THE SCHOOL FOR EXCELLENCE (TSFX)

VCE BIOLOGY UNITS 3 & 4

WRITTEN EXAMINATION 2019

Reading Time: 15 minutes
Writing Time: 2 hours 30 minutes

QUESTION AND ANSWER BOOK

Student Number: | | | | | | | | | | **Letter** |

Structure of Book

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*
A	40	40	40
B	10	10	80
			Total 120

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

Materials Supplied

- Question and answer book of 31 pages.
- Answer sheet for multiple choice questions.

Instructions

- Write your **student number** in the space provided above on this page.
- All written responses must be in English.

At the End of the Examination

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

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

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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** or that **best answers** the question.

A correct answer scores 1, an incorrect answer scores 0.

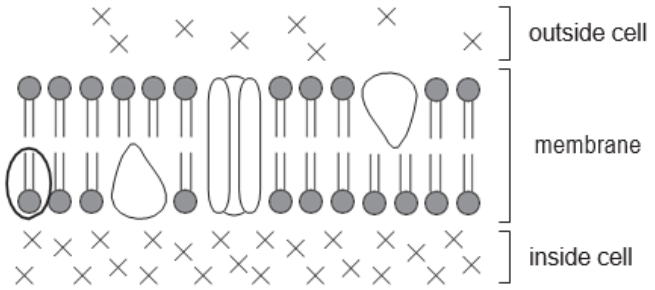
Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

Use the following information to answer Questions 1 and 2.

Consider the following diagram of the plasma membrane.



QUESTION 1
The circled molecule in the membrane is

A. cholesterol
B. a phospholipid
C. a carrier protein
D. a glycolipid

QUESTION 2
If substance X were Na^+ ions they would move:

A. into the cell via a channel protein as they are non-polar.
B. into the cell via a channel protein as they are charged.
C. out of the cell via a channel protein as they are non-polar.
D. out of the cell via a channel protein as they are charged.

QUESTION 3
The breakdown of proteins to smaller peptides in liver cells is an example of

A. a condensation reaction.
B. an endergonic reaction.
C. a catabolic reaction.
D. an anabolic reaction.

QUESTION 4
Growth Hormone (GH) is a naturally occurring peptide hormone produced by the anterior pituitary gland which stimulates growth and cell reproduction.

Which of the following sequences of organelles in an anterior pituitary cell is correct for the synthesis and secretion of Growth Hormone?

A. Nucleus-rough endoplasmic reticulum-ribosomes-Golgi apparatus-secretory vesicles.
B. Mitochondria-ribosomes-Golgi apparatus-secretory vesicles.
C. Ribosomes-rough endoplasmic reticulum-vesicles-Golgi apparatus-secretory vesicles.
D. Ribosomes-vesicles-rough endoplasmic reticulum-Golgi apparatus-secretory vesicles.

QUESTION 5
After tests were performed on an organic molecule found in muscle cells, the following components were identified: adenine, phosphate, uracil and guanine. Scientists could therefore deduce that the molecule was

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

QUESTION 6
After proteins are synthesised, they may undergo a series of changes which results in them being grouped into four structural hierarchy levels. Which of the following statements is correct regarding these structural levels?

A. The primary structure involves a series of amino acids joined by hydrogen bonds.

B. The secondary structure includes folding into alpha pleated sheets held by peptide bonds.

C. The tertiary structure of proteins involves folding of the amino acid chain into a specific 3D shape.

D. All quaternary proteins have four polypeptide chains joined together.

QUESTION 7
When specialised white blood cells called macrophages ingest and destroy bacteria, which of the following is an important step in the process?

A. Ingesting of the bacteria into vacuoles by endocytosis
B. Fusion of the vacuoles containing the ingested bacteria with mitochondria
C. Release of enzymes by lysosomes into the cell cytosol to digest the bacteria
D. Expulsion of unwanted remains of digested bacteria by exocytosis

Use the following information to answer Question 8.

