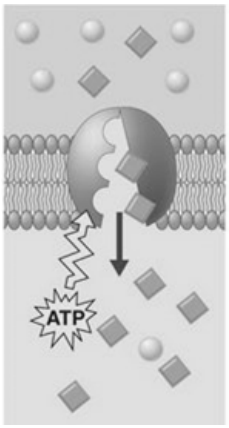
Biology 2018
Assessment Guide

Section A

VCAA Key Knowledge	Question	Answer guide
Independent, dependent and controlled variables	**Question 1** During an experiment, a controlled variable is **A.** kept constant. **B.** only altered once. **C.** also known as the independent variable. **D.** the one factor that is not the same between the experimental and the control group.	*A* *A controlled variable is kept constant in all groups during an experiment.*
Methods of organising, analysing and evaluating primary data to identify patterns and relationships including sources of error and limitations of data and methodologies	**Question 2** When graphing results from an experiment **A.** the existence of a correlation establishes that there is a causal relationship between two variables. **B.** the independent variable is represented on the vertical axis while the dependent variable is represented on the horizontal axis. **C.** the independent variable is represented on the horizontal axis while the dependent variable is represented on the vertical axis. **D.** all experiments will show a correlation between variables.	*C* *As per the VCAA Advice for Teachers page http://www.vcaa.vic.edu.au/Pages/vce/adviceforteachers/biology/graphicalrepofdata.aspx.*
The fluid mosaic model of the structure of the plasma membrane and the movement of hydrophilic and hydrophobic substances across it based on their size and polarity	**Question 3** The size of a molecule influences its passage across a plasma membrane, which means that, generally, **A.** large molecules cannot enter the cell. **B.** small molecules enter the cell via a carrier protein. **C.** water is too large to cross the phospholipid bilayer. **D.** glucose is too large to cross the phospholipid bilayer.	*D* *Glucose is a large molecule and requires a channel protein to cross the membrane.*

Use the following information to answer Questions 4 and 5.



Source: http://kmbiology.weebly.com

The fluid mosaic model of the structure of the plasma membrane and the movement of hydrophilic and hydrophobic substances across it based on their size and polarity

Question 4

The image above represents a process that assists the diamond-shaped molecules to move across the plasma membrane into the cell. Which of the following is correct regarding the process depicted?

A. it is passive
B. it is required to move water across the plasma membrane
C. it occurs only in animals and not in plants
D. it moves molecules against their concentration gradient

D *The process is active transport where molecules are moved across the plasma membrane against their concentration gradient.*

The fluid mosaic model of the structure of the plasma membrane and the movement of hydrophilic and hydrophobic substances across it based on their size and polarity

Question 5

Given the information depicted in the image, it can be assumed that the round-shaped molecules are likely to cross the plasma membrane into the cell

A. at a slower rate than the diamond-shaped molecules.
B. at a faster than the diamond-shaped molecules.
C. and requires energy to do so.
D. by moving between the phospholipid heads.

B *There is a greater difference in molecule concentration on either side of the membrane for the round molecules in comparison to the diamond. This would therefore contribute to a higher rate of movement across the membrane of the round-shaped molecules.*

The role of different organelles including ribosomes, endoplasmic reticulum, Golgi apparatus and associated vesicles in the export of a protein product from the cell through exocytosis

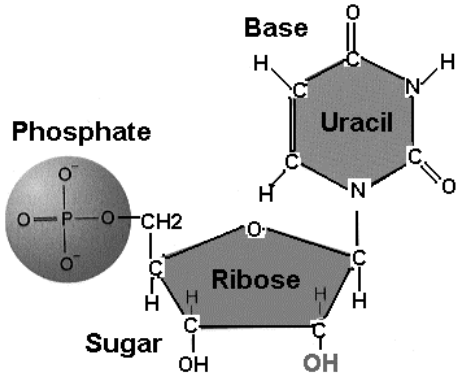
Question 6

Which of the following is not a possible function of the rough or smooth endoplasmic reticulum?

A. synthesis of carbohydrates
B. synthesis of proteins
C. transport of proteins
D. synthesis of lipids

A *Carbohydrates are not synthesised at the endoplasmic reticulum.*

Use the following information to answer Questions 7 and 8.



Source: http://onwe.bioinnovate.co

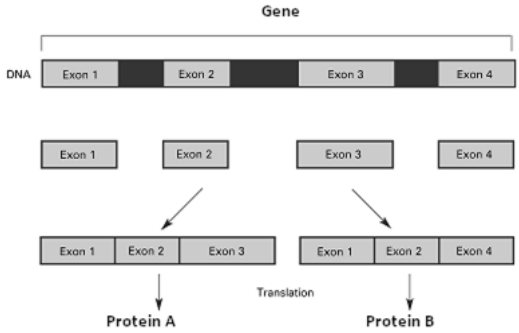
Nucleic acids as information molecules that encode instructions for the synthesis of proteins in cells	**Question 7** The image above depicts **A.** a monomer of DNA. **B.** a nucleic acid. **C.** a monomer of protein. **D.** a monomer of RNA.	*D*	*The image is of an RNA nucleotide. The base uracil and sugar ribose indicates the monomer is from RNA.*

Nucleic acids as information molecules that encode instructions for the synthesis of proteins in cells	**Question 8** The molecule above would be found in the depicted form in the **A.** ribosome **B.** golgi apparatus **C.** nucleus **D.** vesicles	*C*	*RNA nucleotides are found in the nucleus as they are required to form mRNA in the process of transcription.*

The genetic code as a degenerate triplet code and the steps in gene expression including transcription, RNA processing in eukaryotic cells and translation	**Question 9** During translation **A.** mRNA is read in a 3' to 5' direction by the ribosome. **B.** mRNA is read in a 5' to 3' direction by the ribosome. **C.** the tRNA molecule has the codon on one end. **D.** amino acids are joined to one another by polypeptide bonds.	*B*	*The ribosome reads mRNA codons in a 5' to 3' direction during translation.*

Protein functional diversity and the nature of the proteome	**Question 10** Which of the following is not a possible example of the functional diversity of proteins? **A.** an enzyme **B.** an antibody **C.** a neurotransmitter **D.** a plasmid	*D*	*A Units 3&4 Biology student should know that a plasmid is a double stranded DNA molecule and not a protein.*

Use the following information to answer Questions 11 and 12.



Source: https://study.com/academy/lesson/

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

Question 11

What process does the above diagram depict?

A. Alternative splicing
B. Translation
C. Transcription
D. Condensation polymerisation

A *The image depicts two different proteins resulting from one gene. This occurs via alternative splicing. The 2017 VCAA Exam, Q1c, demonstrates that students should understand this concept.*

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

Question 12

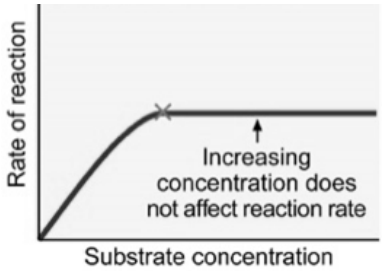
This process can explain

A. how enzyme inhibition occurs.
B. the concept of rational drug design.
C. how the expression of a single gene can lead to the production of different proteins.
D. why antigens and antibodies agglutinate and are removed from the body.

