UNIT 3 BIOLOGY 2006

WRITTEN EXAMINATION 1

(2 HOUR VERSION)

Reading Time: 15 minutes
Writing Time: 2 hours

QUESTION AND ANSWER BOOK

Structure of Book

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*	*Suggested times (minutes)*
A	25	25	25	30
B	5	5	75	90
Total			100	120

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INSTRUCTIONS FOR STUDENTS

- 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 book

Instructions

- Write your name in the space provided on this page.
- All written responses must be in English.

At the end of the examination

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

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

SECTION A - ANSWER SHEET

Name: _____

Please note that the format and requirements of this answer sheet are different to the answer sheet that will be issued in the VCAA examination. Copies of the actual examination answer sheet may be obtained at: **www.vcaa.vic.edu.au**

Choose the correct response or the response which best answers the question by shading the square corresponding to your response in the table below.

Question 1	A	B	C	D
Question 2	A	B	C	D
Question 3	A	B	C	D
Question 4	A	B	C	D
Question 5	A	B	C	D
Question 6	A	B	C	D
Question 7	A	B	C	D
Question 8	A	B	C	D
Question 9	A	B	C	D
Question 10	A	B	C	D
Question 11	A	B	C	D
Question 12	A	B	C	D
Question 13	A	B	C	D
Question 14	A	B	C	D
Question 15	A	B	C	D
Question 16	A	B	C	D
Question 17	A	B	C	D
Question 18	A	B	C	D
Question 19	A	B	C	D
Question 20	A	B	C	D
Question 21	A	B	C	D
Question 22	A	B	C	D
Question 23	A	B	C	D
Question 24	A	B	C	D
Question 25	A	B	C	D

Section A:	**/25**
Section B:	**/80**
Total:	**/105**

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SECTION A – Multiple-choice questions

Instructions for Section A

Answer all questions in pencil on the answer sheet for multiple-choice questions. A correct answer scores1, 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
Cortisone is a naturally occurring steroid hormone with powerful anti-inflammatory effects in the body. Which of the following organelles in an adrenal cortex cell would synthesise cortisone?

A golgi apparatus
B rough endoplasmic reticulum
C smooth endoplasmic reticulum
D peroxisomes

Question 2
The breakdown of starch to maltose in the saliva of your mouth is an example of

A a condensation reaction.
B a hydrolysis reaction.
C an endergonic reaction.
D anabolism.

Question 3
Insulin is a peptide hormone which plays a vital role in blood glucose regulation. Insulin does not have a quaternary structure because.

A no alpha helices are present in the molecule.
B its polypeptide chains lack disulphide bridges.
C its polypeptide chain is not composed of all 20 amino acids.
D it is only composed of one polypeptide chain.

Question 4
A series of experiments were conducted by scientists in order to determine the identity of an unknown organic molecule discovered in the cell of a slime mould. After initial tests were made, the following parts of the molecule were identified: adenine, phosphate, guanine and ribose.

Scientist could therefore be confident in assuming the unknown molecule was

A a protein.
B DNA.
C RNA
D a triglyceride.

Question 5
For centuries alcohol (ethanol) has been recognised as a molecule that can exert its effects on the body in a very short period of time. Ethanol has little difficulty in passing across the membranes of cells lining your mouth, stomach, blood vessels, neurons etc.

Ethanol molecules readily passes across cell membranes due to their small size and

A high water solubility.
B high lipid solubility.
C positive charge.
D low water solubilty.

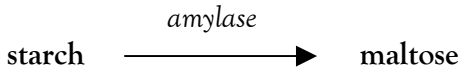
Question 6
Many dentists offer local anaesthetics to their patients prior to drilling into their teeth. The lipid-soluble anaesthetic molecules temporarily prevent the conduction of impulses along sensory neurons from teeth to brain.

An impulse is created when sodium ions and potassium ions pass in opposite directions across the neuron cell membrane. In preventing the conduction of impulses, it is possible that the anaesthetic molecules

A stay embedded in the phospholipid bilayer, thereby kinking membrane proteins.
B attach to the membrane's phosphate heads thereby blocking entry of the ions into the phospholipid bilayer.
C dissolve in the membrane and break it open, dispersing all the phospholipids.
D attach to receptor proteins in the cytosol, ultimately causing apoptosis.

Questions 7-9 refer to the following information:

Human pancreatic amylase catalyses the breakdown of starch to molecules of the disaccharide maltose:



A student designed an experiment to investigate the effects of amylase concentration, temperature and amylase inhibitor on amylase breakdown of starch. The results are illustrated in **Figure 1:**

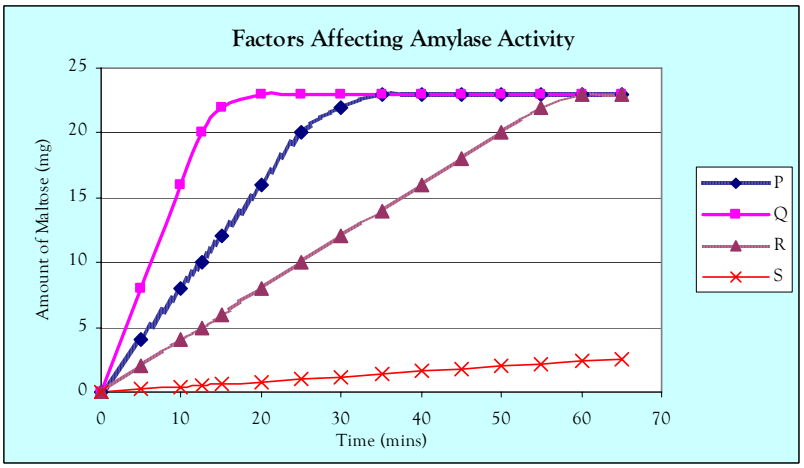


Figure 1

Four setups were made under the following conditions:

1. amylase concentration x at 20°C
2. amylase concentration x at 37°C
3. amylase concentration 2x at 37°C
4. amylase concentration x at 37°C (solution thoroughly bathed in amylase inhibitor)

All other factors were controlled.

