Student Name: _____

BIOLOGY

Unit 3 – Written Examination 1

2009 Trial Examination

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

QUESTION AND ANSWER BOOK

Structure of book

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*
A	25	25	25
B	5	5	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 permitted in this examination.

Materials supplied
- Question and answer book of 24 pages.

Instructions
- Print your name in the space provided on the top of this page.
- All written responses must be in English.

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

SECTION A- Multiple-choice questions

Instructions for Section A
Answer **all** questions.
Choose the response that is **correct** for the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks are **not** deducted for incorrect answers.
If more than 1 answer is completed for any question, no mark will be given.

Question 1

Proteins have four structural levels. The primary structure of a protein could be:

A. The three dimensional shape of the protein
B. The sequence of amino acids in the protein
C. A beta sheet held together by hydrogen bonds
D. Two polypeptide chains combined together

Question 2

DNA provides the instructions for producing polypeptides. DNA is unable to leave the nucleus; instead it is used as a template to produce single stranded messenger RNA. Which of the following processes produces the end product, messenger RNA?

A. Proteomics
B. Translation
C. Transcription
D. Polymerisation

Question 3

Carbon dioxide is one of the products of cellular respiration that needs to be carried from the tissues to the lungs where gas exchange occurs. It mainly transported in the blood:

A. Bound to haemoglobin
B. Associated with the enzyme cytochrome c
C. As bicarbonate ions in plasma
D. As carbonic acid in solution

Question 4

Phospholipids contain large number of cholesterol molecules. Their purpose is to:

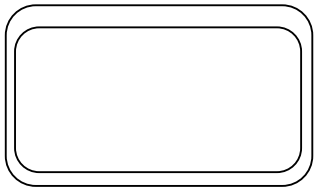
A. Decrease the fluidity of the membrane, making it more stable
B. Act as channels to facilitate material transport
C. Increase the permeability of the membrane to water soluble molecules
D. Facilitate lysis of the membrane during apoptosis

SECTION A - continued

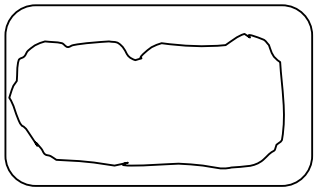
Question 5

Cells from a plant are placed into 2 different solutions. After an hour the cells are examined under a microscope, diagrams of the cells are shown below.

Solution 1



Solution 2



Which of the following statements about the solutions is most correct?

A. Both solutions have the same concentration
B. Solution 1 has a higher solute concentration than solution 2
C. Solution 2 has a higher solute concentration than solution 1
D. Solution 1 is hypotonic and solution 2 is isotonic compared to the cellular cytosol

Question 6

Chloroform is a substance that can be used to rapidly induce unconsciousness. The most accurate conclusion that can be made about chloroform is:

A. It is a large molecule
B. It is a water soluble molecule
C. It is a polyunsaturated molecule
D. It is a lipid soluble molecule

Question 7

The following diagrams show the transport of a substance across a membrane in the direction indicated by the arrow.

Diagram 1

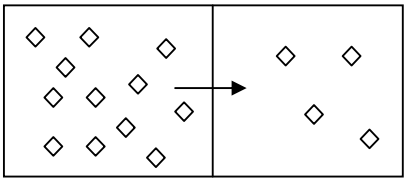
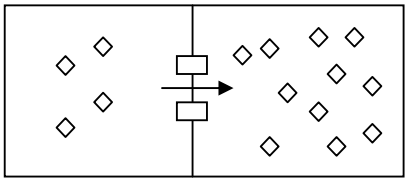


Diagram 2



Which conclusion is the most accurate?

A. Diagram 1 is showing active transport
B. Diagram 2 is showing active transport
C. Diagram 1 is showing facilitated transport
D. Diagram 2 is showing facilitated transport

SECTION A – continued
TURN OVER

Question 8

Cellular respiration is a metabolic process with several stages. The biochemical equation for one of these stages is:

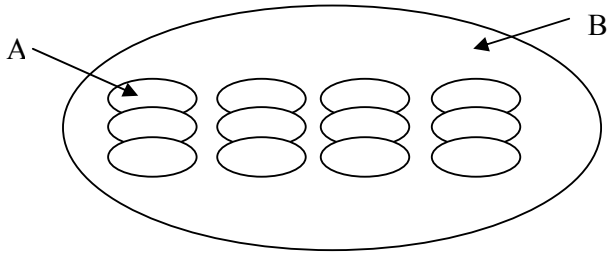
$$\text{Glucose} + 2\text{ADP} + 2\text{Pi} \rightarrow 2\text{ Pyruvate} + 2\text{ATP}$$

Which of the following locations does this reaction occur in?

A. Nucleus
B. Cytosol
C. Mitochondria
D. Endoplasmic reticulum

Question 9

The following diagram shows a chloroplast. Which of row of the table correctly identifies the name of the structure and the reaction occurring in regions A and B in the chloroplast?



