Units 3&4 Biology Practice Exam 2022 – Trial 2 – Assessment Guide

Section A

VCAA Key Knowledge	Question	Answer guide
Inputs, outputs and locations of the light dependent and light independent stages of photosynthesis in C_3 plants (details of biochemical pathway mechanisms are not required) *The factors that affect the rate of photosynthesis: light availability, water availability, temperature and carbon dioxide concentration*	**Question 1** Students set up a photosynthesis experiment by placing aquatic plants into sealed tubes, submerging them in water. They measured the rate of photosynthesis by counting the bubbles that were produced by the plant. Which of the following statements is correct? **A.** fewer bubbles would be produced by a plant that was placed in direct sunlight than a plant that was in a cool, dark room **B.** the bubbles that the students measured were made of oxygen gas **C.** the experiment needs to be repeated three times in order to be accurate **D.** the water is only used to suspend the plants; it is not an input of photosynthesis	***B*** *Oxygen gas is an output of photosynthesis.* *A is incorrect as you would expect a higher rate of photosynthesis when the plant is exposed to greater levels of sunlight and a higher temperature.* *C is incorrect as accuracy describes how close the experimental values are to the 'true' value.* *D is incorrect as water is an input for photosynthesis.*
The characteristics and roles of the components of the adaptive immune response against both extracellular and intracellular threats, including the actions of B lymphocytes and their antibodies, helper T and cytotoxic T cells	**Question 2** In the body, cells that are infected with a virus present the viral antigen on their MHC-II proteins. These antigens can then be identified by lymphocytes as part of the specific immune response. Which of the following lymphocytes would recognise a viral antigen that is displayed by body cells and what would be the next step in the immune response pathway? **A.** a naïve B cell; a helper T cell will release cytokines to activate the naïve B cell **B.** a naïve T cell; a helper T cell will release cytokines to activate cytotoxic T cells **C.** a naïve B cell; the naïve B cell will undergo clonal selection, producing memory B cells and plasma cells **D.** a naïve T cell; the naïve T cell will undergo clonal selection, producing memory T cells and cytotoxic T cells	***B*** *Before cells can undergo clonal selection, they need activation by a helper T cell; hence, D is incorrect. The viral antigen is displayed on the MHC-II protein, which would be recognised by a naïve T cell and triggers the cell-mediated response; thus, A and C are incorrect.*

The general factors that impact on enzyme function in relation to photosynthesis and cellular respiration: changes in temperature, pH, concentration, competitive and non-competitive enzyme inhibitors

Question 3

A non-competitive enzyme inhibitor will

A. bind to the active site.
B. attach to the substrate.
C. change the shape of the active site.
D. not work below 37°C.

C *Non-competitive inhibitors bind outside the enzyme's active site and change the shape of the active site so that substrate cannot bind to it.*

The shared characteristics that define mammals, primates, hominoids and hominins

Question 4

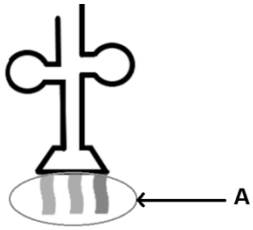
The key distinguishing feature between hominins and primates is

A. a large cranium relative to body weight.
B. opposable thumbs.
C. binocular eyes.
D. bipedalism.

D *Bipedalism is the defining distinguishing characteristic between the two taxa.*
Opposable thumbs, a large cranium and binocular eyes are shared characteristics between hominins and primates.

Use the following information to answer Questions 5 and 6.

Below is a diagram of a nucleic acid involved in gene expression.



Nucleic acids as information molecules that encode instructions for the synthesis of proteins: the structure of DNA, the three main forms of RNA (mRNA, rRNA and tRNA) and a comparison of their respective nucleotides

Question 5

Which option describes the role of this nucleic acid?

A. it encodes genetic information and carries it out of the nucleus
B. it moves genetic information into the nucleus
C. it brings amino acids to ribosomes
D. it is a component in ribosome structure

C *The molecule is tRNA. It brings amino acids to ribosomes and has a distinctive structure, with areas of complementary base pairing and 'bubbles' of single stranded unpaired bases.*

Nucleic acids as information molecules that encode instructions for the synthesis of proteins: the structure of DNA, the three main forms of RNA (mRNA, rRNA and tRNA) and a comparison of their respective nucleotides

Question 6

In the diagram, what is indicated by 'A?'

A. codon
B. anticodon
C. mRNA
D. deoxyribose nucleotide

B *The 'A' in the image indicates the set of three nucleotides at the bottom of the tRNA molecule. This is an anticodon that forms complementary base pairs with the corresponding codon of mRNA.*

Evidence for major trends in hominin evolution from the genus Australopithecus to the genus Homo: changes in brain size and limb structure

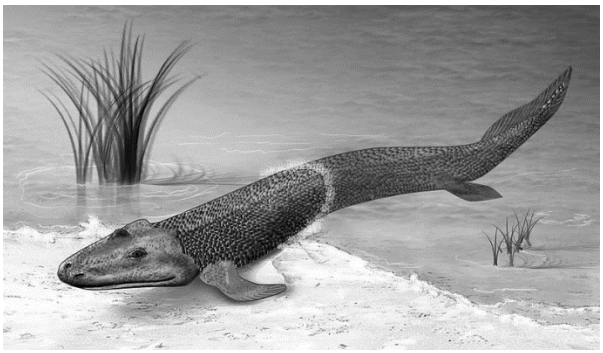
Question 7

Homo sapiens' larger brain size

A. is caused by the cerebrum becoming more folded.
B. has led to lesser social interaction and caregiving.
C. has reduced the energy needs of the human body.
D. is caused by an increase in the size of the sagittal crest.

A *The cerebrum became more folded, allowing greater brain sizes. A larger brain sized has increased alongside social capacity and has greater energy requirements. The sagittal crest has decreased as brain size has grown in* Homo sapiens.

Use the following information to answer Questions 8 – 10.



https://commons.wikimedia.org/wiki/File:Tiktaalik_roseae_life_restor.jpg

A fossil, known as the Tiktaalik fossil, was discovered in 2004. It had gills and fins, but it also had weight-bearing limbs. It is thought to be an evolutionary link between water- and land-dwelling species.

Changes in species over geological time as evidenced from the fossil record: faunal (fossil) succession, index and transitional fossils, relative and absolute dating of fossils

Question 8

Which of the following evolutionary timelines is in the correct chronological order?

A. prokaryotes, eukaryotes, multicellular organisms, water-dwelling animals, the Tiktaalik species, land-dwelling animals, mammals, flowering plants
B. prokaryotes, multicellular organisms, eukaryotes, water-dwelling animals, the Tiktaalik species, land-dwelling animals, mammals, flowering plants
C. prokaryotes, multicellular organisms, eukaryotes, mammals, water-dwelling animals, the Tiktaalik species, land-dwelling animals, flowering plants
D. prokaryotes, eukaryotes, multicellular organisms, water-dwelling animals, the Tiktaalik species, land-dwelling animals, flowering plants, mammals

A *The Tiktaalik species was placed between water- and land-dwelling animals in all options; only option A had the correct order of the other organisms in the timeline of Earth's evolutionary history.*

Changes in species over geological time as evidenced from the fossil record: faunal (fossil) succession, index and transitional fossils, relative and absolute dating of fossils

Question 9

Which fossils provide an evolutionary link between previously identified species and known species?