C *Alternative splicing leads to variation in the exon order in mRNA. This contributes to a single gene being able to code for the production of different proteins.*

The role of enzymes as protein catalysts in biochemical pathways

Question 13



Source: http://www.rsc.org/Education/Teachers/Resources/cfb/enzymes.htm

The diagram above represents the rate of an enzyme catalysed reaction. At point 'X'

A. the enzymes are denatured.
B. the enzymes are saturated.
C. no substrate remains.
D. no product is being produced.

B *At point 'X' the rate of reaction is constant, indicating that all the enzymes are working at maximum capacity.*

The mode of action of enzymes including reversible and irreversible inhibition of their action due to chemical competitors at the active site, and by factors including temperature, concentration and pH

Question 14

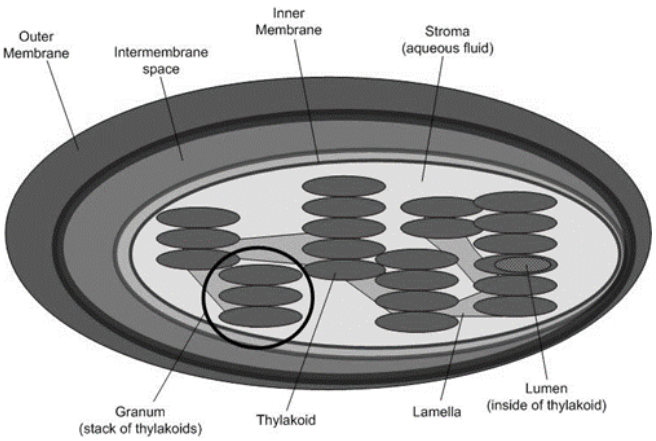
Irreversible denaturation of enzyme action can occur through:

A. temperature.
B. pH.
C. neither A nor B.
D. both A and B.

D *Extremes in temperature and pH can denature an enzyme. This is irreversible.*

Chloroplasts as the site of photosynthesis, an overview of their structure and evidence of their bacterial origins

Question 15



Source: https://commons.wikimedia.org/wiki/File:Cloroplast.png

The reaction that occurs in the structure circled is a reaction that involves

A. the splitting of water molecules.
B. the production of CO_2.
C. the use of O_2 to produce glucose.
D. CO_2 as an input.

A *The light dependent reaction occurs in the grana. Water molecules are split using light energy.*

Factors that affect the rate of cellular respiration, including temperature, glucose availability and oxygen concentration.

Question 16

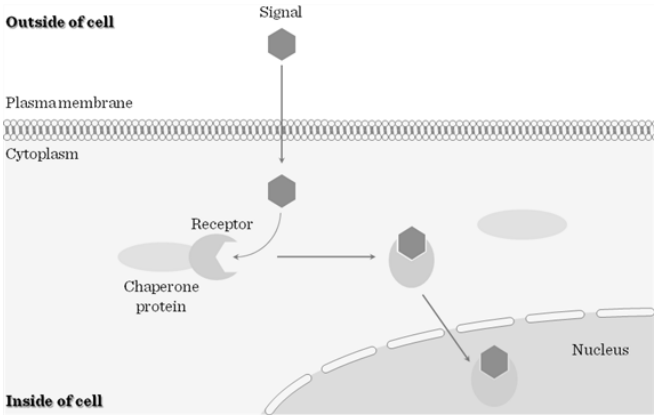
In reference to cellular respiration, a reduction in glucose availability would result in

A. no ATP production.
B. lowered O_2 production.
C. no O_2 production.
D. lowered CO_2 production.

D *CO_2 is an output to cellular respiration, therefore a reduction in glucose availability would result in a reduction in products – such as CO_2.*

The sources and mode of transmission of various signalling molecules to their target cell, including plant and animal hormones, neurotransmitters, cytokines and pheromones

Question 17



Source: http://www.tankonyvtar.hu/en/tartalom/tamop425/0011_1A_Jelatvitel_en_book/ch02.html

If the signalling molecule above led to this cell expressing a gene, it is likely that the end product of this response

A. would result in cell death.
B. would occur faster than a response caused by a signalling molecule with a receptor located on the cell membrane.
C. would occur slower than a response caused by a signalling molecule with a receptor located on the cell membrane.
D. could be enhanced by a drug with a shape complementary to that of the chaperone protein.

C *As gene expression involves steps such as transcription and translation, it is likely that the response, and therefore end product, would take longer than a response activated by a protein-based signalling molecule. It is less common for protein-based signalling molecules to cause gene expression as a cell response.*

Apoptosis as a natural, regulatory process of programmed cell death

Question 18

Which of the following is not likely to be a successful drug designed to prevent the process of apoptosis?

A. a drug that is complementary to active site of the caspase enzymes
B. a drug that is complementary to the death receptor
C. a drug that contributes to significant cell stress
D. a drug that contributes to reduced cell stress

C *Cell stress contributes to initiating the internal or mitochondrial pathway for apoptosis.*

Invading cellular and non-cellular pathogens as a source of non-self antigens, and preventative strategies including physical, chemical and microbiological barriers in animals and plants that keep them out

Question 19

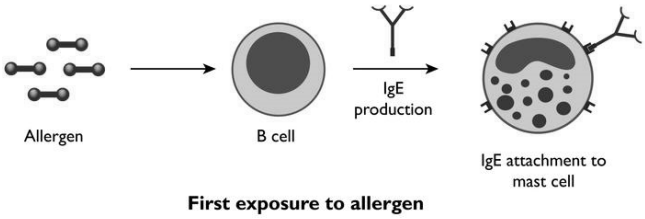
The natural microflora of the body are an example of

A. the innate immune response.
B. the adaptive immune response.
C. the third line of defence.
D. the second line of defence.

A *The natural microflora, or bacteria, of the body act as a barrier to prevent pathogens from entering the body.*

An antigen as a unique molecule or part of a molecule that initiates an immune response including the distinction between non-self antigens, self-antigens and allergens

Question 20



First exposure to allergen

Source: https://www.dreamstime.com/royalty-free-stock-photo-mast-cells-allergy-image13000345

Upon second exposure to the same allergen, an allergic response will likely

A. occur as the mast cell releases anti-histamines.
B. occur as a result of cross linking between the allergen and the IgE antibodies on the mast cell.
C. not occur as the mast cell has been primed.
D. occur as a result of the B cell producing new IgE antibodies.

B *Cross linking between the allergen and the IgE antibodies on the mast cell leads the mast cell to release histamine and this causes the allergic response.*

The role of the lymphatic system in the immune response including the role of secondary lymphoid tissue (with reference to lymph nodes) as the site of antigen recognition by lymphocytes, and as a transport system for antigen presenting cells including dendritic cells

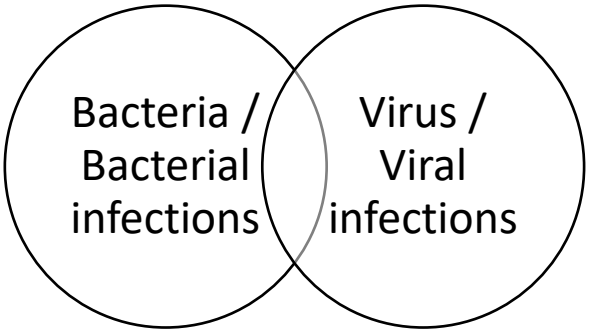
Question 21

The lymphatic system does not contain

A. one way valves.
B. nodes that filter lymph tissue.
C. a pump similar to the heart.
D. white blood cells.

C *Fluid moves through the lymphatic system via one way valves and the pressure created by the movement of muscles.*

Use the following information to answer Questions 22 and 23.



