



Biology Assessment Guide 2017

Section A

VCAA Key Knowledge

Question

Answer guide

Use the following information to answer Questions 1 and 2.

Jessie hypothesised that if she increased the amount of fertiliser given to her plants, then this would make them grow faster. She decided to conduct an experiment to test her prediction.

Independent, dependent and controlled variables

Question 1

The independent variable in Jessie's experiment would be

- A. the speed of growth of the plants.
- B. the amount of light the plants would be exposed to.
- C. the type of plant used.
- D. the amount of fertiliser given to the plants.

D *The independent variable is the factor that is changed between groups in 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

If the measurement tool used by Jessie to assess speed of plant growth was faulty and produced consistently incorrect results, this would be an example of a

- A. random error.
- B. systematic error.
- C. human error.
- D. sample size error.

B *An error in equipment that produces incorrect results by a consistent amount is a systematic error.*

Apply ethical principles when undertaking and reporting investigations

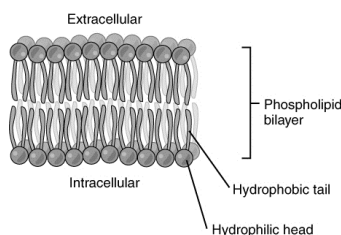
Question 3

Which of the following is not an example of an ethical principle when undertaking and reporting investigations?

- A. respect privacy and confidentiality
- B. do no harm
- C. do not fabricate or falsify data or results
- D. do not experiment on humans

D *Humans can be involved in experiments, however often there are very strict ethical hurdles that must be overcome for an experiment to proceed.*

Use the following information to answer Questions 4 and 5.



Source: <http://www.macroevolution.net/fluid-mosaic-model.html>

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 section of a plasma membrane. Identify the molecule that would not be able to pass through this section.

- A. water
- B. glucose
- C. carbon dioxide
- D. lipid

B Glucose is too large to pass through the phospholipid bilayer.

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

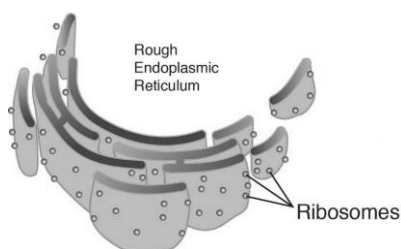
Question 5

In which of the following processes does the plasma membrane play no role?

- A. transcription
- B. active transport
- C. signal transduction
- D. phagocytosis

A Transcription occurs in the nucleus and involves converting DNA to mRNA. The plasma membrane is not involved.

Use the following information to answer Question 6.



Source: <https://www.emaze.com/@AIQQLRQW/Eukaryotic-Cells>

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

A function of the organelle above includes

- A. to carry out photosynthesis.
- B. packaging and transport of DNA.
- C. synthesis and transport of proteins.
- D. synthesis and transport of carbohydrates.

C Proteins are synthesised at the ribosome and transported by the endoplasmic reticulum.

Nucleic acids as information molecules that encode instructions for the synthesis of proteins in cells

Question 7

DNA and RNA are both similar in that they

- A. are both composed of a double helix.
- B. both contain the sugar deoxyribose.
- C. are both translated at the ribosome.
- D. are both composed of nucleotides.

D DNA and RNA are both made up of nucleotide monomers which each contain a pentose sugar, nitrogen containing base and phosphate group.

The functional importance of the four hierarchical levels of protein structure

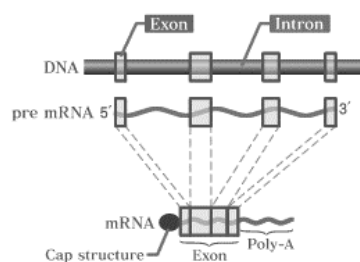
Question 8

Tertiary structure

- A. involves amino acid side chains bonding in a number of ways.
- B. does not influence the function of a protein.
- C. is composed of one or more polypeptide chains.
- D. is characterised by alpha helices and beta pleated sheets.

A The bonding between amino acid side chains contributes to the 3D shape that signifies tertiary protein structure.

Use the following information to answer Question 9.



Source: http://csis-text.c.u-tokyo.ac.jp/images/fig/fig03_8.gif

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

The image above depicts

- A. translation.
- B. RNA processing,
- C. reverse transcription.
- D. the polymerase chain reaction.

B The image depicts introns being removed from pre-mRNA and exons being joined together – this is RNA processing.

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

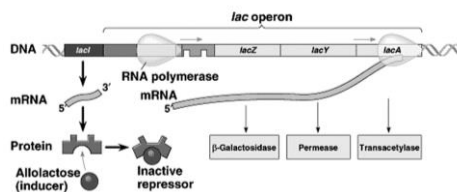
Question 10

The genetic code is a degenerate triplet code; this means

- A. there are three parts of a nucleotide.
- B. that DNA and RNA are composed of only three different bases.
- C. one codon may code for three different amino acids.
- D. several different codons may code for the same amino acid.

D A codon is a three base sequence of mRNA. Several codons can code for the same amino acid.

Use the following information to answer Questions 11 and 12.



Source: <http://www.namrata.co/wp-content/uploads/2013/05/Lac-operon-On.png>

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 11

In the image above lacZ, lacY and lacA are examples of

- A. structural genes.
- B. enzymes.
- C. regulatory genes.
- D. inhibitors.

A Genes under the control of a regulatory gene are structural genes. Structural genes code for proteins that play a structural role in a cell.

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 12

The site where RNA polymerase attaches is the

- A. regulatory gene.
- B. operator region.
- C. promoter region.
- D. ribosome.

C The promoter region is where RNA polymerase attaches before it attempts to read the structural genes.

The cycling of coenzymes (ATP, NADH, and NADPH) as loaded and unloaded forms to move energy, protons and electrons between reactions in the cell

Question 13

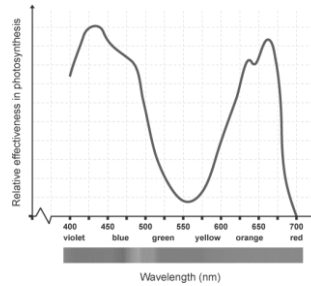
Coenzymes

- A. only have a loaded form.
- B. only move energy between reactions in the cell.
- C. move energy and electrons between reactions in the cell.
- D. move energy, electrons and protons between reactions in the cell.

D As per the study design dot point, coenzymes can move energy, electrons and protons between reactions in the cell.

Use the following information to answer Question 14.

The following action spectrum shows how effective the different wavelengths of light are for photosynthesis.



Source: <http://www.bbc.co.uk/education/guides/z23ggk7/revision/2>

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

Question 14

Which of the following statements is most consistent with the information presented in the graph?

- A. photosynthesis is likely to occur at the highest rate at midday when the wavelengths of light being absorbed by a plant are most likely to be 670nm
- B. the light dependent stage of photosynthesis would not occur if wavelengths of light of only 550nm were present
- C. it would be expected that a plant will produce the highest rate of glucose if exposed to approximately 425nm wavelengths of light
- D. photosynthesis would continue throughout the night as moonlight contributes light of wavelength approximately 650nm

C *The graph demonstrates that photosynthesis is most likely to be occurring at the highest rates at approximately 425nm wavelength of light - photosynthesis produces glucose.*

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

Question 15

Evidence that supports the bacterial origin of chloroplasts includes the

- A. presence of ribosomes.
- B. presence of a double membrane.
- C. both A and B.
- D. presence of a cell wall.