A. trace fossils
B. index fossils
C. linking fossils
D. transitional fossils

D *Transitional fossils have traits of both the ancestor and derived (recent) species; they often fill evolutionary 'gaps' that show relationships between species.*

Changes in species over geological time as evidenced from the fossil record: faunal (fossil) succession, index and transitional fossils, relative and absolute dating of fossils	**Question 10** Which of the following options is not a requirement for fossilisation? A. rapid coverage by sediment B. cool climate C. low light D. high oxygen availability	*D*	*Fossilisation requires low oxygen conditions.*

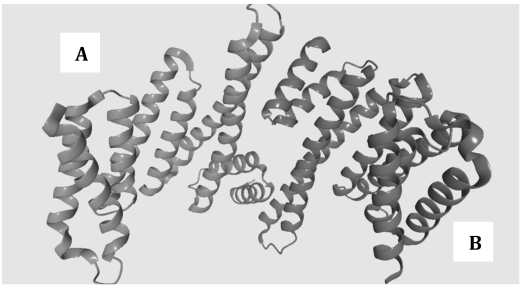
The innate immune response including the steps in an inflammatory response and the characteristics and roles of macrophages, neutrophils, dendritic cells, eosinophils, natural killer cells, mast cells, complement proteins and interferons	**Question 11** Which of the following statements about the inflammatory response is correct? A. the steps in the inflammatory response are inflammation, vasodilation and migration B. in the migration step, complement proteins and phagocytes work to destroy pathogens C. vasodilation causes blood vessels to shrink and blood to build up, leading to swelling and redness at the affected site D. mast cells signal natural killer (NK) cells	*B*	*Complement proteins and phagocytes can enter the site from the bloodstream and combat any pathogens that are present.* *A is incorrect because the first step in the response is initiation.* *C is incorrect because blood vessels widen during vasodilation.* *D is incorrect because mast cells release histamine, not signal natural killer cells.*

The general factors that impact on enzyme function in relation to photosynthesis and cellular respiration: changes in temperature, pH, concentration, competitive and non-competitive enzyme inhibitors	**Question 12** When a fixed number of enzymes have an unending supply of substrate, their activity will A. decrease because too much substrate availability will overwhelm the system. B. continue to rise as long as there is an unending supply of substrate. C. remain unchanged as only environmental factors, like temperature, can change the rate of enzyme activity. D. rise until it reaches a plateau when no further enzymes are available.	*D*	*Enzyme activity will increase with increasing concentrations of substrate until all of the enzymes are occupied, at which point their activity will plateau.*

Scientific and social strategies employed to identify and control the spread of pathogens, including identification of the pathogen and host, modes of transmission and measures to control transmission	**Question 13** Which of the following is not a method of disease transmission? A. airborne transmission B. antibody transmission C. vector transmission D. faecal-oral transmission	*B*	*All options apart from B are methods of disease transmission.*

Use the following information to answer Questions 14 and 15.

Insulin, as indicated in the diagram below, is a protein that is composed of two polypeptide chains (chains A and B) linked by disulphide bonds.



Adapted From: https://upload.wikimedia.org/wikipedia/commons/0/0c/2bq0_14-3-3.png

Amino acids as the monomers of a polypeptide chain and the resultant hierarchical levels of structure that give rise to a functional protein

Question 14

What is the hierarchical level of the protein structure seen in chain A?

A. primary
B. secondary
C. tertiary
D. quaternary

C *Chain A is a 3D folded polypeptide – having a tertiary structure – that is comprised of some secondary structures. It associates with another polypeptide to form the overall quaternary structure of insulin.*

Proteins as a diverse group of molecules that collectively make an organism's proteome, including enzymes as catalysts in biochemical pathways

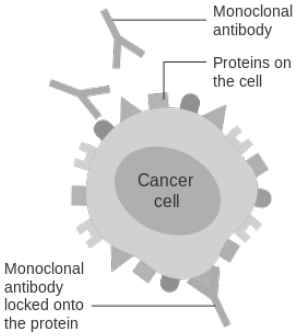
Question 15

What type of protein is insulin?

A. a biochemical enzyme
B. a peptide hormone
C. a regulatory protein
D. a structural protein

B *Insulin is a peptide hormone.*

Use the following information to answer Questions 16 – 18.



Source: https://commons.wikimedia.org/wiki/File:Diagram_showing_a_monoclonal_antibody_attached_to_a_cancer_cell_CRUK_070.svg (Cancer Research UK)

Monoclonal antibodies, as seen in the diagram, can be used to treat cancer as well as other autoimmune diseases though a variety of approaches.

Initiation of an immune response, including antigen presentation, the distinction between self-antigens and non-self antigens, cellular and non-cellular pathogens and allergens

Question 16

The proteins on the cancerous cell to which monoclonal antibodies attach are known as

A. MHC-I proteins.
B. MHC-II proteins.
C. pathogens.
D. non-self antigens.

A *Tumour cells, like other body cells, express MHC-I on their surface which MHC-1 proteins attach to.*

The development of immunotherapy strategies, including the use of monoclonal antibodies for the treatment of autoimmune diseases and cancer

Question 17

Which of the following options is not an approach that monoclonal antibodies use to combat cancer?

A. binding to cancerous cells and marking them as foreign so that they are targeted by natural killer (NK) cells
B. binding to cancerous cells and interacting with complement proteins to form membrane attack complexes
C. binding to cancerous cells and interacting with helper T cells to induce the external apoptosis pathway
D. carrying radioactive isotopes or drugs to cancerous cells by conjugated monoclonal antibodies

C *Monoclonal antibodies do not interact with helper T cells and helper T cells cannot induce apoptosis.*

The difference between natural and artificial immunity and active and passive strategies for acquiring immunity

Question 18

A patient receiving treatment with monoclonal antibodies receives what type of immunity?

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

B *Antibodies are considered passive immunity as the antibodies are not produced by the patient's own body. Giving them as a treatment rather than having them pass from mother to child makes this artificial passive immunity.*

Use the following information to answer Questions 19 – 21.

Barnacles are attached to rocks and cannot travel to avoid natural disasters or to mate with other barnacle populations.

A heatwave in a small coastal town led to the dark barnacles along the shoreline dying off. The lighter-grey barnacles were more likely to survive and now, the population is mostly comprised of light-grey barnacles.

Causes of changing allele frequencies in a population's gene pool, including environmental selection pressures, genetic drift and gene flow; and mutations as the source of new alleles

Question 19

What occurred in this population?

A. natural selection
B. gene flow
C. bottleneck effect
D. viral drift

C *This is an example of the bottleneck effect (when a natural disaster kills off a large portion of the population and changes the allele frequencies in that population).*

Causes of changing allele frequencies in a population's gene pool, including environmental selection pressures, genetic drift and gene flow; and mutations as the source of new alleles

Question 20

What is unable to occur in the barnacle population due to its fixed position?

A. gene flow
B. natural selection
C. genetic drift
D. speciation

A *Gene flow (the movement of alleles between populations) cannot occur for the stationary barnacles. They can still undergo natural selection, genetic drift and speciation as a single population.*

Biological consequences of changing allele frequencies in terms of increased and decreased genetic diversity

Question 21

How would the mass deaths of the dark barnacles and the barnacles' fixed positions likely affect the genetic diversity of the barnacle population?