Invading cellular and non-cellular pathogens as a source of non-self antigens, and preventative strategies including physical, chemical and microbiological barriers in animals and plants that keep them out

Question 22

When considering the Venn diagram above, which of the following would be likely found in the region of overlap?

A. possible to be vaccinated against
B. are living cells
C. can reproduce independently
D. can be treated with antibiotics

A *Types of both viral and bacterial infections can be prevented through vaccination.*

Invading cellular and non-cellular pathogens as a source of non-self antigens, and preventative strategies including physical, chemical and microbiological barriers in animals and plants that keep them out

Question 23

A distinct difference between bacteria and viruses is

A. their mode of transmission.
B. their size.
C. their ability to cause disease.
D. that one can contain DNA and the other cannot.

B *Bacteria are generally much larger than viruses.*

The qualitative treatment of the causes of changing allele frequencies in a population's gene pool including types of mutations (point, frameshift, block) as a source of new alleles, chromosomal abnormalities (aneuploidy and polyploidy),

Question 24

Which of the following is not a type of mutation?

A. frameshift
B. block
C. point
D. aneuploidy

D *Aneuploidy is a chromosomal abnormality.*

The qualitative treatment of the causes of changing allele frequencies in a population's gene pool including environmental selection pressures on phenotypes as the mechanism for natural selection

Question 25

What is the allele frequency for D, if the following genotypes existed in population?
Dd, DD, dd, Dd, dd, Dd, DD, DD, dd, dd

A. 0.45
B. 0.60
C. 45%
D. 60%

A *There are nine D alleles out of a total of 20 alleles. Allele frequency is expressed as a number between 0 and 1.*

Processes of evolution including through the action of mutations and different selection pressures on a fragmented population and subsequent isolating mechanisms (allopatric speciation) that prevent gene flow

Question 26

Allopatric speciation is characterised by

A. the speed of speciation.
B. its isolation to bird species.
C. a geographic isolating mechanism preventing gene flow.
D. its occurrence being limited to the Cambrian period.

C *Allopatric speciation involves some form of geographic isolating mechanism, such as a mountain range that prevents gene flow between two populations.*

Evidence of biological change over time including from palaeontology (the fossil record, the relative and absolute dating of fossils, types of fossils and the steps in fossilisation), biogeography, developmental biology and structural morphology

Question 27

Carbon dating

A. is used to determine the relative age of fossils.

B. is used for determining ages of fossils from the Jurassic period.

C. is most useful for organic remains under 50 000 years old.

D. is most useful for organic remains over 50 000 years old.

C *Due to the relatively rapid break down of organic material, carbon dating is most useful for fossils under the age of 50 000 years old.*

Significant changes in life forms in Earth's geological history including the rise of multicellular organisms, animals on land, the first flowering plants and mammals

Question 28

During its dramatic 4.5 billion year history, Earth has gone through a series of major geological and biological changes. The timescale below highlights several notable prehistoric events and the approximate time in which they occurred.

3.8 billion years ago	First life arises
2.1 billion years ago	Eukaryotes evolved
1.1 billion years ago	First sexually reproducing organisms
530 million years ago	The first fish
475 million years ago	First land plants
370 million years ago	The first amphibians
320 million years ago	The earliest reptiles
225 million years ago	The dinosaurs evolve
200 million years ago	
150 million years ago	First birds
130 million years ago	
14 million years ago	The first great apes appear
2.5 million years ago	Genus Homo evolves
200 thousand years ago	Our species, Homo sapiens evolves
10 thousand years ago	End of the last Ice Age

Source: http://www.bbc.co.uk/nature/history_of_the_earth#periods

The two blank spaces in the table should be filled by

A. 200 million years ago – mammals evolve
130 million years ago – flowering plants evolve

B. 200 million years ago – flowering plants evolve
130 million years ago – mammals evolve

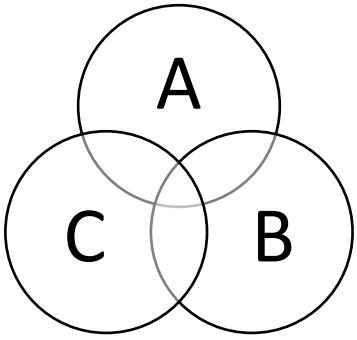
C. 200 million years ago – first animals on land
130 million years ago – flowering plants evolved

D. 200 million years ago – multicellular organisms evolve
130 million years ago – mammals evolve

A *Students should know this information from the key knowledge point 'significant changes in life forms in Earth's geological history including the rise of multicellular organisms, animals on land, the first flowering plants and mammals'.*

Processes of evolution including through the action of mutations and different selection pressures on a fragmented population and subsequent isolating mechanisms (allopatric speciation) that prevent gene flow

Question 29



The diagram above represents three populations of moths, distinguishable by wing colour and pattern. Overlap between the population represents mating that occurs and results in viable offspring.

From the information above, it is reasonable to conclude that

A. similar selection pressures act on each population of moths.
B. there is one species of moth present.
C. there are three species of moth present.
D. differences between the moths is due to the moth changing to suit their environment.

B *As they can interbreed and produce viable offspring, they are the one species of moth.*

Use the following molecular data to answer Questions 30 and 31.

Amino acid position	*Human*	*Species 1*	*Species 2*	*Species 3*
10	*Phe*	*Phe*	*Phe*	*Phe*
11	*Glu*	*Glu*	*Glu*	*His*
12	*Val*	*Val*	*Ile*	*Val*
13	*Cys*	*Ile*	*Cys*	*Ile*
14	*Val*	*Cys*	*Val*	*Val*

Molecular homology as evidence of relatedness between species including DNA and amino acid sequences, mtDNA (the molecular clock) and the DNA hybridisation technique

Question 30

Based on this information, the species most similar to humans is

A. species 1 and 2. They are equally similar.
B. species 1.
C. species 2.
D. species 3.

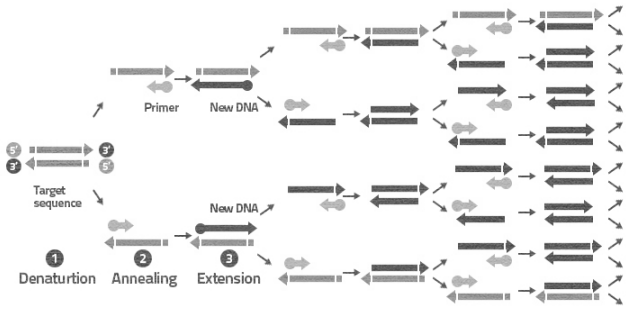
C *Species 2 has the most similar molecular data to the human. There is only one amino acid difference at position 12.*

Molecular homology as evidence of relatedness between species including DNA and amino acid sequences, mtDNA (the molecular clock) and the DNA hybridisation technique	**Question 31** The differences in the molecular data are most likely due to A. differences in their environment. B. variation. C. mutations in RNA. D. mutations in DNA.	*D* *Mutations in DNA result in different amino acid sequences between the species, as DNA codes for amino acids.*

Shared characteristics that define primates, hominoids and hominins	**Question 32** Hominins and primates both share A. reduced body hair. B. bipedal gait. C. claws instead of nails. D. opposable thumbs.	*D* *Hominins and primates both possess opposable thumbs.*

Major trends in hominin evolution from the genus Australopithecus to the genus Homo including structural, functional and cognitive changes and the consequences for cultural evolution	**Question 33** Which of the following is not an example of a feature of cultural evolution? A. can occur quickly B. traits cannot be chosen C. can occur within or between generations D. traits can be transmitted to unrelated people	*B* *Genetic traits that are inherited are part of biological evolution and cannot be chosen.*

Use the following information to answer Questions 34 and 35.



