



THE SCHOOL FOR EXCELLENCE (TSFX)

UNIT 3 BIOLOGY 2008

WRITTEN EXAMINATION 1

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

QUESTION AND ANSWER BOOK

Structure of Booklet

<i>Section</i>	<i>Number of Questions</i>	<i>Number of Questions to be Answered</i>	<i>Number of Marks</i>	<i>Suggested Times (min)</i>
A Multiple Choice Questions	25	25	25	30
B Short Answer Questions	7	7	52	60
			Total 77	Total 90

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SECTION A – MULTIPLE-CHOICE QUESTIONS

Instructions for Section A

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

Plants require nitrogen and magnesium to synthesise chlorophyll.

A magnesium deficiency in the soil will result in

- A. Plants utilising CAM photosynthesis.
- B. Opening stomata to increase the concentration of photosynthetic reactants.
- C. Lower rates of photosynthesis.
- D. Utilisation of light independent reactions at night.

QUESTION 2

Allergies are the result of an immune response. What triggers this response?

- A. Antigens.
- B. Antidotes.
- C. Antibodies.
- D. Antihistamines.

QUESTION 3

Organ transplant patients are given drugs to minimise the rejection of transplanted organs.

These drugs work by

- A. Inhibiting the production of enzymes by the transplanted organ that leads to its rejection.
- B. They suppress the response of T cells which recognize 'foreign' molecules on the transplanted organs.
- C. They reduce the effectiveness of mast cells which cause inflammation in transplanted organs.
- D. They promote the repair of the blood vessel connections between transplanted organ and the host body.

QUESTION 4

Watering seeds usually results in germination when environmental conditions are favourable. It would be expected that

- A. Levels of abscisic acid would be high in germinating seeds.
- B. Levels of abscisic acid would be low in germinating seeds.
- C. Gibberellins levels would be low in germinating seeds.
- D. Gibberellins promote conversion of glucose to starch.

QUESTION 5

Methanol is converted by the enzyme alcohol dehydrogenase to formaldehyde, a cellular toxin. Part of the treatment for methanol ingestion includes giving a patient large amounts of ethanol. The ethanol would

- A. Yield ATP energy used to breakdown formaldehyde.
- B. Alter the active site preventing conversion of methanol to formaldehyde.
- C. Break down the formaldehyde.
- D. Compete with methanol for the active site of alcohol dehydrogenase.

QUESTION 6

Fresh corn is very sweet with around 50% free sugar. Sugar is rapidly converted to starch within one day of picking. To preserve sweetness when processing frozen corn it is placed in boiling water for a few minutes before freezing. This process

- A. Deactivates enzymes that convert sugar to starch.
- B. Breaks down starch to sugar.
- C. Promotes formation of glycogen.
- D. Promotes formation of disaccharides.

QUESTION 7

Cells contain many different enzymes because

- A. Enzymes are temperature specific.
- B. Enzymes are specific in their action.
- C. Enzymes are sensitive to pH changes.
- D. Enzymes are sensitive to substrate concentration.

QUESTION 8

The Wollemi Pine (*Wollemia nobilis*) is easily killed by the fungus *Phytophthora* which lives in the soil. The last small population of Wollemi Pines grows in a remote part of a national park in NSW. Scientist studying this natural population use strategies to prevent the trees becoming infected with *Phytophthora*.

Which procedure would be most effective in preventing the spread of this fungus to the Wollemi Pines?

- A. Inspecting soil samples in the area.
- B. Commercially producing and distributing the Wollemi Pine.
- C. Washing soil from scientists' shoes before they walk in the area.
- D. Preventing the importation the importation of infected Wollemi Pines into Australia.

QUESTION 9

Students performed an investigation to compare the effectiveness of two water treatments for purifying pond water.

Three samples of pond water, A, B and C, were collected and each used to inoculate an agar plate. The plates were incubated at 25°C and examined three days later. The number of visible bacterial colonies on each plate was counted and the results tabulated.