Region A		Region B	
Structure name	Reaction occurring	Structure name	Reaction occurring
A. Grana	Light dependent	Stroma	Light independent
B. Grana	Light independent	Stroma	Light dependent
C. Stroma	Light dependent	Grana	Light independent
D. Stroma	Light independent	Grana	Light dependent

Question 10

Hydrogen ions (H+) created during the light dependent phase are transported to the region of the chloroplast where the light independent phase occurs. The carrier molecule responsible for transporting the hydrogen ions is:

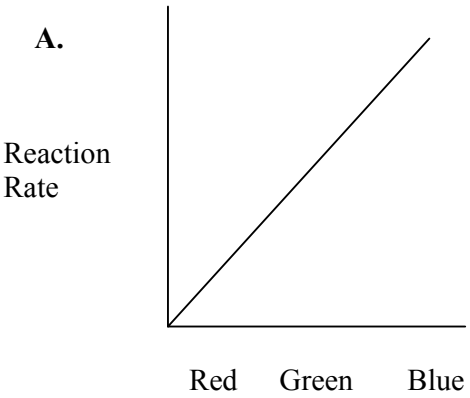
A. NADP
B. ADP
C. ATP
D. $FADH_2$

SECTION A - continued

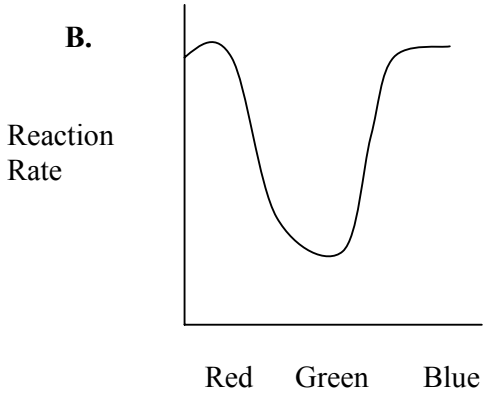
Question 11

The rate of photosynthesis is governed by a number of factors including carbon dioxide concentration, temperature and the wavelength of light. Which of the graphs below correctly shows which wavelength/s of light are most likely to be absorbed and which are likely to be reflected?

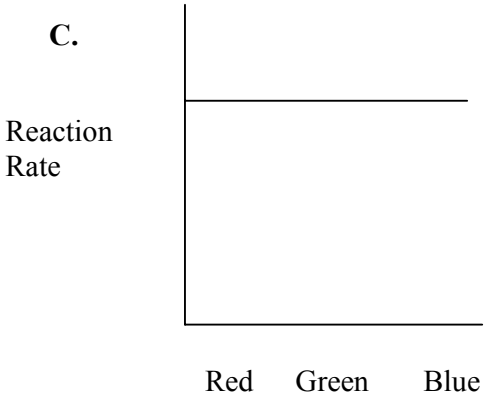
A.



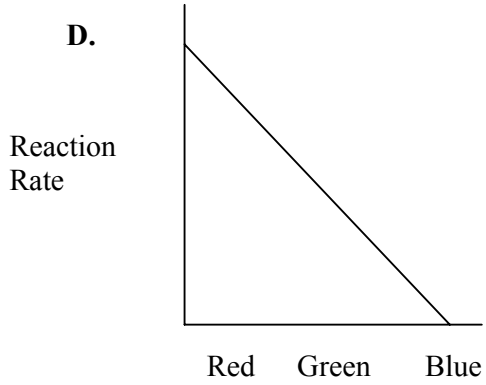
B.



C.



D.



Question 12

Catalase is an enzyme which catalyses the conversion of a hydrogen peroxide (H_2O_2) solution into water (H_2O) and oxygen gas (O_2) according to the following reaction.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

Which of the following would be the best way of estimating the rate of this reaction?

A. Measure the volume of water produced

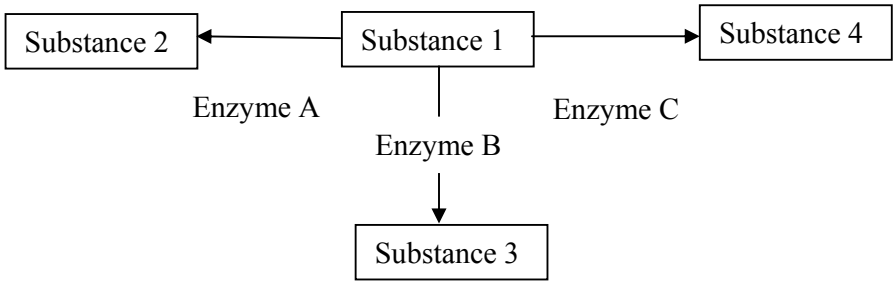
B. Measure the amount of water displaced by oxygen

C. Measure the amount of hydrogen peroxide remaining

D. Measure the amount of enzyme remaining

Use the following information to answer questions 13 and 14

The following diagram shows a segment of a metabolic pathway. Substance 1 is used as a substrate to produce substances 2, 3 and 4.



Question 13

Enzymes A and B need the presence of the magnesium ions (Mg^{2+}) in order to catalyse the reaction. What is the most accurate conclusion that can be drawn if the magnesium ions are absent?

A. Substance 1 will accumulate
B. Substance 2 will accumulate
C. Synthesis of substance 3 will increase
D. Synthesis of substance 1 will increase

Question 14

Metallic ions such as magnesium, copper and zinc are often required to catalyse reactions. These ions are known as:

A. Cofactors
B. Coenzymes
C. Facilitators
D. Catalysts

Use the following information to answer questions 15 and 16

Anti diuretic hormone (ADH) is an amino acid hormone which plays a major role in the maintenance of a relatively stable concentration of body fluids (osmoregulation), by increasing the permeability of the collecting tubules in the kidneys to water.

Question 15

Which of the following is not involved with the transduction of ADH?