The following is a series of amino acids found in a segment of protein:

-Phenylalanine-lysine-serine-tyrosine-serine-

Codons in mRNA

First Base	Second Base								Third Base
	U		C		A		G		
	UUU	Phenylalanine	UCU	Serine	UAU	Tyrosine	UGU	Cysteine	U
U	UUC	Phenylalanine	UCC	Serine	UAC	Tyrosine	UGC	Cysteine	C
	UUA	Leucine	UCA	Serine	UAA	Stop	UGA	Stop	A
	UUG	Leucine	UCG	Serine	UAG	Stop	UGG	Tryptophan	G
	CUU	Leucine	CCU	Proline	CAU	Histidine	CGU	Arginine	U
C	CUC	Leucine	CCC	Proline	CAC	Histidine	CGC	Arginine	C
	CUA	Leucine	CCA	Proline	CAA	Glutamine	CGA	Arginine	A
	CUG	Leucine	CCG	Proline	CAG	Glutamine	CGG	Arginine	G
	AUU	Isoleucine	ACU	Threonine	AAU	Asparagine	AGU	Serine	U
A	AUC	Isoleucine	ACC	Threonine	AAC	Asparagine	AGC	Serine	C
	AUA	Isoleucine	ACA	Threonine	AAA	Lysine	AGA	Arginine	A
	AUG	Methionine or start	ACG	Threonine	AAG	Lysine	AGG	Arginine	G
	GUU	Valine	GCU	Alanine	GAU	Aspartic Acid	GGU	Glycine	U
G	GUC	Valine	GCC	Alanine	GAC	Aspartic Acid	GGC	Glycine	C
	GUA	Valine	GCA	Alanine	GAA	Glutamic Acid	GGA	Glycine	A
	GUG	Valine	GCG	Alanine	GAG	Glutamic Acid	GGG	Glycine	G

QUESTION 8
Using the Genetic Code table above, the DNA sequence that could code for this amino acid segment is

A. UUU-AAA-AGU-UAU-AGC
B. AAA-UUU-UCG-AUA-UCG
C. AAA-TTT-TCA-ATA-TCG
D. TTT-AAA-TGC-ACG-TCG

QUESTION 9
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. denatures enzymes that convert sugar to starch.
B. breaks down starch to sugar.
C. removes the starch from the corn.
D. reduces the enzyme activity that can be reactivated when defrosted.

QUESTION 10
Cells contain many different enzymes because enzymes are

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

QUESTION 11
The chloroplast is the site of photosynthesis in all photosynthetic plants.
Which of the following statements is true regarding photosynthesis?

A. Grana increase the surface area of membranes available for the light-dependent reactions.

B. Water is split in the reactions that occur in the stroma.

C. CO_2 is a reactant for the light-dependent reactions.

D. Light-independent reactions only occur during periods of darkness.

QUESTION 12
During photosynthesis, which of the following products of the light-dependent reaction act as coenzymes to be are used in the light-independent reaction?

A. ATP and oxygen
B. NADH and oxygen
C. NADPH and ATP
D. $FADH_2$ and ATP

QUESTION 13
Glucose produced in photosynthesis is used in cellular respiration.
Which of the following statements is true for this process in animal cells?

A. In aerobic cellular respiration, pyruvate enters the mitochondria and is broken down in the Krebs cycle on the cristae membranes.

B. In anaerobic cellular respiration, the breakdown of pyruvate forms ethanol, CO_2 and 2 ATP.

C. In aerobic cellular respiration, oxygen is a reactant of the electron transport chain reaction that occurs in the mitochondria.

D. CO_2 and ATP are products of the Krebs cycle and electron transport chain in aerobic cellular respiration.

QUESTION 14
Which of the following correctly matches a signalling molecule with its role?

	Molecule	**Role**
A.	Cytokine	Produced by glands and released into blood to stimulate a response in target cells.
B.	Complement	Released to external environment to attract individuals of the same species.
C.	Neurotransmitter	Released by exocytosis and attaches to external membrane receptors on target cells.
D.	Pheromone	Travels in the blood and attracts phagocytes to the infection area.

Use the following information to answer Questions 15 and 16.

Signal transduction pathways can involve the response of millions of molecules to a single hormone molecule. For instance, one molecule of glucagon hormone can cause the breakdown of 100,000,000 molecules of stored glycogen in a liver cell.

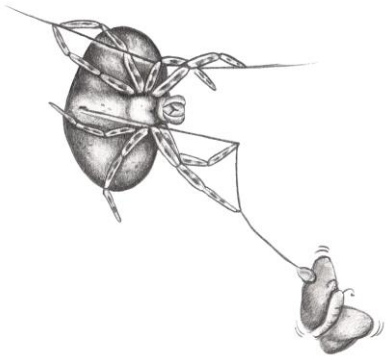
QUESTION 15
If a secondary messenger was involved in a transduction pathway, the original signal could have been provided by

A. a protein hormone such as adrenalin.
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 16
The large increase in the number of molecules activated in the signal transduction pathway, as described in liver cells, is known as

A. magnification.
B. amplification.
C. translation.
D. reception.

QUESTION 17
The bola spider of Australia has a unique technique for capturing its prey. It laces a sticky globule (a bola) with the scent of a female moth, and dangles and twirls the bola from a silky thread in order to attract unsuspecting male moths. If the technique has proven unsuccessful after a period of time, the spider hauls in the bola, only to produce a new one that is laced with the scent of a female of a different moth species.