Question 7
In which of the following are graphs P-S correctly allocated to setups 1-4?

A P = 1; Q = 2; R = 3; S = 4.
B P = 2; Q = 3; R = 1; S = 4.
C P = 2; Q = 3; R = 4; S = 1.
D P = 2; Q = 4; R = 3; S = 1.

Question 8
When examining all setups it can be assumed that the quantity of starch present in

A P was twice the quantity in Q.
B a lot lower in S than in any other setup.
C Q remained the same throughout the experiment.
D all setups was the same.

Question 9
Evidence that the conversion of starch to maltose is an exergonic reaction is provided by setup

A P.
B Q.
C R.
D S.

Question 10
ATP (adenosine triphosphate) is essential to every living cell because

A it captures energy from the breakdown of glucose and ADP (adenosine diphosphate).
B exergonic and endergonic reactions could not take place without it.
C it stores energy in a form that is instantly available to the cell.
D it stores energy released during the breakdown of ADP.

Questions 11-13 refer to the following table summarising respiration:

Process	Site	Product(s)	No. of ATP's produced
I	**II**	pyruvate	**III**
Cellular respiration	**IV**	$CO_2 + H_2O$	36
Fermentation (plants)	**V**	**VI**	**VII**
Fermentation (animals)	cytoplasm	**VIII**	**IX**

Question 11
H^+ ions released during Process **I** are ultimately transported to the

A electron transport chain by NAD^+
B Krebs cycle by NAD^+
C electron transport chain by $NADP^+$
D Calvin cycle by $NADP^+$

Question 12
Site **V** refers to

A cytoplasm
B mitochondrion
C vacuole
D nucleus

Question 13
Product(s) **VIII** refers to

A lactic acid
B lactic acid and CO_2
C ethanol and CO_2
D glucose and oxygen

Question 14
The chloroplast is the site of photosynthesis in all photosynthetic eukaryotes. Which of the following statements is true regarding photosynthesis?

A Grana increase the surface area of membranes available for the light-dependent reactions.
B Light-dependent reactions occur in the stroma.
C CO_2 is a reactant for the light-dependent reactions.
D Light-independent reactions still occur during periods of darkness.

Question 15
During photosynthesis, the following products of the light-dependent reactions are used in the light-independent reactions:

A ATP and oxygen
B glucose and oxygen
C NADPH and ATP
D CO_2 and ATP

Question 16
In a 24 hour period during spring the overall rate of photosynthesis in a daisy would be

A greater than the rate of respiration.
B equal to the rate of respiration.
C less than the rate of respiration.
D independent of water levels in the soil.

Question 17
In hot weather, C_4 plants are more efficient at carrying out photosynthesis than C_3 plants because they

A contain a light-independent pathway enzyme that does not occasionally react with oxygen instead of CO_2
B close their stomata during the day
C produce an initial 3-carbon molecule in the light-independent reaction
D release CO_2 in the light-dependent reactions

Question 18
Signal transduction pathways can involve the response of millions of molecules to a single hormone molecule. For instance, one molecule of adrenalin causes the breakdown of 100,000,000 molecules of glucose from the glycogen store in a liver cell.

If a G protein was involved in a transduction pathway, the original signal could have been provided by

A a peptide hormone such as antidiuretic hormone (ADH).
B a steroid hormone such as progesterone.
C a hormone which binds to a receptor in the target cell nucleus.
D newly transcribed mRNA in the nucleus.

Question 19
Abscisic acid is a plant hormone that plays a role in regulating the size of stomata. It appears to reduce water loss in plants by

A disrupting the process of photosynthesis in guard cells.
B causing the breakdown of starch granules in guard cells.
C interfering with the uptake of potassium ions by guard cells.
D reducing the rate of transpiration from stomata.

Question 20
Which of the following statements about plant hormones is true?

A auxin creates a phototropic response in shoots by stimulating mitosis in cells on the side away from the light source.
B abscisic acid stimulates seed germination by inducing the synthesis of amylase and the subsequent conversion of stored starch to glucose.
C ethylene stimulates positive geotropism in roots.
D auxin inhibits bud development in shoots but stimulates lateral growth in roots.

Question 21
After arising in the middle of the night, Josephine was about to wash her hands. After turning on the hot tap, she placed her hand under the current of water which she expected to be cold. To Josephine's surprise, however, her sister Mavis had just used the bathroom, and hot water immediately flowed forth. Josephine pulled her hand away and felt the pain a split second later.

Josephine did not feel pain until after her hand had been pulled away because

A sensory neurons were not involved in her response.
B a reflex arc had pulled her hand away without any brain involvement.
C the autonomic nervous system was directly involved in her response.
D the supply of neurotransmitter in the pain pathway had been temporarily exhausted.