A. Cyclic AMP
B. ATP
C. Receptors located in the cytosol
D. Enzymes required to activate a second messenger

SECTION A – continued

Question 16

Consuming alcohol inhibits the production of ADH. The effect of consuming alcohol will be:

A. The amount of water being reabsorbed will increase
B. A small volume of concentrated urine will be produced
C. A large volume of dilute urine will be produced
D. The collecting tubules will become more permeable to water

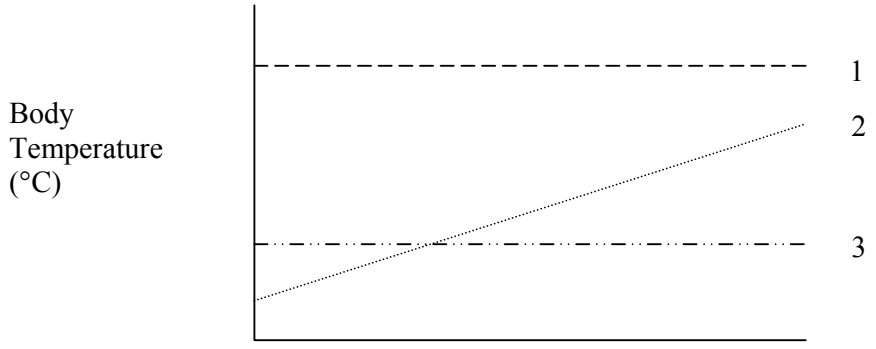
Question 17

A person buys some unripe tomatoes and is able to ripen them rapidly by placing them into a bag with some bananas. This happens because the bananas are releasing:

A. Ethylene
B. Auxin
C. Gibberellins
D. Abscissic Acid

Question 18

The graph below shows the body temperature of 3 different animals over a range of external environmental temperatures



The most accurate conclusion that can be made from this data is that:

A. Animal 1 is an ectotherm
B. Animal 2 is an ectotherm
C. Animal 3 is an ectotherm
D. Animals 1 and 3 must be reptiles

SECTION A – continued
TURN OVER

Question 19
Which of the following events will *not* occur after infection by a virus?

A. Apoptosis of the host cell
B. Release of complement
C. Release of interferon
D. Increase in the production of lymphocytes

Question 20
Which of the following is a specific response to a pathogen?

A. Macrophages engulfing a pathogen
B. Platelets producing blood clotting factors
C. Mast cells secreting histamine
D. B cells undergoing clonal expansion

Question 21
Prions and viruses are both classified as non-cellular infectious agents. The main difference between these agents is:

A. Prions have nucleic acids which viruses lack
B. Viruses have a protein coat which prions lack
C. Viruses have a nucleus which prions lack
D. Viruses reproduce by mitosis and prions reproduce by meiosis

Question 22
A vaccine containing an attenuated virus provides a person with active immunity because:

A. It stimulates apoptosis
B. The vaccine contains antibodies which bind to and neutralise pathogens
C. It activates phagocytic memory cells
D. It contains antigens which stimulate antibody production

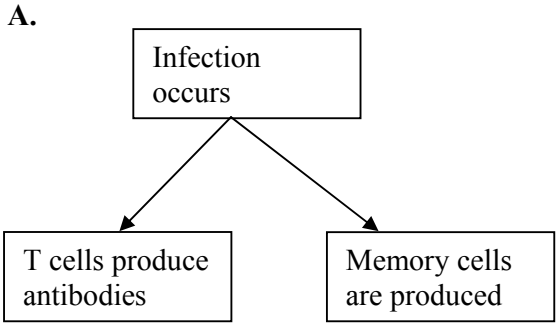
Question 23
Multiple sclerosis is an autoimmune disease that affects the myelin sheath of neurons. This condition occurs because:

A. Production of T cells ceases
B. Lymphocytes break down MHC markers
C. T cells secrete antibodies that are complementary to "self" cells
D. Lymphocytes fail to recognise "self" cells

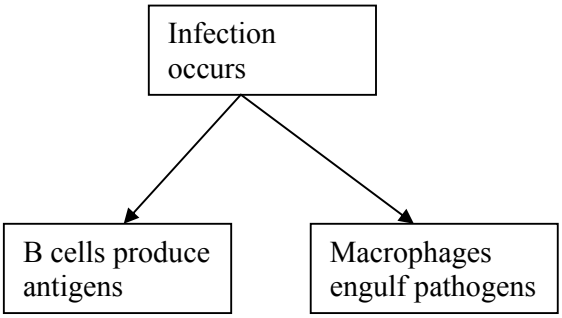
SECTION A – continued

Question 24
Examine the 4 diagrams shown below. Which of the diagrams most correctly shows events that occur during an immune response?

A.



B.



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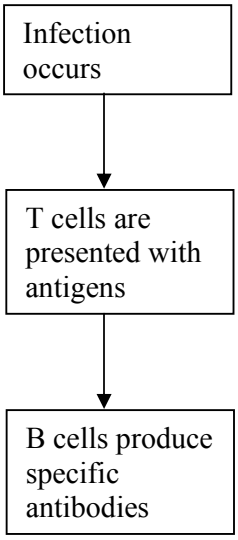
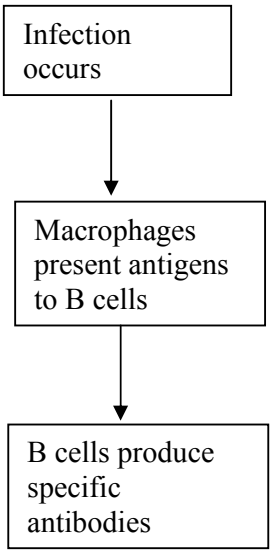


D.



Question 25
After a person has received an organ transplant, they are given drugs in order to minimise the risk of rejection. These drugs work because:

A. They contain antibiotics which prevent infection
B. They contain clotting factors which promote repair of the blood vessels surrounding the transplant
C. They coat the transplanted organ with the Major Histocompatability Complex (MHC) which mimics the recipients MHC
D. They suppress the immune systems ability to recognise "non-self" molecules.

