

2018 VCE Biology Trial Examination Suggested Answers



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Answer Summary for Multiple-Choice Questions 2018 Kilbaha VCE Biology Trial Examination

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

ONE ANSWER PER LINE

ONE ANSWER PER LINE

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

Answer distribution:

A: 8

B: 10

C: 10

D: 12

Answers to Multiple Choice Questions

Question 1

Solution: A

Question 2

Solution: D

The structure and function of membranes is what Key Knowledge 1 is about. Structure E is a phospholipid, structure F is a protein channel, structure G could be a gated protein channel, structure H is a glycoprotein, structure I is a peripheral protein, structure J is cholesterol, structure K is a hydrophilic phospholipid head and structure L is a hydrophobic fatty acid tail.

Question 3

Solution: D

Neurotransmitters are moved into the synaptic cleft by exocytosis. They are lipid insoluble (lipophilic or non-polar) and once in the synaptic cleft, bind to receptors on the post synaptic side of the synapse to pass the nerve message onto the next neuron.

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

Components and structure of plasma membranes:

<https://www.boundless.com/biology/textbooks/boundless-biology-textbook/structure-and-function-of-plasma-membranes-5/components-and-structure-64/>

Question 4**Solution: A**

Transcription converts DNA into mRNA and translation converts the mRNA into protein. The reverse of this entire process cannot occur; however, an enzyme called reverse transcriptase converts RNA into DNA. A is correct because the product of translation (protein) cannot be converted into the product of transcription (RNA).

Study Design Reference:

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

<http://learn.genetics.utah.edu/content/basics/transcribe/>

Question 5**Solution: D**

The 4 levels of protein structure include the primary level (amino acid order), the secondary level (coiling within the polypeptide strand), the tertiary level (3D structure of the polypeptide) and the quaternary level (2 or more polypeptides making the functional protein). Insulin is functional at the quaternary level as there are 2 polypeptides linked together to make the functional protein.

Study Design Reference:

The functional importance of the four hierarchical levels of protein structure

Web Link

<https://biomedapps.curtin.edu.au/biochem/tutorials/prottute/hierarchy.htm>

Question 6**Solution: A**

Condensation reactions occur when larger molecules are formed from small. When amino acids join together, a molecule of water is liberated (condensation) as the larger molecule (polymer) is being formed. ATP forming ADP liberates energy, digesting polypeptides is a hydrolysis reaction (opposite to condensation) and the conversion of glucose to pyruvate during glycolysis is a catabolic reaction.

Study Design Reference:

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

Web Link

https://www.cengage.com/biology/discipline_content/animations/reaction_types.html

Question 7**Solution: A****Question 8****Solution: D**

Interpretation of a diagram relating to protein synthesis is what this question is about. Structure 1 is DNA, structure 2 is mRNA, structure 3 is a codon, structure 4 is tRNA, structure 5 is an anticodon, structure 6 is an amino acid, structure 7 is a ribosome and structure 8 is a polypeptide.

Study Design Reference:

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

Web Link

<https://biomanbio.com/HTML5GamesandLabs/LifeChemgames/protsynthracehtml5page.html>

Question 9**Solution: C**

For lactose digestion in *E. coli*, the lac operon needs to be activated. The presence of lactose binds to a repressor, which then loses contact with the operator region of the lac operon. This enables RNA polymerase to bind to the promoter region of the lac operon and the whole combination of genes is transcribed and translated (galactosidase, permease and transacetylase).

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 10**Solution: B**

The input of pyruvic acid into a cycle which liberates ATP and carbon dioxide is suggestive of the Krebs cycle. This is the part of aerobic respiration that occurs in the matrix of the mitochondria. It is an exergonic reaction that is part of the breakdown of carbohydrates to liberate energy (ATP).

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.wiley.com/college/boyer/0470003790/animations/tca/tca.htm>

Question 11**Solution: B**

Aerobic respiration occurs both in the mitochondria whereas anaerobic respiration occurs in the cytosol. Aerobic respiration requires oxygen as a reactant but anaerobic respiration is the combustion of glucose in the absence of oxygen. Both aerobic and anaerobic respiration use NADH as a hydrogen carrier. There are many more steps in aerobic respiration.

