Name: _____

Teacher's name: _____

Victorian Certificate of Education 2019

STUDENT NUMBER | | | | | | | | | Letter | |

BIOLOGY

Written examination

2019

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

QUESTION AND ANSWER BOOK

Structure of book

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*
A	40	40	40
B	11	11	80
			Total 120

- 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 correction fluid/tape.
- No calculator is allowed in this examination.

Materials supplied
- Question and answer booklet.
- Answer sheet for multiple-choice questions.

Instructions
- Write your **student number** in the space provided above on this page.
- Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.
- 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.

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 score 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

Which of the following correctly describes a difference between DNA and RNA?

A. DNA is a single-stranded molecule containing the nucleotide Thymine, whereas RNA is a double-stranded molecule containing the nucleotide Uracil
B. DNA is a double-stranded molecule containing the nucleotide Thymine, whereas RNA is a single-stranded molecule containing the nucleotide Uracil
C. RNA nucleotides are only found free floating in the nucleus, whereas DNA nucleotides are found in both the nucleus and the cytoplasm
D. nucleotides in both DNA and RNA are joined via condensation polymerisation reactions

Question 2

Facilitated diffusion

A. requires the presence of a peripheral membrane protein.
B. moves molecules against a concentration gradient.
C. requires an expenditure of energy by the cell.
D. requires the presence of a transmembrane protein.

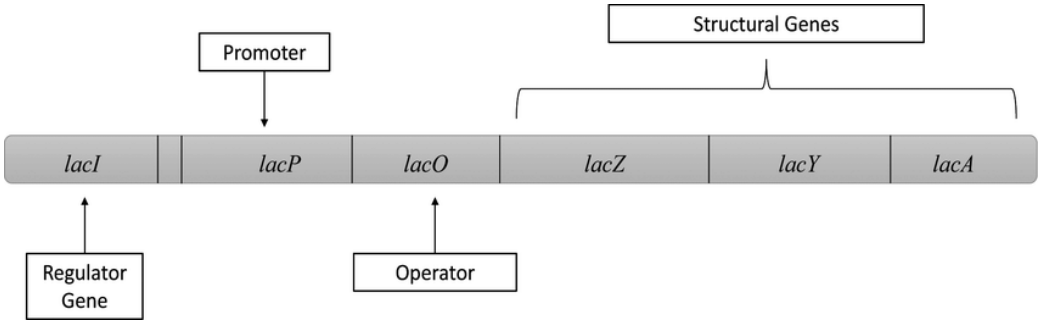
Question 3

The protein chymotrypsin is derived from a parent molecule, chymotrypsinogen. The cell organelle that is most directly involved in the production of chymotrypsin is

A. mitochondria.
B. smooth endoplasmic reticulum.
C. ribosomes.
D. chloroplasts.

Use the following information to answer Questions 4 - 6.

The diagram below is of the lac operon a group of genes found on the chromosome of the bacteria Escherichia coli.



Question 4

Activation of the lac operon requires

A. repressor activation due to the action of RNA polymerase.
B. RNA polymerase being activated by the presence of a repressor.
C. presence of lactase that removes a repressor from the promotor.
D. presence of lactose that removes a repressor from the operator.

Question 5

In a lactose rich environment, which of the following must occur to allow the transcription of the structural genes lacZ, lacY and lacA?

A. RNA polymerase must bind to the promotor region of the gene and the repressor protein must be removed from the operator region
B. RNA polymerase must bind to the operator region of the gene and the repressor protein must be removed from the promotor region
C. DNA polymerase must bind to the promotor region of the gene and the repressor protein must be removed from the operator region
D. lacl must first synthesise RNA polymerase and the lactose in the cell must digest the repressor protein

Question 6

lacl is a regulatory gene. Which of the following best contrasts a regulatory gene and a structural gene?

A. regulatory genes are transcribed into mRNA, whereas structural genes are not
B. regulatory genes carry out processes involved with cellular regulations such as enzyme reactions, whereas structural genes code for cellular structures such as microtubules
C. regulatory genes control the expression of other genes, whereas structural genes code for proteins which form part of the structure or function of an organism
D. structural genes code for proteins that have only quaternary structures, whereas regulatory genes can code for proteins with both tertiary and quaternary structures

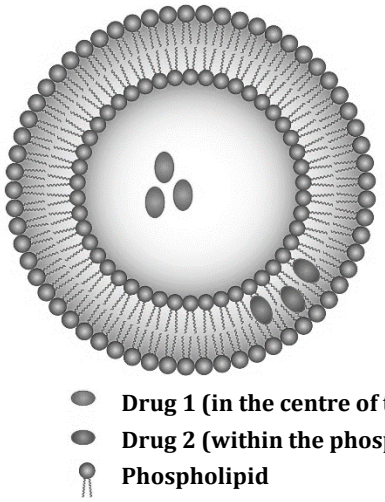
Question 7

Proteins can have different levels of hierarchal organisation. Which of the following is incorrect?

A. peptide bonds are formed between two amino acids in the primary structure of the protein
B. di-sulphide bridges form between two or more peptide chains in the quaternary structure of a protein
C. hydrophobic interactions are used to form alpha-helices in the secondary level of protein structure
D. hydrogen bonds are used to produce beta pleated sheets in the secondary level of protein structure

Use the following information to answer Questions 8 and 9.

Shown below is a 'liposome'. They are found in the cytoplasm and naturally form a phospholipid bilayer. Liposomes can be used to carry a wide variety of substances into the cell such as pharmaceutical drugs.