END OF SECTION A
TURN OVER

SECTION B- Short-answer questions

Instructions for Section B
Answer all questions in the spaces provided.

Question 1

Fibrin is an insoluble fibrous protein that is formed during blood clotting. It forms as a network of fibres which traps blood cells, causes blood to coagulate and seals wounds. When the fibres dry they form a crusty scab which falls off when the tissue underneath heals properly.

There are several stages in the production of fibrin. These have been summarised into the 2 stages shown below

- Thromboplastin converts prothrombin into thrombin
- Thrombin then converts fibrinogen into fibrin.

a. The precursor fibrinogen is a glycoprotein □ynthesized in the liver. Define the term glycoprotein.

_____

_____

1 mark

b. The proteins mentioned above are only a few of the many proteins currently studied by scientists. What term is used to describe the study of proteins?

_____

1 mark

c. One application of studying proteins is that determining their concentration can be used as a diagnostic tool. Thrombosis is a disease caused by the formation of a thrombus or blood clot. The effect of thrombosis depends on the location and size of the clot, but it can be fatal. Explain how the concentration of fibrinogen in a blood sample could be used to diagnose thrombosis.

_____

_____

_____

_____

_____

2 marks

SECTION B – Question 1- continued

d. Proteins fulfill a wide range of functions in our bodies including catalytic proteins, hormones and material transport proteins. In the space provided below provide an example of a structural protein and of a protein involved in material transport.

PROTEIN FUNCTION	PROTEIN NAME
Immunological protein	
Regulatory protein	

2 marks

e. Organic molecules vary in size from small simple molecules to large macromolecules or polymers. Three polymers were analysed and their constituent atoms are listed below.

MOLECULE	CONSTITUENT ATOMS
Molecule 1	Carbon, Hydrogen and Oxygen
Molecule 2	Carbon, Hydrogen, Oxygen, Phosphorus and Nitrogen
Molecule 3	Carbon, Hydrogen, Oxygen, Nitrogen and Sulphur

Identify which of the 3 molecules is a nucleic acid and justify your choice.

2 marks
Total 8 marks

Question 2
Many farmers, particularly those in the beef and dairy industries, face the daily challenge of manure management because untreated manure can introduce pathogens and parasites into the soil and also into the water system through run-off.

On average a cow produces approximately 35 kilograms of manure on a daily basis, which equates to 4 tons of manure per day for a herd consisting of 100 cows.

Composting is one of several techniques used to treat animal manure and other organic wastes, which may contain pathogens or parasites considered to be of public health concern.

There are 2 main forms of composting. Cold composting is accomplished using small amounts of material on a regular basis, with little if any turning of the material being composted. Hot composting is accomplished using larger amounts of material, turning is frequent and bacteria heat the compost pile to temperatures reaching up to 70°C.

SECTION B – Question 2- continued
TURN OVER

a. The heat produced in hot composting is a byproduct of bacterial metabolic reactions. Write a balanced equation for the metabolic process that produces heat as a by-product.

_____

1 mark

b. Microbial decomposition occurs in the thin film of moisture on the surface of the organic particles in a compost heap. The moisture content should be kept at between 50% and 60% and decomposition will cease if the water content goes above 65% or below 30%. Explain why a water content of 20% would cause microbial activity to cease.