C *Ribosomes, a double membrane, replication via binary fission and the presence of DNA are all evidence of the bacterial origin of chloroplasts.*

The location of anaerobic cellular respiration, its inputs and the difference in outputs between animals and yeasts including ATP yield

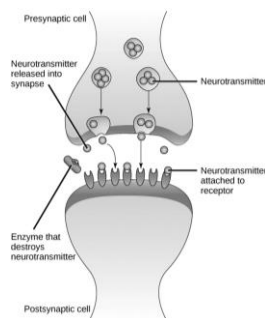
Question 16

Anaerobic respiration

- A. is the body's preferred form of energy production.
- B. is more efficient than aerobic respiration.
- C. is carried out in the mitochondria.
- D. requires more than one input.

D *Glucose, ADP and Pi are all inputs to anaerobic respiration. Note: some texts also reference NAD as an input.*

Use the following information to answer Question 17.



Source: <https://qubeshub.org/groups/summer2017>

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

The image above depicts

- A. pheromones in action.
- B. a hydrophilic signalling molecule in action.
- C. a hydrophobic signalling molecule in action.
- D. rational drug design in action.

B The neurotransmitters in the image are binding to receptors on the cell membrane of the receptor cell. This suggests that they are hydrophilic.

Apoptosis as a natural, regulatory process of programmed cell death

Question 18

Apoptosis

- A. is tightly regulated.
- B. can only be triggered by an external signalling molecule.
- C. is the only cell process that can malfunction and result in cancer.
- D. is less likely to malfunction as people age.

A Apoptosis is programmed cell death and this process is initiated by signalling molecules.

The characteristics and roles of components of the adaptive (specific) immune response including the actions of B lymphocytes and their antibodies (including antibody structure)

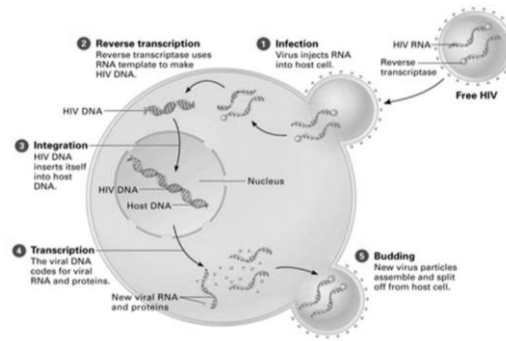
Question 19

Different antigen-binding sites on different antibodies

- A. is a result of the type of pathogen that infects a host.
- B. is a result of the recombination of genetic material that codes for this region.
- C. leads to an individual being able to produce many types of T helper cells.
- D. is a form of passive immunity.

B Antigen binding sites are coded for by DNA. The recombination of specific sequences of DNA leads to the variety of antigen binding sites found on different antibodies.

Use the following information to answer Question 20.



Source: <http://slideplayer.com/slide/10260209/>

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)

Question 20

This image demonstrates that HIV

- A. is cellular.
- B. is an adenovirus.
- C. is a retrovirus.
- D. is unlikely to kill its host cell.

C *HIV replicates via its RNA genome. Virus that contain RNA and use this to replicate are known as retroviruses.*

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 21

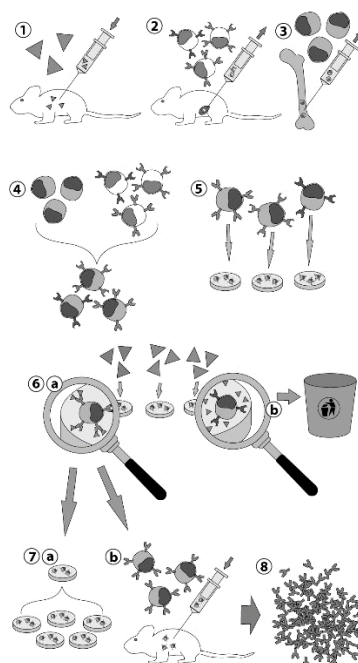
A doctor may prescribe a broad-spectrum antibiotic to treat a suspected bacterial infection. A disadvantage of using a broad-spectrum antibiotic is

- A. it may contribute to the development of antibiotic resistance.
- B. it will slow the ability of a doctor to treat an infection quickly.
- C. it will kill only one type of bacteria.
- D. it will also remove the lining of the stomach.

A *Broad-spectrum antibiotics are effective against a wide range of antibiotics. When used in treatment they may kill off a wide range of bacteria and leave resistant bacteria in the conditions that allow them to flourish, e.g. lack of competition for resources.*

Use the following information to answer Questions 22 and 23.

The steps below outline the steps that may be taken to create monoclonal antibodies.



Source: <http://www.antibodies-online.com/resources/16/1209/monoclonal-antibodies/>

The use of monoclonal antibodies in treating cancer

Question 22

At step 2

- A. an antigen is injected into the mouse.
- B. cancer cells are taken from the mouse.
- C. B cells are taken from the mouse.
- D. only antibodies are removed from the mouse.

C B cells that have the ability to create the desired antibody are taken from the mouse.

The use of monoclonal antibodies in treating cancer

Question 23

Monoclonal antibodies used to treat cancer in a human patient are a form of

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

A Passive immunity is when antibodies are introduced into a person from an external source.

Use the following information to answer Questions 24 and 25.

A population of rabbits was thriving in its habitat until the introduction of a new family of foxes by the local farmer. The farmer wanted to reduce the rabbit numbers as they were eating much of his wheat crop. Prior to the introduction of the fox family, the rabbit population contained a 0.8 allele frequency for light fur (a) and a 0.2 allele frequency for dark fur (A). The fox family tended to hunt at night time where the light fur rabbits were easier to detect and capture.

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 24

After the introduction of the foxes, it is likely that over time

- A. the allele frequency for fur colour would remain unchanged.
- B. the allele frequency for dark fur would decrease.
- C. the allele frequency for light fur would decrease.
- D. a new type of fur colour would develop.

C The foxes are likely to kill more light fur rabbits. This would most likely decrease the allele frequency for light fur in this population.

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

The likely effect on the rabbit population over time due to the introduction of the foxes is an example of

- A. the founder effect.
- B. convergent evolution.
- C. gene flow.
- D. natural selection.

D *The dark fur rabbits have a characteristic that is likely to favour their survival over the light fur rabbits. This is a characteristic of natural selection.*

The manipulation of gene pools through selective breeding programs

Question 26

Selective breeding

- A. always increases genetic variation.
- B. has no impact on the gene pool.
- C. can have health implications for some species.
- D. is limited to animal populations.

C *Selective breeding of animals by humans can lead to some species possessing structural qualities that may increase their risk of developing health conditions.*

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

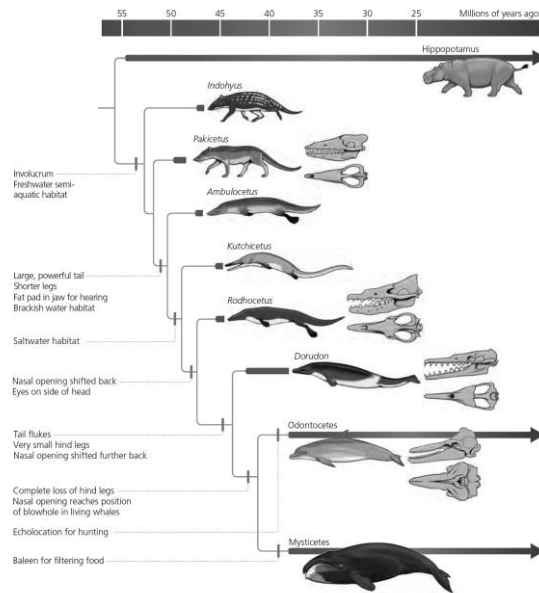
Question 27

The first flowering plants appeared in the

- A. Precambrian period.
- B. Cretaceous period.
- C. Cambrian period.
- D. Quaternary period.

