

2019 VCE Biology Trial Examination Suggested Answers



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Answer Summary for Multiple-Choice Questions 2019 Kilbaha VCE Biology Trial Examination

Q1	A	Q15	B	Q29	C
Q2	C	Q16	C	Q30	B
Q3	A	Q17	B	Q31	D
Q4	C	Q18	D	Q32	B
Q5	B	Q19	D	Q33	A
Q6	B	Q20	B	Q34	B
Q7	A	Q21	B	Q35	B
Q8	C	Q22	C	Q36	C
Q9	C	Q23	A	Q37	D
Q10	D	Q24	B	Q38	A
Q11	C	Q25	A	Q39	C
Q12	D	Q26	C	Q40	B
Q13	C	Q27	C		
Q14	D	Q28	A		

ONE ANSWER PER LINE

ONE ANSWER PER LINE

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

Answer distribution:

A: 8

B: 12

C: 13

D: 7

Answers to Multiple Choice Questions

Question 1

Solution: A

The vesicle is in the process of fusing with the cell membrane and releasing the molecules to be secreted into the external environment.

Study Design Reference

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

Web Link

<https://www.khanacademy.org/science/biology/membranes-and-transport/bulk-transport/a/bulk-transport>

Question 2

Solution: C

The molecules are enclosed within the vesicle and this environment would be expected to contain water, making the molecules hydrophilic (making A incorrect). The phospholipid tails are facing away from the cytoplasm because they are hydrophobic not hydrophilic (making B incorrect). There are more molecules in the extracellular environment compared to within the vesicles (making D incorrect). The only way the vesicle can fuse with the membrane is for the phospholipids to be able to move within the membrane.

Study Design Reference

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

Web Link

<https://biologywise.com/fluid-mosaic-model>

Question 3

Solution: A

The 3 types of RNA are

1. mRNA (messenger): carries the transcribed code from the DNA to the ribosome
2. tRNA (transfer): involved in the translation of the mRNA by binding to the mRNA in groups of 3 nucleotides and carrying a specific amino acid
3. rRNA (ribosomal): the structure of the ribosome is RNA as well as protein

Study Design Reference

the structure of DNA and the three forms of RNA including similarities and differences in their subunits, and their synthesis by condensation polymerisation

Web Link

<https://www.ck12.org/biology/rna/lesson/RNA-MS-LS/>

Question 4**Solution: C**

Students should be able to pick up that the diagram represents the steps involved in gene expression. The amino acids are part of the tRNA (E) as well as freely floating in the cytosol (D) and as part of a polypeptide (F). The other labelled structures do not contain amino acids; however, the membrane (H) would.

Question 5**Solution: B**

For gene expression, molecule B is formed along a template strand from molecule A. From there RNA processing splices out introns and joins exons for translation. Molecule B then moves through the ribosome (G) and tRNA (E) anticodons bind to codons to coordinate which amino acids are joined together to form the polypeptide.

Study Design Reference (for questions 4 and 5)

The synthesis of a polypeptide chain from amino acid monomers by condensation polymerisation

The structure of DNA and the three forms of RNA including similarities and differences in their subunits, and their synthesis by condensation polymerisation

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

Web Link

https://sepuplhs.org/high/sgi/teachers/genetics_act16_sim.html

Question 6**Solution: B**

Another word for restriction endonucleases is restriction enzymes. They are proteins that bacteria produce to cleave DNA within their cytosol. For this reason, they are not formed on the rough endoplasmic reticulum (this is a eukaryotic organelle) or within nucleated cells.

Study Design Reference

This question partly uses theory from unit 3 (the genetic code as a degenerate triplet code and the steps in gene expression including transcription, RNA processing in eukaryotic cells and translation) as well as unit 4 (the use of enzymes including endonucleases (restriction enzymes)).

Web Link

<https://pdb101.rcsb.org/motm/8>

Question 7**Solution: A**

The lac operon is a prokaryotic model explaining gene expression in bacteria. For energy conservation, in an environment free of lactose, a repressor is bound to the operator section of the operon, which prevents RNA polymerase transcribing the genes within the operon. When lactose is present it binds to the repressor changing its shape and so it no longer is bound to the operator. This allows the RNA polymerase to bind to the promoter and transcription of the operon can occur.

Study Design Reference

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.

Web Link

<https://phet.colorado.edu/en/simulation/gene-machine-lac-operon>

Question 8**Solution: C**

The endosymbiotic theory provides an explanation on how the mitochondria and chloroplast came about. Either aerobic bacteria (forming the mitochondria) or photosynthetic bacteria (forming the chloroplast) were consumed by an ancestral eukaryotic cell by endocytosis. Rather than being digested they survived within the cell by providing something for the cell and the cell in return providing protection. Evidence supporting this theory is

- 2 membranes
- Circular DNA
- Prokaryotic-like ribosomes in the mitochondria or chloroplast
- Reproductive capacity

Study Design Reference

Mitochondria as the site of aerobic cellular respiration, an overview of their structure and evidence of their bacterial origins

Web Link

<http://www.sumanasinc.com/webcontent/animations/content/organelles.html>

Question 9**Solution: C**

A human functions most efficiently at a temperature of about 37°C and a pH of about 7. Outside this range, enzymes will not function as efficiently (less collisions or denature). Providing more substrates will increase enzyme activity making biochemical reactions faster.