Source: https://www.valimenta.com/what-is-a-liposome/

Question 8

Based on the information provided in the diagram above and your knowledge of the plasma membrane, which of the following assumptions can be made regarding the structure of the liposome?

A. the interior of the liposome has an aqueous solution as illustrated by the direction of the phosphate heads
B. the hydrophilic phosphate tails face away from the external or internal environments
C. the hydrophobic phosphate heads are repelled by their lipid tails
D. both drugs 1 and 2 are polar in nature

Question 9

What is an advantage of using a liposome as a method of drug delivery?

A. liposomes contain a supply of energy ensuring they only activate their specific target cell
B. it allows a drug easy passage through the cell's phospholipid bilayer
C. both lipophilic and lipophobic drugs can be encapsulated inside the aqueous component of the liposome
D. the liposomes enhance the effect the drug has on the body

Use the following information to answer Questions 10 - 13.

Daniel, Hannah, Kahli and Steve are all carrying out an experiment which investigates the effect that temperature (°C) has on cellular respiration in yeast cells in order to determine the optimal temperature. They measured the rate of gas production (ml/min) under five experimental conditions: 15°C; 30°C; 45°C; 60°C and 75°C.

Their results are presented in the table below.

Student	**Rate of gas production (ml/min)**				
	15°C	30°C	45°C	60°C	75°C
Daniel	1.4	3.6	7.4	5.1	0.9
Hannah	1.2	3.7	7	4.8	1.1
Steve	1.1	3.5	6.9	4.5	0.9
Kahli	1.9	3.9	7.1	4.9	1.2
Average	**1.4**	**3.7**	**7.1**	**4.8**	**1.0**

Question 10

Through each student completing their own experiment and combining their results to form an average, they are most likely to be

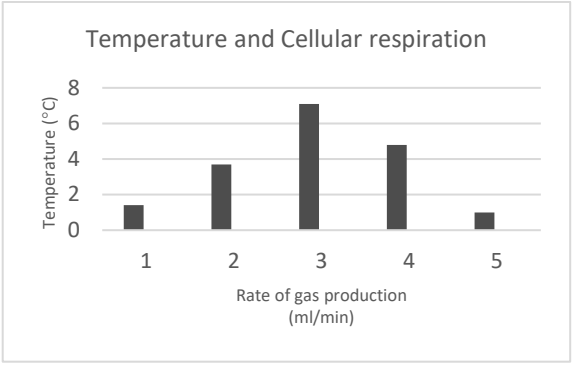
A. increasing the reproducibility of their results.
B. increasing the likelihood of their results being biased.
C. increasing the reliability of their results.
D. increasing the efficiency of their results.

Question 11

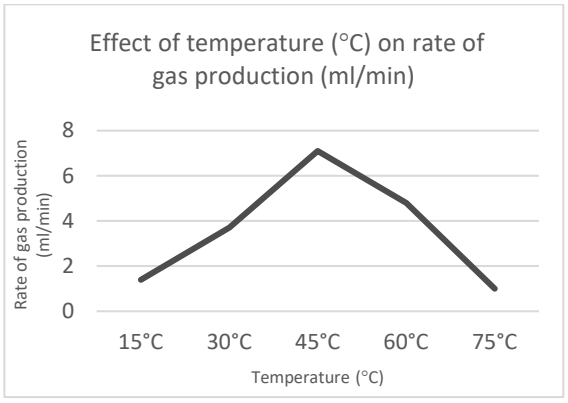
Steve told the other students that the results were 'valid'. Why is Steve likely to be correct?

A. the students tested all possible temperatures
B. the results of the individual student trials are not closely related in value for each experiment
C. all students used a different method to record the results in each trial
D. the temperature had a clear effect on the rate of gas production

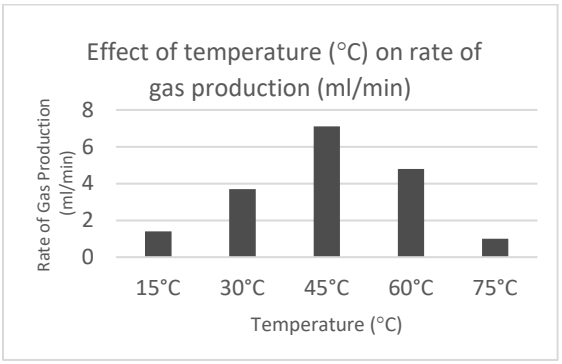
Below are the graphed results created by each student.



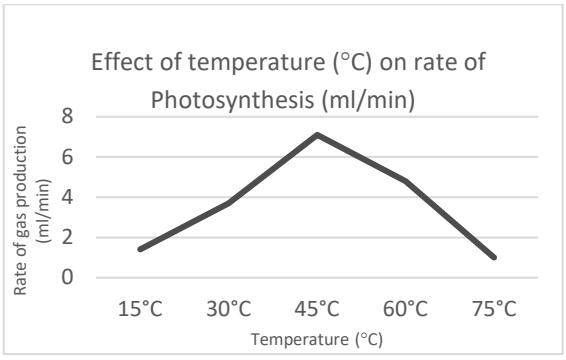
Steve



Hannah



Daniel



Kahli

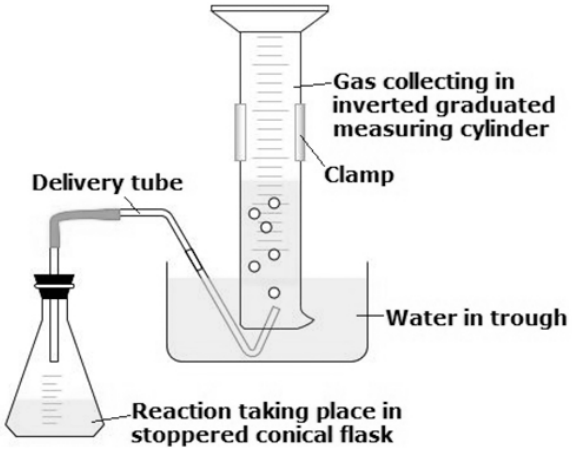
Question 12

Which student's graph best represents the data set for this experiment?