Question 22
A variety of pathogens are non-cellular. These pathogenic agents require a host cell in which to reproduce. Which of the following diseases is caused by a non-cellular pathogenic agent?

A influenza.
B ringworm.
C tetanus.
D malaria.

Question 23
The life cycle of the hydatid tapeworm *Echinococcus granulosis* involves both a primary and intermediate host. The adult tapeworm normally lives inside the intestine of a dog. If necessary it can fertilise its own eggs, which then pass out in the dog's faeces.

In farming areas the sticky eggs attach to grass which is often consumed by sheep. The eggs develop into cysts inside the sheep which lodge in any tissue (e.g. liver, brain and lungs). If a dog eats any such portion of an infected sheep, the life cycle of the tapeworm continues (see Figure 3).

Humans can also become an intermediate host in this life cycle.

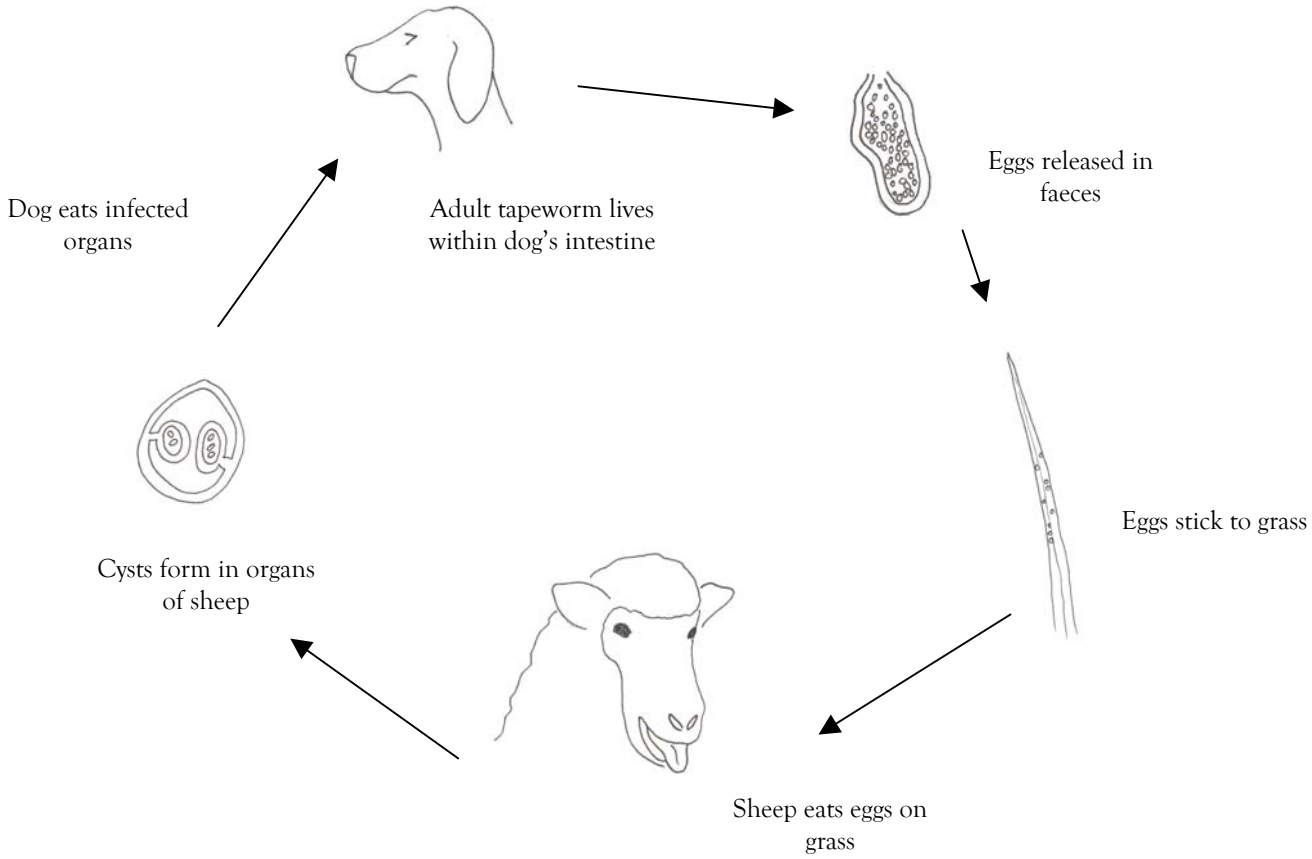


Figure 3: Life cycle of hydatid tapeworm

The risk of children on sheep farms becoming infected with hydatid tapeworm is **not** reduced if

A their meals consist of well cooked lamb.
B pet dogs are regularly wormed.
C they wash their hands after each visit to a paddock.
D dead sheep are immediately removed from paddocks.

The following information is relevant to Questions 24 and 25

Eight of the ten most venomous land snakes are native to Australia. Hence, the development of a wide variety of antivenoms for snakebite has been an important area of biological research in this country.

Today horses are used to provide sufficient quantities of snake antivenom. In the process of accumulating tiger snake antivenom, for instance, a horse is initially injected with a small dose of venom and left to recover. After a couple of weeks, the same horse is injected with another dose of the venom. Blood is collected from the horse over the next day or so, and antibodies to the venom are extracted from the plasma to be used as antivenom.