<i>Sample</i>	A	B	C
<i>Treatment</i>	5 grams of pool chlorine per litre of water	Boiling for one minute	No Treatment
<i>Number of visible bacterial colonies</i>	0	6	22

The dependent variable in this investigation is

- A. The use of a control sample.
- B. The number of visible bacterial colonies.
- C. The use of sterile agar plates for each sample.
- D. Treating the water by boiling or adding pool chlorine.

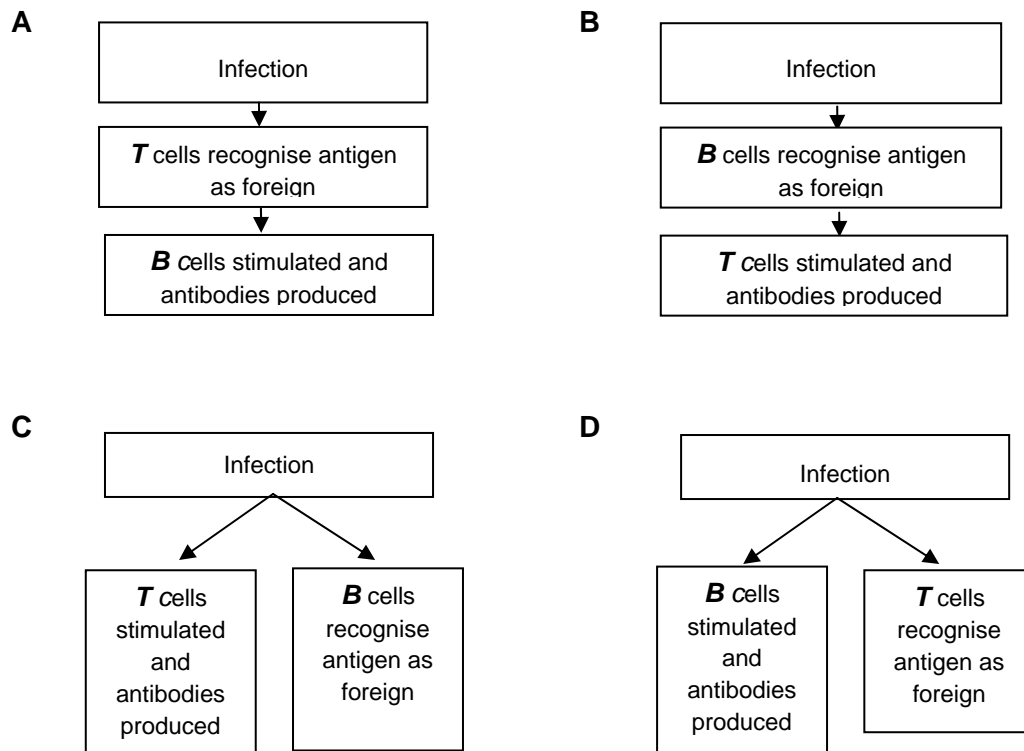
QUESTION 10

Phagocytosis is performed by specialised cells in response to

- A. Vaccination.
- B. Antibody production.
- C. An inflammation response.
- D. Infection.

QUESTION 11

Which flowchart correctly shows an interaction between B and T lymphocytes during an immune response.



QUESTION 12

A sample of double-stranded **DNA** is analysed and 20% of the bases are found to be Adenine. The percentage of the other bases is

- A. 20% thymine
- B. 40% cytosine
- C. 20% uracil
- D. 20% guanine

QUESTION 13

C4 plants have bundle sheath cells – a group of photosynthetic cells around the vascular bundles (xylem and phloem). The role of these sheath cells is to

- A. Physically support the xylem when transpiration rates are low.
- B. Move glucose to the phloem for transport around the plant.
- C. Allow the plant to capture carbon dioxide more effectively.
- D. Allow the plant to capture oxygen more effectively.

QUESTION 14

Analysis of a leaf sample yields chlorophyll a and other accessory pigments such as chlorophyll b and carotenoids. The role of these accessory pigments is to

- A. Directly convert light energy to chemical energy.
- B. Absorb ultra - violet light.
- C. Act in light independent reactions.
- D. Trap light energy.

QUESTION 15

Fresh water fish have tissue that is hypertonic to their environment. To maintain water balance they must

- A. Drink water to enable cells to lose water to the digestive tract.
- B. Excrete large amounts of dilute urine.
- C. Pump ions out through the gill membranes.
- D. Decrease free glucose to reduce osmosis.