The chemical scent used by the spider is a

A. pheromone.
B. neurotransmitter.
C. neurohormone.
D. cytokine.

QUESTION 18
In the course of defending the human body against disease

A. phagocytes secrete antibodies specific to the antigen.
B. macrophages produce antigens.
C. cytotoxic T cells destroy free virus particles.
D. plasma cells synthesise specific antibodies.

QUESTION 19
Active immunity results from which of the following events?

A. A baby receives antibodies from its mother's breast milk.
B. A Rhesus negative mother receives antibodies after giving birth to a Rhesus positive baby.
C. An adolescent receives an injection of attenuated measles virus.
D. A gardener receives an injection of anti-toxin to *Clostridium tetani* bacteria after standing on a dirty garden rake.

QUESTION 20
The innate immune response of the body involves the activity of both cells and molecules. Which of the following is involved in the second line of defense?

A. Antibodies produced by memory B lymphocytes.
B. Sweat secreted by the skin containing lysozyme.
C. Natural Killer cells that destroy virus-infected cells.
D. Cytokine secreted by helper T cells.

QUESTION 21
Allergic conditions result from the exaggerated response of the body to otherwise harmless antigens. There is a greater incidence of allergies today than at any other known time in history. There are many suggested reasons for this increase including changes to our living environment and our modern lifestyle.

Which of the following statements is correct regarding allergic reactions?

A. Ig E antibodies attach to macrophages after the first allergen exposure, causing the release of excessive quantities of histamine.

B. Mast cells release excessive quantities of histamine after allergens attach to Ig A antibodies on their cell membrane, after first exposure to the allergen.

C. Complement proteins, released by mast cells, warn other body cells to produce large quantities of histamine.

D. Mast cells release large quantities of histamine after allergens attach to Ig E antibodies on their cell membrane, after secondary exposure to allergens.

QUESTION 22
Monoclonal antibodies are prepared from

A. human T cells which are cultured for an unlimited number of generations.

B. B cells collected from the lymph of a human exposed to a specific antigen.

C. B cells produced by rats exposed to a specific antigen which are hybridised with tumour cells.

D. human T cells which are hybridised with B cells and then cultured for an unlimited number of generations.

QUESTION 23
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. suppressing the response of T cells which recognize 'foreign' molecules on the transplanted organs.

C. reducing the effectiveness of mast cells which cause inflammation in transplanted organs.

D. promoting the repair of the blood vessel connections between the transplanted organ and the recipient's body.

Use the following information to answer Questions 24 and 25.

QUESTION 24
Students performed an investigation to compare the effectiveness of different antiseptics on killing bacteria. Three antiseptics, A, B and C, were used. Agar plates were inoculated with bacteria and then the antiseptics applied to each 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.

Antiseptic	**A**	**B**	**C**
Number of bacterial colonies	52	27	6

The independent variable in this investigation was the

A. temperature of incubation of the agar plates.
B. number of visible bacterial colonies.
C. effectiveness of the antiseptic.
D. type of antiseptic used.

QUESTION 25
The accuracy of this experiment could have been improved by

A. using a wider variety of antiseptics.
B. using several plates for each antiseptic
C. incubating the plates at different temperatures.
D. using several different strains of bacteria.

QUESTION 26
The restriction enzyme *Taq*1 has the recognition sequence:

T C | G A
A G | C T

If the following DNA sequence were cut with *Taq*1, how many fragments would result?

AACGAATTCGAGTGCACTCGATACTAGC
TTGCTTAAGCTCACGTGAGCTATGATCG

A. 1
B. 2
C. 3
D. 4

QUESTION 27
Which of the following statements is correct for the DNA fragments involved in gel electrophoresis?

A. Due to their size and molecular weight, larger fragments of DNA move more slowly through the gel than smaller fragments.

B. As larger fragments have more negative charge than smaller fragments, they move faster through the gel.

C. As DNA fragments have different amounts of negative charge, they move at different rates through the gel.

D. As smaller fragments have less negative charge, they move faster through the gel towards the positive end than larger fragments.

QUESTION 28
When a bacterium takes up an engineered plasmid into its cell cytosol, this is called

A. translation.
B. transcription.
C. transfection.
D. transformation.

QUESTION 29
A transgenic organism is formed when a

A. gene is 'knocked out' in Atlantic salmon cells allowing them to grow larger.
B. vitamin A gene from daffodils is inserted into rice cells producing 'Golden rice'.
C. gene is inserted into a virus so it can act as a vector.
D. person receives stem cells in a bone marrow transplant.