The response of a horse to two injections of tiger snake venom is shown in Figure 4:

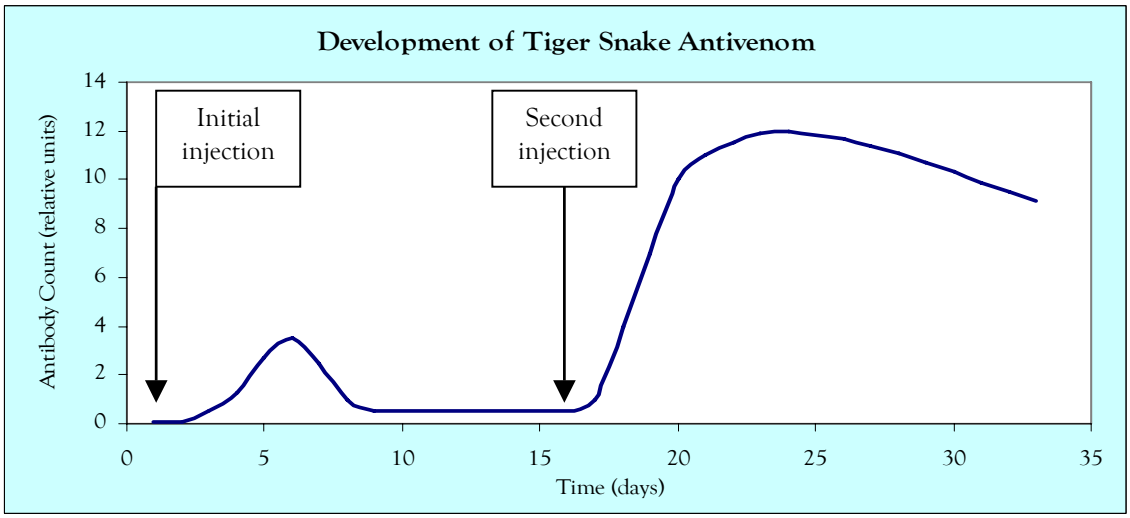


Figure 4

Question 24
The injection of tiger snake venom into the horse is an example of

A natural passive immunity.
B induced passive immunity.
C natural active immunity.
D induced active immunity.

Question 25
The injection of antivenom (horse antibodies) into a snake bite victim is an example of

A natural passive immunity.
B induced passive immunity.
C natural active immunity.
D induced active immunity.

SECTION B – Short answer questions

Instructions for Section B

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

Question 1

The spangled drongo *(Dicrurus hottentotus)* is an acrobatic flying bird distributed from the Kimberleys to Arnhem Land, and from Cape York to north-east Victoria. It has a black plumage which shimmers blue-green. "Drongo" is simply the indigenous name for the same type of bird in Madagascar, and is not a reference to the bird's level of intelligence! It is a very able and attractive bird which chases and feeds on insects in mid air, with its forked tail trailing behind.

The drongo obtains all of its organic nutrients from flying insects. Yet, despite its array of digestive enzymes, it is unable to completely break down the exoskeletons of its prey. Insect exoskeletons are composed of chitin, a derivative of cellulose.

a. To which group of biological macromolecules does chitin belong?

_____

1 mark

b. What would be a suitable name for a chitin-digesting enzyme if it was present in the drongo's gut?

_____

1 mark

Certain microbial organisms do contain enzymes which digest chitin.

c. **i** What subunits (monomers) is chitin ultimately broken down into in the presence of these enzymes?

_____

ii Other than the enzyme, is any other molecule required for the break down of chitin into its monomer units? Explain.

_____

_____

_____

1 + 1 = 2marks

In order to maintain its health and superb acrobatic skills, the drongo requires a diet which includes the macromolecules listed in the table below:

Macromolecule	Carbon	Hydrogen	Oxygen	Nitrogen	Sulphur	Phosphorus
Carbohydrate						
Protein						
Lipid						
Nucleic acid						

d. Complete the table of macromolecules by placing a cross in any box correctly identifying a chemical element that **is always found** in the listed macromolecule.

4 marks

While in pursuit of a scrumptious Leichardt's grasshopper, the drongo inadvertently careered into a wall of spider webs. The strength of the protein webs, enhanced by the presence of beta pleated sheets, ensured the next five minutes was spent scraping the webs from its body.

e. **i.** At what level of protein structure are beta pleated sheets described?

_____

1 mark

ii. What type of bonds help to stabilise the three-dimensional structure of beta pleated sheets in spider webs?

_____

1 mark

f. The subunits of all polypeptides and proteins are amino acids. Draw and label the general structure of an amino acid in the space below:

2 marks

Every protein made in the cells of the drongo, including the keratin that forms its beautiful shimmering feathers, has been coded for by the bird's deoxyribonucleic acid (DNA). DNA never leaves the nucleus when it instructs the cell to make keratin. Instead, it sends a messenger ribonucleic acid (mRNA) molecule into the cytoplasm with the protein-making instructions.

g. Complete the following table distinguishing the structures of DNA and RNA:

Feature	DNA	RNA
Sugar		
No. of strands		
Bases		

3 marks

Total: 15 marks

Question 2
As the drongo was in pursuit of the grasshopper, it almost collided with a frog sitting on a ledge overhanging an estuary. In fright, the frog leapt clear of the bird only to land in the saltwater below. Upon hitting the water the frog swam frantically to shore.

a. What term is used to describe the frog cytosol when its solute concentration is compared with that of the seawater of the estuary?