Study Design Reference

The role of enzymes as protein catalysts in biochemical pathways. 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

Web Link

<https://www.biotopics.co.uk/A15/Enzymes.html>

Question 10**Solution: D**

Students should know the 3 stages of cellular respiration. Including inputs. Outputs and location. The Krebs cycle occurs in the matrix of the mitochondria. The lumen of the ER is there to transport material. The grana of the chloroplast is where the LDR occurs. The cytosol of any eukaryotic cell is the location for many chemical reactions including glycolysis.

Question 11**Solution: C**

The arrows pointing outwards from the cycle indicates the products of it. If 2 cycles are completed there would be 4CO₂, 2ATP, 6NADH and 2FADH₂.

Study Design Reference

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)

Web Link

<https://www.edumedia-sciences.com/en/media/566-krebs-cycle>

Question 12**Solution: D**

Bombykol is a pheromone, which is a type of signalling molecule. It would move through the environment and may come in contact with a male silkworm. It triggers a reaction by specifically binding to cellular receptors within the male. Once this occurs, the message will be transduced (via second messengers) to activate a particular response (in this case the response is a reproductive behaviour)

Study Design Reference

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

Web Link

https://www.wiley.com/college/boyer/0470003790/animations/signal_transduction/signal_transduction.htm

Question 13**Solution: C**

A motor nerve will transport a message to the presynaptic membrane to activate a secretion via exocytosis (6) of neurotransmitters within vesicles (2) into the synapse (4). The neurotransmitters bind to receptors on the post synaptic membrane (5) to activate a response in that cell.

Study Design Reference

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

Web Link

https://highered.mheducation.com/sites/0072495855/student_view0/chapter14/animation_transmission_across_a_synapse.html

Question 14**Solution: D**

Apoptosis helps to keep cells healthy by removing damaged or diseased cells. As a result of this the number of cells within a mature individual stays relatively constant. Too little apoptosis could result in conditions such as cancer and too much apoptosis could result in degenerative diseases such as MS.

Study Design Reference

Apoptosis as a natural, regulatory process of programmed cell death, initiated after a cell receives a signal from inside (mitochondrial pathway) or from outside (death receptor pathway) the cell resulting in the removal of cells that are no longer needed or that may be a threat to an organism, mediated by enzymes (caspases) that cleave specific proteins in the cytoplasm or nucleus (details of specific cytoplasmic or nuclear proteins are not required)

Web Link

<http://www.susanahalpine.com/anim/KubyHTML/Celdeath.htm>

Question 15**Solution: B**

Pathogens with a nucleic acid core encapsulated by a protein shell are viral in nature. Some virus particles evade the immune system because they have a membrane around the entire viral structure. This membrane is from the cell that released the virus and, as a result the immune system may not come in contact with the antigens on the surface of the capsid.

Study Design Reference

Invading cellular and non-cellular pathogens as a source of non-self antigens.

Web Link

<https://www.verywellhealth.com/what-is-a-pathogen-1958836>

Question 16**Solution: C**

A physical barrier in plants is something that is solid that prevents the entry of pathogens into the plant. Even the egg-like structures are physical because they prevent other butterflies laying eggs on the leaf. Chemical defences are usually liquid in nature and serve the same purpose as physical defences. In this case the alkaloid is chemical.

Study Design Reference

Preventative strategies including physical, chemical and microbiological barriers in animals and plants that keep them out.

Web Link

<https://www.bbc.com/bitesize/guides/z29trwx/revision/3>

Question 17**Solution: B**

Self-markers are on the surface of every cell in the body of a human so that the immune system is not activated in their presence. Foreign material (pathogens, toxins) carry non self-markers so that the immune system is activated. Transplanted cells, even very compatible ones, will usually display non self-markers and so anti-rejection medication will be required.

Study Design Reference

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

Web Link

<https://study.com/academy/lesson/non-self-antigens-self-antigens-allergens.html>

Question 18**Solution: D**

The lymphatic system is a one-way system that collects material from capillary beds (such as virus/bacteria/toxins). This material is moved through ducts to nodes with the use of one-way valves. There is a good chance of an interaction between the pathogen and cells of the active immune response in the lymph nodes.

Study Design Reference

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

Web Link

<http://aia5.adam.com/content.aspx?productId=117&pid=1&gid=002247>

Question 19**Solution: D****Question 20****Solution: B**

Based on the series of diagrams an active immune response is being directed against a pathogen (cell 1). The pathogen is endocytosed and small fragments are displayed on an antigen presenting cell (cell 2). The APC (part of the innate immune response is moved through the lymph ducts to the lymph nodes where it comes in contact with a naïve T cell that differentiates into a helper T cell (cell 3). The helper T cell via MHC II secrete cytokines to activate naïve B (cell 5) to differentiate into plasma cells (cell 6) and a naïve T cell to differentiate into cytotoxic cells (cell 4).

Study Design Reference

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.

Web Link

<https://www.khanacademy.org/test-prep/mcat/organ-systems/the-immune-system/a/adaptive-immunity>

Question 21**Solution: B**

Chromosomal mutations can be predicted in this question based on the information provided in the diagrams. All the mutations are block mutations that involves the transfer of genes from one chromosome to another, which usually occurs as a mistake during meiosis. Choice A is a straight translocation of a section of chromosome 4 to chromosome 20, which is also occurring in D where parts of both chromosomes are exchanged. Choice C is a deletion where a section of a chromosome is removed. Choice B is an inversion as the section of the chromosome removed is replaced but around the other way.