Source: https://theory.labster.com

Amplification of DNA using the polymerase chain reaction	**Question 34** During the extension stage, the most ideal temperature is typically A. 72 degrees B. 50 degrees C. 82 degrees D. 95 degrees	*A* *In polymerase chain reaction, the extension phase is typically carried out at 72 degrees.*

Amplification of DNA using the polymerase chain reaction

Question 35

The purpose of a primer in this reaction is

A. to act as a short sequence of nucleotides that provides a starting point for DNA synthesis.
B. to move along the original DNA strand and add complementary nucleotides.
C. to act as the 'glue' to join complementary nucleotides together.
D. to separate the DNA and prime it, ready for a copy to be made.

A *Primers are required for the enzyme to commence reading the DNA.*

Techniques that apply DNA knowledge (specifically gene cloning, genetic screening and DNA profiling) including social and ethical implications and issues

Question 36

Which of the following is not an ethical implication of genetic screening of a newborn baby?

A. the rights of the individual to this information in the future
B. whether there is certainty that this information can be kept secure
C. whether it is right to perform such a test on a baby that cannot consent
D. the cost of the genetic screening test

D *This is an economic implication not an ethical one.*

Strategies that deal with the emergence of new diseases in a globally connected world, including the distinction between epidemics and pandemics, the use of scientific knowledge to identify the pathogen, and the types of treatments

Question 37

Which of the following statements best describes an epidemic?

A. a new disease that has not yet had a vaccination developed for it
B. a disease affecting a large number of individuals within a population, community, or region at the same time
C. the spread of a disease between countries and continents
D. the spread of a disease that is limited to one family

B *Option C describes a pandemic.*

The concept of rational drug design in terms of the complementary nature (shape and charge) of small molecules that are designed to bind tightly to target biomolecules (limited to enzymes) resulting in the enzyme's inhibition and giving rise to a consequential therapeutic benefit, illustrated by the Australian development of the antiviral drug Relenza as a neuraminidase inhibitor

Question 38

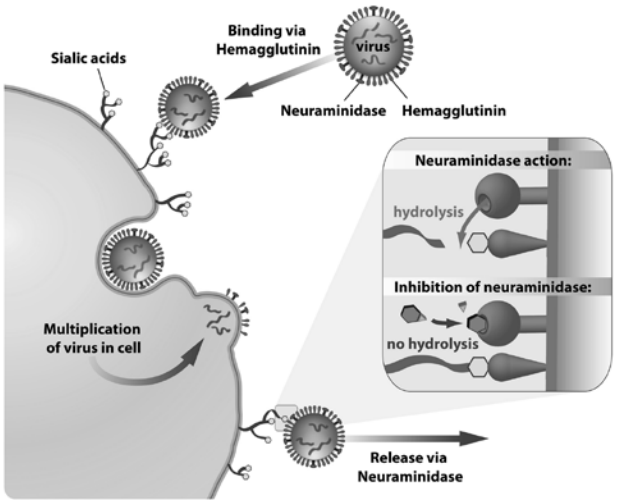
Rheumatoid arthritis is an autoimmune disorder that occurs when the immune system mistakenly attacks its own body's tissues. Rheumatoid arthritis affects the lining of the body's joints, causing a painful swelling that can eventually result in bone erosion and joint deformity. A new drug was designed to help people with this condition and is able to provide great therapeutic benefit. An example of a therapeutic benefit for the individual would be that

A. patients would only be required to take one pill per day instead of two
B. the drug would prevent the condition from being inherited by the patient's children
C. joints would swell less and the individual would experience less pain
D. the drug would prevent the condition from being transmitted to other people who had come into contact with the affected person

C *Therapeutic benefit is some form of treatment that benefits the patient affected by the condition. Option A does not refer to any impact on the condition; B and D do not relate to direct benefit to the patient in regards to the condition.*

The concept of rational drug design in terms of the complementary nature (shape and charge) of small molecules that are designed to bind tightly to target biomolecules (limited to enzymes) resulting in the enzyme's inhibition and giving rise to a consequential therapeutic benefit, illustrated by the Australian development of the antiviral drug Relenza as a neuraminidase inhibitor

Question 39



Source: https://medicalxpress.com/news/2013-02-flu-drug-virus-tracks.html

The inhibition of neuraminidase occurs via the action of:

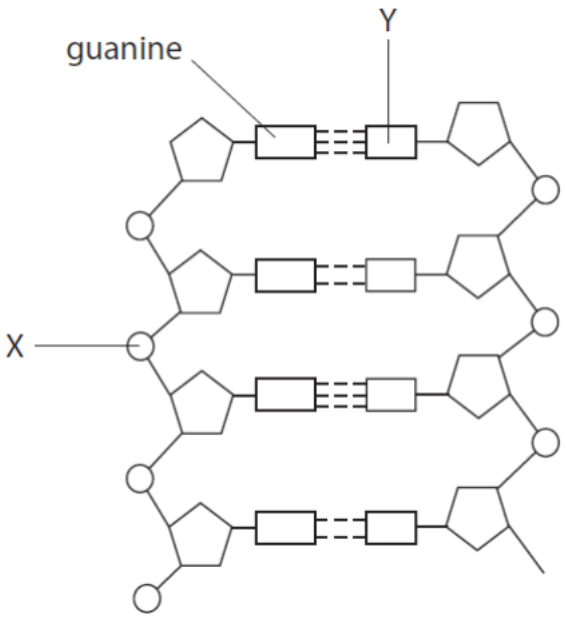
A. an antiviral drug.
B. the drug Relenza.
C. a drug that is complementary in nature to neuraminidase.
D. all of the above.

D *All of these options relate to the action of the antiviral drug Relenza that is an example referred to in the Study Design that students should be aware of.*

The use of chemical agents against pathogens including the distinction between antibiotics and antiviral drugs with reference to their mode of action and biological effectiveness	**Question 40** Which of the following is unlikely to contribute to antibiotic resistance? **A.** over-prescription of antibiotics **B.** overuse of antibiotics in livestock and fish farming **C.** patients finishing the entire antibiotic course **D.** absence of new antibiotics being discovered	*C* *Patients not finishing the entire antibiotic course would likely contribute to resistance, whereas option C is the opposite of this.*

Section B

VCAA Key Knowledge	Question	Answer guide



Source: https://blogs.glowscotland.org.uk/gc/hyndsecbiohunit1

The structure of DNA and the three forms of RNA including similarities and differences in their subunits, and their synthesis by condensation polymerisation	**Question 1a** (1 mark) List the full name of the molecule in the diagram above.	**Answer:** • *Deoxyribonucleic acid.* **Marking protocol:** One mark the above point.

The structure of DNA and the three forms of RNA including similarities and differences in their subunits, and their synthesis by condensation polymerisation	**Question 1b** (2 marks) Identify the labels X and Y.	**Answer:** • *X: Phosphate group.* • *Y: Cytosine.* **Marking protocol:** One mark for each of the above points.