B *Flowering plants appear in the fossil record in the Cretaceous period.*

Use the following information to answer Questions 28 and 29.



Source: <http://phenomena.nationalgeographic.com/bigger-whale-tree/>

The use of phylogenetic trees to show relatedness between species

Question 28

The information above suggests that Kutuchicetus

- A. used echolocation for hunting.
- B. was most closely related to mysticetes.
- C. lived in saltwater.
- D. hunted mainly freshwater fish.

C The information provided demonstrates all organisms from Kutuchicetus onwards live/d in saltwater.

Patterns of biological change over geological time including divergent evolution, convergent evolution and mass extinctions

Question 29

The image above depicts

- A. divergent evolution.
- B. convergent evolution.
- C. analogous structures.
- D. allopatric speciation.

A The organisms are becoming more different as time progresses.

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 30

The following are all examples of trends in hominin evolution except

- A. the anterior movement of the foramen magnum.
- B. an increase in brain case size.
- C. a decrease in size of the teeth.
- D. a decrease in size of the heel bone.

D The heel bone increased in size to assist with upright walking.

Use the following information to answer Question 31.

Many biologists and social scientists have noted that with the development of human culture, the biological evolution of *Homo sapiens* was taken over by socio-cultural evolution. The construction of artificial environments and social structures created new criteria for selection, and biological fitness was replaced by 'cultural fitness', which is often different for different cultures and is generally not measured by the number of offspring. Moreover, the mechanism of socio-cultural evolution is different from the model of biological evolution that was proposed by Charles Darwin (1809–1882), and refined by many others. In essence, socio-cultural evolution is 'Lamarckian' in nature—it is an example of acquired inheritance, as described by the French naturalist Jean-Baptiste Lamarck (1744–1829)—because humans are able to pass on cultural achievements to the next generation.

Source: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3327546/>

*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 31

This information suggests

- A. cultural evolution is solely linked to one's gene.
- B. cultural evolution is likely to be quicker than biological evolution.
- C. biological evolution is likely to be taken over by cultural evolution in all species.
- D. Lamarck was more correct than Darwin when explaining the nature of evolution.

B *Cultural evolution is not dependent on genetics and therefore can occur more quickly than biological evolution.*

The use of enzymes including endonucleases (restriction enzymes), ligases and polymerases

Question 32

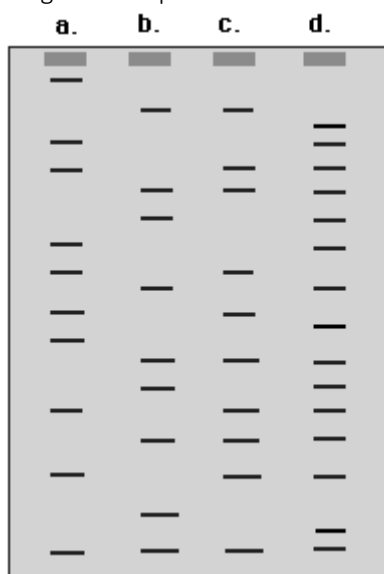
The similarity between DNA and RNA polymerase is that

- A. they both lead to the production of semi-conservative molecules.
- B. they both act outside the nucleus.
- C. they both create a nucleic acid strand consisting of complementary nucleotides in a 3' – 5' direction.
- D. they both read DNA in a 3' – 5' direction.

D *DNA is always read in a 3' – 5' direction.*

Use the following information to answer Question 33.

The image below depicts a gel electrophoresis run from a husband (a) and wife (b).



Source: http://www.pleasanton.k12.ca.us/avhsweb/thiel/bio/labs/gel_lab.html

The use of gel electrophoresis in sorting DNA fragments, including interpretation of gel runs

Question 33

From the information above, which of the following statements is correct?

- A. neither lane c or d is likely to be a child of the husband or wife
- B. lane d is likely the child of the husband and wife
- C. lane c is likely the child of the husband and wife
- D. lane c and d are identical twins

C All of the banding patterns for lane c match either the husband or wife's banding patterns.

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 34

Transgenic organisms

- A. contain genes from other species.
- B. have had their own genetic material altered.
- C. cannot be used to increase resistance to disease.
- D. are restricted to plant species.

A This is the definition of a transgenic organism.

Use the following information to answer Question 35.

Late in the spring of 1918 the Spanish wire service Agencia Fabra sent cables of an unusual nature to Reuter's news service headquarters in London. "A strange form of disease has appeared in Madrid," it said. "The disease is of a mild nature, no deaths having been reported." The illness began with a cough, then headache and backache, fatigue, high fever, racing heart, loss of appetite and labored breathing. It usually lasted about three days. Cases had cropped up over the spring and summer in other countries, too, from Norway to India, China to Costa Rica. But in Spain, suddenly 8 million people were down with the bug. And as the summer of 1918 turned to fall, the disease lost its mildness: people started to die.

The influenza commonly called "Spanish flu" killed more people than the guns of World War I. Estimates put the worldwide death toll at 21,642,274. Some one billion people were affected by the disease -- half of the total human population. It came at a time when 19 nations were at war and the disruption, stress, and privation of war certainly aided the flu's transmission. It killed people on every continent except Antarctica, with the most lives lost in Asia and the highest percentage of population killed in India. From August 1918, when cases of the flu started looking abnormally high, until the following July when they returned to about normal, 20 million Americans became sick and more than 500,000 died. In October, 1918, the flu reached its peak, killing about 195,000 Americans. About 57,000 American soldiers died from influenza while the U.S. was at war; about 53,500 died in battle.

Source: <http://www.pbs.org/wgbh/aso/databank/entries/dm18fl.html>

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 35

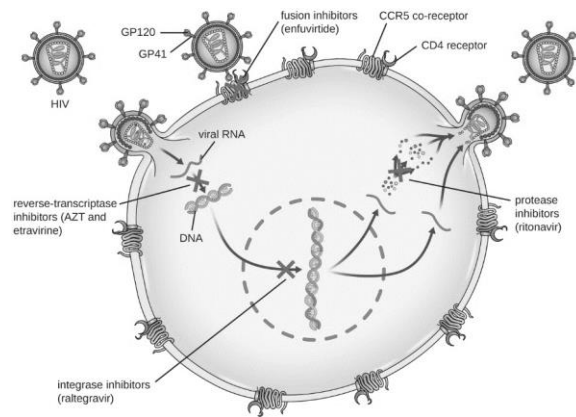
The 'Spanish flu' is an example of a/an

- A. epidemic.
- B. pandemic.
- C. vector.
- D. genetically modified organism.

B *Pandemics occur over a wide geographic area, usually multiple countries.*

Use the following information to answer Question 36.