Study Design Reference:

Mitochondria as the site of aerobic cellular respiration

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

Web Link

<https://www.powtoon.com/online-presentation/cU7WX90yOnz/anaerobic-and-aerobic-respirationanimated/?mode=Movie>

Question 12**Solution: C**

Signalling molecules come in 2 forms. Those that bind to surface receptors and those that bind to internal receptors. The lipid insoluble molecules (for example protein) bind to surface receptors and trigger an internal cellular response via signal transduction. The lipid soluble molecules (for example steroids) dissolve across the membrane and bind to internal receptor, which stimulates a response.

Study Design Reference:

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 (details of specific chemicals, names of second messengers, G protein pathways, reaction mechanisms or cascade reactions are not required)

Web Link

<https://www.khanacademy.org/science/biology/cell-signaling/mechanisms-of-cell-signaling/a/signal-perception>

Question 13**Solution: A**

Signalling molecules to be aware of include hormones (plant and animal), neurotransmitters, pheromones and cytokines. Each have different roles and within the body lymphocytes (like a Killer T cell) release cytokines that leads to the destruction of target cells.

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://en.wikipedia.org/wiki/Cell_signaling

Question 14**Solution: D****Question 15****Solution: A**

The diagram illustrates how insulin acts at a cellular level to reduce the blood glucose levels. Insulin (1) binds to a receptor and via signal transduction (2) stimulates second messengers and finally enzyme activation (4-6), which leads to lowered blood glucose levels (3).

Study Design Reference:

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.youtube.com/watch?v=FkkK5ITmBYQ>

Question 16**Solution: C**

Pathogens can be cellular or non-cellular. In this case bacteria are cellular but both a virus and prion are not. A virus does not metabolise on its own and so is not regarded as a living cellular thing even though it carries other factors (nucleic acid) that cells contain. A prion is a protein that can change the shape of other proteins they come in contact with and so, cause disease.

Study Design Reference:

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

Web Link

<https://quizlet.com/209626466/cellular-and-non-cellular-pathogens-flash-cards/>

Question 17**Solution: C**

Plants do not have immune systems and so cannot be vaccinated. A vector is a transmitter of disease and so if a vector was involved this would provide an opportunity to spread the disease. It would make no difference if the virus was a DNA or RNA virus in terms of symptom development. If Anti-viral chemicals are within the plant the impact of the anti-viral should take immediate effect when the virus initially enters the plant.

Study Design Reference:

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

Web Link

<https://courses.lumenlearning.com/boundless-biology/chapter/plant-defense-mechanisms/>

Question 18**Solution: D**

The innate immune response is a line of cellular defence that functions in the same way each time, regardless of the threat. In the list of cells in the question, the B cell response is an adaptive response, not innate. Complement are soluble proteins, which are innate, but there is no cell to identify them. Antigen presenting cells (APCs) are a part of the innate response by liaising between the detection of antigens and a specific B and T cell response. Neutrophils are an innate response that identify foreign cells and phagocytosing them.

Study Design Reference:

The characteristics and roles of components (macrophages, neutrophils, mast cells, dendritic cells, complement proteins) of the innate (non-specific) immune response to an antigen including the steps in the inflammatory response.

Web Link

<https://www.sciencemusicvideos.com/ap-biology/module-29-menu-the-immune-system/immune-system-1-non-specific-innate-responses-interactive-tutorial/>

Question 19**Solution: C**

The transplanted kidney cells carry antigens on their surface that will activate the immune system to reject the organ. Specific cytotoxic T cells will be formed that will destroy the kidney and this is called the cell mediated response. Both humoral and cell mediated immunity will be in action in this case but suppressing the T cell response will allow the kidney to remain intact.

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

<http://www.hhmi.org/biointeractive/cells-of-the-immune-system>

Question 20**Solution: D**

Herd immunity is achieved when about 95% of the individuals within an area are vaccinated. Young (unvaccinated) and old (immune system lower in effectiveness) are more vulnerable to disease so it is impossible to have 100% vaccination. When there are only a few unvaccinated, the reservoir of places for pathogen replication is less and so the chance of the pathogen spreading to another individual who is unvaccinated is minimal.

Study Design Reference:

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

Web Link

<http://rocs.hu-berlin.de/D3/herd/>

Question 21**Solution: C**

An inversion mutation is when a segment of DNA (or chromosome) is reversed end to end. Other types of DNA mutations include deletions additions and substitutions. If the mutations are gene mutations, they all have the capacity to change the amino acid order of the protein product. In this question the inversion is in the second triplet that has changed from AAG to GAA.