A. it would increase the frequency and number of unique alleles, leading to greater genetic diversity
B. it would reduce the frequency and number of unique alleles, leading to greater genetic diversity
C. it would increase the frequency and number of unique alleles, leading to lower genetic diversity
D. it would reduce the frequency and number of unique alleles, leading to lower genetic diversity

D *Bottleneck events and a lack of gene flow both reduce allele frequencies, leading to lower genetic diversity.*

The use of recombinant plasmids as vectors to transform bacterial cells as demonstrated by the production of human insulin

Question 22

What is the function of having an antibiotic resistance gene in a plasmid for bacterial transformations?

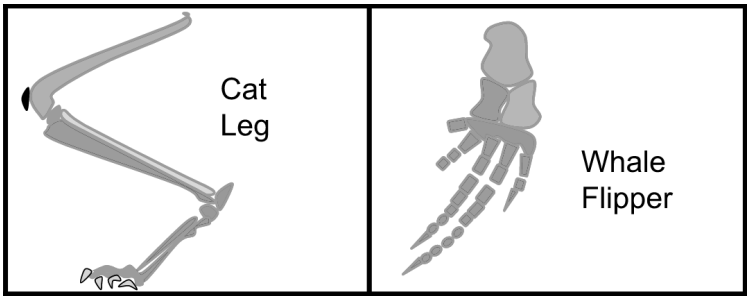
A. to activate the GFP gene in plasmids
B. to select for bacteria that have taken up the plasmid
C. to ensure that the gene of interest has been inserted into the plasmid
D. to kill off any recombinant plasmids

B *The antibiotic resistance gene is already present in the plasmid and will provide antibiotic resistance to the bacteria that take up the plasmid, whether or not the gene of interest is inserted. This allows scientists to grow and select only bacteria with the plasmid when plated on an antibiotic medium.*

Evidence of relatedness between species: structural morphology – homologous and vestigial structures; and molecular homology – DNA and amino acid sequences

Question 23

Cat limbs and whale fins both developed from the same structures in shared ancestors, as indicated in the diagram below.



Adapted From: https://upload.wikimedia.org/wikipedia/commons/0/08/_Structures.svg

What is this an example of?

A. vestigial structures
B. homologous structures
C. analogous structures
D. trace structures

B *Homologous structures are derived from a common ancestor and are still found in current species.*

The human fossil record as an example of a classification scheme that is open to differing interpretations that are contested, refined or replaced when challenged by new evidence, including evidence for interbreeding between Homo sapiens and Homo neanderthalensis and evidence of new putative Homo species

Question 24

Present day Europeans and Asians have around 1-3% neanderthal DNA. This suggests that

A. modern *Homo sapiens* are descended from neanderthals.
B. neanderthals and *Homo sapiens* experienced genetic drift between populations.
C. neanderthals and some humans lived at the same physical location at the same time.
D. neanderthals do not have mtDNA.

C *Neanderthals and humans are thought to have interbred due to the 1-3% neanderthal DNA in certain modern humans. They would have had to have lived at the same location at the same time to interbreed.*

Consequences of bacterial resistance and viral antigenic drift and shift in terms of ongoing challenges for treatment strategies and vaccination against pathogens

Question 25

Antibiotic-resistant bacteria pose a significant public health issue. Which of the following does not contribute to this issue?

A. natural selection acting on bacteria
B. overprescribing or inappropriately prescribing antibiotics
C. antigenic drift changing surface antigens
D. a patient stopping a course of antibiotics as soon as symptoms clear

C *Antigenic drift refers to changes in viruses, not bacteria. Natural selection, overprescribing and stopping a course of antibiotics prematurely, rather than finishing it completely, contribute to antibiotic resistance.*

The innate immune response including the steps in an inflammatory response and the characteristics and roles of macrophages, neutrophils, dendritic cells, eosinophils, natural killer cells, mast cells, complement proteins and interferons

Question 26

What is not a role of complement proteins?

A. attracting phagocytes to pathogens
B. releasing interferons to neighbouring cells
C. forming membrane attack complexes (MACs)
D. sticking to the outside of pathogens to aid recognition

B *Body cells release interferons to neighbouring cells, not complement proteins.*

Inputs, outputs and locations of the light dependent and light independent stages of photosynthesis in C_3 plants (details of biochemical pathway mechanisms are not required)

Question 27

The light-independent reaction of photosynthesis

A. always occurs in mesophyll cells.
B. can only occur at low temperatures.
C. is also known as the Calvin cycle.
D. uses sunlight to split H_2O.

C *The light-independent reaction is also often known as the Calvin cycle. It does not only occur in mesophyll cells, and it can occur at a wider range than 'low' temperatures. The light-dependant reaction uses sunlight to split H_2O.*

Use the following information to answer Questions 28 and 29.

Second Base									
First Base	U		C		A		G		**Third Base**
U	UUU	phe	UCU	ser	UAU	tyr	UGU	cys	U
	UUC		UCC		UAC		UGC		C
	UUA	leu	UCA		UAA	STOP CODON	UGA	STOP CODON	A
	UUG		UCG		UAG		UGG	trp	G
C	CUU	leu	CCU	pro	CAU	his	CGU	arg	U
	CUC		CCC		CAC		CGC		C
	CUA		CCA		CAA	gln	CGA		A
	CUG		CCG		CAG		CGG		G
A	AUU	ile	ACU	thr	AAU	asn	AGU	ser	U
	AUC		ACC		AAC		AGC		C
	AUA		ACA		AAA	lys	AGA	arg	A
	AUG	met (START CODON)	ACG		AAG		AGG		G
G	GUU	val	GCU	ala	GAU	asp	GGU	gly	U
	GUC		GCC		GAC		GGC		C
	GUA		GCA		GAA	glu	GGA		A
	GUG		GCG		GAG		GGG		G

Source: https://commons.wikimedia.org/wiki/File:Amino_Acid_Codon_Table.svg

mRNA	CGAUGAAAACUACCUCGUAAGGAG

The genetic code as a universal triplet code that is degenerate and the steps in gene expression, including transcription, RNA processing in eukaryotic cells and translation by ribosomes

Question 28

What is the correct amino acid sequence that would be produced if the mRNA sequence above was translated?

A. arg
B. met – lys – thr – thr – ser
C. arg – cys – lys – leu – pro – lys – glu
D. met – lys – thr – thr – ser – tyr

B *Protein translation begins with Met (AUG) and ends with a stop codon. The other options have mistranslated stop codons or started at the incorrect reading frame.*

The role of rough endoplasmic reticulum, Golgi apparatus and associated vesicles in the export of proteins from a cell via the protein secretory pathway

Question 29

Which of the following correctly lists the movement of proteins after translation by ribosomes on the rough endoplasmic reticulum?

A. secretory vesicle, Golgi apparatus, transport vesicle, plasma membrane
B. Golgi apparatus, transport vesicle, plasma membrane, secretory vesicle
C. transport vesicle, Golgi apparatus, secretory vesicle, plasma membrane
D. plasma membrane, secretory vesicle, Golgi apparatus, excretory vesicle

C *Transport vesicles travel between the rough endoplasmic reticulum and the Golgi apparatus, where proteins are folded and modified, before a secretory vesicle transports the proteins to the plasma membrane for exocytosis.*

Physical, chemical and microbiota barriers as preventative mechanisms of pathogenic infection in animals and plants

Question 30

Which of the following is not a chemical barrier in animals?