The image below depicts HIV infection and locations where antiviral drugs can act in an attempt to limit the infection.



Source: <http://cnx.org/contents/3liHYUow@3/Mechanisms-of-Other-Antimicrob>

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 36

This image demonstrates that antiviral drugs cannot

- A. inhibit viral entry to a host cell.
- B. inhibit the production of proteins essential to the assembly of new viruses.
- C. inhibit the insertion of the viral genome into the host cell DNA.
- D. inhibit new viruses from leaving the host cell.

D *The image presented does not demonstrate that the virus may be prevented from leaving the host cell.*

Methods of organising, analysing and evaluating primary data to identify patterns and relationships including sources of error and limitations of data and methodologies

Question 37

Which of the following statements is correct concerning experimental design?

- A. qualitative data is usually concerned with measuring things
- B. qualitative data is usually concerned with analysing themes
- C. semi-structured interviews are usually the method of choice for quantitative data collection
- D. a hypothesis is a statement of fact

B *Qualitative data is often collected via interviews and the information is then transcribed and themes are sought from this information.*

The conventions of scientific report writing and scientific poster presentation including biological terminology and representations, standard abbreviations, units of measurement and acknowledgment of references

Question 38

In a scientific report

- A. acknowledgement of references is not required.
- B. scientists should consider all data collected when determining a conclusion, even data that has been manipulated to achieve a desired outcome.
- C. when drawing a graph the independent variable is represented on the horizontal axis while the dependent variable is represented on the vertical axis.
- D. possible sources of error are not acknowledged.

C *This information comes directly from the VCAA.*

The characteristics of scientific research methodologies and techniques of primary qualitative and quantitative data collection relevant to the selected investigation, including laboratory work (biochemistry, cytology, immunology) and/or fieldwork (geomorphology); precision, accuracy, reliability and validity of data; and minimisation of experimental bias

Question 39

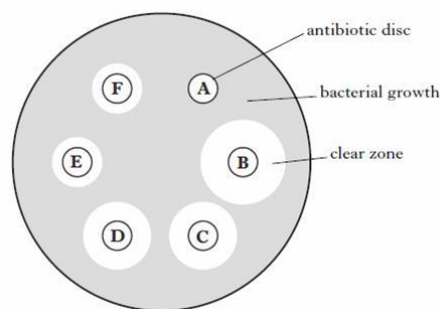
A measurement is valid if

- A. it measures what it claims to be measuring.
- B. controlled variables have been allowed to change in an experiment.
- C. the results are reproducible.
- D. all of the above.

A *Validity refers to results being a true reflection of what an experiment sets out to measure.*

Use the following information to answer Question 40.

A patient was found to be suffering from a bacterial infection caused by unknown bacteria. The bacteria's sensitivity to different antibiotics (A-F) was tested. The results are shown in the plate below.



Source: <https://blogs.glowscotland.org.uk/gc/hydnsecscis2revision/microbiology-1/>

Question 40

From the image, it can be concluded that

- A. antibiotic A was more effective than antibiotic E.
- B. antibiotic B was least effective.
- C. antibiotic C and D were equally effective.
- D. none of the antibiotics should be used to treat this bacterial infection.

C *Antibiotic C and D have the same size clear zone and therefore can be deemed to be equally effective against the unknown bacteria.*

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

Section B

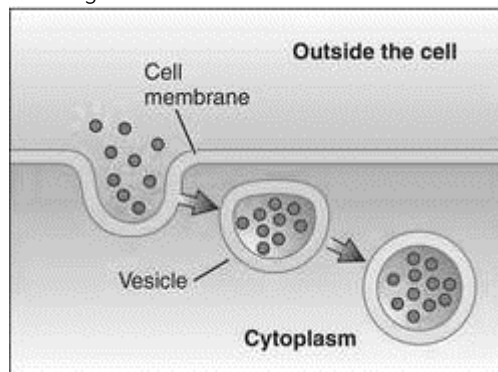
Cellular engulfment of material by endocytosis.

Question 1a (3 marks)

Draw and label a cell engulfing material via the process of endocytosis.

Answer:

- A diagram similar to this:



Source: <http://medical-dictionary.thefreedictionary.com/endocytosis>

Marking protocol:

One mark for clear labelling of the inside and outside of the cell. A second mark for an image showing materials being taken into the cell. A third mark for appropriate labelling.

Cellular engulfment of material by endocytosis.

Question 1b (1 mark)

Outline why a cell may engage in endocytosis.

Answer:

- To transport large polar molecules such as proteins into the cell.
- To consume cell debris/material for breakdown and recycling.

Marking protocol:

One mark for either of the above points or any other appropriate response.

Use the following information to answer Question 2.

Messenger RNA Codons and Amino Acids for Which They Code

		Second base				
		U	C	A	G	
First base	U	UUU } PHE UUC } UUA } LEU UUG }	UCU } UCC } UCA } SER UCG }	UAU } TYR UAC } UAA } STOP UAG }	UGU } CYS UGC } UGA } STOP UGG } TRP	U C A G
	C	CUU } CUC } LEU CUA } CUG }	CCU } CCC } CCA } PRO CCG }	CAU } HIS CAC } CAA } GLN CAG }	CGU } CGC } ARG CGA } CGG }	U C A G
	A	AUU } AUC } ILE AUA } AUG } MET or START	ACU } ACC } ACA } THR ACG }	AAU } ASN AAC } AAA } LYS AAG }	AGU } SER AGC } AGA } ARG AGG }	U C A G
	G	GUU } GUC } VAL GUA } GUG }	GCU } GCC } GCA } ALA GCG }	GAU } ASP GAC } GAA } GLU GAG }	GGU } GGC } GLY GGA } GGG }	U C A G

Source: <http://iamqc.blogspot.com.au/2010/05/programming-fundamentals-in-biomedical.html>

The following DNA sequence comes from a gene found on chromosome 4.

TTACTGGAAGTGC

This DNA sequence contributes to producing a polypeptide which forms part of an enzyme involved in the breakdown of a specific carbohydrate.

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

Question 2a (1 mark)

Name the enzyme that is involved in converting this sequence of DNA to RNA via the process of transcription.

Answer:

- RNA polymerase

Marking protocol:

One mark for the above point.

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

Question 2b (1 mark)

List the anticodon sequence that corresponds with this DNA sequence.

Answer:

- *UUACUGGAACUGCGA*

Marking protocol:

One mark for the above point.

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

Question 2c (1 mark)

List the amino acid sequence that corresponds with this DNA sequence.

Answer:

- *ASN, ASP, LEU, ASP, ALA.*

Marking protocol:

One mark for the above point.

A mutation occurred to the original DNA sequence and the following is the new DNA sequence following the mutation:

TTACTGGCAACTGCGA

Types of mutations (point, frameshift, block)

Question 2d (1 mark)

Name the type of mutation that occurred.

Answer:

- *Point mutation – addition.*

Marking protocol:

One mark for the above point.

The functional importance of the four hierarchical levels of protein structure

Question 2e (3 marks)

Describe the impact that this mutation would have on the polypeptide produced. How may this then impact on an individual?