_____

1 mark

b. Clearly explain why the frog was so frantic to get out of the saltwater.

_____

_____

_____

_____

_____

2 marks

While the frog was swimming in the estuary the motor neurons sending impulses to its leg muscles were very active. This involved the rapid exchange of sodium and potassium ions across the neuron cell membranes. The frog successfully made it to shore and immediately dived into a freshwater pool.

Figure 5 represents a section of a neuron cell membrane in the frog.

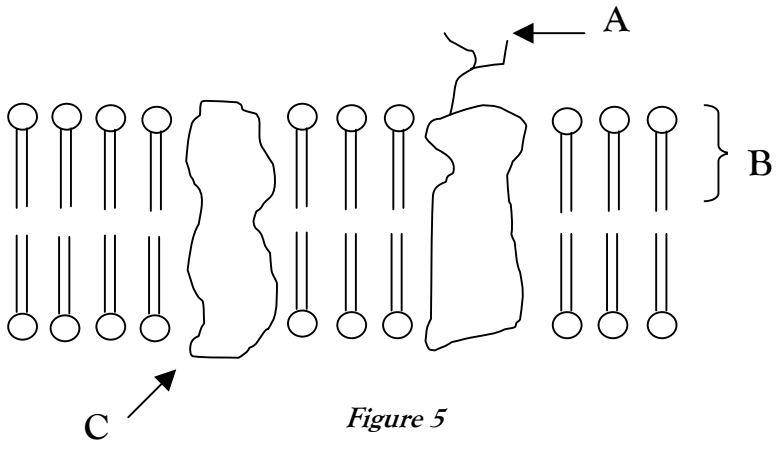


Figure 5

c. Label structures A-C of the frog cell membrane:

A _____

B _____

C _____

3 marks

d. i. Through which region of the cell membrane (A, B or C) did the passage of sodium ions take place?

_____

1 mark

ii. Why are ions required to take this route across membranes?

_____

1 mark

A sodium ion concentration gradient exists at all times when a neuron is resting, with a much higher sodium concentration outside of the cell than inside.

e. i. By what process would the sodium ions of the frog have entered the cytosol of its motor neurons while it was swimming?

_____

1 mark

ii. By what process would the sodium ions have been returned to their original location to reinstate the concentration gradient?

_____

1 mark

iii. In terms of energy requirements, distinguish between the two processes noted in your responses to i. and ii.

_____

_____

_____

_____

1 mark

Total: 11 marks

Question 3
Once the entire spider web had been removed, the spangled drongo resumed its search for flying insects. It soon noticed a pair of grasshoppers, with the male flying directly behind the female.

a. What type of chemical was the female grasshopper using to attract the male?

_____

1 mark

The spangled drongo had little difficulty in grabbing the male grasshopper in flight, as the male was suffering the effects of an insecticide that had been sprayed on the leaves it had been consuming. This particular insecticide stops the action of enzymes which digest neurotransmitter molecules after they have stimulated receptors on post synaptic membranes (see Figure 8).

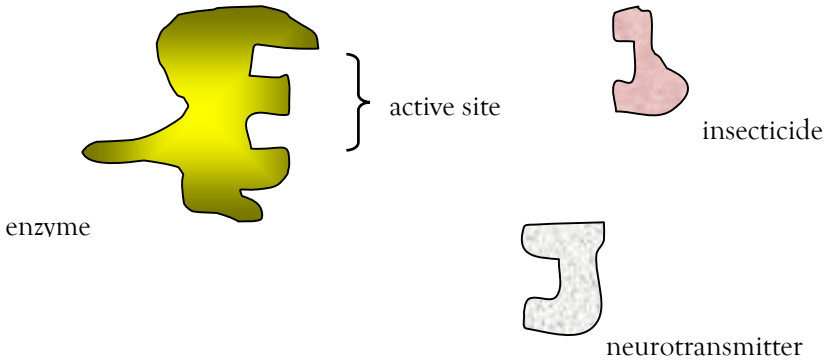


Figure 8: Enzyme, substrate and insecticide

b. As a consequence of its action on the enzyme, what term is used to describe the insecticide in this situation?

_____

1 mark

c. Use the information in the diagram to explain how the insecticide affects enzyme activity.

_____

_____

_____

_____

2 marks

d. Suggest how the inactivation of the enzyme leads to the death of the grasshopper.

_____

_____

_____

1 mark

While the drongo was giving chase, a funnel-web spider was consuming a grasshopper of its own on the gravel below. The action of funnel web spider venom is different to that of the insecticide. It interferes with the movement of sodium ions across membranes.

e. If the synapse is unaffected, suggest how a neuron is affected by funnel web venom?

_____

_____

1 mark

The Leichardt's grasshopper is very active in the subtropical temperatures of northern Australia. On some cool evenings, however, temperatures can fall below 15°C. Alternatively, in periods of extreme heat, temperatures can reach well over 40°C. At these times grasshoppers become inactive.

f. Explain the decline in activity of the grasshopper during

i. cool weather conditions.

_____

_____

_____

_____

ii. very hot conditions

_____

_____

_____

_____

2 + 2 = 4 marks

Total: 10 marks

Question 4
Rod, a handsome young resident of Pelican Spit, is keen to win the fancy of Roxanne, a 19-year old barmaid at the Pelican Spit Hotel. At one stage Rod was having little success in his attempts to lure Roxanne, as the thyroid gland in his neck started to swell due to a lack of iodine in his diet. Iodine is an essential element of the hormone thyroxin, a hormone synthesised in the thyroid gland.