Study Design Reference

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).

Web Link

<https://www.thoughtco.com/chromosome-mutation-373448>

Question 22**Solution: C**

Any mutation can lead to an unhealthy outcome but the question states most likely. If mutations occur in groups of 3 they may lead to a deletion of 1 or 2 amino acids from the polypeptide; however, this may not hinder the function of the protein if the shape is not significantly changed (making B and D incorrect). Single gene substitutions change 1 nucleotide and this may not change the amino acid. A deletion of 1 nucleotide will change every codon downstream from the mutation and so would significantly change the sequence of the polypeptide (also called a frameshift mutation).

Study Design Reference

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

Web Link

<https://learn.genetics.utah.edu/content/basics/mutation/>

Question 23**Solution: A**

The population decreased due to hunting and those seals left carried less genetic variety compared to each other. When they began repopulation, the genetic variety derives from the original stock of the depleted population. This is known as a genetic bottleneck. Founding populations repopulate a new area and artificial selection relates to humans choosing the organisms to breed.

Study Design Reference

Environmental selection pressures on phenotypes as the mechanism for natural selection, gene flow, and genetic drift (bottleneck and founder effects) and the biological consequences of such changes in terms of increased or reduced genetic diversity

Web Link

https://evolution.berkeley.edu/evolibrary/article/side_0_0/bottlenecks_01

Question 24**Solution: B**

The original population would have had a range of beak phenotypes (and sizes). The question relates to food type and hardness. Based on the question it seems there are 2 distinct populations starting to emerge. It is likely the phenotype selected for in a niche offering large hard seeds would be beaks that are larger and in a niche offering insects would be suited to smaller beaks. The size of the bird is a less likely feature to be selected based on the information provided.

Study Design Reference

Environmental selection pressures on phenotypes as the mechanism for natural selection and the biological consequences of such changes in terms of increased or reduced genetic diversity

Web Link

<https://www.khanacademy.org/science/biology/her/heredity-and-genetics/a/natural-selection-in-populations>

Question 25**Solution: A**

For the best chance of fossilisation, organisms would need to be rapidly buried, which would mean scavengers are less likely to find them and eat them. If the burial is in an environment that is cold (ice, bottom of a lake) then there is a lower rate of decomposition because the decomposers do not thrive in these types of environments.

Study Design Reference

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

Web Link

http://geology.isu.edu/Alamo/fossils/process_fossilization.php

Question 26**Solution: C**

Relative dating is where one fossil is compared to another and a judgement call is made as to which one is older. For example, a fossil found in a strata layer deeper than another would be older (stratigraphic correlation). Absolute dating is a process that determines how old a fossil is. Usually volcanic layers above and below are used to complete this process because fossils are usually comprised of sedimentary rock (particles of various ages). Carbon dating is only used to date organic material and is only accurate for about 50,000 years as C^{14} decays more rapidly than other isotopes.

Study Design Reference

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

Web Link

<https://www.fossilera.com/pages/dating-fossils>

Question 27**Solution: C**

The more recent the branch in the evolutionary tree, the more related the organisms are (making A incorrect). The more branches that separate organisms in the evolutionary tree, the more distantly they are related. The elephant and the mouse are less closely related to each other than the elephant is to the armadillo (making B incorrect). The tammar wallaby and opossum had a recent ancestor and so diverged, not converged (making D incorrect). It is logical to assume that some type of environmental pressure separated the lobed fishes from the tetrapods.

Study Design Reference

The use of phylogenetic trees to show relatedness between species

Web Link

<https://learn.genetics.utah.edu/content/evolution/tree/>

Question 28**Solution: A**

Hominins are referred to as ancestral humans dating back to the ancestor between chimpanzees and modern humans. Hominoids refer to the tailless apes and primates refer to all organisms with an opposable digit (thumb). Culture developed in different species of hominins (but not restricted to) as a result of solving problems and varied according to the group.

Study Design Reference

Shared characteristics that define primates, hominoids and hominins

Web Link

https://en.wikipedia.org/wiki/Evolution_of_primates

Question 29**Solution: C**

The *Australopithecines* were the first hominin to show evidence of bipedalism. As such they had a similar positioning of the foramen magnum (central). Other features consistent with bipedalism was a bowl shaped pelvis (supporting the upper torso) and an equal arm to leg ratio (no longer arboreal). The main difference between the 2 genera is the cranial capacity (larger in the *Homo* genus)

Study Design Reference

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

Web Link

<http://www.becominghuman.org/node/human-lineage-through-time>

Question 30**Solution: B**

The evidence shows gene flow between traditionally separate species. The evidence is in the modern human genome and based on the evidence provided, some groups of modern humans would be expected to have more *Denisovan* DNA in them compared to *Neanderthal* because the gene flow occurred 40,000 years ago compared to 80,000 years ago. More evidence is emerging as time progresses and so D is incorrect because new discoveries may be made that refutes the current view.

Study Design Reference

the human fossil record as an example of a classification scheme that is open to interpretations that are contested, refined or replaced when new evidence challenges them or when a new model has greater explanatory power, including whether *Homo sapiens* and *Homo neanderthalensis* interbred and the placement of *Homo denisovans* into the *Homo* evolutionary tree.