Answer:

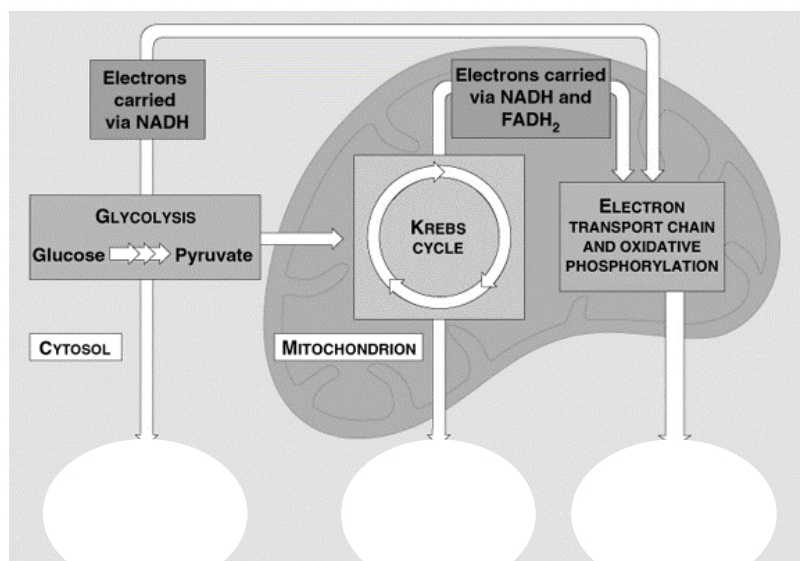
- *The polypeptide produced is likely to be altered as the point mutation has contributed to a frameshift mutation.*
- *From the amino acid LEU (inclusive) there is likely to be a change in all the following amino acids.*
- *This may cause the enzyme to lose function and this may mean that the specific carbohydrate cannot be broken down.*

Marking protocol:

One mark for each of the above points.

Use the following information to answer Question 3.

The following diagram depicts the stages in aerobic respiration. Several of the outputs from each stage have been obstructed from view.



Source: <http://www.instruction.greenriver.edu/kmarr/Biology%2020211/Lecture%20Notes/Cellular%20Respiration%20Webpage/Respiration%20Web%20Notes.html>

The purpose of cellular respiration

Question 3a (1 mark)

Describe the purpose of cellular respiration.

Answer:

- Cellular respiration is a process that breaks down glucose in order to produce ATP.

Marking protocol:

One mark for the above point.

The main inputs and outputs of the Krebs (citric acid) cycle and electron transport chain including ATP yield (details of the biochemical pathway mechanisms are not required)

Question 3b (1 mark)

List two outputs of the electron transport chain.

Answer:

- ATP
- FAD
- NAD
- H₂O

Marking protocol:

One mark for any **two** of the above points, to a maximum of one.

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

Question 3c (4 marks)

Design an experiment that could test the effect of temperature on the rate of cellular respiration.

Answer:

- Set up five groups, each with a mixture of the same number of mitochondria, such as 100, in identical cytosol solutions.
- Expose each group to a different temperature, for example ranging from 15 degrees – 35 degrees in 5 degree increments.
- Place the same concentration of glucose in each mixture, and expose each group to the same constant concentration of oxygen.
- Measure over a set time period, for example 1 hour, the total amount of ATP produced by each mixture. This can be used to give an indication of the effect of temperature on the rate of cellular respiration – higher amounts of ATP produced would indicate a higher rate of cellular respiration.

Marking protocol:

One mark for each of the above points or four similar points that are essential to experimental design.

Independent, dependent and controlled variables

Question 3d (2 marks)

What is a controlled variable?
List one controlled variable from the experiment you have described in 3c.

Answer:

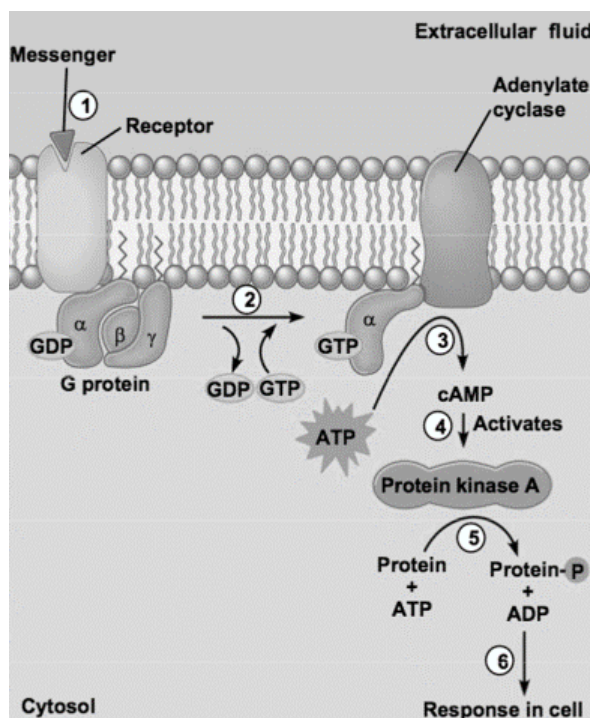
- A controlled variable is a variable that has been held constant in an experiment in order to test the relationship between the independent and dependent variables.
- An example from the experiment is the concentration of glucose.

Marking protocol:

One mark for each of the above points.

Use the following information to answer Question 4.

The following depicts a cell response following activation by a signalling molecule.



Source: <http://classconnection.s3.amazonaws.com>

Difference in signal transduction for hydrophilic and hydrophobic signals in terms of the position of receptors (on the membrane and in the cytosol) and initiation of transduction

Question 4a (1 mark)

List the nature of the signalling molecule in the diagram.

Answer:

- Protein based.

Marking protocol:

One mark for the above point.

Difference in signal transduction for hydrophilic and hydrophobic signals in terms of the position of receptors (on the membrane and in the cytosol) and initiation of transduction

Question 4b (2 marks)

List two features of the type of signalling molecule depicted in the image.

Answer:

- The receptor is located on the cell membrane.
- It activates second messenger molecules.
- It can dissolve in the bloodstream.
- It generally leads to relatively quick cell responses when compared to lipid based signalling molecules.

Marking protocol:

One mark each for any two of the above points, to a maximum of two.

The stimulus-response model when applied to the cell in terms of signal transduction as a three-step process involving reception, transduction and cellular response

Question 4c (2 marks)

Steps 2-5 in the diagram are the part of the second step in signal transduction. Name this step and describe it.

Answer:

- *Transduction.*
- *Information from the receptor is passed on to an effector.*

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 4d (3 marks)

A scientist wished to prevent the particular cellular response depicted in the diagram. She decided to do this following the steps in rational drug design, targeting the enzyme protein kinase. Outline the steps the scientist would need to follow to achieve her aim.

Answer:

- *Identify the shape of the active site of protein kinase.*
- *Create a molecule that is complementary in shape to the active site of protein kinase.*
- *Incorporate this molecule into a drug that can be taken safely.*

Marking protocol:

One mark for each of the above points.

The role of the lymphatic system in the immune response

Question 5a (1 mark)

Outline the purpose of the lymphatic system.

Answer:

- *The lymphatic system is a network of tubes throughout the body that drains fluid (called lymph) from tissues and empties it back into the bloodstream.*

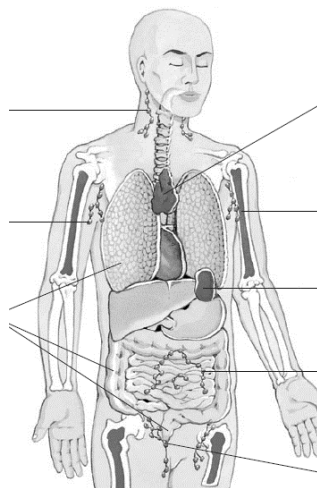
Marking protocol:

One mark for the above point.