The structure of DNA and the three forms of RNA including similarities and differences in their subunits, and their synthesis by condensation polymerisation	**Question 1c** (2 marks) In reference to this molecule, explain the meaning of the term 'anti-parallel'.	**Answer:** • *The strands of a DNA double helix are said to be 'anti-parallel' because they have the same chemical structure, but run in opposite in directions.* • *One runs in the 3' to 5' direction and the other in the 5' to 3' direction.* **Marking protocol:** One mark for each of the above points.

The role of different organelles including ribosomes, endoplasmic reticulum, Golgi apparatus and associated vesicles in the export of a protein product from the cell through exocytosis	**Question 1d** (3 marks) Identify three places in a plant cell where this molecule can be located.	**Answer:** • *Nucleus.* • *Chloroplast.* • *Mitochondria.* **Marking protocol:** One mark for each of the above points.

The genetic code as a degenerate triplet code and the steps in gene expression including transcription, RNA processing in eukaryotic cells and translation.	**Question 1e** (5 marks) During protein synthesis this molecule is read and another molecule is created. Describe the steps in this process, including the name of the process and of the new molecule produced.	**Answer:** • *Transcription.* • *The DNA molecule is unwound and separated.* • *The RNA polymerase enzyme moves along and reads the template strand of the DNA molecule.* • *As this occurs, complementary RNA bases are added to a new molecule of RNA.* • *The final product is a molecule of pre-mRNA.* **Marking protocol:** One mark for each of the above points.

Amylase is an enzyme that breaks down the polysaccharide starch into the monosaccharide glucose. The following results relate to three different experiments where amylase was tested to determine when its optimal activity was.

In Test 1 and 2, the temperature and pH were the only factors altered in either experiment as indicated in the table; the concentration of amylase and concentration of starch used remained the same. In Test 1, the pH was 7.0 and in Test 2, the temperature was 37.5° C.

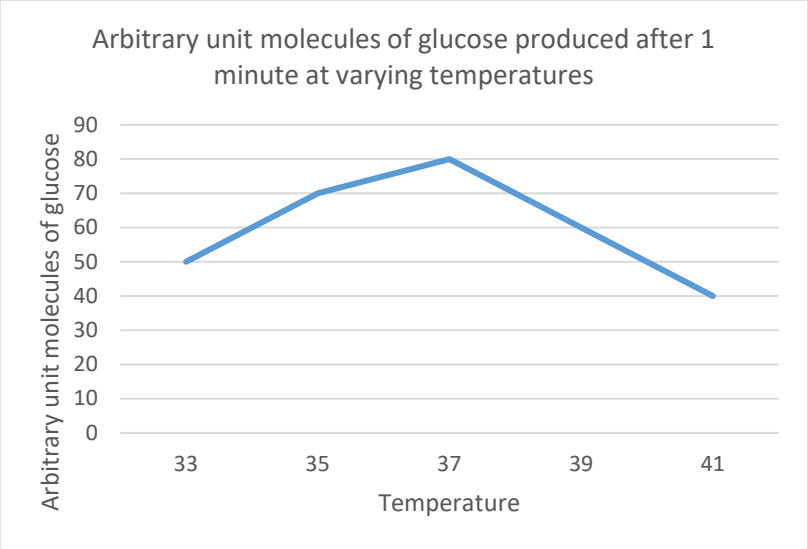
In Test 3, the temperature and pH used were the optimal for the enzyme amylase; the concentration of starch was the same as in Test 1 and 2, but the concentration of amylase was increased as indicated in the table.

Test 1 – Temperature (°C)	*Arbitrary unit molecules of glucose produced after 1 minute.*
33	*50*
35	*70*
37	*80*
39	*60*
41	*40*

Test 2 - pH	*Arbitrary unit molecules of glucose produced after 1 minute.*
4.5	*35*
5.5	*65*
6.5	*85*
7.5	*75*
8.5	*40*

Test 3 - Concentration of amylase in arbitrary units	*Arbitrary unit molecules of glucose produced after 1 minute.*
15	*80*
20	*100*
25	*140*
30	*140*
35	*140*

Independent, dependent and controlled variables	**Question 2a** (3 marks) State two variables that would need to be controlled in Test 2 to ensure that valid conclusions can be drawn from the results. Outline why such variables need to be controlled, referencing the dependent variable and independent variable in your response.	**Answer:** Examples of variables that would need to be controlled include: • *Temperature.* • *Concentration of starch.* • *Concentration of amylase.* • *Method of measurement for arbitrary unit molecules of glucose produced after 1 minute.* • *Method used to time for 1 minute.* • *Type of equipment used to mix starch and amylase.* AND • *These variables need to be kept constant across the differing pH levels tested, so that the change in arbitrary unit molecules of glucose produced after 1 minute (dependent variable), can be attributed to the change in the pH level (independent variable).* **Marking protocol:** One mark for two correct variables that need to be controlled. Two additional marks for outlining the need to control such variables, with one of these being awarded to correctly stating the dependent and independent variable in the answer.

Methods of organising, analysing and evaluating primary data to identify patterns and relationships including sources of error and limitations of data and methodologies	**Question 2b** (3 marks) Graph the results for Test 1.	**Answer:**  **Marking protocol:** One mark for correct plotting, one mark each for correctly labelled and set out axis.

Methods of organising, analysing and evaluating primary data to identify patterns and relationships including sources of error and limitations of data and methodologies	**Question 2c** (1 mark) Draw a conclusion regarding the optimal temperature for the action of amylase. Refer to data in your answer.	**Answer:** • *From the results, the optimal temperature for the action of amylase appears to be 37°C. This is where the highest arbitrary unit molecules of glucose are produced after 1 minute: 80 units.* **Marking protocol:** One mark for the above point.

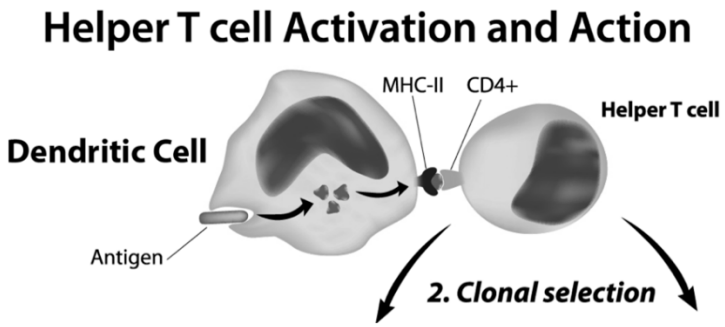
Models, theories and classification keys, and their use in organising and explaining observed phenomena and biological concepts including their limitations *The role of enzymes as protein catalysts in biochemical pathways*	**Question 2d** (2 marks) Given your knowledge of enzyme structure and function, describe the likely reason for the results obtained at 41°C in Test 1.	**Answer:** • *It is likely that the enzyme amylase has begun to denature at this temperature.* • *This means that the active site is likely to have begun to change shape, and therefore, starch is less able to combine easily with the amylase, leading to fewer molecules of glucose (40 arbitrary units) being produced at this temperature.* **Marking protocol:** One mark for each of the above points.