Thyroxin increases the metabolic rate of all body cells, and the hypothalamus continually regulates metabolic rate by monitoring thyroxin levels in the bloodstream (see Figure 6):

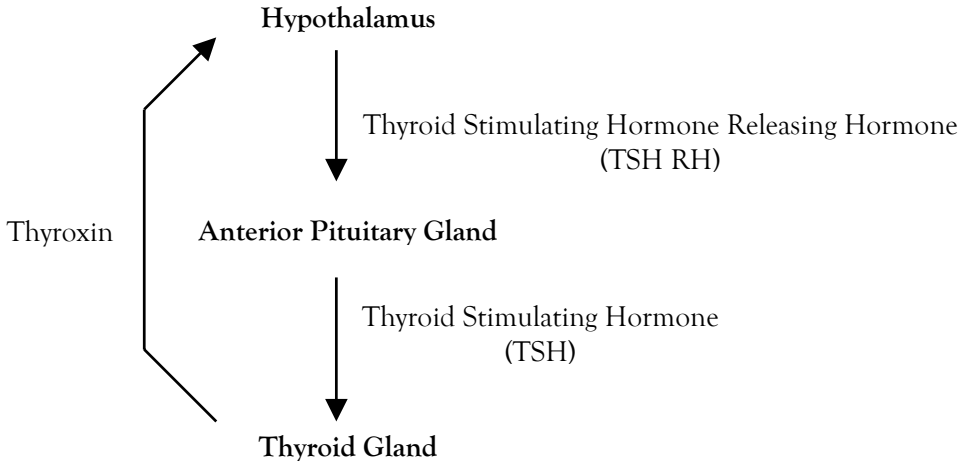


Figure 6: Regulation of Metabolism

The pituitary gland has two sections, the anterior and posterior lobe, and each lobe contains its own variety of hormones. Thyroid stimulating hormone (TSH) is synthesised in the pituitary gland.

a. **i.** From which lobe of the pituitary gland is TSH released?

_____

1 mark

ii. Explain your answer to part i.

_____

_____

_____

_____

_____

2 marks

b. What type of feedback is involved with a fall in metabolic rate? Explain.

2 marks

c. Use Figure X to suggest why an iodine-deficient diet caused Rod's thyroid gland to swell.

2 marks

Despite repeated rebuffs to his advances, Dylan has also developed a strong interest in Roxanne. A diabetic since he was young, Dylan carries a portable pump which continually injects small doses of insulin into his bloodstream. As a consequence, Dylan can maintain an active and healthy lifestyle by generally keeping his blood glucose levels within the normal range of 3.6 – 6.8 mmol/L.

d. Insulin is a peptide hormone secreted by the beta cells of the pancreas. Outline all the steps involved in the production and export of insulin from a beta cell, from the release of insulin mRNA from the nucleus to secretion of insulin into the bloodstream.

6 marks

On one of their few relaxed moments together, Rod and Dylan shared some sweets and their blood glucose levels were immediately examined (see Figure 7). No more food was consumed for the next five hours.

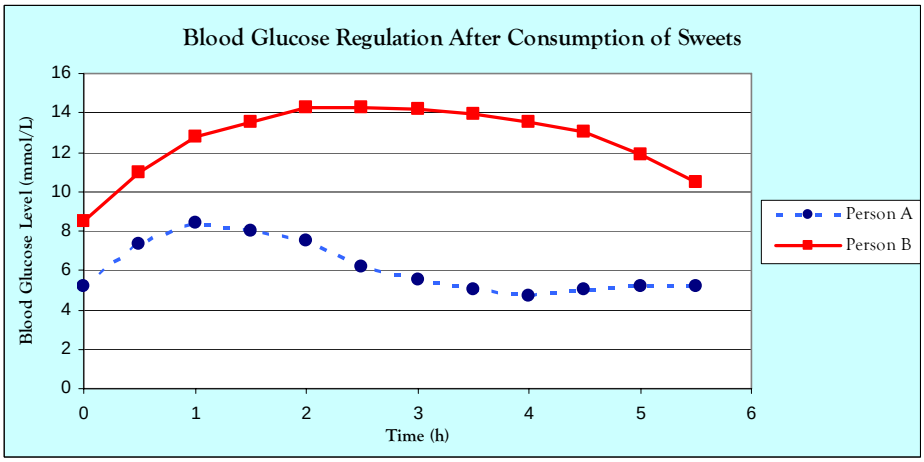


Figure 7

e. Which person in Figure Y is Rod, who is **not** a diabetic? Explain.

3 marks

Rod and Dylan's interest in Roxanne developed when they were both young teenagers. A steroid hormone that played a role in their interest is testosterone, which is secreted in increased quantities at that age.

A target cell for testosterone is also a target cell for insulin.

f. State the location of a receptor for each of the following hormones in this cell:

i. insulin

_____

ii. testosterone

_____

1 + 1 = 2 marks

g. Explain why the receptor for insulin cannot be found in the same location as the receptor for testosterone.

_____

_____

_____

_____

_____

2 marks

h. Which molecule(s) activates the gene responding to testosterone?