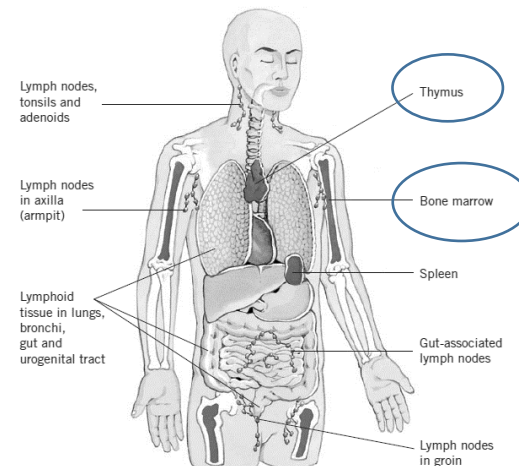
The role of the lymphatic system in the immune response including the role of secondary lymphoid tissue (with reference to lymph nodes) as the site of antigen recognition by lymphocytes, and as a transport system for antigen presenting cells including dendritic cells

Question 5b (2 marks)

Label the location of the two primary lymphoid tissues.



Answer:



Source: https://www.lymphnet.org/sites/files/styles/inline-left/public/images/inline-images/lymphatic_system.jpg?tok=1iKMwxf

Marking protocol:

One mark for each of the above points (circled) correctly labelled.

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 5c (4 marks)

Complete the flow chart below using the following statements.

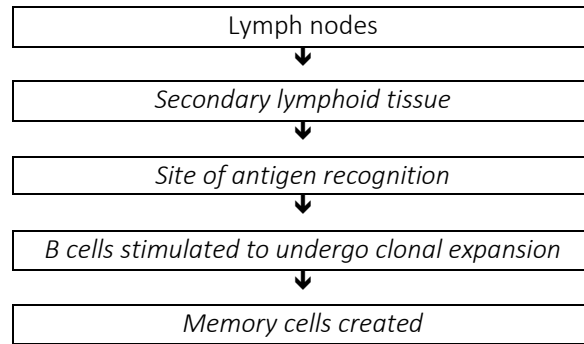
Memory cells created

Site of antigen recognition

Secondary lymphoid tissue

B cells stimulated to undergo clonal expansion

Answer:



Marking protocol:

One mark for each of the above points in the correct spot.

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 5d (2 marks)

The lymphatic system is different and similar in several ways to the circulatory system. List one difference and one similarity.

Answer:

Difference:

- *There is no pump in the lymphatic system whereas there is one (the heart) in the circulatory system.*
- *The lymphatic system does not contain red blood cell whereas the circulatory system does.*

Similarity:

- *Both systems contain white blood cells.*
- *Both systems can transport pathogens.*

Marking protocol:

One mark for any of the above points; one difference and one similarity, to a maximum of two.

Use the following information to answer Question 6.

Multiple sclerosis (MS) is a condition of the central nervous system, interfering with nerve impulses within the brain, spinal cord and optic nerves. It is characterised by sclerosis; a Greek word meaning scars. These scars occur within the central nervous system and depending on where they develop, manifest into various symptoms.

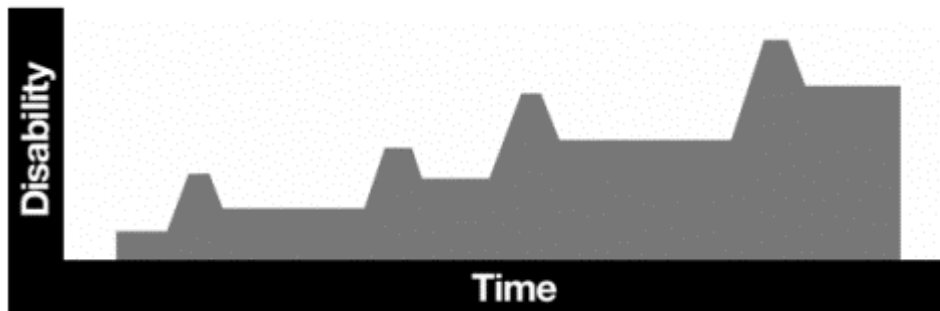
MS affects over 23,000 in Australia and more than two million diagnosed worldwide. Most people are diagnosed between the ages of 20-40, but it can affect younger and older people too. Roughly three times as many women have MS as men.

There is currently no known cure for MS however there are a number of treatment options available to help manage symptoms and slow progression of the disease.

Types of MS

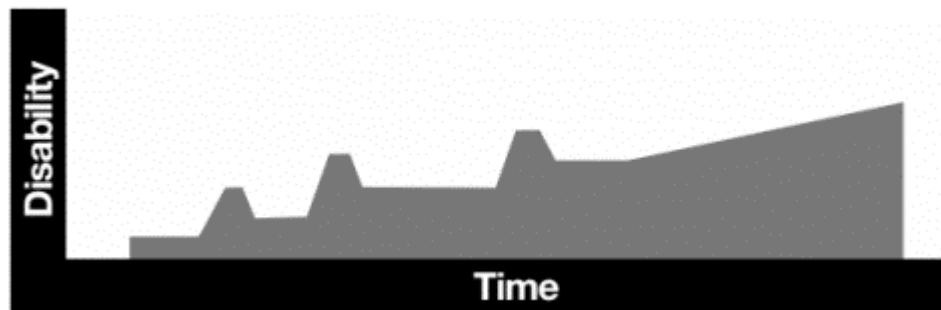
1. Relapsing-remitting (RRMS)

Relapsing-remitting (RRMS) - characterised by partial or total recovery after attacks (also called exacerbations, relapses, or flares). The most common form of MS. 70 to 75% of people with MS initially begin with a relapsing-remitting course.



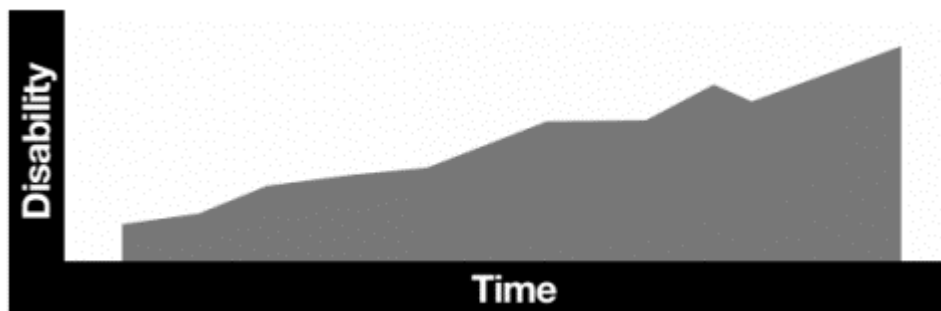
2. Secondary progressive (SPMS)

Secondary progressive (SPMS) – a relapsing-remitting course which later becomes steadily progressive. Attacks and partial recoveries may continue to occur. Of the 70-75% who start with relapsing-remitting disease, more than 50% will develop SPMS within 10 years; 90% within 25 years.