Independent, dependent and controlled variables	**Question 2e** (2 marks) Given the experimental design of the temperature and pH tests, describe why it is difficult to compare the results between Test 1 and Test 2, and difficult to make a conclusion about the combined optimal temperature **and** pH for amylase function.	**Answer:** • *In Test 1, the pH was 7.0 and in Test 2, the temperature was 37.5°C. These values are different from the temperatures and pH tested in either Test 1 or Test 2 respectively.* • *Therefore, as none of the conditions were identical across the two tests, it is difficult to make a conclusion about the combined optimal temperature **and** pH for amylase function.* **Marking protocol:** One mark for each of the above points.

The role of enzymes as protein catalysts in biochemical pathways	**Question 2f** (2 marks) Explain a likely reason why the arbitrary unit molecules of glucose produced after one minute remained constant at 140 units for amylase concentrations 25-35.	**Answer:** • *It is likely that at amylase concentrations 25-35, all of the starch product had been broken down after one minute.* • *Therefore, an increase in glucose units did not go beyond 140 units at these concentrations.* **Marking protocol:** One mark for each of the above points.

The functional distinction between structural genes and regulatory genes	**Question 3a** (2 marks) What is the functional difference between a regulatory gene and a structural gene?	**Answer:** • *Structural genes code for proteins required for the body to function, whereas…* • *…a regulatory gene produces proteins that act to switch on or off structural genes.* **Marking protocol:** One mark for each of the above points.

Use of the lac operon as a simple prokaryotic model that illustrates the switching off and on of genes by proteins (transcriptional factors) expressed by regulatory genes.	**Question 3b** (2 marks) In relation to energy conservation, explain the importance of transcriptional factors in the lac operon.	**Answer:** • *Transcriptional factors expressed by the regulatory gene, without the presence of lactose, combine with the operator and prevent the enzymes (structural genes) that break down lactose from being produced.* • *This means that energy is conserved, as these enzymes are not required when no lactose is present, as there is nothing to break down.* **Marking protocol:** One mark for each of the above points.



Source: https://immunecells21.com/dendritic-cells/dendritic-cells-immuncells21/

The characteristics and roles of components (macrophages, neutrophils, mast cells, dendritic cells, complement proteins) of the innate (non-specific) immune response to an antigen including the steps in the inflammatory response	**Question 4a** (1 mark) Which immune response do dendritic cells belong to?	**Answer:** • *The innate immune response.* **Marking protocol:** One mark for the above point.

The characteristics and roles of components (macrophages, neutrophils, mast cells, dendritic cells, complement proteins) of the innate (non-specific) immune response to an antigen including the steps in the inflammatory response	**Question 4b** (2 marks) With reference to the image above, outline the role of a dendritic cell as messengers between the two types of immune responses.	**Answer:** • *Dendritic cells are antigen presenting cells. They engulf pathogens, process antigen material, and present it on their cell surface (on MHC-II markers) to Helper T cells.* • *They act as messengers between the innate and adaptive immune responses.* **Marking protocol:** One mark for each of the above points.

The characteristics and roles of components of the adaptive (specific) immune response including the actions of B lymphocytes and their antibodies (including antibody structure) in humoral immunity, and the actions of T helper and T cytotoxic cells in cell-mediated immunity.	**Question 4c** (3 marks) Describe clonal selection, expansion and differentiation, including a reference to Helper T cells.	**Answer:** • *Once Helper T cells are activated by an antigen presenting cell, they produce cytokines to stimulate B cells (who have also detected the antigen).* • *B cells then proliferate and differentiate to produce plasma cells, which produce specific antibodies.* • *B cells also differentiate into memory cells, which remain in the body in case of future re-infection.* **Marking protocol:** One mark for each of the above points.

The deficiencies and malfunctions of the immune system as a cause of human diseases including autoimmune diseases (illustrated by multiple sclerosis), immune deficiency diseases (illustrated by HIV) and allergic reactions (illustrated by reactions to pollen)	**Question 4d** (1 mark) Name the immune deficiency disease that can result when large numbers of Helper T cells are destroyed.	**Answer:** • *Acquired Immune Deficiency Syndrome (AIDS).* **Marking protocol:** One mark for the above point.

The difference between natural and artificial immunity, and active and passive strategies for acquiring immunity	**Question 4e** (1 mark) Is the form of immunity initiated by Helper T cells active or passive? Justify your response.	**Answer:** • *Active.* • *It involves the production of specific antibodies and memory cells by the body.* **Marking protocol:** One mark for both of the above points.

Although the Cretaceous-Tertiary (or K-T) extinction event is the most well-known because it wiped out the dinosaurs, a series of other mass extinction events have occurred throughout the history of the Earth, some even more devastating than K-T. The most severe occurred at the end of the Permian period when 96% of all species perished. This along with K-T are two of the Big Five mass extinctions, each of which wiped out at least half of all species. Many smaller scale mass extinctions have occurred; indeed, the disappearance of many animals and plants at the hands of humans in prehistoric, historic and modern times will eventually be shown in the fossil record as mass extinctions.

Source: http://www.bbc.co.uk/nature/extinction_events

Patterns of biological change over geological time including divergent evolution, convergent evolution and mass extinctions.	**Question 5ai** (1 mark) What is a mass extinction?	**Answer:** • *Mass extinctions are periods in earth's history when abnormally large numbers of species die out simultaneously or within a limited time frame.* **Marking protocol:** One mark for the above point.

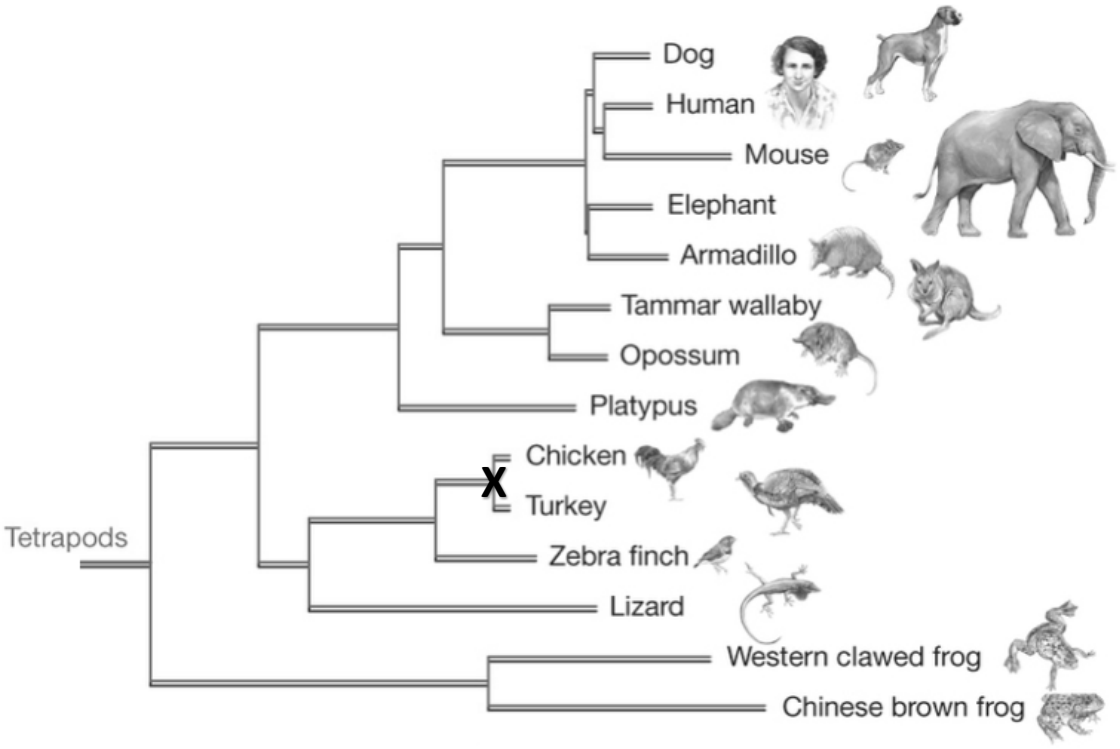
Patterns of biological change over geological time including divergent evolution, convergent evolution and mass extinctions.	**Question 5aii** (1 mark) Describe why, following mass extinctions, there may be significant differences in the fossil record.	**Answer:** • *As a high number of species are wiped out during mass extinctions, other species then proliferate and are therefore present in the fossil record following mass extinctions.* **Marking protocol:** One mark for the above point.