A. Steve
B. Hannah
C. Daniel
D. Kahli

The four students used the method listed below:

1. Obtain one set of 'gas collection apparatus' (see the image below).
2. Obtain 25ml of 10% yeast solution in a large test tube and 25ml of 10% glucose solution in a separate large test tube.
3. Incubate both test tubes separately at the desired temperature for 10 minutes.
4. Also place the conical incubation flask from the 'gas collection apparatus' at the desired temperature.
5. Mix the yeast and the glucose solutions together into the conical incubation flask. Leave the flask open at the desired temperature for 10 minutes.
6. Set up the measuring cylinder by inverting it (full of tap water) as illustrated in the photograph.
7. Seal the conical incubation flask and record the volume of gas produced in the 100ml measuring cylinder over the next 15 minutes. Only start timing once the first bubble appears.
8. After the allocated time, record the volume of gas produced and calculate the rate (ml/min).



Source:https://www.ruzivodigitallearning.co.zw/demo/content/1244/2-17/HS/

Question 13

Steve, Hannah, Daniel and Kahli were all discussing controlled variables. Based on the method above, which student correctly identifies the necessary controls?

A. Steve: room temperature; 10% glucose solution; amount of water in water trough
B. Hannah: 10% glucose solution; amount of yeast; 15 minutes collection time
C. Daniel: 10% glucose solution; amount of yeast; length of delivery tube
D. Kahli: size of flask; size of measuring cylinder; 10% glucose solution

Question 14

Phosphofructokinase is an enzyme involved in glycolysis. In which part of the cell would you expect to find the highest concentration of phosphofructokinase?

A. Cristae
B. Mitochondrial matrix
C. Ribosome
D. Cytosol

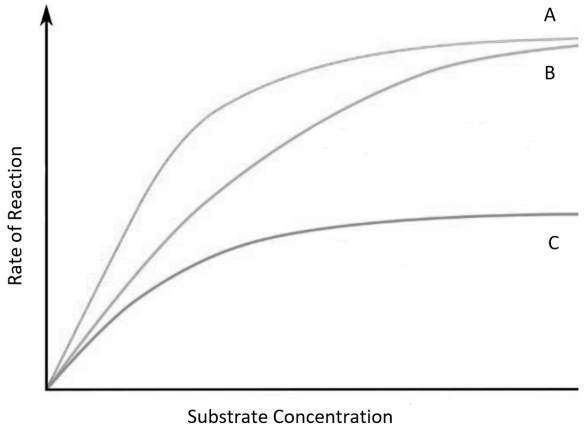
Question 15

The electron transport chain is a chemical process in cellular respiration. Which of the following is incorrect about the electron transport chain?

A. under ideal circumstances, the process generates 36/38 molecules of ATP
B. oxygen is the final electron acceptor of the process
C. the process requires NADH
D. the process occurs on the inner mitochondrial membrane

Question 16

Enzymes are involved in catalysing biochemical reactions. The following graph demonstrates the effect of different inhibitors on the rate of enzyme reaction.



Which of the following best describes the trends in the graph above?

A. Line A represents normal enzyme functioning; Line B represents competitive inhibition; Line C represents non-competitive inhibition
B. Line A represents normal enzyme functioning; Line B represents non-competitive inhibition; Line C represents competitive inhibition
C. Line A represents non-competitive inhibition; Line B normal enzyme function; Line C represents competitive inhibition
D. Line A represents competitive inhibition; Line B normal enzyme function; Line C represents non-competitive inhibition

Use the following information to answer Questions 17 and 18.

Creatine kinase (CK) or creatine phosphokinase (CPK) is an enzyme chiefly found in the brain, skeletal muscles, and heart. The active site of CK contains a cysteinyl residue that is essential for substrate binding. Substitution of this cysteine with a serine results in an extreme decrease in enzyme activity. Consequently, CK is susceptible to inactivation by molecules produced by oxidative reactions (reactions in which oxygen is gained or lost from the reaction).

An elevated level of creatine kinase is seen in heart attacks, when the heart muscle is damaged, or in conditions that produce damage to the skeletal muscles or brain. Recent studies have shown that individuals with long term alcohol abuse may also have elevated levels of CK in their blood stream.

Question 17

Using the information provided above and your knowledge of enzymes, why would alcoholism lead to increased levels of CK in the bloodstream?

A. the CK protein is denatured by residual alcohol
B. long-term alcohol abuse has a direct toxic action on enzymes responsible for muscular contraction signalling for the release of the CK protein
C. muscle cells undergo apoptosis in the presence of both alcohol and the CK protein
D. increased concentrations of the CK protein is a result of hydrophobic signal transduction

Question 18

Peroxynitrite is a molecule formed by an oxidation reaction. What would be a likely effect of Peroxynitrite on a CK reaction?