Use the following information to answer Questions 30 and 31.

The fossilised remains of a *Sclerocephalus haeuseri* have been dated back to 300 million years old. This animal is believed to be one of the early fossil ancestors in the evolution of amphibians.

Sclerocephalus haeuseri
evofossil.com/amphibians.html

QUESTION 30
This type of fossil appears to have features of both fish and amphibians. Due to these features, it could be used as

A. a trace fossil.
B. a transition fossil.
C. an index fossil.
D. an ancestral fossil.

QUESTION 31
The type of rock in which this fossil was found was most likely

A. sedimentary.
B. metamorphic.
C. igneous.
D. conglomerate.

QUESTION 32
A *Tyrannosaurus* fossil was discovered in the Badlands of North America. It was later dated to be approximately 190 million years old. Which of the following dating methods would have been used to date this dinosaur?

A. Radioactive isotopic carbon-14 dating.
B. Radioactive isotopic potassium/argon dating.
C. Stratigraphy.
D. Relative dating methods.

QUESTION 33
Large flightless birds called ratites include ostriches, emus and cassowaries. They are only found living today in Africa, South America, Australia, Papua New Guinea and New Zealand. Their distribution and features indicate

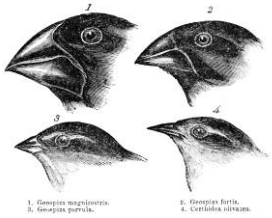
A. they evolved from an ancestral species by convergent evolution, as all the ratites share analogous structures.

B. evolution from an ancestral species by divergent evolution, as all ratites share homologous structures.

C. the existence of an ancestral species that was a water bird, which migrated to each continent where the ratites are currently found.

D. each type of ratite evolved from a separate ancestral species and they are not related as they are on different continents.

QUESTION 34
The diagram below illustrates four of the different species of Darwin's finches. Darwin's observations of these and other finches on the Galapagos Islands contributed to his proposed theory of evolution.



en.wikipedia.org

Darwin proposed that all the finches likely came from a common ancestor but had become different enough to be classified as separate species.

The process of new species forming from a common ancestor is called

A. Natural selection.
B. Bottleneck effect.
C. Founder effect.
D. Allopatric speciation.

QUESTION 35
A hominin fossil, *Homo floresiensis,* called the hobbit, was discovered on the Indonesian island of Flores in 2003. Three-dimension modelling methods were used to compare the cranial features of the original Flores skull to those of a simulated fossil human (of similar stature) to determine if this was a species distinct from modern humans. The scientists were able to demonstrate that the original "hobbit" skull fitted the expectations for a small more primitive fossil hominin species and not a modern human.

Features of the original Flores skull would have included a

A. larger cranium.
B. reduced brow-ridge.
C. foramen magnum more central underneath the skull.
D. protruding wider jaw line.

QUESTION 36
There are two main theories that have been suggested to explain the spread of hominins out of Africa: the Multi-Regional theory and the Out of Africa theory.

Evidence to support the Out of Africa theory would include

A. transitional forms of hominins being found in Africa, Europe and Asia.
B. discovery of New World monkeys with a pelvis adapted for bipedalism.
C. greater variation in mtDNA in African populations than in other populations.
D. modern humans appearing in the fossil record throughout Africa, Asia and Europe during the same period.

QUESTION 37
Comparing data from the sequencing of the Neanderthal genome and genetic evidence (both mitochondrial DNA and nuclear DNA) from human fossil fragments found in the Denisova cave in Siberia has produced evidence that raises questions with regards to hypotheses on human dispersal and speciation.

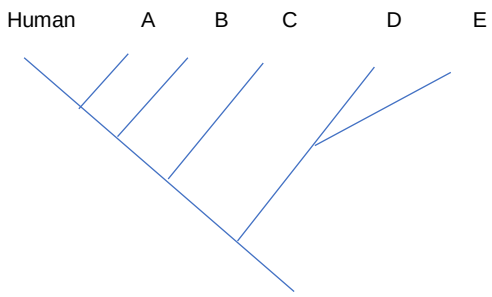
Another molecular biology technique that can be used to determine the genetic distance between two organisms is

A. Gene expression.
B. DNA gel electrophoresis.
C. DNA hybridisation.
D. Gene regulation.

QUESTION 38
One step in human cultural evolution was the discovery of how to grow and store crops. A further step in crop modification involved selective breeding. The impact of selective breeding may be

A. reduction in genetic diversity within species globally.
B. expansion in the gene pool of a species.
C. maintenance of a species viability that could otherwise become extinct.
D. an increase in genetic variation within species result in genetic drift.