3. Primary progressive (PPMS)

Primary progressive (PPMS) - a progressive course from onset. Symptoms generally do not remit. 15% of people with MS are diagnosed with PPMS, although the diagnosis usually needs to be made after the fact, when the person has been living for a period of time with progressive disability but not acute attacks.



Source: <https://www.msaustralia.org.au/about-ms/types-ms>

<i>The deficiencies and malfunctions of the immune system as a cause of human diseases including autoimmune diseases (illustrated by multiple sclerosis)</i>	Question 6a (2 marks) List and define the type of immune disease that MS is an example of.	Answer: • <i>Autoimmune disease.</i> • <i>Where a person's immune system attacks self-cells that it recognises, incorrectly, as non-self.</i> Marking protocol: One mark for each of the above points.
<i>The deficiencies and malfunctions of the immune system as a cause of human diseases including autoimmune diseases (illustrated by multiple sclerosis)</i>	Question 6b (2 marks) Scientists wished to trial a new drug to treat MS with the intention to prevent its progression. Explain which type of MS is likely to be easiest to monitor for improvement during a drug trial.	Answer: • <i>Primary progressive.</i> • <i>As this type of MS has a progressive course from the outset it would be easier to determine if the drug is having an effect on preventing this progression.</i> Marking protocol: One mark for each of the above points.
<i>Methods of organising, analysing and evaluating primary data to identify patterns and relationships including sources of error and limitations of data and methodologies</i>	Question 6c (1 mark) Describe the evidence that scientists would need to gather to indicate that the drug is effective in treating the type of MS you named in 6b.	Answer: • <i>A halt in the progression of MS would need to be observed in conjunction with taking the drug as part of a valid and reliable experiment (randomised controlled trial).</i> Marking protocol: One mark for the above point.
<i>The difference between natural and artificial immunity, and active and passive strategies for acquiring immunity</i>	Question 6d (3 marks) A student suggested that a vaccination would be an easy method of treating MS. Outline whether or not you agree with this student and justify your response.	Answer: • <i>Disagree.</i> • <i>A vaccination is designed to stimulate the immune system to quickly detect and remove pathogens. In the case of an autoimmune disease the 'pathogen' is the body's own immune cells that are attacking itself.</i> • <i>It is therefore likely to be difficult to create a vaccination to stimulate immune cells to attack immune cells.</i> Marking protocol: One mark for each of the above points.
<i>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</i>	Question 7a (1 mark) Define evolution.	Answer: • <i>The change in genetic composition of a population over successive generations.</i> Marking protocol: One mark for the above point.

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

Question 7b (1 mark)

List a source of new alleles in a population.

Answer:

- *Mutations.*

Marking protocol:

One mark for the above point.

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 7c (4 marks)

Describe how your answer to 7b may lead to a new species. Use allopatric speciation as the basis of your response.

Answer:

- *Allopatric speciation is when members of a population become isolated from one another due to a geographic barrier that prevents gene flow.*
- *In each isolated population, mutations may occur which may result in new alleles and new phenotypes being present.*
- *If these new phenotypes are selected for in the particular environment each isolated population finds itself in, then this may lead to the two populations becoming distinctly different.*
- *When members of the two isolated populations are brought back together to interbreed, if no fertile offspring can be produced, then they can be deemed different species.*

Marking protocol:

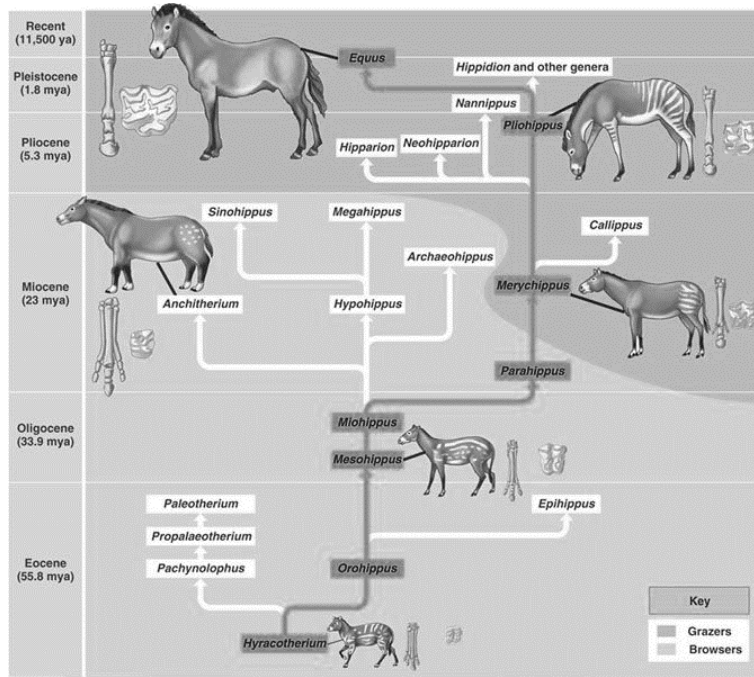
One mark for each of the above points.

Use the following information to answer Question 8.

1. The fossils remain within the rock until uncovered through erosion or excavation.
2. An organism dies and is buried before the remains are completely destroyed.
3. Dissolved minerals, transported by ground-waters in the sediment, fill tiny spaces in the bones. The combination of pressure, chemical reactions and time eventually turns the sediments into rock and the bones into mineralised fossils.
4. Over time, layers of sediment build up and press down on the buried remains.

<i>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)</i>	Question 8a (1 mark) List the numbers from the information above that would correspond with the correct sequence of steps in fossilisation.	Answer: • 2, 4, 3, 1 Marking protocol: One mark for the above point.
<i>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</i>	Question 8b (2 marks) List two trends in life forms in Earth's geological history that can be observed from examining the fossil record.	Answer: • Simple to complex life forms. • Single celled to multicellular life forms. • Aquatic to terrestrial life forms. • Reptiles to mammals. • Non-flowering plants to flowering plants. Marking protocol: One mark each for two of the above points (or any other appropriate responses), to a maximum of two.
<i>Patterns of biological change over geological time including divergent evolution, convergent evolution and mass extinctions</i>	Question 8c (2 marks) Describe the evidence in the fossil record that would indicate a mass extinction event is likely to have occurred. List an example of an event that may have led to mass extinction.	Answer: • When studying layers of rock strata, a mass extinction event would be indicated by the lower, older rock layer containing a great diversity of fossil life forms, while the younger layer immediately above contains significantly less fossil evidence in comparison. AND ONE OF • Asteroid hitting the earth • Significant volcanic activity • Severe ice age Marking protocol: One mark for the first point and one mark for one of the second set of points.

Use the following information to answer Question 9.



Source: <https://s-media-cache-ak0.pinimg.com/736x/1f/bb/20/1fbb2013fa69d034e23c38261eaa271e--prehistoric-animals-extinct-animals.jpg>

The use of phylogenetic trees to show relatedness between species

Question 9a (1 mark)
Name the type of diagram above that is used to demonstrate relatedness between species.

Answer:
• *Phylogenetic tree.*

Marking protocol:
One mark for the above point.

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

Question 9b (1 mark)
The DNA hybridisation technique was used to establish the relatedness between some of the species in the diagram above. List the species that is most likely to have the most similar DNA to Hipparion.

Answer:
• *Neohipparion.*

Marking protocol:
One mark for the above point.

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

Question 9c (3 marks)
Describe the steps in the DNA hybridisation technique.