_____

1 mark

Total: 21 marks

Question 5
Months of subtle courting has finally paid off for Rod. Roxanne has accepted his invitation to share a picnic on the sandy slopes of Mullet Cove. With the gentle sound of lapping waves and an abundance of pollen in the air, Rod's level of adrenalin causes his heart to pound apace!

So keen was Rod on making this adventure more than a nutritional success, he gave the Monaro a complete cut and polish and had its interior fully steam cleaned. Possibly due to all the stress and exertion involved in preparations, Rod was now coming down with the common cold. He assumed it was the same infection he had suffered two months ago, and his respiratory tract was secreting large quantities of mucous at the worst possible time.

a. What type of pathogen causes a cold?

_____

1 mark

b. The secretion of mucous has only occurred **after** Rod has contracted the cold. How will mucous assist Rod during his period of infection?

_____

_____

_____

1 mark

Now they have been detected by the body, the pathogens circulating in Rod are being engulfed by macrophages.

c. Is the action of macrophages a specific or non-specific defence mechanism? Explain.

_____

_____

_____

2 marks

Unfortunately, the pathogen is still spreading in Rod. Since the detection of the pathogen, however, the macrophages have been releasing interleukin-1 (a cytokine) to activate the third line of defence in Rod's body. Interleukin-1 mobilises the helper T cells (T_H cells), and they in turn release interleukin-2 (another cytokine) to stimulate two other types of white blood cells involved in the third line of defence.

One of the cells stimulated by interleukin-2 is the cytotoxic T cell (T_C cell).

d. **i.** Where do T cells mature?

_____

1 mark

ii. Describe the role of T_C cells in defending Rod against his cold.

2 marks

iii. How does the mode of action of a T_C cell differ from that of a natural killer cell?

1 mark

The other type of cell stimulated by interleukin-2 is the B cell? In a process known as clonal selection, B cells divide into plasma cells.

e. Where do B cells mature?

1 mark

f. How do plasma cells assist macrophages in capturing and digesting as many pathogens as possible?

2 marks

g. Is it likely that the same pathogen is responsible for both Rod's current and previous infection of the common cold? Explain.

2 marks

A shuffling sound in the nearby scrub only caught Rod's attention momentarily. It was Dylan lurking in the bushes behind the idyllic picnic scene. Enraged by Rod's success in luring Roxanne away for a romantic interlude, he was keen on somehow thwarting Rod's romantic advances with Roxanne.

While carefully advancing on Rod and Roxanne from behind a dune, however, Dylan inadvertently aroused a nest of jumping jack ants. Jumping jack venom is a well known cause of anaphylactic shock in allergic individuals. In fact, the Tasmanian jumping jack ant is recognised for producing the most toxic venom of any ant in the world.

h. Which antibody (immunoglobulin) is responsible for allergies?

_____

1 mark

As Rod and Roxanne lay on the beach awaiting their glorious sunset, a high pitched screech emerged from the scrub behind. Initially believing the source to be a startled spangled drongo (well known in the region for their strange metallic calls), they were shocked to view Dylan jumping over the dune gasping for air and collapsing before them. This is the second time Dylan had ever been stung by jumping jacks, however, this time his reaction to the sting was severe.

Despite Dylan's distressed state, with the Monaro in showcase condition, Rod and Roxanne were able to whisk him to hospital where he received a life-saving injection of adrenalin. This was not the only success of the evening, however, as Roxanne was clearly interested in experiencing more Monaro-based adventures with Rod.

i. Explain how Dylan's lung bronchioles constricted in response to the injection of jumping jack venom.

_____

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_____

3 marks

Total: 17 marks

UNIT 3 BIOLOGY 2006
WRITTEN EXAMINATION 1 - SOLUTIONS

(2 HOUR VERSION)

COMPLIMENTS OF THE SCHOOL FOR EXCELLENCE

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SECTION A – MULTIPLE CHOICE

Suggested Answers

Question 1 C
Question 2 B
Question 3 D
Question 4 C
Question 5 B

Question 6 A
Question 7 B
Question 8 D
Question 9 D
Question 10 C

Question 11 A
Question 12 A
Question 13 A
Question 14 A
Question 15 C

Question 16 A
Question 17 A
Question 18 A
Question 19 C
Question 20 D

Question 21 B
Question 22 A
Question 23 A
Question 24 D
Question 25 B

Section A:	/25
Section B:	/80
Total:	/105

SECTION B – SHORT ANSWER QUESTIONS

Question 1

a. Carbohydrates (polysaccharides)

b. Chitinase (1 mark)

c. **i.** Glucose (1 mark)
ii. Water molecules are required to be split in the hydrolysis reaction (1 mark).

d.

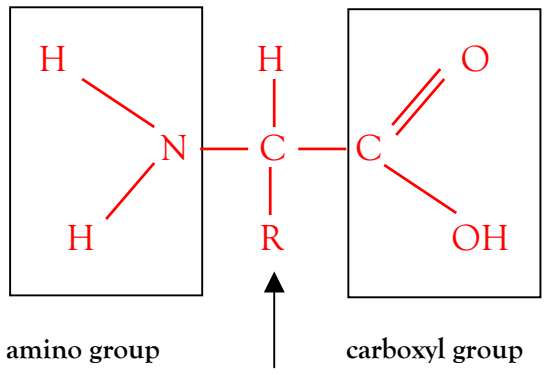
Macromolecule	Carbon	Hydrogen	Oxygen	Nitrogen	Sulphur	Phosphorus
Carbohydrate	. X	X	X			
Protein	X	X	X	X		
Lipid	X	X	X			
Nucleic acid	X	X	X	X		X

(4 marks)

e. **i.** Secondary structure

ii. Hydrogen bonds

f. The basic structure of a generalised amino acid:



amino group **carboxyl group** (2 marks)

R group

g.