A. acidic sweat
B. lysozyme enzymes in tears
C. stomach acid
D. cilia in the airways

D *Cilia in the airways are a physical barrier in animals. All others are chemical barriers.*

Key Science Skills

Question 31

A study wanted to assess the effectiveness of a new antiviral drug on the severity of symptoms of adults infected with SARS Cov-19. Two groups of infected patients of equal size were created. One group received an antiviral drug and one group received just a sugar pill, alongside general monitoring of their health. The group that received the antiviral drug was the

A. control group.
B. experimental group.
C. independent group.
D. variable group.

B *The group receiving the drug is the experimental group, the control group does not receive the drug, the other two are not correct terms.*

Use the following information to answer Questions 32 – 34.

Scientists are attempting to create future-ready wheat by introducing drought-tolerance genes into the genome of common wheat (*Triticum aestivum*). Scientists screened genes from common wheat crops that were grown in areas of low rainfall as well as Wild Emmer wheat (*Triticum dicoccoides)*, which is known for its drought tolerance.

Source: https://www.hindawi.com/journals/tswj/2013/548246/

The use of genetically modified and transgenic organisms in agriculture to increase crop productivity and to provide resistance to disease

Potential uses and applications of CRISPR-Cas9 technologies to improve photosynthetic efficiencies and crop yields

Question 32

Which of the following experiments conducted with common wheat will create a transgenic organism?

	Species From Which the Gene is Sourced	Method of Gene Introduction
A.	Common Wheat (*T. aestivum*)	Crossbreeding Plants
B.	Common Wheat (*T. aestivum*)	CRISPR-cas9
C.	Wild Emmer Wheat (*T. dicoccoides)*	Crossbreeding Plants
D.	Wild Emmer Wheat (*T. dicoccoides)*	CRISP-cas9

D *Transgenic organisms are genetically modified organisms with genes that are introduced from a different species.*
B is not transgenic; it has a gene from the same species and A and C are not GMOs.

Identify and analyse experimental data qualitatively, handing where appropriate concepts of: accuracy, precision, repeatability, reproducibility and validity of measurements; errors (random and systematic); and certainty in data, including effects of sample size in obtaining reliable data

Question 33

The modified crops were then grown in threes in drought conditions at two temperature points. Wheat yields were measured at the end of the season.

Which of the following measurements are the most precise?

	Crop and Temperature	Crop Yield (tonnes per hectare)
A.	Common Wheat at 37°C	1.674, 1.766, 1.507
B.	Common Wheat at 41°C	1.354, 1.357, 1.349
C.	Wild Emmer Wheat at 37°C	2.011, 1.988, 2.107
D.	Wild Emmer Wheat at 41°C	1.832, 1.932, 1.745

B *'Precision' refers to how close the measurements are to one another. B has the closest measurements.*

Manipulation of gene pools through selective breeding programs

Question 34

Crossbreeding plants is an example of

A. selective breeding.
B. genetically modified organisms.
C. ethical maleficence.
D. natural selection.

A *Selective breeding is the deliberate and controlled reproduction of organisms to produce desired traits.*

The genetic code as a universal triplet code that is degenerate and the steps in gene expression, including transcription, RNA processing in eukaryotic cells and translation by ribosomes

Question 35

The genetic code is described as degenerate, meaning that

A. more than one codon codes for an amino acid.
B. it is the same in every organism.
C. it requires an mRNA copy of DNA to be made before translation can occur.
D. the genetic code is only made up of four bases.

A *The definition of degenerate means that more than one codon of the genetic code (a combination of three nucleotides) codes for an amino acid.*

Evidence of speciation as a consequence of isolation and genetic divergence, including Galapagos finches as an example of allopatric speciation and Howea palms on Lord Howe Island as an example of sympatric speciation

Question 36

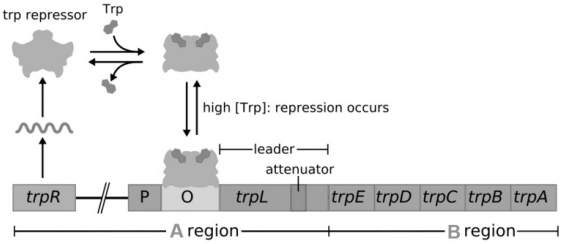
Which is the correct definition and example of the type of speciation provided?

A. Galapagos finches are an example of sympatric speciation; they developed into a new species without a geographic barrier
B. Galapagos finches are an example of allopatric speciation; they developed into a new species without a geographic barrier
C. Howea palms are an example of sympatric speciation; they developed into a new species without a geographic barrier
D. Howea palms are an example of allopatric speciation; they developed into a new species without a geographic barrier

C *Sympatric speciation is when populations evolve into different species without a geographic barrier in place, like Howea palms.*

Use the following information to answer Questions 37 and 38.

The below image shows a diagrammatic representation of the *trp* operon.



Adapted From: https://commons.wikimedia.org/wiki/File:Trpoperon.svg

The structure of genes: exons, introns and promoter and operator regions

Question 37

Regulatory genes

A. are shown in the B region of the diagram.
B. create proteins that assist in cell structure or proteins that perform roles around the body.
C. can code for proteins that stop gene expression.
D. only control the expression of a single structural gene.

C *Regulatory genes code for proteins that control the expression of structural genes.*

The basic elements of gene regulation: prokaryotic trp operon as a simplified example of a regulatory process

The structure of genes: exons, introns and promoter and operator regions

Question 38

Which statement about the *trp* operon is correct?

A. structural genes will only be expressed when there is high cellular tryptophan levels

B. tryptophan molecules bind to RNA polymerase to change its shape and prevent transcription

C. when there are high cellular levels of tryptophan, an antiterminator hairpin will form in mRNA

D. a longer mRNA molecule will be produced when low levels of tryptophan are in the cell

D *When cellular tryptophan levels are low, the genes will be freely expressed (no repression) and the mRNA molecule will not be truncated/shortened (no attenuation). A is incorrect as genes are expressed when there are low tryptophan levels. B is incorrect as tryptophan binds to the repressor protein. C is incorrect as a termination hairpin will form in mRNA when there are high levels of tryptophan in the cell.*

Use the following information to answer Questions 39 and 40.

The table below and phylogenetic tree provided in Question 40 show the results of sequencing a 9-base pair region of the genomes of four species of fruit bat and comparing it to an ancestral sequence.

Origin	Sequence
Ancestral sequence	GCGATCTGC
Species A	GCCATCTGC
Species B	GCAATGTCC
Species C	GCTATGTCC
Species D	TCGATCTAC

Causes of changing allele frequencies in a population's gene pool, including environmental selection pressures, genetic drift and gene flow; and mutations as the source of new alleles

Question 39

What type of mutations occurred between the ancestral sequence and the sequence in Species C?

A. frameshift mutation

B. point mutation

C. block mutation

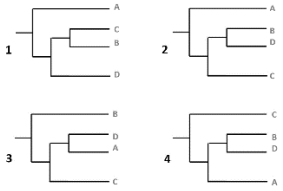
D. somatic mutation

B *Point mutations change a single nucleotide to a different nucleotide.*

The use and interpretation of phylogenetic trees as evidence for the relatedness between species

Question 40

Which phylogenetic tree correctly represents the data from the table?