A. it would act as a non-competitive inhibitor
B. it would act as a competitive inhibitor
C. it would act as a reversible inhibitor
D. it would act as an irreversible inhibitor

Question 19

Which of the following organelles are believed to have a bacterial origin?

A. chloroplast and nucleus
B. chloroplast and endoplasmic reticulum
C. chloroplast and mitochondria
D. chloroplast and golgi body

Question 20

Which of the following is not an example of a physical method of defence in a plant?

A. waxy cuticle on leaves
B. thick bark
C. enzymes released by the plant in response to pathogen
D. formation of 'galls'

Use the following information to answer Questions 21 and 22.

Cyanide is a highly toxic chemical compound which can be found in many products such as ink, textiles and plastics. It is a relatively small molecule with little overall charge. In large concentrations, cyanide is toxic because it binds to cytochrome c oxidase which is a complex used in the electron transport chain.

Question 21

If an individual was exposed to a high concentration of cyanide, which of the following best explains the effect on the body?

A. the infected individual's plasma membranes would lose permeability to oxygen molecules
B. the inner membrane of the mitochondria in the infected individual would be broken down
C. the rate of glycolysis would decrease in the infected individual
D. aerobic respiration in the affected individual would be affected

Question 22

Based on the information provided, which of the following would best describe the passage of cyanide through the plasma membrane?

A. cyanide would bind to an extracellular receptor and activate a second messenger within the cell
B. cyanide would diffuse directly through the plasma membrane and bind to an intracellular receptor
C. cyanide would enter the cell though pinocytosis
D. the cell membrane is impermeable to cyanide

Use the following information to answer Questions 23 – 25

Apoptosis, also known as programmed cell death, results in the controlled destruction of cells within the body. It relies on the normal functioning of many genes, including the p53 tumour suppressor gene which produces the p53 protein. The p53 protein when correctly produced, suppresses the formation of cancerous tumours.

Question 23

Which of the following is not a step in apoptosis?

A. release of Bcl-2 from the mitochondria
B. destruction of the cell's genome
C. destruction of the cell's cytoskeleton
D. formation of apoptotic bodies

Question 24

Which of the following is not a reason for a cell to undergo apoptosis?

A. it has been damaged by trauma
B. it has encountered a bacterium
C. it has been damaged by radiation
D. it is infected by a virus

Question 25

Apoptosis plays a role in the prevention of cancer formation. Which of the following scenarios would most likely result in the formation of cancer?

A. DNA damage in the p53 gene causing overproduction of the p53 protein
B. necrosis occurring in place of apoptosis
C. tumour forming cells undergoing excessive apoptosis
D. Bcl-2 anti-apoptotic proteins being continually produced

Question 26

Which of the following best describes the role of an antigen presenting cell?

A. antigen presenting cells act as an intermediary from the adaptive to the innate immune system by displaying and presenting foreign antigens on their MHC-1 markers

B. antigen presenting cells undergo clonal expansion when presented with a foreign antigen

C. antigen presenting cells act as an intermediary between the innate and adaptive immune systems by displaying and presenting foreign antigens on their MHC-2 markers

D. antigen presenting cells act as an intermediary between the innate and adaptive immune systems by releasing cytokines to naive B-cells

Question 27

In a population, a trait is most likely to show continuous variation if

A. the trait is influenced by many genes.

B. the environment has little effect on the expression of the trait.

C. genes controlling the trait are closely linked.

D. there is a low mutation rate in the gene controlling the trait.

Question 28

Producing new alleles of genes in various species and generating new genetic variation is due to

A. the low number of genes that affect a trait.

B. low numbers of new generations.

C. loss of chromosomes during cell division.

D. genetic mutation.

Question 29

The closest living relative to homo sapiens is the *Pan troglodytes*, the chimpanzee. Approximately 1 percent of the DNA has changed in the 6 million years since the human and chimpanzee lineages diverged.

The measurement of the rate of accumulation of random genetic changes in the genomes of chimpanzees and humans is called

A. evolution.

B. molecular homology.

C. absolute dating.

D. stratigraphy.

Question 30

When distantly related species become more similar over time, this is known as

A. adaptive radiation.

B. parallel evolution.

C. divergent evolution.

D. convergent evolution.

Use the following information to answer Questions 31 and 32.

Below is an image of the Virginia opossum *'Didelphis virginiana'.* A large population of these opossums became isolated by the formation of a large body of water, separating the original population into two smaller populations. This separation became permanent.

Source: https://www.shutterstock.com/image-photo/virginia-opossum-didelphis-virginiana-on-white-596961299

Question 31

Based on the information above, which of the following events is least likely to occur?

A. speciation occurring within a few generations after isolation
B. the gestation periods of the new populations remaining the same as the original population
C. members of the new populations being exposed to different selection pressures
D. phenotypic variations beginning to occur between the two populations