QUESTION 16

People who lived in the United Kingdom during the 1980's and 1990's are not accepted as blood donors in Australia because they might have eaten beef infected with prions. This precaution is being taken because

- A. Donated blood might contain prions capable of altering protein structure in brain cells.
- B. Donated blood might contain prion toxins causing blood poisoning.
- C. Donated blood might contain prion DNA that results in prion replication in brain cells.
- D. Donated blood might contain prions capable of causing viral infections.

QUESTION 17

The process of cellular respiration involves the electron transport chain. In this process

- A. Acetyl-CoA carries electrons.
- B. The Calvin cycle is used to move electrons.
- C. Cytochromes located in the matrix carry electrons.
- D. NADH and FADH₂ deliver electrons.

QUESTION 18

Monoclonal antibodies are prepared by

- A. T cells which are cultured indefinitely to produce the antibodies.
- B. B cells which are cultured indefinitely to produce the antibodies.
- C. Selected B cells which are hybridised with tumour cells.
- D. T cells which are hybridised with B cells.

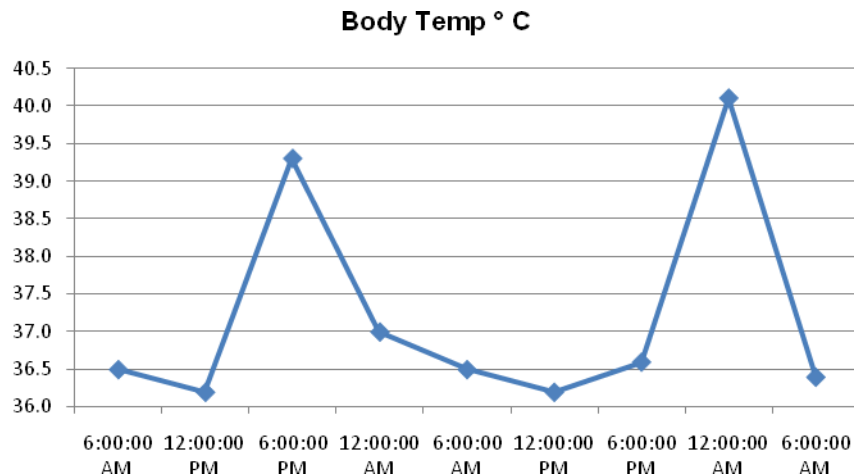
QUESTION 19

The sympathetic nervous system controls

- A. Dilation of smooth muscle in arterioles.
- B. Slowing heart rate.
- C. Increasing peristalsis to aid digestion.
- D. Release of adrenalin.

QUESTION 20

The following graph is part of a temperature chart of a patient infected with a particular strain of malaria.



Body temperature in this patient could be expected to

- A. Settle around 37°C as the infection has passed.
- B. Increase above 39°C within the next 8 hours.
- C. Increase above 39°C within the next 24 hours.
- D. Increase and remain high as toxins are released.

QUESTION 21

The Geographer Cone shell *Conus geographus* produces a toxin that retards the movement of sodium across muscle membranes. This toxin would be expected to cause

- A. Continual muscle contraction causing spasms.
- B. The inability of muscles involved in breathing to contract.
- C. Loss of neurotransmitter so muscles cannot contract when required.
- D. Interference in neural impulses to the CNS.

QUESTION 22

Lysosomes are membrane bound sacs found in certain cells. They

- A. Contain dissolved digestive enzymes.
- B. Secrete enzymes through exocytosis.
- C. Occur in prokaryotic cells.
- D. Have a role in storage of substances.

QUESTION 23

Bacteria and foreign bodies enter blood cells by endocytosis. This process is known as

- A. Vaccination.
- B. Antibody production.
- C. An inflammation response.
- D. Phagocytosis.