_____

_____

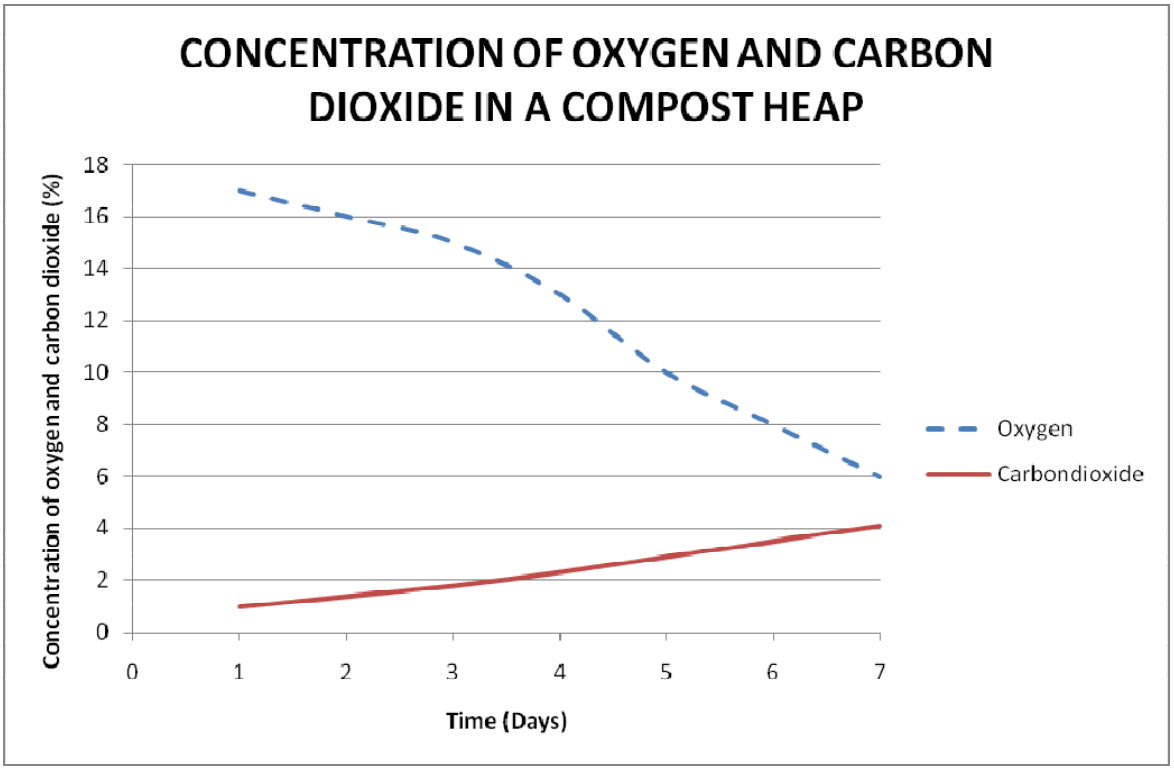
_____

_____

_____

2 marks

The diagram below shows changes that occur to the percentage of gases present within a compost heap over the period of a week.



SECTION B - Question 2- continued

c. The concentrations of oxygen and carbon dioxide were obtained on a daily basis by using a probe and a data logger.

Explain why the oxygen and carbon dioxide concentrations have changed as shown in the graph on the previous page.

2 marks

d. At the end of the week the compost pile was turned over several times using a rake. Predict what will happen to the concentration of oxygen immediately hours after having been turned and 24 hours after having been turned. Explain why this will have occurred.

2 marks

SECTION B – Question 2 – continued

TURN OVER

e. Manure that has been composted is an excellent source of organic nutrients and is much in demand. In addition to killing 99.9% of pathogenic bacteria, it has been hypothesised that the temperature achieved during hot composting could be used to kill any weed seeds in the compost mixture. Design an experiment that could be used to support this hypothesis.

3 marks

f. Yeast cells are amongst the many different types of micro organisms that may be found in compost piles. They respire aerobically when sufficient oxygen is available, but use an alternate pathway when oxygen levels decrease.

Identify the name of the alternate pathway.

1 mark

g. Identify the product/s of this pathway.

1 mark

Total 12 marks

SECTION B – continued

Question 3

Homeostasis is the maintenance of a relatively stable internal environment despite internal or external fluctuations. Animals have two communication systems which regulate and co-ordinate homeostasis; these are the hormonal system and the nervous system.

A person makes himself a cup of coffee and attempts to pick up the cup immediately after adding the boiling water. As a result he drops the cup. He then makes another cup of coffee, this time leaving it to sit for several minutes before successfully picking up the cup.

a. Explain why the response to this type of stimulus is governed by the nervous system rather than the hormonal system.

1 mark

b. What term is used to describe this type of nervous response?

1 mark

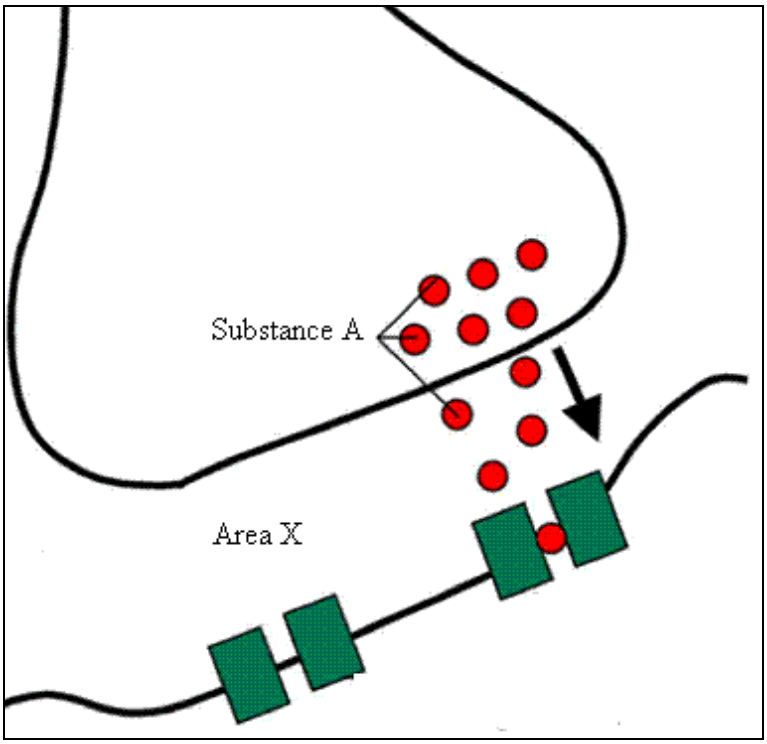
c. In both cases the coffee cup is hot to the touch. Explain why there is a reaction when picking up the first cup which did not occur when picking up the second cup.

2 marks

SECTION B – Question 3 – continued

TURN OVER

The diagram below shows a part of the process that occurs during the transmission of a nervous impulse.



d. Explain the significance of substance A and area X in the transmission of a nervous impulse.

2 marks

SECTION B – Question 3 - continued

Use the following information to answer sections e and f.

Acetylcholinesterase is an enzyme present in nervous tissue and muscles. It is secreted into the synaptic cleft where it catalyses the hydrolysis of acetylcholine into choline and acetate. Choline is then taken up by the presynaptic terminal where it is combined with acetyl coenzyme A to reform acetylcholine.

e. The production of acetylcholine is the result of a feedback process. Draw a diagram showing the feedback loop which is responsible for the production of acetylcholine.

2 marks

f. What term is used to describe the function of substances such as acetylcholine?