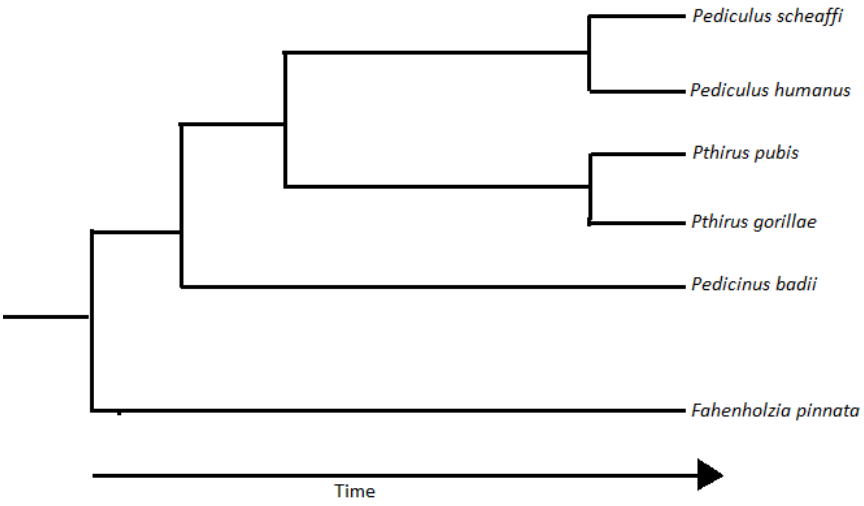
Question 32

A group of scientists noticed similarities between the two smaller populations of opossums. How could they tell if the opossums were still the same species?

A. analyse the diets of both populations
B. analyse the structural morphology of both populations
C. determine if members of each population can reproduce to produce viable offspring
D. determine the differences in the BMP4 gene of both populations

Question 33

The following phylogenetic tree illustrates relatedness for different species of lice. It has been constructed based on morphological and molecular data.



Source: https://www.researchgate.net/figure/Phylogenetic-tree-for-9-rodent-species-used-in-the-study_fig1_51718132

Based on the information in the tree, which of the following responses is most accurate?

A. the six species of lice would have evolved by parallel evolution
B. *Fahenholzia pinnata* isn't a species of lice
C. *Pediculus humanus* shares a more recent common ancestor with *Pthirus gorillae* than with *Pedicinus badii*
D. *Pediculus humanus* is more closely related to *Pedicunus badii* than it is to *Pediculus scheaffi*

Question 34

Which of the following is not an example of cultural evolution?

A. use of complex tools
B. cave painting depicting history
C. burial rights
D. structural similarities in pentadactyl bones

Question 35

Which of the following classifications is incorrect?

A. Orangutans are primates
B. Chimpanzees are mammals
C. Homo erectus is classed as a hominin
D. Australopithecines are from the genus *Homo*

Question 36

Hominoids share similarities with hominins. Which of the following is correct for both groups?

A. omnivorous, colour vision, opposable thumbs, live in large social groups and simple tool use
B. omnivorous, colour vision, opposable thumbs, live in large social groups and complex tool use
C. omnivorous, colour vision, opposable thumbs, solitary living and simple tool use
D. colour vision, opposable thumbs, flat nails, well developed sense of smell, live in large social groups and simple tool use

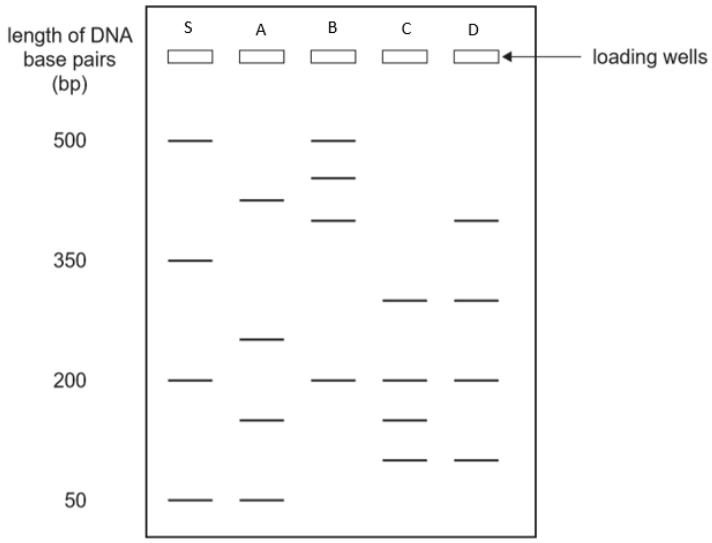
Question 37

Despite the vast phenotypic differences, domesticated dogs all belong to the same species, '*Canis lupus familiaris'*. Which biological phenomena is most likely responsible for such variety seen in domesticated dogs?

A. selective breeding
B. natural selection
C. cloning
D. convergent evolution

Use the following information to answer Questions 38 and 39.

The image below is of a DNA analysis technique. Four samples of DNA (A, B, C and D) were taken from four people and cut with a restriction enzyme, loaded into wells, then the lengths of each fragment were compared.



Question 38

The image above depicts which DNA analysis technique?

A. DNA hybridisation
B. gel electrophoresis
C. phylogenetics
D. cloning

Question 39

Which lane contains fragments with the respective lengths of 400pb, 300bp, 200bp and 100bp?

A. A
B. B
C. C
D. D

Question 40

Which of the following best describes the distinction between a genetically modified organism (GMO) and a transgenic organism?

