_____

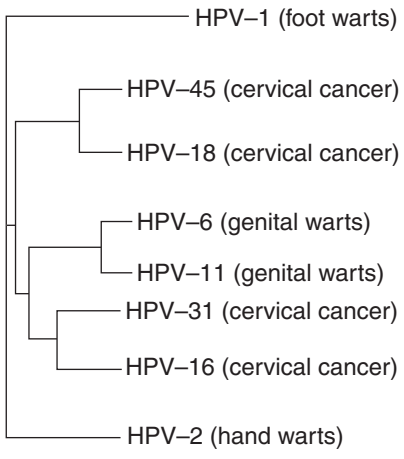
_____

3 marks

Total 11 marks

Question 5

Lingering infection with certain types of high-risk human papillomavirus (HPV), such as HPVs 16, 18, 31 and 45, can lead to the development of cervical cancer. The diagram below shows the relationship between these HPV types as well as other related HPVs.



a. Describe the general structure of a virus.

_____

_____

1 mark

b. Suggest how HPV might cause cervical cells to become cancerous.

_____

_____

_____

_____

2 marks

A vaccine against cervical cancer and other diseases caused by HPV has been developed. The vaccine is designed to prevent infection with HPV types 16, 18, 6 and 11. The vaccine contains VLPs (virus-like particles) assembled from the antigenic proteins of HPVs 6, 11, 16 and 18.

c. Define an antigen.

_____

1 mark

Since VLPs lack the viral DNA, they cannot induce cancer. They do, however, trigger an antibody response that protects vaccine recipients from becoming infected with the HPV types represented in the vaccine.

d. Describe how virus-like particles (VLPs) trigger an antibody response.

_____

_____

_____

_____

_____

2 marks

e. Explain why the vaccine does not protect against infection by HPV types 31 and 45 which also cause cervical cancer.

_____

_____

_____

_____

_____

2 marks

Total 8 marks

Question 6

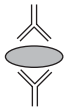
Snake venoms are usually antigenic proteins. Some venoms bind to red blood cells and cause them to agglutinate (clump together) which can lead to death.

To treat a snake bite, it is necessary to know the type of venom involved, but most victims of snake bite cannot identify the snake that bit them. Snake venom detection kits (SVDKs) are therefore used to identify the venom.

Snake venom detection kits are based on enzyme-linked immunosorbent assay (ELISA). The ELISA procedure is described below.

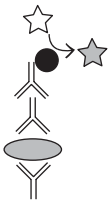
A testing well is coated with a 'capture antibody' which binds to a specific antigen found in the venom of a particular species of snake.

A sample containing venom is added, and any antigen present binds to the capture antibody.



A 'detecting antibody' is added which binds to the antigen.

A secondary antibody with an attached enzyme is added, and binds to the detecting antibody.



A colourless substrate called a chromagen is added, and is converted by the enzyme to a detectable coloured dye.

a. Why do SVDKs for use in desert regions of Australia need to be kept refrigerated to retain their effectiveness?

_____

_____

1 mark

b. Explain how an antibody (anti-venom) might neutralise a snake venom.

_____

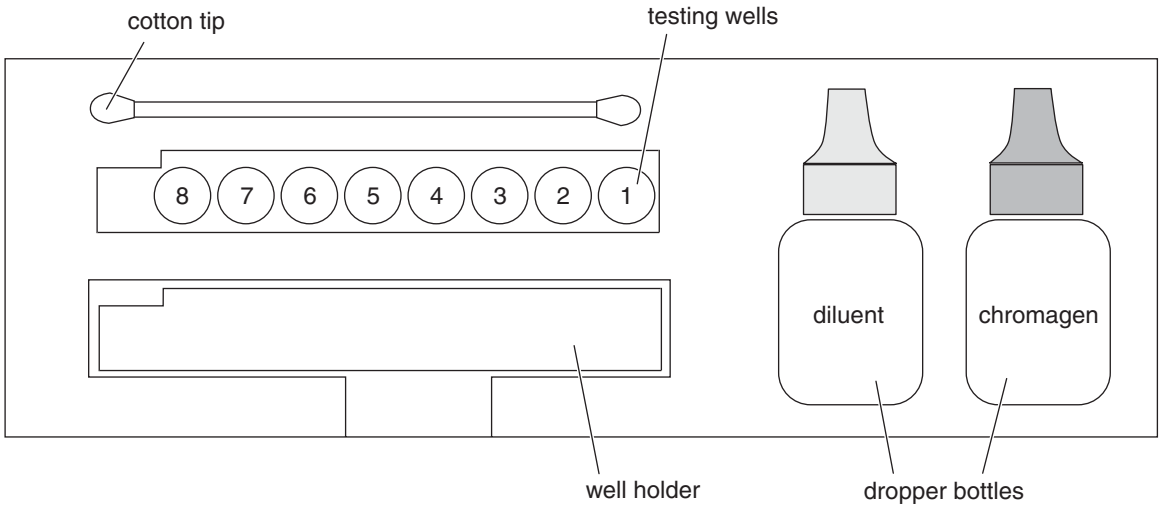
_____

_____

_____

2 marks

c. The diagram below shows the items contained in a SVDK.

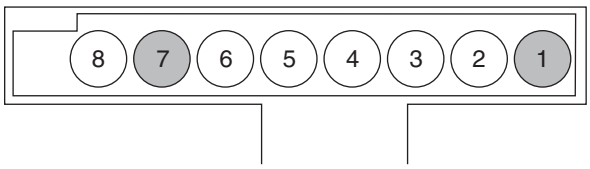


To use the kit the testing wells are placed in the well holder. Wells one to five contain capture antibodies (anti-venoms) corresponding to the five different venom types produced by land snakes in Australia. These are tiger snake (1), brown snake (2), black snake (3), death adder (4) and taipan (5).

The sixth well is the negative control. The seventh well is the positive control. The eighth well is a blank, containing no capture antibody.

To sample venom from the bite site, the cotton tip is moistened in the diluent and placed on the bite site. The cotton tip is then placed in the diluent and stirred around to dissolve the venom. One drop of the dissolved venom is added to each testing well. Several minutes later, the wells are washed out thoroughly with water. Then one drop of chromagen is added to each well and the results are observed.

A typical SVDK result is shown in the diagram below, with a colour change indicated by the grey shading.



i. Which type of snake would cause this result?

_____

ii. Describe the contents of the positive control well for it to give a positive result. What is the purpose of the positive control?

_____

_____

_____

_____

1 + 2 = 3 marks

d. In many cases of snake bite, the snake cannot be identified and an SVDK is not available. In such cases, victims are treated with a polyvalent anti-venom, which contains a mixture of antibodies capable of neutralising a range of venoms.

Explain why treatment with a polyvalent anti-venom carries a high risk of complications.

_____

_____

_____

_____

_____

2 marks
Total 8 marks

END OF QUESTION AND ANSWER BOOKLET