QUESTION 39
Comparative DNA studies of primates allowed the following cladogram to be drawn.



The correct lettering for the primate groups would be:

A. A=Gorilla, B=Orangutan, C=Chimpanzee, D=old world monkeys, E=new world monkeys
B. A=Chimpanzee, B=Orangutan, C=Gorilla, D=old world monkeys, E=new world monkeys
C. A=Chimpanzee, B=Gorilla, C=Orangutan, D=old world monkeys, E=new world monkeys
D. A=Gorilla, B=Orangutan, C=Chimpanzee, D=old world monkeys, E=new world monkeys

QUESTION 40
When conducting a controlled experiment, one way of making the data more precise would be to

A. repeat the experiment numerous times.
B. calibrate the equipment before measuring the dependent variable each time.
C. include more levels of the independent variable.
D. include a control set up.

END OF SECTION A

SECTION B – Short Answer Questions

Instructions for Section B

Answer **all** questions in the spaces provided. Write using blue or black pen.

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

QUESTION 1 (7 marks)
The 2020 Tokyo Olympics will bring together many different types of athletes who have very specific training programs depending on their chosen event. For example, endurance athletes, such as the marathon runners, 'carbohydrate load' in the days leading up to their event, during which they consume a diet high in carbohydrates.

a. **i.** Write a balanced equation for the ATP producing cellular respiration reaction occurring in the muscle cells of the marathon runner. 1 mark

_____

_____

ii. How does the cellular respiration reaction occurring in the muscle cells of a 100m sprint athlete differ from the cellular respiration reaction in a marathon runner in terms of the amount of ATP produced per glucose molecule? 1 mark

_____

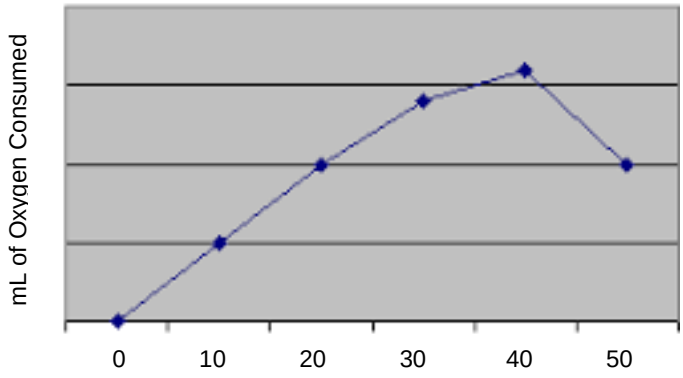
_____

iii. A similar reaction to the one taking place in the muscle cells of the 100m sprint runner occurs in yeast cells, but the breakdown of pyruvate results in different end products. What are the different end products produced in the yeast cells compared to the muscle cells of the sprint runner? 2 marks

_____

_____

b. The rate of cellular respiration in living organisms can be affected by several factors. Below is a graph showing the cellular respiration rate at different temperatures, measured by volume of oxygen consumed by an organism, over the course of an experiment. 2 marks



Explain the change in rate of cellular respiration as the temperature changes from 10 degrees C to 37 degrees C.

_____

_____

_____

_____

c. Mitochondria are involved in cellular respiration in eukaryotic cells. The theory of endosymbiosis suggests mitochondria were once independently existing microbes, similar to bacteria that have evolved to become organelles functioning within eukaryotic cells. 1 mark

State one piece of evidence used to support this theory.

_____

_____

_____

QUESTION 2 (12 marks)
Duchenne Muscular Dystrophy is a recessive genetic disorder in humans caused by a mutation of the DMD gene. This gene is located on the X chromosome and codes for dystrophin which forms an important structural role in muscle fibres. The mutated allele does not produce dystrophin so DMD sufferers experience progressive muscle weakness, and eventual death.

a. **i** What is an allele? 1 mark

_____

_____

ii. To which group of compounds does dystrophin belong? 1 mark

_____

iii. On which organelle in the muscle cells is dystrophin synthesised? 1 mark

_____

iv. Name and briefly describe the process occurring on the organelle named in part **iii** that results in the expression of the dystrophin gene. 3 marks