A. all GMO are examples of transgenic organisms
B. a GMO has had one gene altered by genetic engineering techniques, whereas a transgenic organism has had two or more genes altered by genetic engineering techniques
C. a transgenic organism has been modified by the insertion of at least one gene not found in that species, whereas a GMO has had its existing genes altered
D. a transgenic organism has been altered by genetic engineering techniques under laboratory settings, whereas a GMO has been altered by environmental settings

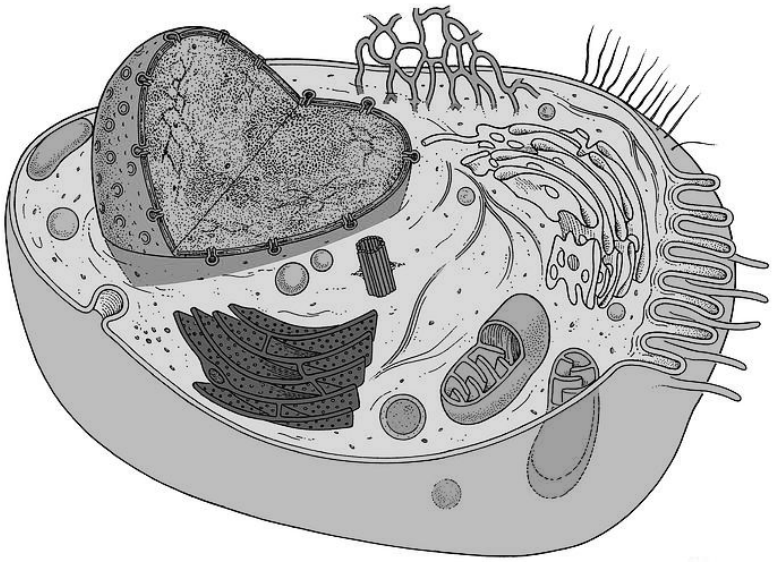
SECTION B – Short-answer questions

Instructions for Section B

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

Question 1 (4 marks)

Below is an image of an animal cell.



Source: https://fineartamerica.com/featured/animal-cell-diagram-science-source.html

a. Describe the role of the plasma membrane in the cell pictured above. 1 mark

b. Name two cell organelles visible in the image above and describe their role in endocytosis. 2 marks

c. Provide an example of material which could move into the cell via endocytosis. 1 mark

Question 2 (6 marks)

Carbon monoxide is an odourless gas which, in high concentrations, has extremely adverse effects on the human body. Carbon monoxide poisoning is caused by the inhalation of combustion fumes. Once in the body, carbon monoxide is a competitive inhibitor for oxygen and binds to haemoglobin molecules in the bloodstream. This limits the amount of oxygen available to respiring cells.

a. What is the purpose of cellular respiration? 1 mark

b. What is the total energy yield provided by aerobic respiration from one molecule of glucose? 1 mark

c. Describe the role of oxygen in cellular respiration and outline the impact carbon monoxide poisoning may have on this process. 2 marks

d. Using your knowledge of the process of aerobic respiration explain why carbon monoxide poisoning often results in death. 2 marks

Question 3 (6 marks)

a. List two pieces of evidence to support the theory of endosymbiosis in relation to chloroplasts. 2 marks

b. What are the two distinct stages of photosynthesis and where does each occur? 2 marks

c. Photosynthesis is a 'cyclic' process. What does this refer to? Give evidence to support your response. 2 marks

Question 4 (5 marks)

Helga was gardening when she accidently pricked her finger on a rose thorn. Quickly, she noticed the site of injury turning red and becoming swollen.

a. Name the innate immune response Helga is most likely to be experiencing and describe two events which occur during this response. 3 marks

b. The immune response of 'fever' can raise body temperature by up to two degrees Celsius. Explain two ways increasing body temperature can assist in the immune response named in 4a. 2 marks

Question 5 (7 marks)

Human immunodeficiency virus (HIV) is a virus that can be transmitted through the exchange of certain bodily fluids from an infected individual to a non-infected individual. Once infected, the virus targets specific aspects of the human immune system and, if left untreated, it can lead to the disease known as 'acquired immunodeficiency syndrome' (AIDS). According to the centre of disease control, in 2017, there were about 1.8 million new cases of HIV and approximately 36.9 million people living with the virus worldwide. 21.7 million of the infected individuals were receiving medicine to treat HIV called antiretroviral therapy (ART). An estimated 940,000 people died from AIDS-related illnesses in 2017.

Source: https://www.cdc.gov/hiv/statistics/overview/index.html

a. Describe the general structure of a virus. 2 marks

b. What is meant by the term 'immunodeficiency' disease? 1 mark

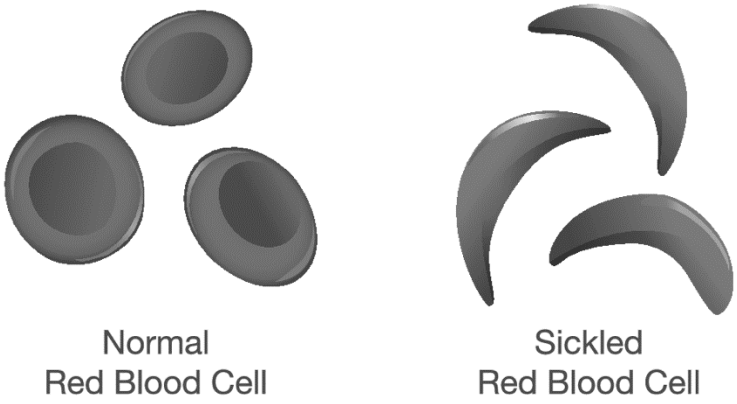
c. Is HIV considered to be an epidemic or a pandemic? Provide a reason to support your answer. 2 marks

d. HIV is said to attack one type of immune cell. What is the name given to this cell type? Give an example of its role in the body's defences. 2 marks

Question 6 (7 marks)

Sickle-cell anaemia is an inherited blood disorder which affects the shape of the haemoglobin molecule, therefore affecting red blood cells. In healthy red blood cells, the haemoglobin molecule is flexible, giving these cells the ability to readily squeeze through tiny capillaries and deliver oxygen to cells in need. In the case of individuals with sickle-cell anaemia, a mutation occurs in the gene which produces the haemoglobin-Beta chain. This mutation results in an overall conformational change of the haemoglobin molecule which subsequently becomes rigid and fixed, thus causing the red blood cells to lose the ability to easily fit through capillaries.