Evidence of biological change over time including from palaeontology (the fossil record, the relative and absolute dating of fossils, types of fossils and the steps in fossilisation), biogeography, developmental biology and structural morphology	**Question 5b** (2 marks) Identify two types of fossils that may be present in the fossil record of the earth.	**Answer:** • *Mold.* • *Cast.* • *Direct.* • *Indirect.* **Marking protocol:** One mark for any of the above points, to a maximum of two.

Evidence of biological change over time including from palaeontology (the fossil record, the relative and absolute dating of fossils, types of fossils and the steps in fossilisation), biogeography, developmental biology and structural morphology	**Question 5c** (4 marks) The fossil record is one piece of evidence of biological change over time. Name and describe two others.	**Answer:** • *Biogeography.* *Where evolution and evolutionary relationships are determined based on the distribution of species across earth over time.* • *Structural morphology.* *Where evolution and evolutionary relationships are determined based on similarities or differences in structure.* • *Developmental biology.* *Where evolution and evolutionary relationships are determined based on similarities or differences in embryonic development.* **Marking protocol:** Two marks for any of the above points, to a maximum of four. One mark for the name and one mark for the description.

Evidence of biological change over time including from palaeontology (the fossil record, the relative and absolute dating of fossils, types of fossils and the steps in fossilisation), biogeography, developmental biology and structural morphology	**Question 5d** (2 marks) Using an example, outline why terrestrial animals are less likely to fossilise when compared to aquatic animals.	**Answer:** • *Terrestrial or land animals live in an environment where the conditions for fossilisation are less favourable than in aquatic environments.* • *For example, it is less likely that a terrestrial animal, such as a fox, will die and be covered by mud or silk before being consumed than it is for an aquatic animal that dies, such as a fish.* **Marking protocol:** One mark for each of the above points.

Scientists can examine a range of evidence to create a phylogenetic tree. One such tree is depicted in the image below.



Source: Adapted from https://whyevolutionistrue.files.wordpress.com/2013/04/coelacanth-genome-tree.jpg

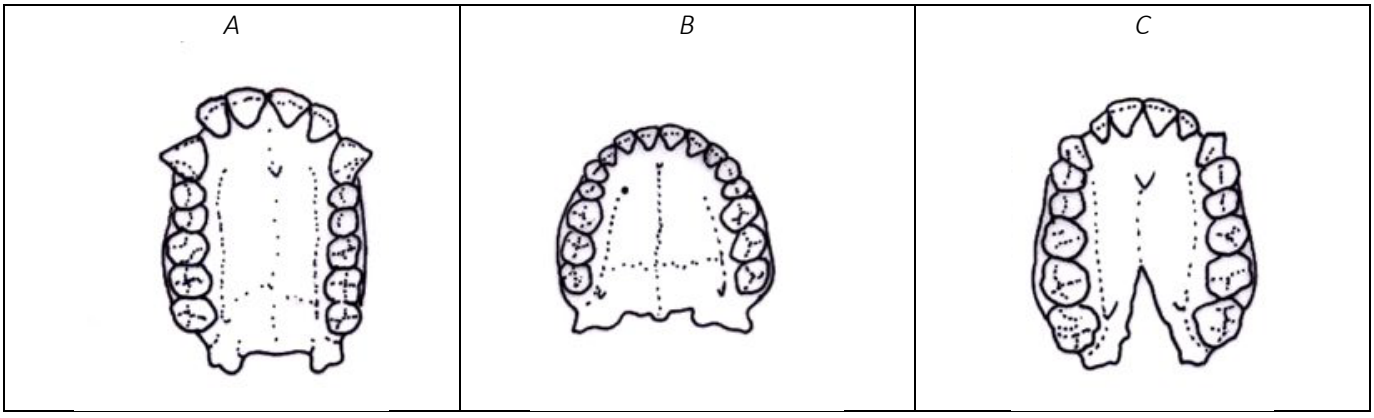
The use of phylogenetic trees to show relatedness between species	**Question 6a** (1 mark) What is the purpose of a phylogenetic tree such as the one in the image above?	**Answer:** • *Phylogenetic trees demonstrate evolutionary relationships between organisms.* **Marking protocol:** One mark for the above point.

The use of phylogenetic trees to show relatedness between species	**Question 6b** (1 mark) According to the phylogenetic tree, which two species is the platypus most closely related to?	**Answer:** • *Opossum.* • *Tammar wallaby.* **Marking protocol:** One mark for both of the above points.

The qualitative treatment of the causes of changing allele frequencies in a population's gene pool including types of mutations (point, frameshift, block) as a source of new alleles, chromosomal abnormalities (aneuploidy and polyploidy), environmental selection pressures on phenotypes as the mechanism for natural selection	**Question 6c** (4 marks) At point X on the diagram, the Chicken and Turkey diverged and eventually became separate species. Outline how this may have occurred using the following terms in your response: • Common ancestor • Geographic isolating mechanism • Generations • Viable offspring	**Answer:** • *The Chicken and Turkey had a common ancestor, and in this species, there must have been phenotypic variation.* • *At point X, there may have been a geographic isolating mechanism, such as a mountain range, that separated the common ancestor. These two new populations are then likely to have been exposed to different selection pressures that selected for different characteristics in each group.* • *Over many generations with no gene flow between the two populations, they are likely to have diverged and become different species.* • *This could be confirmed by their inability to produce viable offspring when brought back together to mate.* **Marking protocol:** One mark for each of the above points or a similar answer that incorporates all terms.

Molecular homology as evidence of relatedness between species including DNA and amino acid sequences, mtDNA (the molecular clock) and the DNA hybridisation technique	**Question 6d** (2 marks) A phylogenetic tree can be created by comparing the similarities and differences between specific molecular sequences of different species. Identify two molecules that could be used in this manner.	**Answer:** • *DNA* • *Amino acid sequence* • *mtDNA* **Marking protocol:** One mark for any of the above points, to a maximum of two.

The dental arcade is the shape made by the rows of teeth in the upper jaw. This illustration shows the difference between the dental arcade of an ape, Australopithecus africanus and modern human, Homo sapiens.



Source: https://australianmuseum.net.au/image/dental-arcade

Major trends in hominin evolution from the genus Australopithecus to the genus Homo including structural, functional and cognitive changes and the consequences for cultural evolution	**Question 7a** (1 mark) Which dental arcade is most likely to be that of Australopithecus africanus?	**Answer:** • *C* **Marking protocol:** One mark for the above point.