Feature	DNA	RNA
Sugar	deoxyribose	ribose
No. of strands	two	one
Bases	adenine, thymine, guanine, cytosine	adenine, uracil, guanine, cytosine

(3 marks)

Total: 15 marks

Question 2

a. Hypotonic

b. The frog was at risk of dehydrating due to loss of water via osmosis (1 mark). Water molecules were continually passing from an area of high water concentration (in the cytosol of frog cells) to an area of lower water concentration (saltwater) (1 mark).

c. A = carbohydrate/antigen
B = phospholipid
C = protein

d. **i.** C (protein)
ii. Ions (charged particles) are not lipid soluble.

e. **i.** Facilitated diffusion
ii. Active transport
iii. Facilitated diffusion involves the passive movement of ions while active transport requires a supply of energy in the form of ATP.

Total: 11 marks

Question 3

a. Pheromone (1 mark)

b. Competitive inhibitor (1 mark)

c. The insecticide competes with the neurotransmitter for the active site on the enzyme (1 mark), hence, an enzyme-substrate complex with the neurotransmitter cannot form (1 mark).

d. Over stimulation of the post-synaptic membrane by accumulating neurotransmitter leads to death (1 mark).

e. Funnel web venom prevents the passage of sodium ions across neuron membranes, hence, it prevents impulses from being generated along the axon.

f. **i.** Decreased molecular movement in the ectothermic grasshopper (1 mark) reduces the rate at which enzyme-substrate complexes can form during cell reactions (1 mark).

ii. Some degree of denaturation of enzymes can occur with excessive periods of heat (1 mark). The change in shape of enzyme active sites prevents enzyme-substrate complexes from forming (1 mark).

Total: 10 marks

Question 4

a. **i.** Anterior pituitary

ii. The anterior pituitary gland synthesises its own hormones (e.g. TSH) (1 mark). By contrast, the posterior pituitary gland releases hormones which have been synthesised in the hypothalamus (1 mark).

b. Negative feedback (1 mark).
The hypothalamus releases increased levels of TSH RH in response to low levels of thyroxin, and reduces TSH RH levels in response to high levels of thyroxin (1 mark).

c. Iodine is a necessary component of thyroxin. Without iodine, the thyroid gland cannot synthesise thyroxin. In response, the hypothalamus continually releases TSH RH (1 mark), causing the pituitary gland to continuously release TSH, thus overstimulating the thyroid gland and causing it to swell (1 mark).

d. Insulin gene transcribes mRNA (1 mark).
Insulin is synthesised after mRNA travels from nucleus to be read by ribosomes (1 mark) on rough endoplasmic reticulum (1 mark).
Rough ER transports insulin, via vesicles, to the golgi apparatus (1 mark).
Golgi apparatus is used to modify and package the insulin (1 mark)
in secretory vesicles (1 mark)
which merge with the cell membrane and release insulin via exocytosis (1 mark).

e. Person A (1 mark)
Rod's blood glucose levels return to the normal range of 3.6 – 6.8 mmol/L within 2.5 hours of eating the sweets (1 mark) whereas Dylan's blood glucose levels (8.5 – 14.2 mmol/L) are outside the normal range for the entire 5.5 hours of the experiment (1 mark).

f. **i.** Cell membrane (1 mark).

ii. Within cytosol or nucleus (1 mark).

g. Insulin is a peptide hormone and is not lipid soluble, so it cannot pass through the cell membrane (1 mark). Steroid hormones such as testosterone are lipid soluble and have no difficulty passing through the phospholipid bilayer of the cell membrane to reach receptors inside the cell (1 mark).

h. Hormone/receptor complex (1 mark).

Total: 21 marks

Question 5

a. Virus (1 mark).

b. Increased secretion of mucous will reduce the chance of a secondary infection (mucous traps bacteria, pollen, dust etc.) while Rod's immune system tackles the viral infection (1 mark).

c. Non-specific (1 mark). Macrophages attempt to engulf particles containing any non-self molecules (1 mark).

d. **i.** Thymus gland (1 mark).

ii. T_C cells attack cells invaded by the cold virus, i.e. cells containing class I protein markers and the viral antigen on their surface (1 mark). T_C cells attach to the infected cells and lyse them, destroying the cells (1 mark).
Note: T_C cells do not destroy free viruses.

iii. Natural killer cells also attack viral-infected cells, however, unlike T_C cells, they are not specific in their action, i.e. they will attack a cell infected by any type of virus.

e. Bone marrow (1 mark).

f. Plasma cells release free antibodies which attach to foreign antigens (1 mark). Antibodies act as flags, attracting macrophages, and clump antigens together making it easier for macrophages to locate and engulf antigen-antibody complexes (1 mark).

g. No. Rod will have formed memory cells to his previous infection (1 mark) so his current infection is most likely due to another viral strain (1 mark).

h. IgE (1 mark).

i. IgE antibodies have previously attached to mast cells lining Rod's respiratory tract (1 mark). In an allergic response to the sting the mast cells release excessive levels of histamine leading to bronchiole constriction (1 mark).

Total: 17 marks