_____

_____

_____

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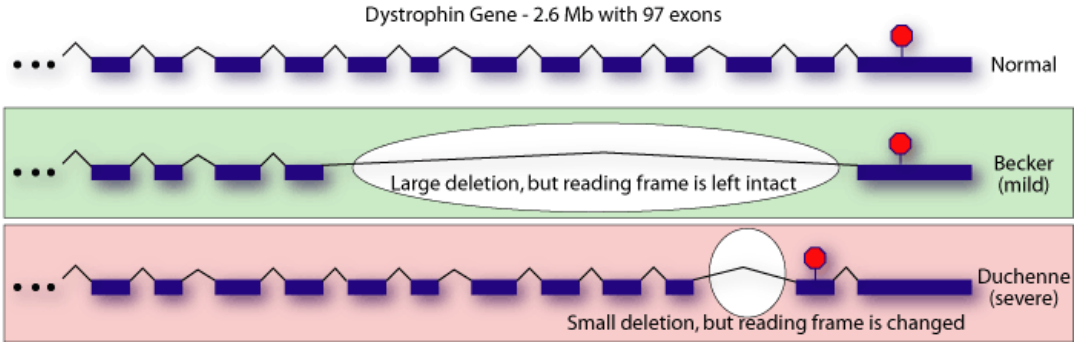
_____

_____

b. The gene that codes for dystrophin, together with two faulty forms of the gene, are shown below.



i. What is an exon? 1 mark

_____

_____

ii. Using the information shown in the diagram, compare the significance of a large deletion mutation as in Becker MD with a small reading frame mutation as in Duchene MD on the severity of the type of Muscular Dystrophy. Explain why this difference occurs. 2 marks

_____

_____

_____

_____

_____

Although there are many different mutations that cause DMD, some are caused by point mutations which result in the production of a stop codon.

iii. What is a point mutation? 1 mark

_____

_____

If the amino acid sequence which leads to the production of the faulty dystrophin is:

methionine – cysteine – tyrosine – proline – serine – proline – glycine – serine

and the mRNA sequence that corresponds to this amino acid sequence is:

AUG UGU UAC CCC UCU CCA CAG UCU

iv. Write the DNA sequence of the template strand corresponding with this section of the gene. 1 mark

_____

v. Would this be the only DNA base sequence that could code for this part of the faulty dystrophin molecule? Explain your answer. 1 mark

_____

_____

_____

_____

_____

QUESTION 3 (9 marks)
It is important that cells can communicate with each other in order that vital functions are carried out efficiently. Signalling molecules carry information between cells which then respond to these molecules in a variety of ways.

An example of a signalling molecule is antidiuretic hormone (ADH), a protein-based hormone, which is released by the hypothalamus. An increase in blood solute concentration triggers the release of ADH which travels to the kidney resulting in the increased membrane permeability of the target cells and absorption of water back into the blood stream.

a. What is a hormone? 1 mark

_____

_____

_____

b. As ADH is carried around the body, it passes by many cells of the body. Explain why only the target cells in the kidney respond to the ADH. 1 mark

_____

_____

_____

c. Using your knowledge and the information given, describe the following steps that occur when ADH reaches the target cells in the kidney. 3 marks

Reception:

_____

_____

_____

_____

Transduction:

_____

_____

_____

Cellular Response:

_____

_____

_____

d. Another important role of cellular signals is their involvement in apoptosis. Apoptosis can be activated by the intrinsic or extrinsic pathways. Once activated, the organised destruction of the cell occurs.

i. Name one intrinsic and one extrinsic stimulus for apoptosis. 2 marks

Intrinsic:

_____

_____

Extrinsic:

_____

_____

ii. Describe the stages involved in the organised destruction of the cell during apoptosis after the receptor has been activated. 2 marks

_____

_____

_____

_____

_____

QUESTION 4 (9 marks)
Type 1 diabetes is an autoimmune disease that affects over 120,000 people in Australia. People with Type 1 diabetes are unable to control their blood sugar levels as they do not produce the hormone insulin. They require daily injections of insulin.

a. What is an autoimmune disease? 1 mark

Scientists have developed a drug that may be able to reduce the development of Type 1 diabetes symptoms in children. Before doing clinical trials of the drug with children, they need to test it in the laboratory using mice of the same age, size and that are genetically similar.

b. Design a controlled experiment that could be carried out in the laboratory to test the effectiveness of the drug. In your answer name the independent and dependent variables and controlled variables. Describe the results expected if the drug was effective. 4 marks

The manufacture of insulin is now done by genetic engineering using recombinant DNA technology. To carry out the technique several “tools” are used.

c. For each “tool” describe its purpose in recombinant DNA technology. 4 marks

Tool	**Use in Recombinant DNA Technology**
Restriction Enzyme	
PCR	
Gel Electrophoresis	
Plasmids	

QUESTION 5 (14 marks)
In order to maintain optimal functioning of cells, organisms need to have measures to ensure that pathogens do not enter the tissues. If pathogens do enter the body, there need to be ways to detect and remove them. This is the role of the internal defence systems.