Web Link

<https://www.nature.com/articles/d41586-018-06004-0>

Question 31**Solution: D**

Each restriction enzyme will cut the DNA at its specific recognition binding site. *Pst*I has 1 binding site and so will cut the DNA into 2 fragments (not 1). *Alu*I has 2 binding sites and will cut the DNA into 3 fragments (not 2). There is no binding site for *Bam*HI and 1 for *Hae*III and they will collectively cut the DNA into 2 fragments (not 3). All 4 enzymes together will collectively cut the DNA into 5 fragments because there are 4 recognition sites present.

Study Design Reference

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

Web Link

http://www.phschool.com/science/biology_place/biocoach/red/intro.html

Question 32**Solution: B**

Neither antibiotic resistance gene has been interrupted in the process of generating the recombinant plasmids. This means that the transgenic bacteria will be resistant to both antibiotics either individually or together. There would be growth in all 4 agar plates

Study Design Reference

The use of recombinant plasmids as vectors to transform bacterial cells.

Web Link

<https://www.dnalc.org/resources/animations/transformation1.html> (needs flash)

Question 33**Solution: A**

DNA amplification is achieved via a process called PCR (Polymerase Chain Reaction). Step I (denaturation) is achieved by heating the DNA to the point where the hydrogen bonds are broken but the polynucleotide strands remain intact (about 95°C). Step II (annealing) is where primers join onto target sections of the DNA and requires cooler temperatures to enable the hydrogen bonds to form (about 60°C). Step III (extension) is where a DNA polymerase enzyme extracted from a bacterium that lives in a hot environment, binds to the primer and forms new strands (about 72°C).

Question 34**Solution: B**

Chemical A is the primer, a single stranded piece of DNA that is complementary to a target section of the original DNA strand. Chemical B is DNA polymerase (*taq* polymerase) that joins nucleotides onto the target DNA, eventually forming new strands.

Study Design Reference

Amplification of DNA using the polymerase chain reaction

Web Link

<https://learn.genetics.utah.edu/content/labs/pcr/>

Question 35**Solution: B**

Prior to getting the results of a genetic profile the DNA needs to be extracted from the victim, the suspects and the crime scene samples. Samples of cells are then put through a process to purify the DNA for further testing. The DNA is then amplified to gain sufficient quantities of particular gene loci so that when gel electrophoresis is applied a profile can be gained.

Question 36**Solution: C**

The profile illustrates that 3 bands from the crime scene are from the victim and the remaining 3 bands from the crime scene are consistent with the bands from suspect 2. None of suspect 1's bands are in the band pattern from the crime scene. This eliminates suspect 1 from the crime scene.

Study Design Reference

Amplification of DNA using the polymerase chain reaction. The use of gel electrophoresis in sorting DNA fragments, including interpretation of gel runs. Techniques that apply DNA knowledge (specifically gene cloning, genetic screening and DNA profiling) including social and ethical implications and issues

Web Link

<https://learn.genetics.utah.edu/content/labs/gel/>

Question 37**Solution: D**

Any organism that has had its genome manipulated in any way is referred to as a genetically modified organism. If DNA has been transferred from one species to another it is referred to as transgenic as well as genetically modified. A gene switched on or off to give an organism an advantage would be a GMO but not transgenic. A gene transferred from a human to a bacterium would make the bacteria both a GM organism that is transgenic.

Study Design Reference

The distinction between genetically modified and transgenic organisms

Web Link

<http://www.bt.ucsd.edu/gmo.html>

Question 38**Solution: A**

The dependent variable in this experiment is the factor that was measured, the % cells surviving after the treatment. Concentrations of acyclovir were listed and the % surviving were also listed, constituting quantitative data (not qualitative). It is not appropriate to suggest the data is without validity. No information was provided about how 1 IV only was changed and the data seems to illustrate a trend.

Study Design Reference

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

Web Link

<https://www.khanacademy.org/science/high-school-biology/hs-biology-foundations/hs-biology-and-the-scientific-method/v/the-scientific-method>

Question 39**Solution: C**

A and D are not hypothesise as they are not making a clear prediction based on proximity to Africa and mt DNA differences. Based on the Out of Africa model, ancient humans migrated from there and colonised all areas of the world over time. MtDNA can be used as a clock because the DNA mutates at a set rate. The group closest to Africa would show more differences in their mtDNA because they have had a longer time to accumulate the mutations.

Study Design Reference

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

Web Link

<https://genographic.nationalgeographic.com/human-journey/>

Question 40**Solution: B**

Precision is how close to each other multiple tests are testing the same IV using the same method with the same equipment. Accuracy is how close to the actual value the gained experimental data is. In the context of the example given, the centre of the target would refer to high accuracy and the closeness of the crosses would refer to precision.