A. tree 1

B. tree 2

C. tree 3

D. tree 4

A *Species A has one nucleotide change compared to the ancestral sequence, species D has two changes, and species B and C have three.*

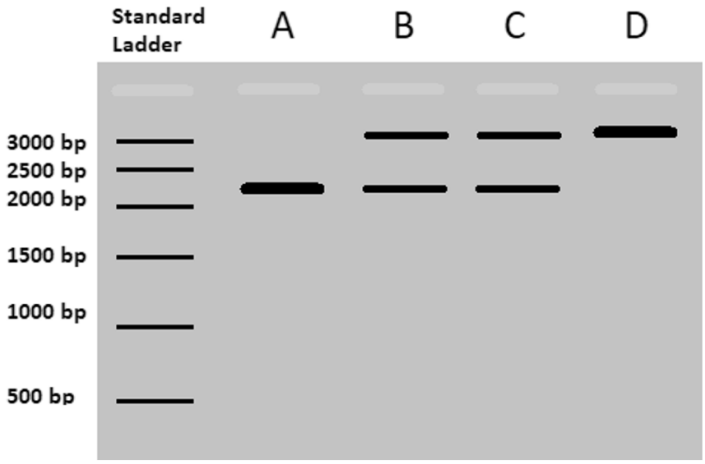
Section B

VCAA Key Knowledge	Question	Answer guide

Scientists in Melbourne have been experimenting using CRISPR in mice to inactivate a mutated version of the GG1 gene that they believe may be disease-causing in humans and mammals. In mice, the GG1 gene is 2380 base pairs (bp) long. The mutated variation known as GG1-B is 2930 bp long.

Scientists screened baby mice for the GG1-B variant using polymerase chain reaction (PCR) to target and amplify the gene.

The results for four different mice (A, B, C, D) were run on gel electrophoresis alongside a standard ladder – these results are included in the image below.



Amplification of DNA using polymerase chain reaction and the use of gel electrophoresis in sorting DNA fragments, including the interpretation of gel runs for DNA profiling	**Question 1a** (3 marks) Which of the four mice is homozygous for the GG1-B variant? Justify your answer.	**Answer:** • *The mouse that is homozygous for the GG1-B variant is mouse D.* • *This means that it has two copies of the GG1-B allele, which is 2930 bp long.* • *Mouse D has a thick band close to 3000 bp (corresponding to the GG1-B allele) according to the standard ladder and no other bands present on the gel.* **Marking protocol:** One mark for each of the above points.

Amplification of DNA using polymerase chain reaction and the use of gel electrophoresis in sorting DNA fragments, including the interpretation of gel runs for DNA profiling	**Question 1b** (3 marks) Outline the steps of a single cycle of polymerase chain reaction (PCR).	**Answer:** • *Denaturation – DNA is heated to 90-95°C to break the hydrogen bonds that hold two strands together.* • *Annealing – Primers bind to the single stranded DNA; this occurs at 50-55°C.* • *Elongation – Taq polymerase binds to the primers and synthesises a new complementary strand of DNA; this occurs at 72°C.* **Marking protocol:** One mark for each of the above points.

The use of enzymes to manipulate DNA, including polymerase to synthesise DNA, ligase to join DNA and endonucleases to cut DNA *The function of CRISPR-Cas9 in bacteria and the application of this function in editing an organism's genome*	**Question 1c** (2 marks) Name the component that acts as the endonuclease during CRISPR-Cas9 and explain why it does not work like a typical restriction enzyme.	**Answer:** • *The component that acts as an endonuclease is Cas9.* • *Cas9 does not work like a typical restriction enzyme, as restriction enzymes recognise a set sequence (at the recognition site), whereas Cas9 cuts at a sequence that is designated by guide RNA.* **Marking protocol:** One mark for each of the above points.

The function of CRISPR-Cas9 in bacteria and the application of this function in editing an organism's genome	**Question 1d** (2 marks) Scientists are exploring the potential of using CRISPR-Cas9 for gene editing in humans. Describe two potential ethical issues with using CRISPR-Cas9 to eliminate genetic diseases.	**Answer:** • *CRISPR-Cas9 could have unforeseen off-target effects in the individual being treated (non-maleficence).* • *Genetically modified embryos may experience unforeseen negative consequences during a pregnancy (non-maleficence).* • *Embryos cannot give informed consent (respect).* • *Some people believe experimenting on embryos does not respect the sanctity of life (respect).* • *Gene-editing technology is expensive and, thus, may only be available as a medical tool to wealthy people (justice).* • *CRISPR-Cas9 could be used to target traits that are not life-threatening but are considered 'genetically inferior,' perpetuating prejudice (respect).* **Marking protocol:** One mark for any of the above points, to a maximum of two. Any other reasonable response should be awarded marks. If students have written more than two points, mark only the first two points that are listed.

The function of CRISPR-Cas9 in bacteria and the application of this function in editing an organism's genome	**Question 1e** (2 marks) Using CRISPR to correct the genetic basis of inherited genetic diseases is mainly suggested for embryos. Explain why this process would be most effective in embryos as compared to adults.	**Answer:** • *Making changes to the genome in embryos means that those changes will carry through to all cells of the body as the embryo grows and as cells replicate and differentiate.* • *On the other hand, making changes to the genes of an adult will only affect the cells that are directly edited.* **Marking protocol:** One mark for each of the above points.

The general structure of the biochemical pathways in photosynthesis and cellular respiration from initial reactant to final product

The main inputs, outputs and locations of glycolysis, Krebs Cycle and electron transport chain including ATP yield (details of biochemical pathway mechanisms are not required)

Question 2a (1 mark)
State the total ATP yield produced by one molecule of glucose in aerobic cellular respiration.

Answer:
- *30/32 ATP.*

Marking protocol:
One mark for the above point.

The main inputs, outputs and locations of glycolysis, Krebs Cycle and electron transport chain including ATP yield (details of biochemical pathway mechanisms are not required)

Question 2b (2 marks)
Name the regions 'A' and 'B' that are indicated in the below diagram and name the cellular respiration process that occurs at each part.

Adapted From: https://commons.wikimedia.org/wiki/File:Mitochondrion.JPG

Answer:
- *'A' is the matrix of the mitochondria; the Krebs cycle occurs here.*
- *'B' is the mitochondrial cristae (the inner membrane); the electron transport chain occurs here.*

Marking protocol:
One mark for each of the above points.

The main inputs, outputs and locations of glycolysis, Krebs Cycle and electron transport chain including ATP yield (details of biochemical pathway mechanisms are not required)

Question 2c (2 marks)
Name the molecule that glucose is broken down into during glycolysis, and name the further derived molecule that is an input of the Krebs cycle.

Answer:
- *Glucose is broken down into (2x) pyruvate molecules.*
- *(2x) Acetyl-CoA molecules, which are derived from the 2x pyruvate molecules, are an input of the Krebs cycle.*

Marking protocol:
One mark for each of the above points.

Vaccination for COVID-19 is one of the main forms of combatting the disease and controlling spread. COVID-19 vaccines either introduce or have the body create a fragment of the disease to which the immune system responds, building immunity for future infections.

The role of the lymphatic system in the immune response as a transport network and the role of lymph nodes as sites for antigen recognition by T and B lymphocytes	**Question 3a** (1 mark) How does the lymphatic system streamline the recognition of the viral antigen?	**Answer:** • *The lymphatic system will move antigen-presenting cells from sites of infection/entry to the lymph nodes for recognition by lymphocytes (by both B and T cells).* **Marking protocol:** One mark for the above point.