a. What is a pathogen? 1 mark

_____

_____

b. The first line of defence involves physical and chemical barriers to the entry of pathogens.

i. Describe how one physical barrier in animals acts to keep pathogens from entering the tissues. 1 mark

_____

ii. Describe how one chemical barrier in plants might help to destroy microscopic pathogens. 1 mark

_____

c. In animals the innate immune response involves leucocytes that detect "self" from "non-self". Explain how they do this. 1 mark

_____

_____

_____

d. The disease tetanus in humans is usually caused by a bacterium *Clostridium tetani* entering a break in the skin, reproducing and secreting tetanus toxin. The toxin causes skeletal muscles to contract continually. The tetanus toxin has been found to work in the synapse between nerve and muscle cells. It prevents the signalling molecule from being released from the post-synaptic muscle receptors and so the muscles stay contracted.

i. Name the group of signalling molecules involved. 1 mark

_____

ii. Name and describe the process by which they are released from the pre-synaptic nerve cells. 2 marks

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iii. How do the signalling molecules named in (i) reach the post-synaptic muscle cell receptors? 1 mark

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iv. After the detection of the toxin as foreign there is an immune response resulting in the release of specific antibodies to the tetanus toxin. Draw a labelled diagram of an antibody. 2 marks

e. Use a written response and/or a flowchart to describe the steps involved in the activation and action of the humoral immune response, following the second line of defence (innate) action against a bacterial infection. Include the following terms in your answer: 4 marks

macrophages, antibodies, T helper cells, memory B cells, cytokines, plasma B cells, B lymphocytes

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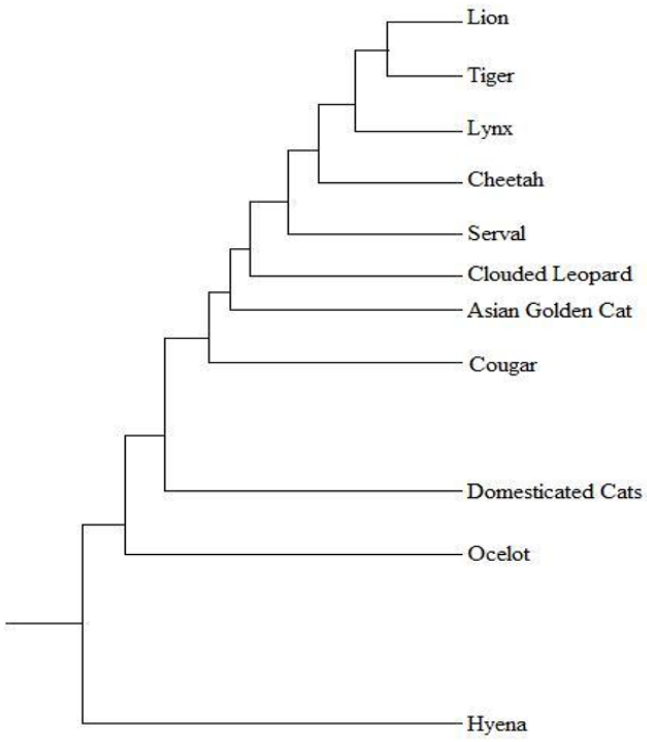
QUESTION 6 (5 marks)
Doctors working in remote villages in Africa regularly prescribed the use of antibiotic K to treat bacterial eye infections. Initially the drug was very effective reducing the number of infections recorded, however within two years, the same drug had almost no effect and the incidence of the eye infections increased.

a. Why was an antibiotic being used to treat these eye infection? 1 mark

b. Name and explain the process that resulted in the resistance to antibiotic K by the bacteria over the two years. 4 marks

QUESTION 7 (6 marks)
From a variety of research evidence, the following phylogenetic tree has been developed for the evolution of the feline (cat) family



a. What term would be used to describe the evolution of these feline (cat) groups? 1 mark

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b. DNA hybridisation has been used to compare the DNA from each of the species of cats and determine the degree of similarity between them. Explain briefly how this technique is carried out. 2 marks

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c. What other evidence would support the answer in **a.**? 1 mark

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d. Explain which two out of the tiger, cougar and cheetah are more closely related. 2 marks