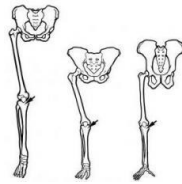
Answer:

- *DNA hybridisation involves mixing two different samples of DNA and dissociating their double helices via heating.*
- *Slow cooling is then applied to the mix which allows complementary bases to anneal and leads to the formation of hybrid stands.*
- *Heat is then re-applied and this melting temperature is used to provide information on the degree of similarity between the two DNA samples.*

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

Use the following information to answer Question 10.

Below are drawings of lower knee bones of a chimpanzee (right), early human (middle), and modern human (left). The chimpanzee knee joint is lightly built, so chimpanzees cannot rest their weight on one leg at a time to walk for long periods. The early human knee joint was strong, enabling this early human to regularly support its weight on one leg at a time during walking.



Source: <http://humanorigins.si.edu/human-characteristics/walking-upright>

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 10a (1 mark)

Use the image above to provide an **additional** reason why modern day humans are better suited to walking upright for long periods than chimpanzees.

Answer:

- The increased hip-knee joint angle allows modern humans to maintain greater balance when walking upright.
- The broader more 'bowl-shaped' pelvis in modern humans supported greater weight distribution that made walking upright easier.
- The bones of the foot in modern humans, such as a larger heel bone, made walking upright easier.

Marking protocol:

One mark for one 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 10b (2 marks)

List two reasons why walking upright may have assisted early humans to survive.

Answer:

- Making it easier to pick fruits and other food from low-lying branches.
- Freeing hands for carrying food, tools, or babies.
- Enabling early humans to appear larger and more intimidating.
- Helping early humans cover wide, open landscapes quickly and efficiently.

Marking protocol:

One mark for any of the above points, to a maximum of two.

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 10c (2 marks)

Describe how walking upright may have influenced cultural evolution in modern day humans.

Answer:

- Walking upright meant the hands were generally free to be used for other purposes, this may have included writing, drawing and developing tools/technology.
- These activities may have all contributed to the transmission of knowledge, customs, beliefs, language, etc. and therefore influenced culture in modern day humans.

Marking protocol:

One mark for each of the above points.

Shared characteristics that define primates, hominoids and hominins

Question 10d (2 marks)

A chimpanzee is an example of a primate, as are modern day humans. List two other examples of primates.

Answer:

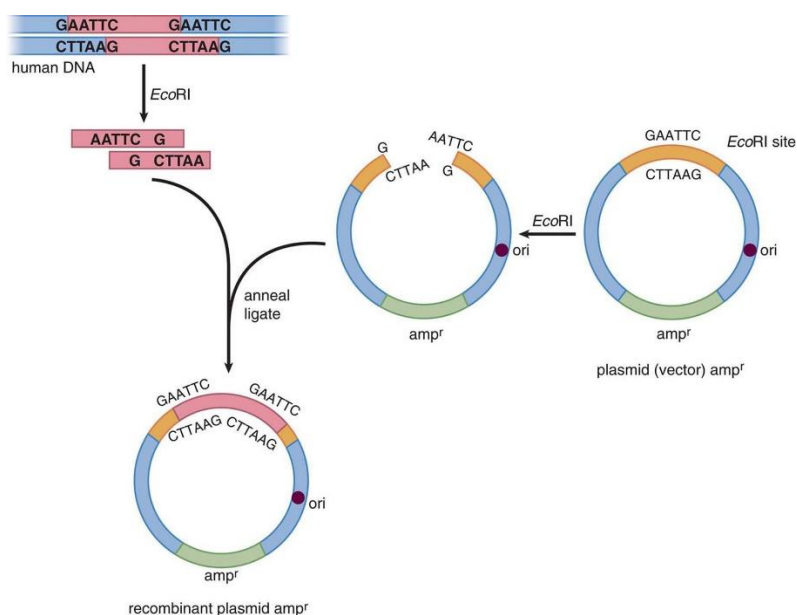
- Orangutan.
- Gorilla.
- Lemur.
- Gibbons.
- Any homo species.

Marking protocol:

One mark for any two of the above points, to a maximum of two. Note: there are numerous other acceptable answers, however, those listed above are the most common expected responses.

Use the following information to answer Question 11.

The following is a summary of part of a process that can be used to clone a gene. The recombinant plasmid can be taken up by a bacterial cell and then copies of the required gene can be made. The 'amp^r' gene provides resistance to the antibiotic ampicillin.



Source: http://schoolbag.info/chemistry/mcat_biochemistry/mcat_biochemistry.files/image149.jpg

The use of enzymes including endonucleases (restriction enzymes), ligases and polymerases

Question 11a (3 marks)

What is EcoRI an example of?
Describe the function of this molecule in the given scenario.

Answer:

- A restriction enzyme.
- EcoRI is used to cut the sequence of required human DNA out and then it is also used to cut the plasmid open.
- Using the same restriction enzyme to perform both of these roles ensures that the human DNA will have complementary bases available so it can be incorporated into the plasmid.

Marking protocol:

One mark for each of the above points.

The use of recombinant plasmids as vectors to transform bacterial cells

Question 11b (2 marks)

Why may scientists have incorporated the amp^r gene into the plasmid?

Answer:

- To determine which bacteria take up the plasmid when cultured.
- The antibiotic can be administered to bacteria and the bacteria that have survived can be assumed to have taken up the plasmid.

Marking protocol:

One mark for each of the above points.

<i>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</i>	Question 11c (2 marks) List two modes of action regarding how antibiotics may kill bacteria or prevent them replicating.	Answer: • <i>They may destroy the cell wall.</i> • <i>They may prevent protein synthesis.</i> • <i>They may prevent cell wall synthesis.</i> • <i>They may interrupt DNA synthesis.</i> Marking protocol: One mark for any two the above points, to a maximum of two.
<i>The use of recombinant plasmids as vectors to transform bacterial cells</i>	Question 11d (2 marks) Bacteria are often the choice of scientists for gene cloning and studying gene expression. Provide two reasons why this may be the case.	Answer: • <i>The simplistic nature of bacteria makes it easy to work with.</i> • <i>Bacteria replicate quickly via binary fission.</i> • <i>Bacteria are often highly susceptible to hosting foreign DNA.</i> • <i>Bacteria are generally safe to work with if handled with care.</i> Marking protocol: One mark for any of two of the above points, to a maximum of two.
<i>The use of recombinant plasmids as vectors to transform bacterial cells</i>	Question 11e (1 mark) Name the process where bacterial cells take up a plasmid and express the genes of the plasmid.	Answer: • <i>Transformation.</i> Marking protocol: One mark for the above point.
<i>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</i>	Question 12a (1 mark) What is a genetically modified organism?	Answer: • <i>Organisms in which their DNA has been altered in a way that does not occur naturally by mating and/or natural recombination and is usually done via genetic engineering.</i> Marking protocol: One mark for the above point.
<i>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</i>	Question 12b (2 marks) List two examples of why a farmer may want to genetically modify a food crop.	Answer: <i>Genetically modified food crops may possess advantages such as:</i> • <i>increased crop productivity.</i> • <i>increased resistance to predation by insects.</i> • <i>increased resistance to disease.</i> Marking protocol: One mark for any two of the above points, to a maximum of two.



VCE BIOLOGY
Written Examination
ANSWER SHEET – 2017

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