The characteristics and roles of the components of the adaptive immune response against both extracellular and intracellular threats, including the actions of B lymphocytes and their antibodies, helper T and cytotoxic T cells	**Question 3b** (4 marks) Outline the steps that occur in the cell-mediated immune response that leads the body to produce cytotoxic T cells when it encounters a viral antigen.	**Answer:** • *Antigen presenting cells (APCs) encounter and engulf viral fragments, displaying viral antigens on MHC-II proteins.* • *Naïve T cells with complementary/matching antigen receptors recognise the antigens that are displayed by the APCs.* • *Helper T cells with complementary receptors also recognise the viral antigens and release cytokines, causing naïve T cells to undergo clonal selection.* • *Naïve T cells then undergo clonal selection (expansion and differentiation), differentiating into cytotoxic T cells.* **Marking protocol:** One mark for each of the above points.

Vaccination programs and their role in maintaining herd immunity for a specific disease in a human population	**Question 3c** (1 mark) Describe why having a majority of people being vaccinated and gaining herd immunity is important in combatting and controlling disease.	**Answer:** • *Herd immunity means that those who have compromised immune systems and cannot be vaccinated are protected.* • *Herd immunity means that the spread of the virus is limited, reducing the change of mutations that can lead to an increase in the chance of breakthrough infections and new strains.* **Marking protocol:** One mark for either of the above points.

Scientific and social strategies employed to identify and control the spread of pathogens, including identification of the pathogen and host, modes of transmission and measures to control transmission	**Question 3d** (3 marks) List three measures, other than vaccination and herd immunity, that may be used to control and/or screen disease transmission.	**Answer:** • *Handwashing.* • *Using sanitisers/antiseptics/disinfectants.* • *Lockdowns to prevent movement.* • *Quarantine to prevent transmission.* • *Screening a population with routine testing.* • *Screening medication sales to see trends in symptoms among populations.* • *Identifying the pathogen and method of spread.* • *Mask-wearing and social distancing (if the disease spread is airborne).* • *Targeting and treating the cause of disease with medicine.* **Marking protocol:** One mark for any of the above points, to a maximum of three.

Consequences of bacterial resistance and viral antigenic drift and shift in terms of ongoing challenges for treatment strategies and vaccination against pathogens	**Question 3e** (2 marks) Describe antigenic drift and outline how it can impact the effectiveness of a vaccine.	**Answer:** • *Antigenic drift refers to small mutations in the genes coding for viral surface antigens.* • *It can reduce the effectiveness of a vaccine as the immune system will be primed to respond to the old surface antigen and, therefore, the immune system may not recognise mutated viral antigens, or it may have a slower response to them.* **Marking protocol:** One mark for each of the above points.

The basis of the 'Out of Africa' model is that *Homo sapiens* evolved first in Africa and then spread around the world between 100,000 and 200,000 years ago, superseding all other hominin species.

Modern humans had reached Asia approximately 70,000 years ago before moving down through South-east Asia and into Australia approximately 50,000 years ago. *Homo sapiens*, however, were not the first hominins to inhabit this region; *Homo erectus* had already been in Asia for at least 1.5 million years.

The remains of an Indigenous man, dubbed 'Mungo Man,' was discovered in a lake from the World Heritage-listed Willandra Lakes region in far-western New South Wales. The remains have been dated to be over 40,000 years old.

Source: https://australian.museum/learn/science/human-evolution/the-spread-of-people-to-australia/

Changes in species over geological time as evidenced from the fossil record: faunal (fossil) succession, index and transitional fossils, relative and absolute dating of fossils	**Question 4ai** (1 mark) Radiocarbon dating can be used for organic samples up to 60,000 years old. What is the half-life of carbon-14?	**Answer:** • *5730 years.* **Marking protocol:** One mark for the above point.

Changes in species over geological time as evidenced from the fossil record: faunal (fossil) succession, index and transitional fossils, relative and absolute dating of fossils	**Question 4aii** (1 mark) Radiocarbon dating determines numerical age for fossils and other materials. Can this be considered absolute or relative dating?	**Answer:** • *Absolute dating.* **Marking protocol:** One mark for the above point.

Evaluate investigation methods and possible sources of personal errors/mistakes or bias, and suggest improvements to increase accuracy and precision, and to reduce the likelihood of errors	**Question 4b** (2 marks) Researchers attempted to extract mitochondrial DNA (mtDNA) from Mungo Man and sequence it; however, further research has discovered that the sample had been contaminated with modern human DNA, likely from people handling the bones. What kind of scientific error is this? Justify your answer.	**Answer:** • *It was a personal error.* • *Personal errors include mistakes or miscalculations – errors on the part of the person or people who was/were conducting the research.* **Marking protocol:** One mark for each of the above points. Note: In VCE Biology *Advice for teachers*, three types of error are noted: personal, systematic and random. Human error is not one of these and is not an accepted answer here.

Ways of using fossil and DNA evidence (mtDNA and whole genomes) to explain the migration of modern human populations around the world, including the migration of Aboriginal and Torres Strait Islander populations and their connection to Country and Place	**Question 4c** (2 marks) Why is mitochondrial DNA (mtDNA) especially useful for determining evolutionary relationships?	**Answer:** • *mtDNA has a higher mutation rate than nuclear DNA, providing enough accumulated differences for clear evolutionary comparisons.* • *There is no recombination in mtDNA because it is only inherited from the mother (meaning that, except for mutations, mtDNA does not change between generations).* **Marking protocol:** One mark for each of the above points.

Ways of using fossil and DNA evidence (mtDNA and whole genomes) to explain the migration of modern human populations around the world, including the migration of Aboriginal and Torres Strait Islander populations and their connection to Country and Place	**Question 4d** (2 marks) Does the discovery and dating of the Lake Mungo remains directly impact or contradict the 'Out of Africa' hypothesis? Justify your answer.	**Answer:** • *No, it does not contradict it.* • *The remains of Mungo Man are estimated to be over 40,000 years old and ancient humans were said to have migrated to Australia around 50,000 years ago.* **Marking protocol:** One mark for each of the above points.

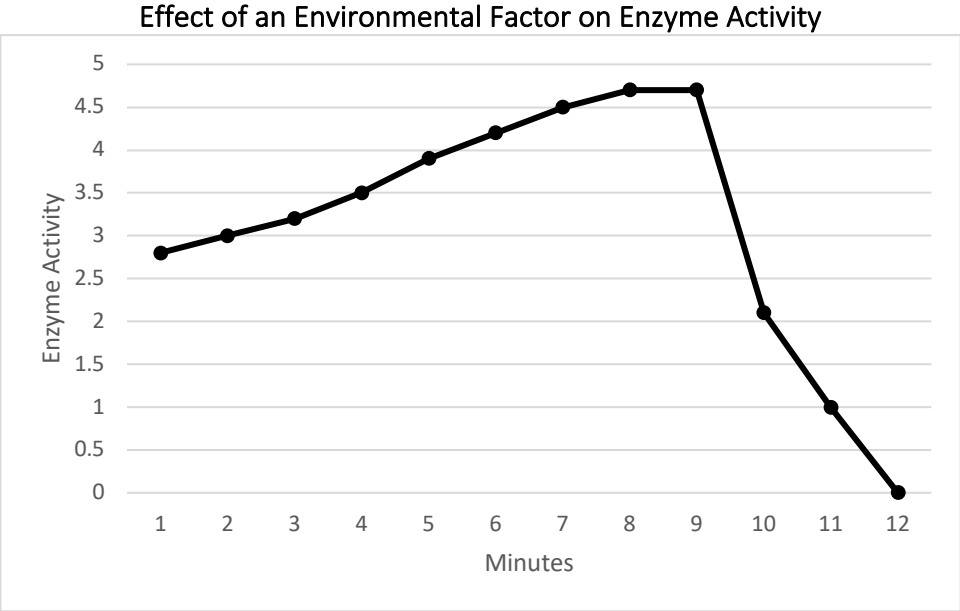
Biochemical processes such as photosynthesis require enzymes and coenzymes to facilitate and speed up reactions.