The image below shows a representation of the appearance of a sickle-cell in contrast to a 'normal' healthy red blood cell.



Source: https://www.shutterstock.com/image-vector/difference-normal-red-blood-cell-sickle-737705131

a. Complete the table by defining the term mutation and providing one advantage and one disadvantage of mutations in a population. 3 marks

Definition	Advantage	Disadvantage

b. Below is a section of DNA nucleotides pertaining to a healthy individual without sickle-cell anaemia. 1 mark

CTG ACT CCT GAG GAG AAG TCT

Write the anticodon piece for this section of DNA.

_____

c. Below is the sequence of DNA nucleotides found in an individual with sickle-cell anaemia. 1 mark

CTG ACT CCT GTG GAG AAG TCT

Compare this DNA sequence with the sequence from the previous question. What type of mutation has occurred?

d. Describe the difference between a block mutation and a chromosomal abnormality. 2 marks

Question 7 (8 marks)

'*Gymnobelideus leadbeateri*' whose common name is the Leadbeater's possum is a critically endangered mammalian species only found in parts of the Victorian central highlands. In the early 1900s, the possum was thought to be extinct, however, small populations of the species were discovered in the 1960s.

The populations grew until their numbers peaked at 7500 members in the 1980s. From its peak in the 1980s, the populations underwent a rapid decrease, losing approximately 90% of its members due to a population bottleneck. Since then, the possum has struggled to recover numbers. Events such as the 2006 Black Saturday fires destroyed almost 50% of the possum's remaining habitat. Today, it is estimated there is only 1000-1200 possums remaining.

a. Give an example of a scenario that can cause a population to bottleneck and the effect of this on the subsequent gene pool. 2 marks

b. Complete the table below by ordering the events from the most recent to the most distant. 3 marks

- Flowering plants first appear
- Evolution of the Leadbeater's possum
- First multicellular organisms
- Evolution of reptiles
- Mammalian line diverges from birds and reptiles
- Animals become terrestrial

Most Recent	*Event*
1	
2	
3	
4	
5	
6	
Most Distant	

c. Give three examples of conditions which are typically required for fossilisation of a species such as the Leadbeater's possum. 3 marks

Question 8 (7 marks)

Samples of over 500 bones, thought to be of Hominid origin, were discovered in a cave in northern Africa in 2015. An image of this discovery is included below. From the bones, scientists almost compiled a complete skeleton, however, they were unable to determine if the bones belonged to the genus '*Homo'*, the genus '*Australopithecus*', or the more distant genus '*Pan'*. They plan to further analyse these bones to determine what links, if any, they possess to modern-day humans.

Source: https://www.shutterstock.com/image-photo/archaeologists-excavated-skeleton-neanderthal-bones-skull-726083320

a. Provide two physical attributes of the skeleton in the case study which could be used to assist the scientist in determining that the genus of the bones was '*Homo*' as compared to the genus '*Australopithecus*'. 2 marks

b. Describe two major physical features that define humans as primates. 2 marks

c. A molecular clock is a unique concept which biologists can use to calculate nucleotide differences in conservative genes across multiple species. 1 mark

The scientists tested the bones they found against those of a modern-day human, a modern-day chimpanzee and a sample taken from a known 'Australopithecus'. The results are shown in the table below.

Modern-Day Human	Australopithecus	Chimpanzee
99.1	98.2	97.6

Based on the information in the table, which of the three species do the unknown bones share a more recent common ancestor?

d. A common trend seen in mammalian species is that with an increase in cranial capacity, the species also show an increased cultural evolution. 2 marks

Provide two examples of how cultural evolution is linked to increases in brain size.

Question 9 (7 marks)

In 1996, the FBI launched 'CODIS', a national DNA database that stores information relating to 13 specific gene loci. These loci have variable numbers of short tandem repeat sequences (STRs). An example of one of these is the CSF1PO locus which has between six and fifteen repeats of the AGAT tetranucleotide.

a. Prior to analysis, genetic samples are amplified using Polymerase Chain Reaction (PCR). 3 marks

Identify the three stages of PCR and briefly explain what occurs during each stage.

b. What is the specific temperature that is important in the third stage of PCR? Describe the importance of this temperature in PCR. 2 marks

c. In future, the FBI could potentially obtain DNA from every new born baby and store it for future use. 2 marks

Provide two ethical issues associated with obtaining, and the long-term storage of DNA.

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Question 10 (9 marks)

Understanding Parkinson's Disease

Parkinson's disease is a brain disorder that generally occurs in the elderly population. Cells in the brains of these patients start to die, resulting in movement symptoms including tremor and difficulty walking. Currently, it is unknown why these brain cells die, and there is no cure for this disease. In comparing the healthy brain to the Parkinson's disease brain, we can begin to understand the how this disease occurs.

In the healthy brain, cellular processes that are required for normal functioning produce toxic waste products. As high levels of these toxic products can damage cells, they are rapidly converted to non-toxic species by various enzymes called antioxidants. One such enzyme, Superoxide dismutase 1 (SOD1) is a key antioxidant protein in the human brain. SOD1 protein is coded for by the SOD1 gene, located on chromosome 21 of the human genome. SOD1 requires a specific protein structure which includes a large quantity of beta-pleated sheets in order to function. The molecule is manufactured and matures in the cytosol however, without the addition of two co-factors; copper and zinc, it is considered an unstable protein.