QUESTION 24

Bacteria grown at lower environmental temperatures are found to have higher levels of unsaturated fatty acids in the membrane lipids. If bacteria are grown at higher environmental temperatures the level of unsaturated fatty acids in the membrane lipids is lower. The best explanation for this is

- A. Increased levels of unsaturated fatty acids raises the melting point of the membrane.
- B. Membrane fluidity is essential to the functioning of the membrane
- C. Decreased levels of unsaturated fatty acids decreases the melting point of the membrane.
- D. Unsaturated fatty acids decrease membrane fluidity.

QUESTION 25

A change in the primary structure of a protein can have a significant effect on the function of a protein because

- A. The shape of the protein is affected.
- B. No sulfur bridges form.
- C. All ionic bonds are broken.
- D. Covalent bonds are weakened.

SECTION B: EXTENDED RESPONSE QUESTIONS

Instructions for Section B

Answer this section in pen.
Answer all questions in the spaces provided.

QUESTION 1

a. The plasma membrane is made up of a phospholipid bilayer into which proteins and glycoproteins protrude.

i. Name one other biomacromolecule found in a cell membrane.

ii. What is the function of the molecule named in part i of this question?

iii. Name the subunits that combine to form the biomacromolecule named in part i of this question.

iv. Select one property of this molecule and explain how this relates to its function in the cell membrane.

1+1+1+1 = 4 marks

b. On its outer surface, a plasma membrane of an invading cell has substances that identify it being foreign.

i. What are these substances called?

ii. Describe what would happen if these substances recognised an introduced cell as being foreign or non self.

1+1 = 2 marks

Total 6 marks

QUESTION 2

The 2008 Beijing Olympics will bring together many different types of athletes who have very specific training regimes depending on their chosen event. For example, endurance athletes, such as the marathon runners 'carbohydrate load' in the days leading up to their event. Here, they consume a diet high in carbohydrates to maximize their glycogen stores.

- a. i. Why would an endurance athlete 'carbohydrate load' and how would this affect their performance?

- ii. Write a balanced equation for the reaction occurring in the muscles of the marathon runner.

- iii. How do the reactions occurring in an athlete competing in a 100m sprint differ from the marathon runner in terms of the amount of ATP produced?

- iv. A reaction similar to the one taking place in the 100m runners occurs in yeast. But the breakdown of pyruvate results in a different end-product. What are the different end products produced in the yeast and the marathon runner

- v. Why are different end-products formed?

1+1+1+1+1 = 5 marks

Total 5 marks

QUESTION 3

Mitochondria are the site of the biochemical pathways of aerobic cellular respiration.

- a. i. Suggest the biological advantage for the many folds of membranes of the mitochondrion.

- ii. What molecule from glycolysis crosses the outer membrane and enters the mitochondria?

- iii. Name the biochemical pathway that takes place in the cristae of the mitochondria.

1+1+1 = 3 marks

- b. A marathon runner would experience large fluctuations in internal body temperature and their nervous and endocrine systems would have to operate efficiently to maintain homeostasis. Define homeostasis.

1 mark

Total 4 marks

QUESTION 4

a. In people with chronic myeloid leukaemia, cells are produced with a damaged receptor protein. This receptor protein, tyrosine kinase helps regulate cell growth and cell division in a normal healthy person. When the receptor protein is damaged it sends out a signal to the cells to continuously grow and divide resulting in huge numbers of white blood cells characteristic of leukaemia.

i. What type of protein molecule is tyrosine kinase?

ii. Describe how you would expect this molecule to enter the cell and then act on it's target.

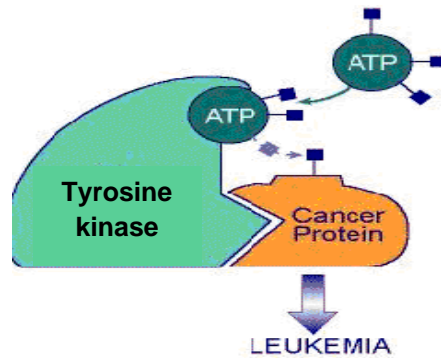
iii. Using your knowledge of DNA and protein synthesis, explain how a damaged molecule of tyrosine kinase could occur.

1+1+2 = 4 marks

b. Rational drug design is an important application of molecular biology. Explain what is meant by the term 'rational drug design'.