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://www.yourgenome.org/facts/what-types-of-mutation-are-there>

Question 22**Solution: B**

The population has reduced in size over 2 generations (could be through poaching). The remaining small population increases in size; however, the genetic diversity between individuals is reduced (compared to before the population decreased in size). This is the result of a genetic bottleneck.

Study Design Reference:

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, 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/bottlenecks_01

Question 23**Solution: C**

When using stratigraphic correlation, the general rule is that the deeper into the strata, the older the fossil. When applying this across strata in different locations, index fossils need to be used as a point of reference. In this case the index fossil is the leaf-like fossil in all 3 layers. As the bone is above the leaf-like fossil in layer 3, that particular layer has been formed more recently than any other layer.

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.sciencelearn.org.nz/resources/1485-relative-dating>

Question 24**Solution: B****Question 25****Solution: B**

Evolutionary trees are interpreted using the time scale as well as how the organisms are connected together. Dalmanites branched away about 50MYA and the branch before or the branch after would lead towards the closest relative. Rodhocetus has the closest branch and so would be the closest relative. Using the scale (and a ruler!), Mysticetes and Odontocetes diverged about 36MYA.

Study Design Reference:

The use of phylogenetic trees to show relatedness between species

Web Link

<http://learn.genetics.utah.edu/beta/evolution/tree/>

Question 26**Solution: C**

Absolute dating is the process of determining the actual age of a fossil. It is done by using radio isotopic dating, in this case Carbon dating. A half of the particular isotope decays in a set amount of time (known as the half-life) and so the amount of the isotope left in a particular fossil is a measure of the age. For the 25,000 year-old organic material, the graph shows that after 50% of the carbon 14 has decayed, the fossil is about 6,000 years old. When 25% of carbon 14 is present the fossil is around 12,000 years old. When 12.5% is present the material is 18,000 years old and when there is a bit over 6% present the material is 24,000 years old. 4 half-lives is the answer to the question.

Study Design Reference:

Evidence of biological change over time including the absolute dating of fossils

Web Link

<https://www.sciencelearn.org.nz/resources/1486-absolute-dating>

Question 27**Solution: C**

It would be expected, regardless of phenotype, that the variation of alleles contributing toward the 'average' phenotype of beak size would be similar if the environment was steady (making A and B incorrect). Genes do not mutate to suit the environment, the variant form of the gene must be preexisting. The BMP4 gene is active for a shorter time compared to their longer beaked relatives.

Study Design Reference:

The evolution of novel phenotypes arising from chance events within genomes, specifically sets of genes that regulate developmental processes and lead to changes in the expression of a few master genes found across the animal phyla, as demonstrated by the expression of gene BMP4 in beak formation of the Galapagos finches and jaw formation of cichlid fish in Africa.

Web Link

<http://www.hras.org/sw/swjan07.html>

Question 28**Solution: B**

Homo habilis was accredited with the first prolific use of tools because a large amount of flint tools was located with the fossilised remains of them. The *Australopithecines* demonstrated that bipedalism evolved before increased cranial capacity. *Homo erectus* was accredited with the first use of fire and *Homo neanderthalensis* were accredited with coexistence, cross breeding and similar cultural behaviours with *Homo sapiens*.

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://humanorigins.si.edu/evidence/human-evolution-timeline-interactive>

Question 29**Solution: D**

The premise behind DNA hybridization is that the more similar the nucleotide sequence the higher the melting temperature required to separate the DNA strands (called the melting temperature T_m). The lower the temperature the less related the organisms are.

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

<http://www.phgfoundation.org/tutorials/dna/2.html>

Question 30**Solution: A**

For PCR to work 4 main ‘ingredients’ need to be mixed together, DNA sample, nucleotides, DNA polymerase and primers. To allow specific sections of DNA to be targeted, primers are added. These are single stranded sections of DNA that are complementary to sections that are located at either end of the target DNA. Often they are 20-30 nucleotides long to ensure that the only sections in the genome that are being targeted are the ones on either end of the target.

Study Design Reference:

Amplification of DNA using the polymerase chain reaction

Web Link

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

Question 31**Solution: B**

A is incorrect because those 2 restriction enzymes have 1 cutting site each on the plasmid, which would liberate 2 fragments (not 3). C is incorrect because cutting at 2 sites would liberate 2 strands with different annealing combinations, making it difficult to insert a gene of interest. D is incorrect because the recombinant plasmid, being bigger would move less distance in a gel rather than further. B is correct because the plasmid would need to be in a bacterium prior to the gene being expressed, so on its own the plasmid would not be susceptible to the tetracycline.