_____

1 mark

SECTION B – Question 3 – continued
TURN OVER

Heat stroke is a potentially fatal condition caused by prolonged overheating. It is characterised by a high body core temperature and hot, dry skin. People with heat stoke show signs of mental confusion, loss of motor control, and may lose consciousness.

g. With reference to the information provided on the previous page, explain why heat stroke can cause loss of motor control.

2 marks

Total 11marks

Question 4

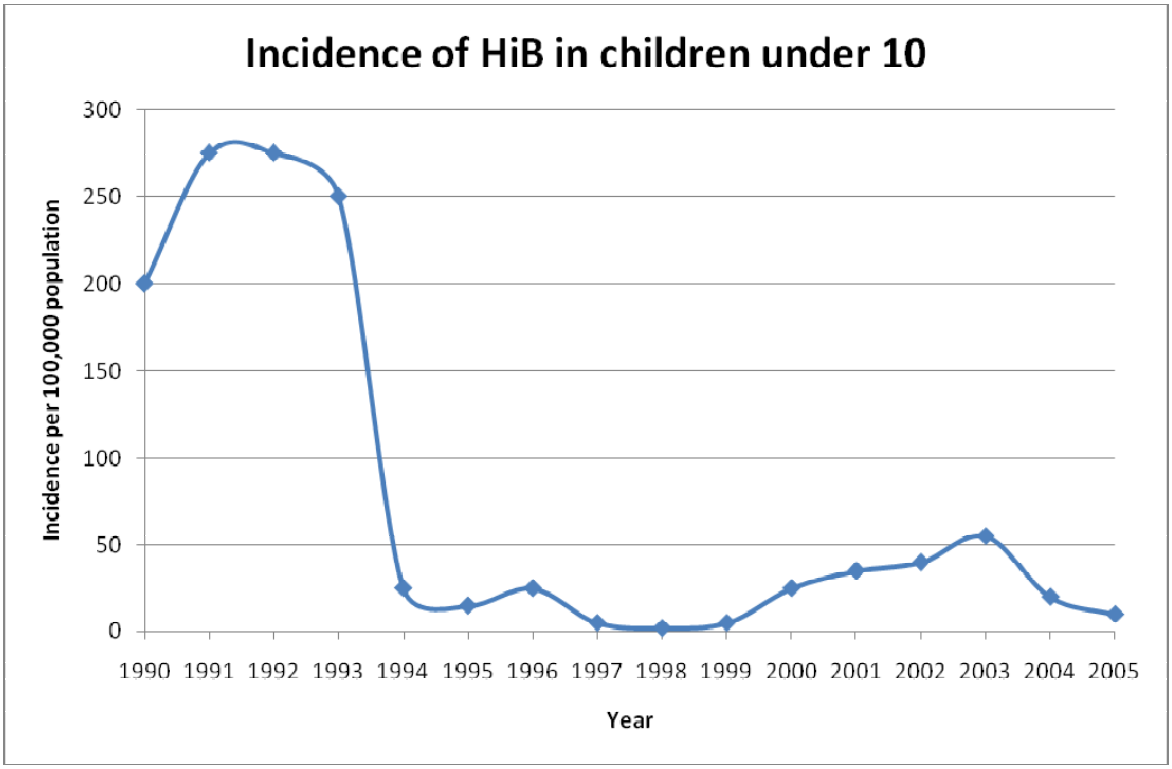
Haemophilus influenzae B (HiB) is a bacterial opportunistic pathogen that colonises the respiratory tract. It is frequently asymptomatic but may cause pneumonia, respiratory tract infections and meningitis. Historically HiB particularly infects babies and young children. Vaccination for HiB is now included in a conjugate vaccine which also provides protection against diphtheria, whooping cough, tetanus, hepatitis B and polio.

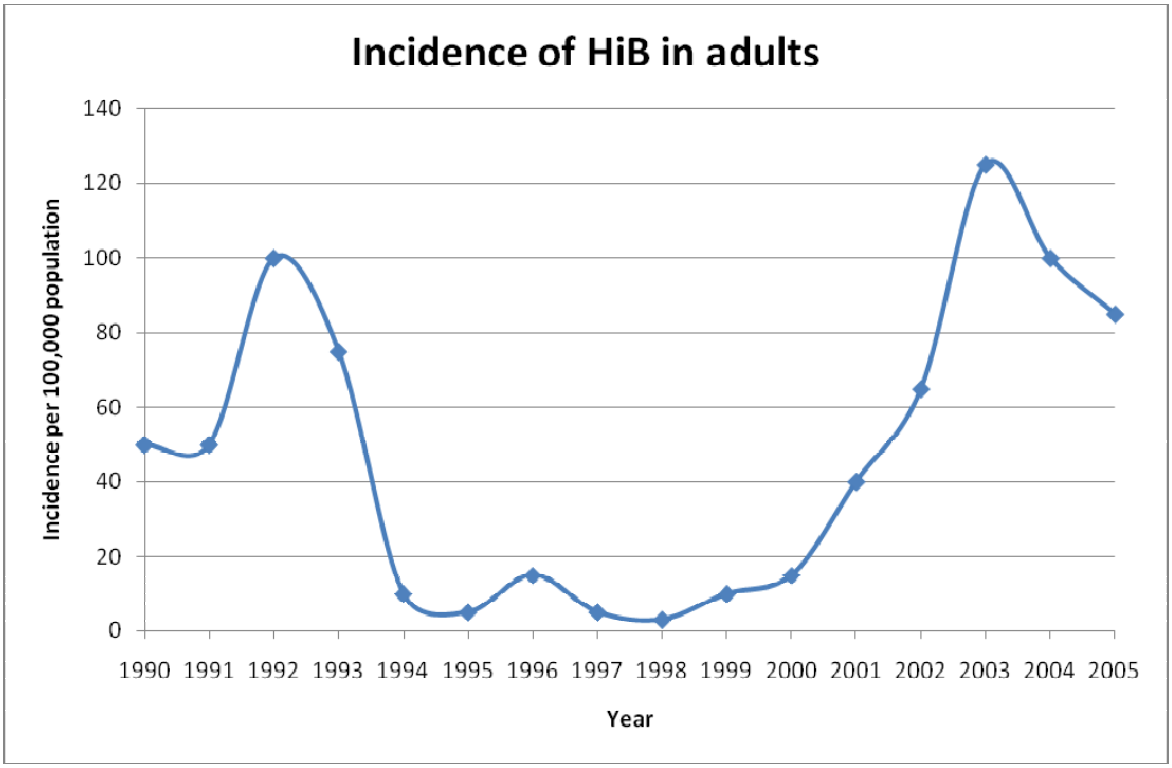
a. The Sabin vaccine previously used for polio included attenuated viruses. Define the term attenuated and explain why many of these vaccines have been replaced by subunit vaccines.