Major trends in hominin evolution from the genus Australopithecus to the genus Homo including structural, functional and cognitive changes and the consequences for cultural evolution	**Question 7b** (1 mark) Justify your answer to 7a.	**Answer:** • *Given B is the most parabolic jaw and therefore likely belongs to the modern human, and A is the least parabolic and likely belongs to the ape, Australopithecus africanus is likely C.* OR • *The canine teeth in jaw C are less sharp than jaw A, which likely belongs to the ape, and more sharp than jaw B which likely belongs to the modern human, therefore Australopithecus africanus is likely C.* **Marking protocol:** One mark for either of the above points.

Major trends in hominin evolution from the genus Australopithecus to the genus Homo including structural, functional and cognitive changes and the consequences for cultural evolution	**Question 7c** (2 marks) In addition to changes in the dental arcade from the genus *Australopithecus* to the genus *Homo,* structural changes in the pelvis occurred. Give an example of such a change and outline how this change was advantageous to members of the genus *Homo*.	**Answer:** • *The pelvis became broader and more 'bowl-shaped' from Australopithecus to Homo.* • *This supported greater weight distribution which made walking upright easier for members of the genus Homo, therefore making it easier to pick fruits and other food from low-lying tree branches.* **Marking protocol:** One mark for each of the above points.

Major trends in hominin evolution from the genus Australopithecus to the genus Homo including structural, functional and cognitive changes and the consequences for cultural evolution	**Question 7d** (3 marks) Describe cultural evolution and outline how it may have influenced the structures seen in the image.	**Answer:** • *Cultural evolution refers to changes in human societies over time where those changes are socially transmitted, not genetically inherited.* • *The method for the development and use of tools may have been passed on through generations, therefore requiring less use of sharp teeth for fighting.* • *This may have contributed to jaws with less sharp canine teeth as observed from images A to C to B.* **Marking protocol:** One mark for each of the above points.

The use of gel electrophoresis in sorting DNA fragments, including interpretation of gel runs	**Question 8a** (1 mark) Name the technique used to sort DNA fragments based on their size.	**Answer:** • *Gel electrophoresis.* **Marking protocol:** One mark for the above point.

The use of gel electrophoresis in sorting DNA fragments, including interpretation of gel runs	**Question 8b** (4 marks) Describe the steps involved in sorting DNA fragments using the technique named in 8a. Include an explanation of how this technique works to sort such fragments.	**Answer:** • *DNA samples are placed into wells in one end of the slab of gel (the negative electrode end).* • *Electrodes are attached to each end of the gel and an electric current is passed through the gel from the negative end to positive end.* • *DNA is negatively charged, so it moves towards the positive end of the gel.* • *The smaller pieces are lighter so are able to travel further along the gel than the longer pieces. The size of each piece of DNA gives information about the number of bases present in each strand.* **Marking protocol:** One mark for each of the above points.

Techniques that apply DNA knowledge (specifically gene cloning, genetic screening and DNA profiling) including social and ethical implications and issues	**Question 8c** (4 marks) Outline how the technique named in 8a could be used by law enforcement officials in a case where there are multiple suspects and a blood sample from the crime scene.	**Answer:** • *A blood sample could be taken from the multiple suspects and the DNA isolated from each blood sample.* • *The same specific region of DNA from the suspects' blood samples (the same region as the blood sample from the crime scene) should be amplified via PCR and a restriction enzyme(s) used to digest the DNA into fragments.* • *The fragments should then be run in gel electrophoresis.* • *The DNA from the blood sample from the crime scene should also be run through gel electrophoresis, as outlined above, to determine if there is a match with one of the suspects.* **Marking protocol:** One mark for each of the above points.

Orb-web spiders produce a variety of silks that have excellent mechanical properties. For example, their dragline silk proteins are among the strongest fibres, approximately five times stronger than steel. It is difficult however to produce an artificial fibre that can be as long and strong.

Transgenic silkworms have been created to produce the dragline silk protein in their cocoon silk. Using these silkworms, significant amounts of the silk can then be produced in a controlled environment.

Source: Adapted from http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0105325

The distinction between genetically modified and transgenic organisms, their use in agriculture to increase crop productivity and to provide resistance to insect predation and/or disease, and the biological, social and ethical implications that are raised by their use	**Question 9a** (2 marks) Referencing the information provided, what is a transgenic organism?	**Answer:** • *A transgenic organism contains genes from another species.* • *For example, the transgenic silkworm would possess the dragline silk protein gene from the orb-web spider.* **Marking protocol:** One mark for each of the above points.

The distinction between genetically modified and transgenic organisms, their use in agriculture to increase crop productivity and to provide resistance to insect predation and/or disease, and the biological, social and ethical implications that are raised by their use	**Question 9b** (2 marks) Some scientists are concerned with the potential negative biological implications that could arise from the creation of transgenic organisms such as the transgenic silkworm. In relation to the information provided, outline one biological implication and why it may be of concern.	**Answer:** • *There is the potential for the transgenic silkworm to move from the 'controlled environment' into the natural environment.* • *This could potentially lead to the 'original' non-transgenic species and the transgenic silkworms mating, therefore potentially leading to the loss of the 'original' species over time, reducing genetic variation.* **Marking protocol:** One mark for each of the above points.

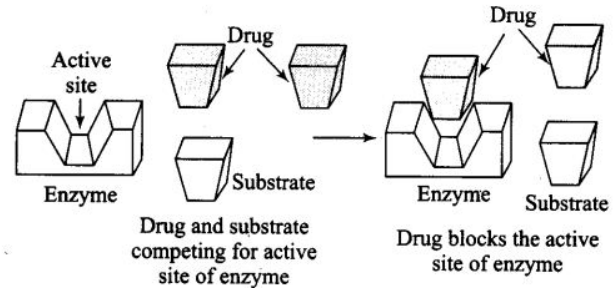
The concept of rational drug design in terms of the complementary nature (shape and charge) of small molecules that are designed to bind tightly to target biomolecules (limited to enzymes) resulting in the enzyme's inhibition

Question 10a (2 marks)
Explain the steps involved in rational drug design. You may use an illustration to support your response.

Answer:

- *Research into a disease/condition shows an enzyme associated with the disease and a drug is designed to act specifically on this enzyme.*
- *The drug binds to the enzyme to prevent the disease/condition from occurring.*

Example of a possible illustration:



Source: http://www.learncbse.in

Marking protocol:

One mark for each of the above points. If a response does not correctly explain the steps but uses an illustration that demonstrates a drug preventing the function on an enzyme, it can be awarded a maximum of one mark.

The concept of rational drug design in terms of the complementary nature (shape and charge) of small molecules that are designed to bind tightly to target biomolecules (limited to enzymes) resulting in the enzyme's inhibition

Question 10b (2 marks)
Contrast the two types of inhibition of enzymes that may be the focus of drugs developed through rational drug design.

Answer:

- *Competitive inhibition is where the active site of an enzyme is blocked by the drug preventing the substrate from combining with it,*
- *whereas non-competitive inhibition is where the drug binds to another part of the enzyme (the allosteric site), causing the enzyme to change shape so that the substrate can no longer bind with it.*

Marking protocol:

One mark for each of the above points. If the response names both competitive and non-competitive inhibition, however incorrectly describes them, it can be awarded one mark.

VCE BIOLOGY
Written Examination
ANSWER SHEET – 2018

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					