1 mark

- c. Glivec is a molecularly targeted drug treatment for chronic myeloid leukaemia. It works by blocking a specific signal transduction pathway. The diagram below shows what happens in a person with chronic myeloid leukaemia without Glivec. Tyrosine kinase has a shape that allows a cancer protein to bind to it as well as ATP.



- i. What is the role of ATP in this reaction?

- ii. Explain what is meant by a signal transduction pathway.

- iii. Explain using a labelled diagram how Glivec could successfully treat chronic myeloid leukaemia.

- iv. What do you consider to be the major advantage of Glivec over the more conventional treatment of chemotherapy?

1+2+2+1 = 6 marks

Total 12 marks

QUESTION 5

An immune cell may communicate with itself, an autocrine effect, with a cell nearby, a paracrine effect, or with a cell further away, an endocrine effect.

a. i. What is a cytokine?

ii. Are cytokines more likely to be paracrine or endocrine in action? Explain.

iii. Is the chemical communication between helper T-cells and B-cells autocrine, paracrine or endocrine? Explain.

1+2+2 = 5 marks

Total 5 marks

QUESTION 6

a. The helper T-cell is the host cell for the “Human Immunodeficiency Virus” (HIV) and it is now known that lipids make up about 30% by weight of the HIV-1 virus.

i. What is a virus?

ii. Name one natural feature of the body that acts as a first line of defence when a person comes in contact with a virus.

iii. Two species of HIV infect humans: HIV-1 and HIV-2. HIV-1 is more virulent and more easily transmitted. HIV-1 is the source of the majority of HIV infections throughout the world, while HIV-2 is not as easily transmitted and is largely confined to West Africa. HIV-1 virus is a retrovirus which has RNA as its genetic material. Draw a labelled diagram of a monomer of RNA.

iv. Outline how HIV could infects cells causing AIDS

v. Why do so many people infected with HIV develop opportunistic infections?

vi. Suggest a way of developing a new antiviral strategy with drugs that would prevent the spread of HIV-1.

vii. Give a reason why it is not possible to develop a live, attenuated vaccine for HIV.

1+1+2+2+1+2+1 = 10 marks

Imagine you are a scientist working for the Centre for Disease Control and Prevention in the United States in the year 1981. A number of doctors in Los Angeles has reported an outbreak of *Pneumocystis carinii* pneumonia (now still classified as PCP but known to be caused by *Pneumocystis jirovecii*) in five homosexual men in Los Angeles. This strain of pneumonia is very rare in people with normal immune systems but common among people with weakened immune systems.

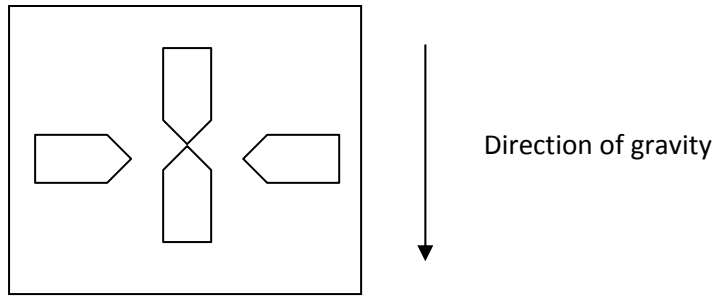
- b. What precautions would you need to take before carrying out your tests to determine the cause of this new outbreak.

2 marks







Total 13 marks

QUESTION 7

An experiment was carried out to investigate the growth of roots. Four soaked wheat seeds were attached to moistened cotton wool which was placed vertically in a sealed container in even light. The pointed part of the seed represents the position of the root.



Observations were made over the following four days. The results for **Day 4** are shown in the table below.

Orientation of Seed	Direction of Root Growth
 A	
 B	
 C	
 D	

- Complete the table by drawing the arrows for seeds C and D according to the direction you would expect the roots to grow.
- What is the name given to the plant response investigated in this experiment?

- Describe how the bending in root A occurred in relation to the plant hormone responsible.

- d. Design an experiment that could be conducted to test the hypothesis that “this hormone is produced by the growing tips of plants”.

1+1+2+3 = 7 marks

Total 7 marks

End of Paper