2 marks

SECTION B – Question 4 - continued

The two graphs below show the incidence of HiB infection in adults and children over a period of 15 years.





SECTION B – Question 4 – continued

TURN OVER

b. Infection in adults was comparatively rare compared to that of children. Explain why those age groups in regular contact with children are more likely to contract this disease.

1 mark

c. State what happened to the incidence of HiB in children between 1993 and 1994. Provide one reason that could account for this trend.

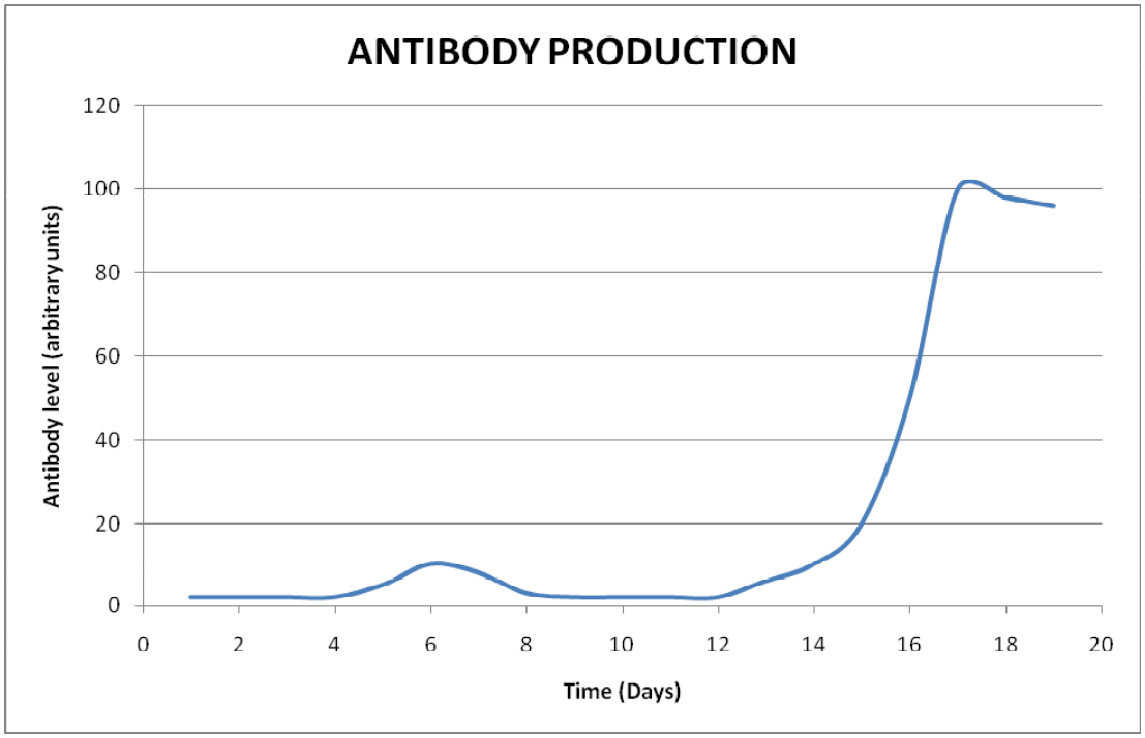
2 marks

d. In October 2003 a booster programme for the HiB antigen was introduced, resulting in a decrease in the incidence of HiB in both adults and children. Explain why the decrease in the number of adult cases did not decrease as rapidly as the number of cases in children.

2 marks

SECTION B - continued

There is always a time lapse called a latent period between the time where a person is exposed to an antigen and the production of antibodies. The diagram below shows the level of antibodies present in a child after the initial vaccination and the booster shot.



e. Explain why the latent period is longer after the original exposure compared to the latent period after the booster shot.

2 marks

f. Plants have a variety of defence mechanisms which protect them from infection by bacteria. Identify one physical barrier which will prevent a pathogen from penetrating the plant tissues.