Study Design Reference

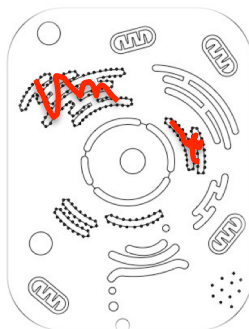
The characteristics of scientific research methodologies and techniques of primary qualitative and quantitative data collection relevant to the selected investigation, including laboratory work (biochemistry, cytology, immunology) and/or fieldwork (geomorphology); precision, accuracy, reliability and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

Web Link

<https://www.ck12.org/chemistry/Accuracy-and-Precision/>

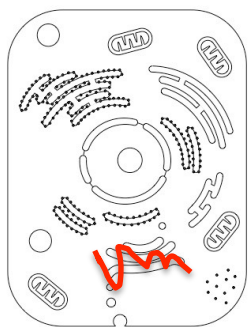
Short Answer**Question 1 (Total 3 marks)**

(i) After 5 minutes



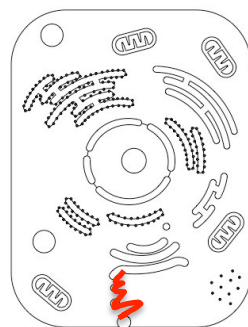
The amino acids would cluster around the ribosomes embedded in the ER because that is where the amino acids are synthesised into protein. **1 mark**

(ii) After 10 minutes



The Golgi apparatus will collect (and modify) the synthesised proteins in a series of membrane bound sacs **1 mark**

(iii) After 15 minutes



Membrane bound vesicles filled with protein fragment away from the Golgi apparatus for their eventual exocytosis from the cell **1 mark**

Study Design Reference

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

Web Link

<https://www.khanacademy.org/science/biology/structure-of-a-cell/tour-of-organelles/a/the-endomembrane-system>

Question 2 (Total 8 marks)**a)**

Template DNA	G	C	T	T	A	T	A	C	G	A	T
Complementary RNA	C	G	A	A	U	A	U	G	C	U	A

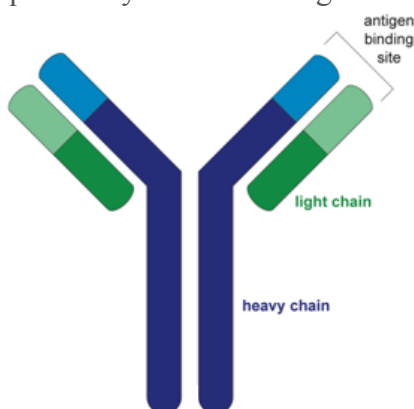
(1 mark)**b)** One of the steps during RNA processing is alternative splicing**(1 mark)**

This involves splicing different sequences of exons together which will lead to different polypeptide sequences, hence different shaped antibodies **(1 mark)**

c) The original polypeptide chain formed from translation has a specific sequence of amino acids, which is referred to as the primary level of arrangement **(1 mark)**

Depending on the R groups of each amino acid, they will twist and coil to form stable 3 dimensional shapes, which is referred to as the tertiary level of arrangement. **(1 mark)**

Often, several polypeptide chains join together to form a structural protein, which is referred to as the quaternary level of arrangement. **(1 mark)**

d)4 polypeptides **(1 mark)**Correct orientation **(1 mark)****Study Design Reference**

Nucleic acids as information molecules that encode instructions for the synthesis of proteins in cells. The functional importance of the four hierarchical levels of protein structure. The genetic code as a degenerate triplet code and the steps in gene expression including transcription, RNA processing in eukaryotic cells and translation. An antigen as a unique molecule or part of a molecule that initiates an immune response

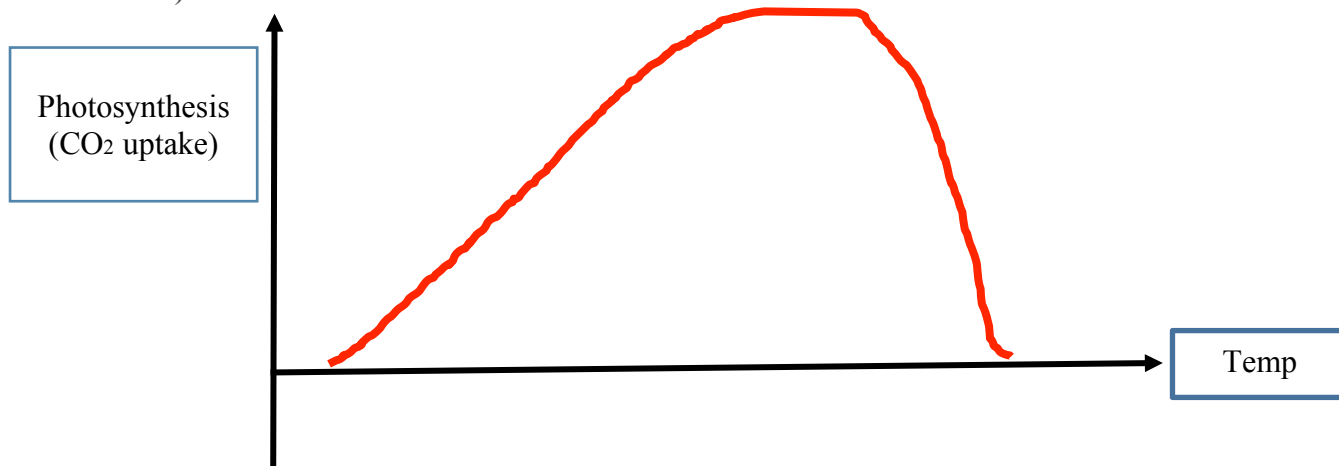
Web Link

<http://www.biology.arizona.edu/immunology/tutorials/antibody/structure.html>

Question 3 (Total 8 marks)

- a) Plant growth has increased because carbon dioxide is an input for photosynthesis, which will provide more chemical energy (glucose) for growth. **(1 mark)**
- b) Green light is reflected and the other wavelengths are absorbed **(1 mark)**

c)