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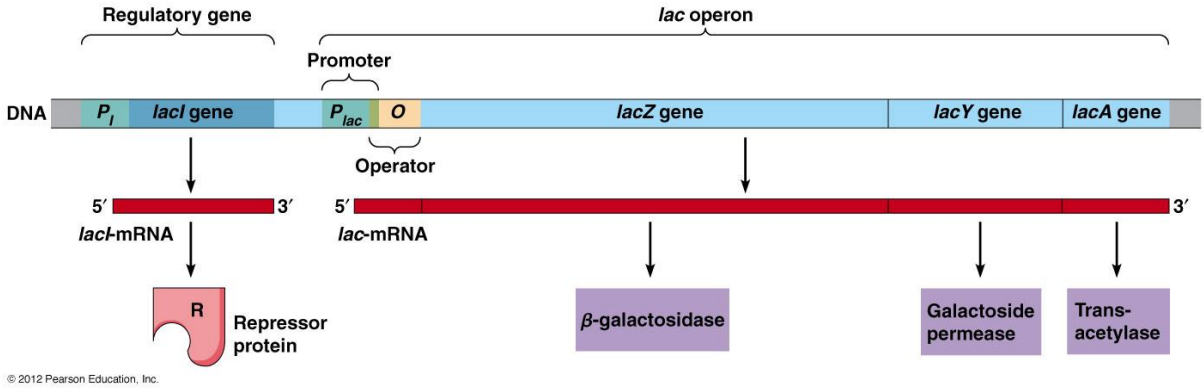
QUESTION 8 (5 marks)
The diagram below shows gene regulation in the *lac* operon.



a. State one benefit of gene regulation to the cells of an organism. 1 mark

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b. Explain the function of the repressor protein in gene regulation in the *lac* operon. 2 marks

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c. Another example of gene regulation and expression is the role of the master gene BMP4 in jaw development in cichlid fish. Explain how the master gene BPM4 controls the jaw development that results in different shapes and sizes of the jaws in the different species of cichlid fish. 2 marks

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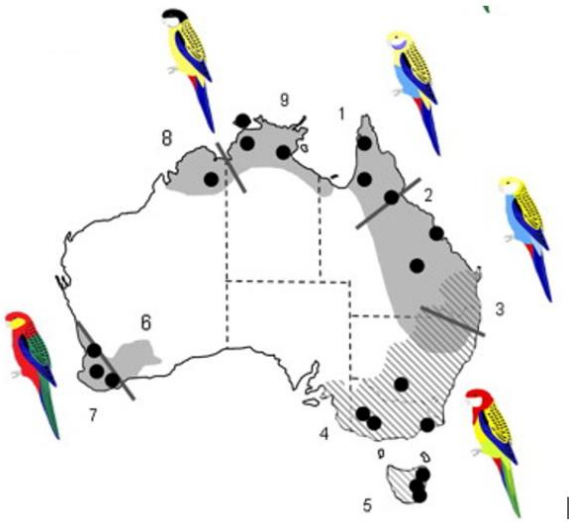
QUESTION 9 (8 marks)
A large variety of parrots are native to Australia and can be found in a range of habitats. The image below shows the distribution of one group of parrots.



Scientists investigating these parrot species have determined that the parrots are all closely related but those in southern western Australia (Group 6 & 7) belong to a different species but all the other parrot populations are variations within the same species.

a. How would the scientists determine if the parrots belonged to the same species? 1 mark

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b. Explain how the parrots in southern western Australia (Group 6 & 7) have become a separate species to the other species in Australia. 3 marks

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c. Although the parrots of northern Australia (group 8) are a long geographical distance from those in southern Victoria (group 4), it is believed that gene flow still exists between the two groups. 1 mark

What is meant by gene flow?

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d. Scientists believe that the population in Tasmania (group 5) may undergo genetic drift. Explain the process of genetic drift. 2 marks

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e. Why would genetic drift be of concern in a species? 1 mark

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QUESTION 10 (5 marks)
In the late 1970s, anthropologists discovered a fossil of a skull in the Apidima caves in southern Greece. From recent computer modelling and reconstruction, it was determined that the skull was a specimen of *Homo sapiens*. Dating of fossilised bone fragments, the skull was aged at 210,000 years old.

a. Explain one feature of the skull that would enable the scientists to determine it was a specimen of *Homo sapiens* and not from another *Homo* species. 1 mark

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Since the publication of these results, there have been questions from other scientists about the validity and accuracy of the data presented regarding the age of the skull. Radioactive isotopic dating was used to determine its age but the scientists did not use the carbon-14 isotope.

b. Why didn't they use carbon-14 to get the accurate age of the fossil? 2 marks

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c. If the suggested age of the fossil is accepted by the scientific community as being 210,000 years old, would this alter the current ideas of the evolution and distribution of *Homo sapiens* globally? Explain. 2 marks

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END OF QUESTION AND ANSWER BOOK