The general role of enzymes and coenzymes in facilitating steps in photosynthesis and cellular respiration	**Question 5a** (3 marks) Write the unloaded form of ATP and describe its role in the light-dependent and light-independent stages of photosynthesis.	**Answer:** • *ADP (+ Pi)* • *In the light-dependent stage: ADP + Pi form ATP, storing energy from sunlight in a high-energy phosphate bond.* • *In the light-independent stage: The phosphate bond in ATP is broken to release energy (required to convert CO_2 and H+ into glucose) and ADP + Pi form again.* **Marking protocol:** One mark for each of the above points.

Rubisco is an enzyme in photosynthesis that fixates carbon. If it binds to the wrong substrate, Rubisco undergoes a process called photorespiration.

The role of Rubisco in photosynthesis, including adaptations of C_3, C_4 and CAM plants to maximise the efficiency of photosynthesis	**Question 5b** (2 marks) Name the alternate substrate that Rubisco may bind to and outline the effect that this has on photosynthesis.	**Answer:** • *Rubisco uses oxygen as an alternative substrate in photorespiration.* • *This disrupts photosynthesis, reducing glucose output and wasting energy.* **Marking protocol:** One mark for each of the above points.

The two key factors that determine whether Rubisco undergoes carbon fixation or photorespiration are temperature and substrate concentration. A team was studying the impact of these different environmental factors on Rubisco enzyme activity. The results from one of their experiments is shown below.



The factors that affect the rate of photosynthesis: light availability, water availability, temperature and carbon dioxide concentration

Question 5c (3 marks)
Referring to the graph, what change was made at nine minutes? Justify your answer, referencing the data.

Answer:

- *The temperature was increased rapidly/significantly.*
- *High temperatures will rapidly denature enzymes and reduce/stop enzyme activity. (Changes in pH or cooling the temperature, meanwhile, will not produce the steep dip that is shown).*
- *This is reflected on the graph, which shows a sharp dip in enzyme activity after nine minutes.*

Marking protocol:
One mark for each of the above points.
NB: For the first dot point, 'a change in temperature' is <u>not</u> an acceptable answer – an *increase* in temperature must be specified.

When designing their experiments on factors that affect enzyme activity, the team were careful to only test one factor at a time.

Develop aims and questions, formulate hypotheses and make predictions

Identify independent, dependent and controlled variables in controlled experiments

Question 5d (2 marks)
Given this approach, if the substrate concentration was being changed between groups in the experiment, explain what should happen to the temperature and why.

Answer:

- *The temperature should remain unchanged (controlled variable).*
- *Only one variable should be changed between groups to increase the experiment's validity, ensuring that changes in the measured outcome (dependent variable) are only caused by changes in the independent variable.*

Marking protocol:
One mark for each of the above points.

Changing weather conditions, including rising temperatures and water unavailability, can increase photorespiration in plants. While 85-90% of plants undergo regular photosynthesis, some plants have adaptations to decrease photorespiration and maximise photosynthesis.

Sources: Khan Academy (https://www.khanacademy.org/science/biology/photosynthesis-in-plants/photorespiration--c3-c4-cam-plants/a/c3-c4-and-cam-plants-agriculture); Science Direct (https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/c3-photosynthesis (taken from A.S. Raghavendra, in Encyclopedia of Applied Plant Sciences, 2003))

The role of Rubisco in photosynthesis, including adaptations of C_3, C_4 and CAM plants to maximise the efficiency of photosynthesis	**Question 5e** (3 marks) Describe the adaptations of C_4 and CAM plants to maximise photosynthesis.	**Answer:** • *C_4 and CAM plants fix carbon into a (organic carbon-based) molecule before releasing it into the Calvin cycle.* • *In C_4 plants, carbon fixation and the remainder of the Calvin cycle occur in separate cells (carbon fixation occurs in mesophyll cells and the rest of the Calvin cycle occurs in bundle sheath cells).* • *In CAM plants, carbon fixation and the rest of the Calvin cycle occur at different times (carbon fixation occurs at night with the remainder of the Calvin cycle occurring during the day).* **Marking protocol:** One mark for each of the above points.

Galapagos finches developed into different species after they dispersed across different islands, creating geographic isolation between the Finch populations.

Source: https://www.pbs.org/wgbh/evolution/library/01/6/l_016_02.html

Evidence of speciation as a consequence of isolation and genetic divergence, including Galapagos finches as an example of allopatric speciation and Howea palms on Lord Howe Island as an example of sympatric speciation	**Question 6a** (4 marks) What type of speciation is this? Describe the process.	**Answer:** • *Galapagos finches are an example of allopatric speciation.* • *Allopatric speciation involves a geographical barrier preventing gene flow/interbreeding.* • *Different selection pressures favouring different phenotypes act on the separate populations.* • *Over time, changes accumulate, and the different populations become separate species.* **Marking protocol:** One mark for each of the above points.

Causes of changing allele frequencies in a population's gene pool, including environmental selection pressures, genetic drift and gene flow; and mutations as the source of new alleles	**Question 6b** (1 mark) Small groups of finches from an island group would be able to cross large distances with the right wind. Identify the term for when a population is seeded by a small group of individuals with different allele frequencies to the main population.	**Answer:** • *Founder effect.* **Marking protocol:** One mark for the above point.

Evidence of speciation as a consequence of isolation and genetic divergence, including Galapagos finches as an example of allopatric speciation and Howea palms on Lord Howe Island as an example of sympatric speciation	**Question 6c** (3 marks) Outline the steps of natural selection for the Galapagos finches.	**Answer:** • *Individuals in the finch populations had genetic variation presenting in phenotypic differences. Finch populations on different islands also had different selection pressures.* • *Individual finches that had advantageous phenotypes for their specific environmental selection pressures were more likely to survive and reproduce.* • *The advantageous phenotype was passed onto offspring; over time, the frequency of the advantageous allele increased in the population of that island.* **Marking protocol:** One mark for each of the above points.

Biological consequences of changing allele frequencies in terms of increased and decreased genetic diversity	**Question 6d** (2 marks) Over a long period of time, with little change in selection pressures, how is natural selection likely to affect genetic diversity? Why is this the case?	**Answer:** • *Natural selection is likely to reduce genetic diversity.* • *With little change in selection pressures, only certain individuals with advantageous alleles may successfully reproduce, reducing the variety of alleles that are present in the population.* **Marking protocol:** One mark for each of the above points.

The first European settlers in Australia brought with them infectious diseases that severely impacted the Aboriginal and Torres Strait Islander populations, resulting in mass infections and death.

"Smallpox spread across the country with the advance of European settlement, bringing with it shocking death rates. The disease affected entire generations of the First Nations populations and survivors were in many cases left without family or community leaders." (National Museum of Australia)

Source: https://www.nma.gov.au/defining-moments/resources/smallpox-epidemic

The emergence of new pathogens and re-emergence of known pathogens in a globally connected world, including the impact of European arrival on Aboriginal and Torres Strait Islander peoples	**Question 7a** (3 marks) Give three reasons why smallpox and other European diseases would have had such a severe impact on the First Nations populations.	**Answer:** • *The First Nations people would not have had natural active immunity to the diseases.* • *Changing and forced living conditions led to a lack of access to clean water.* • *The overall impact of colonisation on health and wellbeing would have made the populations more vulnerable to disease.* • *Their medicine was not developed to deal with European diseases.* • *At the time, the high population densities of First Nations peoples (in forced camps) allowed the rapid spread of the diseases.* **Marking protocol:** One mark for any of the above points, to a maximum of three.