Correct axis included **(1 mark)**
 Correct shape of line graph **(1 mark)**

d)

Reaction	Specific Location	Reactant(s)	Product(s)
Light dependent	Grana (thylakoid)	1. Water 2. NADP 3. ADP/Pi	1. Oxygen 2. NADPH 3. ATP
Light independent	Stroma	1. Carbon dioxide 2. NADPH 3. ATP	1. Glucose 2. NADP 3. ADP/Pi

NOTE: Subtract 1 mark for any error up to 4 marks

4 marks

Study Design Reference

Inputs and outputs of the light dependent and light independent (Calvin cycle) stages of photosynthesis in C3 plants (details of the biochemical pathway mechanisms are not required) factors that affect the rate of photosynthesis, including light, temperature and carbon dioxide concentration

Web Link

<https://biomanbio.com/HTML5GamesandLabs/PhotoRespgames/photointeractivehtml5page.html>

Question 4 (9 marks)

- a) If ACC oxidase were absent, ACC could not convert to ethylene, which would slow the rate of fruit ripening **(1 mark)**
- b) When the ethylene binds to a membrane receptor a series of secondary messenger are activated (transduction) that lead to the activation of cellular respiration (response) **(1 mark)**
- c) Cell respiration produces ATP that is needed at the ribosome to combine amino acids together to form proteins such as pectinase **(1 mark)**
- d) 5°C **(1 mark)**

A lower number of collisions between ACC and ACC oxidase due to less kinetic energy (compared to the other temperatures). This means less ethylene will be formed per unit time, slowing the ripening rate **(1 mark)**

- e) Have 1000 unripe fruit (say apples) and divide into 5 equally sized groups of 200 apples. Place each group into an equally sized container kept at the same temperature, with the same concentration of oxygen for the same time. These are controlled variable (3 must be included) **(1 mark)**

Expose each group to a varying level of ethylene from 0 (control) to a large concentration. This is the independent variable **(1 mark)**

After the allocated time, measure the ripeness of the fruit (% softness, concentration of carbon dioxide in container, colour). This is the dependent variable. **(1 mark)**

The ethylene concentration that has the highest level of ripening would be regarded as the optimal ethylene concentration to use **(1 mark)**

Study Design Reference

The role of enzymes as protein catalysts in biochemical pathways

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

Independent, dependent and controlled variables

Web Link

<https://kids.frontiersin.org/article/10.3389/frym.2018.00016>

Question 5 (6 marks)

- a) Target cells for epinephrine have specific receptors that are complementary to the hormone and once this interaction occurs, a response will be elicited **(1 mark)**
- b) Initially the peanut allergen activates an immune response that develops specific B cells that lead to the production of antibodies against the allergen. The antibodies bind to receptors on the surface of mast cells that concentrate in areas of the body such as the throat and bronchi. **(1 mark)**

Subsequent exposures lead to more antibodies binding to more receptor sites on more mast cells. **(1 mark)**

The allergens bind to the antibodies on the mast cells activating a secretion of histamines that cause localised vasodilation of blood vessels, in this case the airways/throat can have a great deal of trouble getting air through them. This is what is referred to as a hypersensitive reaction. **(1 mark)**

- c) Difficulty breathing will be alleviated by adrenalin because lung smooth muscle will relax making it easier to breath **(1 mark)**

Red, inflamed and itchy skin will be alleviated with the adrenalin stimulating the constriction of blood vessels going to the skin (peripheral blood vessels). This will lead to less blood going to this area of the body. **(1 mark)**

Study Design Reference

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)

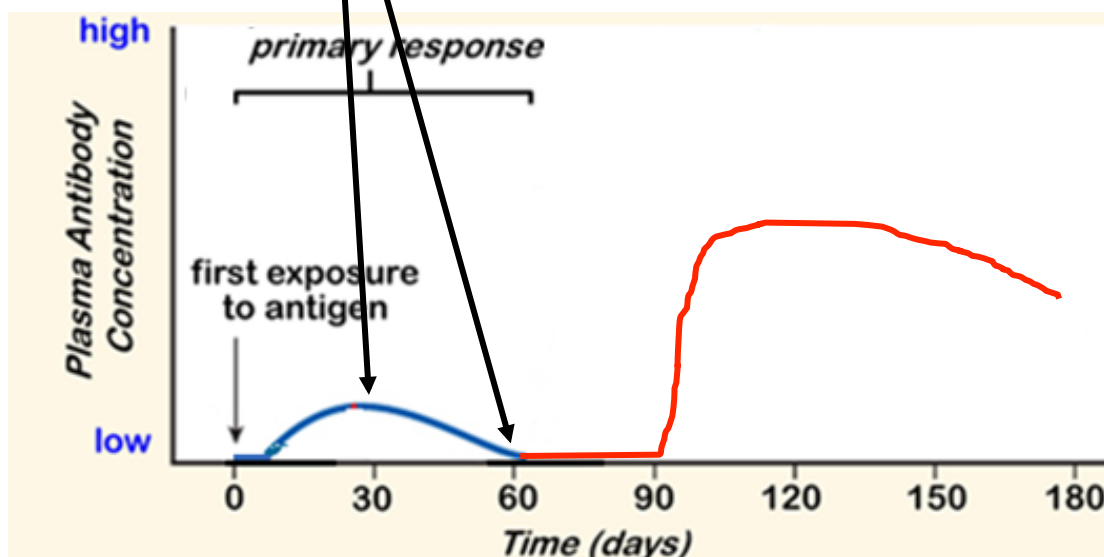
Web Link

<https://www.myvmc.com/anatomy/allergy-and-the-immune-system/>

Question 6 (10 Marks)

- a) (i) The plasma B cells would be at the highest concentration when the maximum concentration of antibodies are present **(1 mark)**

(ii) The memory B cells would be at their highest at about 60 days as the level of antibodies are at their lowest meaning the antigen is destroyed and memory B cells remain in the system as a future protection. **(1 mark)**



- (iii) Upon exposure the flu virus the memory cells will differentiate into plasma cells and form antibodies faster than 1st exposure as well as reaching levels higher than the 1st exposure (1 mark).