In the Parkinson's disease brain, SOD1 does not function normally, and this results in an increase in toxic chemicals. Brain cells in this region are then damaged by the build-up of these toxic chemicals and can eventually undergo apoptosis. In some cases, the dysfunction of SOD1 is due to genetic mutations, while in other cases, it is a result of alterations in protein structure and interaction with its co-factors. Understanding why this enzyme is not functioning in the brain of Parkinson's disease patients could help scientists develop a cure for this disease.

Source: http://sydney.edu.au/medicine/people/academics/profiles/sian.genoud.393.php

a. Describe the role of a coenzyme in an enzymatic reaction. 2 marks

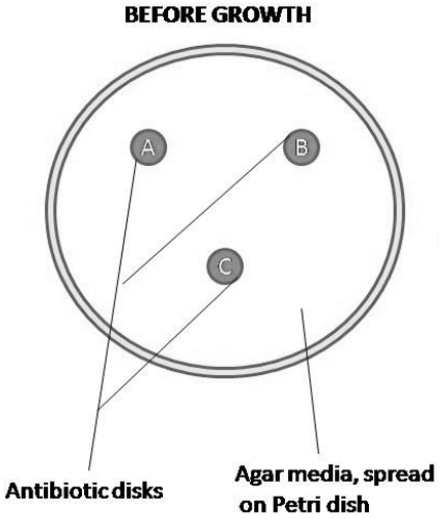
b. Describe two ways the specific structure of the SOD1 antioxidant protein can be achieved and how this structure plays a key role in its function. 3 marks

c. Using information from the article, complete the table below by describing two factors that could contribute to Parkinson's disease and how these factors may be responsible. Do not use the same example twice. 4 marks

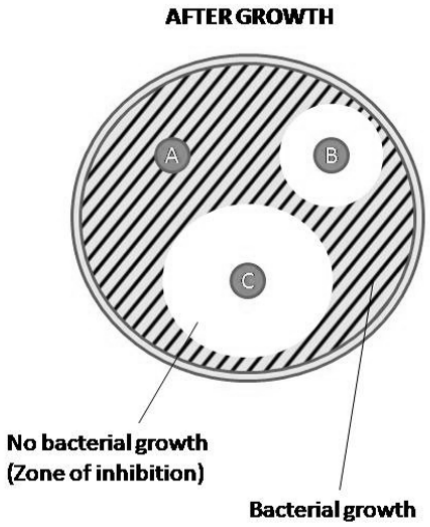
Disease causing factor	Biological explanation

Question 11 (14 marks)

Olivia and Evan are two students who conducted an experiment to determine the effect that different antibiotics have on bacterial growth. They used an agar solution which contained a strain of Escherichia coli (E. coli) bacteria and three types of antibiotics A, B and C. Each student used a single agar plate of identical size with the same agar media. They both placed three antibiotic disks, labelled A, B and C sporadically across the plate as shown below. Olivia also sealed an agar plate with no antibiotic disks present.



They incubated the three plates at 42°C for 24 hours and recorded their results by measuring the diameter of the 'zone of inhibition'. An example of one of their results is pictured below.



They recorded their results in a table:

Agar Plate	Zone of inhibition A	Zone of inhibition B	Zone of inhibition C
Olivia	0cm	1.1cm	2.8cm
Evan	0cm	0.9cm	2.9cm

The agar disk with no antibiotic disks showed complete bacterial growth.

a. Write a suitable hypothesis for this experiment. 1 mark

b. In relation to this experiment, identify the independent variable and the dependent variable. 2 marks

c. Identify three variables which Oliva and Evan controlled during their investigation. 3 marks

d. Provide two safety considerations in this experiment. 2 marks

e. Identify a variable which Olivia and Evan did not control. How could this affect the experimental results? 2 marks

f. Would you consider the results of Oliva and Evan's experiment to be valid? Explain your answer. 2 marks

g. Write a brief conclusion for the experiment. In your conclusion, include a limitation of this experiment. 2 marks

END OF QUESTION AND ANSWER BOOK

Extra space for responses

Clearly number all responses in this space.

VCE BIOLOGY
Written Examination
ANSWER SHEET – 2019

STUDENT NAME:

Use a **PENCIL** for **ALL** entries. For each question, shade the box which indicates your answer.

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

NO MARK will be given if more than one answer is completed for any question.

If you make a mistake, **ERASE** the incorrect answer – **DO NOT** cross it out.

1	A	B	C	D	18	A	B	C	D	35	A	B	C	D
2	A	B	C	D	19	A	B	C	D	36	A	B	C	D
3	A	B	C	D	20	A	B	C	D	37	A	B	C	D
4	A	B	C	D	21	A	B	C	D	38	A	B	C	D
5	A	B	C	D	22	A	B	C	D	39	A	B	C	D
6	A	B	C	D	23	A	B	C	D	40	A	B	C	D
7	A	B	C	D	24	A	B	C	D					
8	A	B	C	D	25	A	B	C	D					
9	A	B	C	D	26	A	B	C	D					
10	A	B	C	D	27	A	B	C	D					
11	A	B	C	D	28	A	B	C	D					
12	A	B	C	D	29	A	B	C	D					
13	A	B	C	D	30	A	B	C	D					
14	A	B	C	D	31	A	B	C	D					
15	A	B	C	D	32	A	B	C	D					
16	A	B	C	D	33	A	B	C	D					
17	A	B	C	D	34	A	B	C	D					