The innate immune response including the steps in an inflammatory response and the characteristics and roles of macrophages, neutrophils, dendritic cells, eosinophils, natural killer cells, mast cells, complement proteins and interferons	**Question 7b** (1 mark) One of the main symptoms of smallpox is a fever. What is the purpose of a fever in the body?	**Answer:** • *A fever raises the body temperature to an abnormally high temperature to kill pathogens in the body.* **Marking protocol:** One mark for the above point.

Biofuels that are made from biomass are considered to be a potentially greener alternative to fossil fuels.

Source: https://www.intechopen.com/chapters/65086

Uses and applications of anaerobic fermentation of biomass for biofuel production	**Question 8a** (2 marks) Give two reasons why biofuels are considered more environmentally friendly than fossil fuels.	**Answer:** • *Biofuels are renewable, whereas fossil fuels are not renewable.* • *Biofuels are (theoretically) carbon-neutral, whereas fossil fuels are not carbon-neutral.* • *Biofuels recycle waste from industries such as crops, farming and forestry; fossil fuels are derived from raw materials.* **Marking protocol:** One mark for any of the above points, to a maximum of two.

The factors that affect the rate of cellular respiration: temperature, glucose availability and oxygen concentration	**Question 8b** (2 marks) What are two of the required environmental factors to induce anaerobic respiration?	**Answer:** • *A lack of oxygen.* • *The presence of glucose substrate.* • *A temperature within the enzymes' operating ranges.* • *A pH within the enzymes' operating ranges.* • *The presence of an organism that performs anaerobic respiration, such as yeast.* **Marking protocol:** One mark for any of the above points, to a maximum of two.

Uses and applications of anaerobic fermentation of biomass for biofuel production	**Question 8c** (2 marks) List the biofuel that can be made by anaerobic fermentation and one application of this fuel.	**Answer:** • *Bioethanol.* • *Bioethanol can be used as a fuel for travel.* • *Bioethanol can be used for power generation.* • *Bioethanol can be used for heating.* **Marking protocol:** One mark for identifying bioethanol, and one mark for an application of this fuel. Any other reasonable application for bioethanol should be accepted.

The location, inputs and the difference in outputs of anaerobic fermentation in animals and yeasts	**Question 8d** (2 marks) List the outputs of anaerobic respiration for plants/yeast as opposed to animals.	**Answer:** • *Plants/yeast: 2 ethanol + 2 CO_2 + 2 ATP.* • *Animals: 2 lactic acid + 2 ATP.* **Marking protocol:** One mark for each of the above points.

The genetic code as a universal triplet code that is degenerate and the steps in gene expression, including transcription, RNA processing in eukaryotic cells and translation by ribosomes	**Question 9a** (3 marks) Outline the steps in the process of transcription.	**Answer:** • *DNA is unwound/unzipped.* • *RNA polymerase attaches to the DNA template strand and reads it, building a strand of complementary RNA nucleotides.* • *A strand of pre-mRNA is formed as the final product.* **Marking protocol:** One mark for each of the above points.

The genetic code as a universal triplet code that is degenerate and the steps in gene expression, including transcription, RNA processing in eukaryotic cells and translation by ribosomes	**Question 9b** (2 marks) Describe how a single gene can produce multiple different mRNA strands.	**Answer:** • *A single gene is comprised of exons and introns.* • *During mRNA processing, different combinations of exons can be spliced together to create different mRNA strands from the one gene.* **Marking protocol:** One mark for each of the above points.

Humans have two sets of chromosomes (i.e., humans are diploid). It is common for plants to have more than two sets of chromosomes; this can be advantageous, especially to crop plants, due to increased heterozygosity and as this can protect against the effects of deleterious mutations. It also, however, often results in reduced fertility due to meiotic errors, allowing for the production of seedless varieties.

Source: https://www.researchgate.net/profile/Wellington-Clarindo/publication/288831058_The__and_its_key_role_in_plant_breeding/links/5688bf43308ae8f6ec752430a/The-and-its-key-role-in-plant-breeding.pdf

Causes of changing allele frequencies in a population's gene pool, including environmental selection pressures, genetic drift and gene flow; and mutations as the source of new alleles	**Question 10a** (1 mark) Common in plants, what is the term for having multiple sets of chromosomes?	**Answer:** • *Polyploidy.* **Marking protocol:** One mark for the above point.

Causes of changing allele frequencies in a population's gene pool, including environmental selection pressures, genetic drift and gene flow; and mutations as the source of new alleles	**Question 10b** (1 mark) What term is used to describe having one or more chromosomes missing from a set of chromosomes, or having one or more additional chromosomes?	**Answer:** • *Aneuploidy.* **Marking protocol:** One mark for the above point.

The use of genetically modified and transgenic organisms in agriculture to increase crop productivity and to provide resistance to disease	**Question 10c** (2 marks) Plants with high yields or desirable traits, such as seedless fruit, have been developed using genetic modification (GMO), but some consumers and farmers have rejected GMO products and crops. Outline one concern and one benefit regarding GMO crops.	**Answer:** *Concerns* • *GMO crops may lead to a loss of genetic diversity.* • *There may be unforeseen impacts from potential crosspollination or weeds/pests developing resistance.* • *GMOs are unnatural/like 'playing God.'* • *People worry about whether GMOs are possibly unsafe to consume.* • *There is an initial impact on farmers (cost of new seeds, difficult regulations).* *Benefit* • *GMO crops are more productive (improving food security and profits for farmers).* • *GMO crops can be made to be more drought/disease tolerant.* • *GMO crops can be made to be insect-resistant, requiring less pesticide/management.* • *GMO foods can have improved nutritional benefits or taste (improving public health and making them more appealing to consumers).* **Marking protocol:** One mark for a one 'concern' and one mark for one 'benefit' point, to a maximum of two.

VCE BIOLOGY
Written Examination
ANSWER SHEET – 2022

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
2	A	**B**	C	D
3	A	B	**C**	D
4	A	B	C	**D**
5	A	B	**C**	D
6	A	**B**	C	D
7	**A**	B	C	D
8	**A**	B	C	D
9	A	B	C	**D**
10	A	B	C	**D**
11	A	**B**	C	D
12	A	B	C	**D**
13	A	**B**	C	D
14	A	B	**C**	D

15	A	**B**	C	D
16	**A**	B	C	D
17	A	B	**C**	D
18	A	**B**	C	D
19	A	B	**C**	D
20	**A**	B	C	D
21	A	B	C	**D**
22	A	**B**	C	D
23	A	**B**	C	D
24	A	B	**C**	D
25	A	B	**C**	D
26	A	**B**	C	D
27	A	B	**C**	D
28	A	**B**	C	D

29	A	B	**C**	D
30	A	B	C	**D**
31	A	**B**	C	D
32	A	B	C	**D**
33	A	**B**	C	D
34	**A**	B	C	D
35	**A**	B	C	D
36	A	B	**C**	D
37	A	B	**C**	D
38	A	B	C	**D**
39	A	**B**	C	D
40	**A**	B	C	D