The antibodies will remain in the system for longer but will taper slowly with time **(1 mark)**

(2 marks)

- b) Specific Helper T cells will remain in the system as a result of the vaccination against the influenza virus **(1 mark)**

Once activated by the antigens on the 'live' form of the virus the Helper T cells will coordinate the type of response by communicating with the memory B cells (humoral) as well as memory T cells (cell mediated). In this case the memory B cells would be more effective at removing the virus prior to it causing flu symptoms **(1 mark)**

- c) Relenza (Tamiflu) is the name of the antiviral medication given for flu **(1 mark)**

It works by preventing the neuraminidase enzyme on the virus cutting the link between the host cell and the virus, thus preventing the virus from being released from the host cell **(1 mark)**

- d) William should understand that the antiviral medication is only useful for 1-2 days after being exposed to the virus as this is when the action of the virus will be sensitive to this type of action **(1 mark)**

The vaccine will provide long lasting immunity against the virus and so long as it has been administered at least a week prior to contracting the virus, it should provide effective protection. In a typical environment it is way more important to have the vaccine making Ibrahim's argument better than William's. **(1 mark)**

Study Design Reference

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.

Vaccination programs and their role in maintaining herd immunity for a particular disease in the human population

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

Web Link

Vaccine: <https://www.historyofvaccines.org/content/how-vaccines-work>

Antivirals: <https://myhealth.alberta.ca/Health/pages/conditions.aspx?hwid=tb1911>

Question 7 (8 marks)

a) (i) 7 million years ago

1 mark

(ii) The ancestral group was split into 2 groups and
Each group was exposed to different environmental selective pressures that led to
the 2 different lineages

1 mark

1 mark

(iii) Divergent evolution

1 mark

b) Through artificial selection/selective breeding (humans emerged at the same time as
dogs diversified)

1 mark

Humans chose the dog feature desired and only allowed those dogs to breed, thus
producing offspring more likely with the desired feature

1 mark

c) Domestic dogs and grey wolves should be considered to belong to the same species

1 mark

The phylogenetic tree should be modified to include both the domestic dog and the grey
wolf to be included on the same branch that diverged from the coyote

OR

The scientific naming should be modified to name them as sub-species, for example the
domestic dog could be *Canis familiaris lupus* and the grey wolf *Canis lupus lupus*

1 mark

Study Design Reference

The use of phylogenetic trees to show relatedness between species

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

The manipulation of gene pools through selective breeding programs.

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

Web Link

Phylogenetic trees: https://evolution.berkeley.edu/evolibrary/article/phylogenetics_02

Dog breeding: <https://www.hhmi.org/biointeractive/dog-breeding>

Question 8 (8 marks)

- a) Area A contains the oldest fossils

1 mark

The starfish looking fossil is below the oldest volcanic layer, meaning area B and C are above this layer. Area D has the youngest volcanic layer as fossils from area C are low in area D. Students must make a logical comparison that discounts the other layers.

1 mark

- b) Volcanic layers contain rock that can be dated back to when it was formed. Using radio isotopic dating will give the age of the layer

1 mark

Sedimentary rock including the fossils contain sediments of a range of ages and so cannot be used to age the fossil.

1 mark

- c) 125 million years ago the continents were connected together and this is when the *Proteaceae* plants evolved and were distributed across a large area

1 mark

As a result of continental drift the *Proteaceae* plants are found geographically isolated from each other suggesting evolution of these plants occurred prior to the separation of the continents

1 mark

- d) Convergent evolution

1 mark

Unrelated organisms living in similar environments (in this case water) may have certain features favoured (in this case front appendages useful for swimming)

1 mark**Study Design Reference**

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

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

Web Link

https://www.khanacademy.org/science/biology/her/evolution-and-natural-selection/a/lines-of-evidence-for-evolution?utm_account=Grant&utm_campaignname=Grant_Science_Dynamic&gclid=EAlaIqObChMIyNWEvO7q4QIVzYBwCh2vSwcMEAMYASAAEgIn3vD_BwE

Question 9 (6 marks)

- a) Provide anaerobic conditions for the yeast. Yeast with glucose in an oxygen free environment will produce ethanol (and carbon dioxide) as a by-product of cellular respiration. **(1 mark)**
- b) Knowing the sequences of nucleotides (from DNA) coding for proteins that may serve some purpose (medical) **(1 mark)**

The DNA can then be synthesized and spliced into the genome of an organism with the specific purpose of expressing that gene **(1 mark)**