1 mark

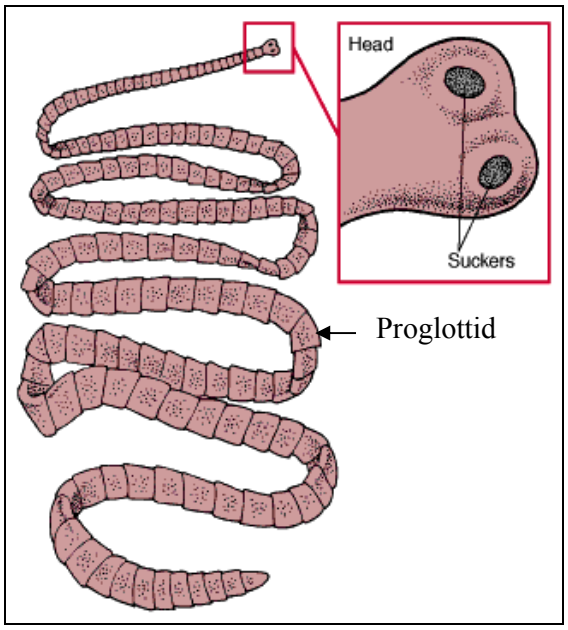
Total 10 marks

SECTION B – continued

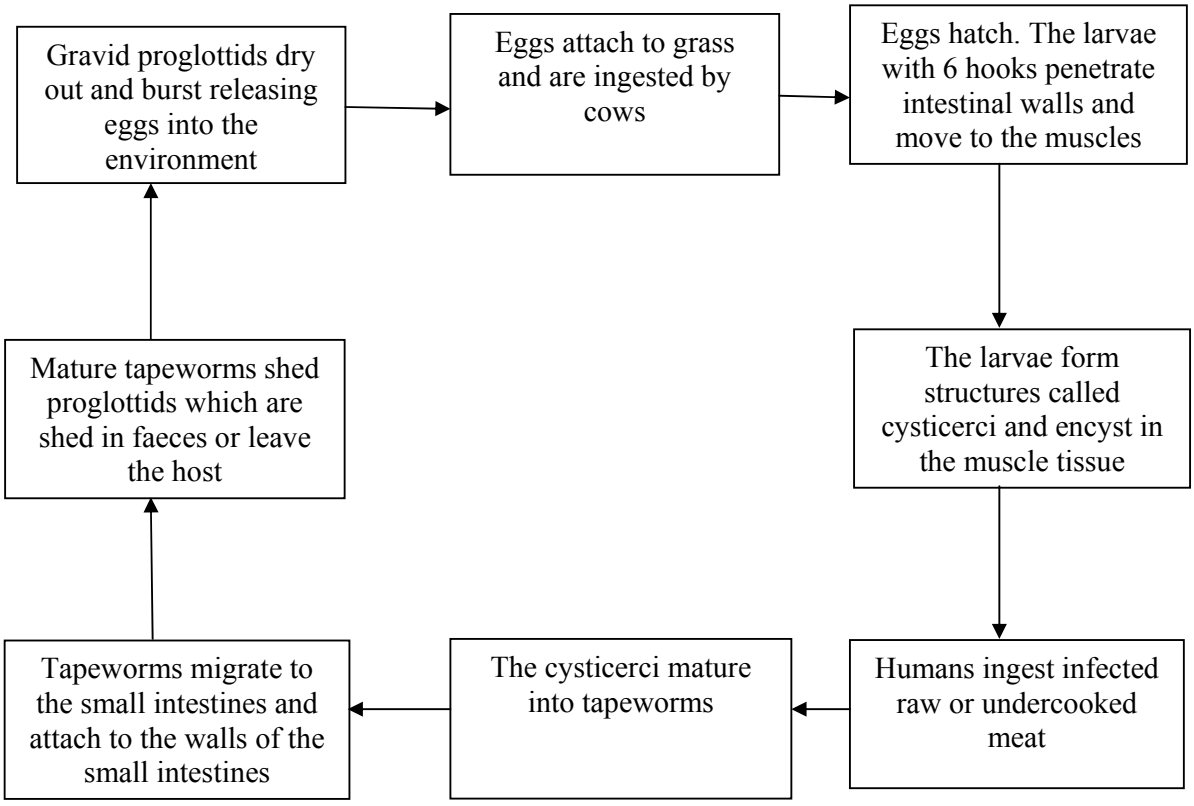
TURN OVER

Question 5

Taenia saginata, the beef tapeworm is one of the most common human parasites in the world. The adult tapeworm is usually about 5 metres in length, but may grow to be as large as 25 metres. The adult tapeworm has a pear shaped scolex (head) with 4 suckers and a long flat body which is made up of between 1000 and 2000 proglottids (egg bearing segments).



The life cycle of the tapeworm is shown in the diagram below.



SECTION B - Question 5 - continued

a. What is the role of the cow in the lifecycle of the tapeworm?

1 mark

b. Identify an advantage of the cyst stage in the life cycle of the tapeworm.

1 mark

c. List another feature that a tapeworm possesses which would assist it to survive in a human and describe how this feature benefits the tapeworm.

2 marks

d. There are 3 levels of defence in the human immune system. Explain why the first level of defence is largely ineffective against infection by Taenia saginata.

2 marks

SECTION B – Question 5 - continued
TURN OVER

e. The adult tapeworm can survive inside the human small intestine for more than 25 years. It is estimated that more than 10% of the population in third world countries are infected by this parasite. Explain one way the spread of this parasite could be controlled.

_____

_____

_____

1 mark

Endoparasites such as tapeworms have specialised features that enable them to survive within a host, whereas ectoparasites have specialised features that enable them to survive on the outer surface of a host.

f. Explain why endoparasites either have a very simple digestive system or lack a digestive system altogether.

_____

_____

_____

1 mark

g. Identify which type of parasite, ectoparasites or endoparasites, would have the most complex form of locomotion and justify your answer.

_____

_____

_____

1 mark

Total 9 marks

END OF QUESTION AND ANSWER BOOK