- c) The synthetic organism would be both. A GMO is one that has had its genome manipulated and a transgenic organism is one who has DNA (or the artificially synthesized DNA) from another organism inserted into its genome (like the paclitaxel gene). Could argue that it is not transgenic because the synthetic DNA has been manufactured rather than sourced from another organism **(1 mark)**

d)

	Advantage	Disadvantage
Natural Biology	Commercially viable products are available (beer, yoghurt, paclitaxel) are available without genetic manipulation.	Takes a very large environmental sacrifice (e.g. 1 treatment: 6*200 year old trees) to make a very small quantity of paclitaxel.
Synthetic Biology	Will make cancer treatment products cheaper and so available to more people.	It is unnatural to generate products in this fashion

NOTE: each section needs to be completed and should relate to the article. Any segment missing or irrelevant should get a 1 mark penalty **(2 marks)**

Study Design Reference

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

Web Link

<https://www.nongmoproject.org/high-risk/synthetic-biology/>

Question 10 (7 marks)**a)**

Individual A:

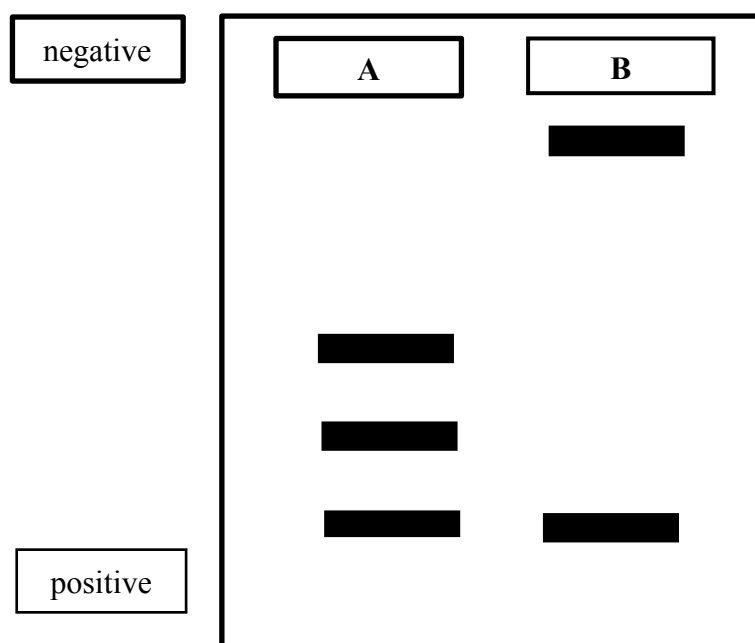
5'ACGTAGCTAGCTACGGCCGCAGCCGGATGCTAGGCCGATCCATCCCGGA3'
 3'TGCATCGATCGATGCCGGCGTCGGCCTACGATCCGGCTAGGTAGGGCCT5'

Individual B:

5'ACGTAGCTAGCTACGCCCCGCAGCCGGATGCTAGGCCGATCCATCCCGGA3'
 3'TGCATCGATCGATGCCGGCGTCGGCCTACGATCCGGCTAGGTAGGGCCT5'

(1 mark)**b) (i)** see diagram**(1 mark)**

(ii) see diagram (3 bands for individual A (15,16,18) close together and down low, 2 bands for individual B (15, 31) **(2 marks)**



(iii) a point mutation may have occurred in the first of the GGCC enzyme binding sites meaning strand B only had 1 binding site for HaeIII rather than 2 **(1 mark)**

c) Only 1 difference between the 2 individuals in a small section of DNA would not be precise enough to make a conclusion about identity. **(1 mark)**

Only 1 gene loci has been tested in this case, and more than 1 gene loci should be tested to provide better resolution in disputes such as these. **(1 mark)**

Study Design Reference

The use of gel electrophoresis in sorting DNA fragments, including interpretation of gel runs
 Techniques that apply DNA knowledge (specifically gene cloning, genetic screening and DNA profiling) including social and ethical implications and issues

Web Link

<https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/dna-profiling>

Question 11 (7 marks)

- a) Ebola is at epidemic proportions as it is restricted to the Democratic Republic of Congo. If it spread from there to the rest of the world it would then be regarded as a pandemic.
(1 mark)

- b) (i) With the 4 experimenters, for each TC concentration, the % monkey cell lines surviving were relatively close to each other making the data precise. (1 mark)

(ii) The 4 experimenters, using the same method has gained results that are similar to each other making the results reproducible. (1 mark)

- c) Validity is ensuring only 1 IV is being tested and so reasons not to use the TC for human treatment would include

Monkey cell lines were used rather than human cell lines making using it for human treatment not valid because there could be different reactions in different animals
(1 mark)

Cell lines were used rather than whole organisms making using it for human treatment not valid because individual cells may respond differently compared to whole organisms. (1 mark)

- d) The expense would prevent both forms of protection being introduced

Vaccines take time (2 weeks) to develop an immunity and it is inconsistent unless the strain of the Ebola is known and so this form of protection would not be the preferred form of protection in this type of area. (1 mark)

TC would be preferred at concentrations above 10 mmol as the survivability is relatively high and antiviral drugs are useful to provide protection if the exposure in the area is inevitable (1 mark)

Study Design Reference

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

Web Link

<http://www.health.gov.au/internet/main/publishing.nsf/Content/panflu-avail-anti-vacc-1>

**End of 2019 Kilbaha VCE Biology Trial Examination Units 3 and 4
Detailed Answers to Short Answer Questions**

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