Study Design Reference:

The use of enzymes including endonucleases (restriction enzymes), ligases and polymerases. The use of gel electrophoresis in sorting DNA fragments, including interpretation of gel runs. The use of recombinant plasmids as vectors to transform bacterial cells.

Web Link

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

Question 32**Solution: D**

Any organism that has had its gene expression altered artificially is regarded as a genetically modified organism. Any organism that has had its genome altered by adding DNA from another species into the genome is regarded as transgenic. The addition of a human gene into a bacterial genome is an example of a transgenic genetically modified organism.

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.nature.com/scitable/topicpage/genetically-modified-organisms-gmos-transgenic-crops-and-732>

Question 33**Solution: C**

In these types of cases there is 1 allele of the 3 gene loci passed from each parent to the child. Locus 1 and 2 has provided 1 allele from each of the parents and so based on this information the child could be biologically related to both mother and father. Locus 3 has only 1 band and so each parent could pass the same sized fragment to the child. It would be expected this common band would be 'thicker' illustrating more DNA. D is incorrect as each person has 2 alleles. It cannot be concluded if the man is or is not the biological father, so the only way to sort out this dispute would be to test more gene loci.

Study Design Reference:

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

Web Link

<http://genetics.thetech.org/ask/ask20>

Question 34**Solution: D**

The country needs to ensure that as many people are vaccinated prior to the flu season rather than waiting for individuals to become infected when a vaccine would not be useful. Quarantining all individuals in an area where there is an outbreak would reduce the spread but is an overreaction for a disease like the flu. Antibiotics will not work against viruses as they are used to kill bacterial infections. Relenza is a useful medication to have as it targets flu virus early in incubation and prevent other cells from becoming infected. This would reduce the incidence of the spread of the disease.

Study Design Reference:

Strategies that deal with the emergence of new diseases in a globally connected world, including the types of treatments
The Australian development of the antiviral drug Relenza as a neuraminidase inhibitor

Web Link

<http://www.hhmi.org/biointeractive/viral-outbreak-science-emerging-disease>

Question 35**Solution: B**

When a disease spreads from a localized area to a broader area it is regarded as an epidemic turning into a pandemic. This would spread according to many factors such as incubation period, virulence, method of transmission and the type of pathogen.

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

<https://www.cdc.gov/mobile/applications/sto/web-app.html>

Question 36**Solution: B**

A diagnostic procedure to identify an unknown bacterium is where several tests are conducted and based on the results a diagnosis can hopefully be made. In this case *Citerobacter freundii* by working backwards would have the following results.

- Methyl red positive reaction
- Negative indole reaction
- Positive ability to ferment lactose
- Gram negative

Study Design Reference:

Strategies that deal with the emergence of new diseases in a globally connected world and the use of scientific knowledge to identify the pathogen

Web Link

<http://www.hhmi.org/biointeractive/bacterial-identification-virtual-lab>

Question 37**Solution: A**

Controlled conditions are those that are the same when each experiment is conducted. This ensures one independent variable is tested. In this particular experiment the length of the seedlings is the dependent variable and is therefore not a controlled variable. Conditions such as temperature, oxygen levels and light levels should be the same.

Question 38**Solution: D**

The experiment shows only quantitative measurements (making A incorrect). B is incorrect because an hypothesis should be constructed prior to the completion of an experiment (it is an educated guess). With plants there are ethical guidelines possible for the human working with them, for example they may cause a rash when handling them (making C incorrect). When there was 0 GA there was still growth inferring that GA is within the seeds also

Question 39**Solution: D**

Precision relates to data collected for each independent variable tested. Batch 3 is the 5 seeds exposed to the 5 different levels of GA (making A incorrect). 20mg/L provides better growth than 10mg/L (making B incorrect). The accuracy cannot be determined (making C incorrect) because this relates to the known value, which is not known. The repeatability is appropriate as each IV was tested 6 times and the data gained is reasonably precise for most IVs tested.

Question 40**Solution: B**

The graphic representation must have the DV on the vertical axis and the IV on the horizontal axis (making C incorrect). The horizontal axis must be properly scaled (making D incorrect). It is inappropriate to include each batch as a different line on the one axis. It is better to average the data and plot 1 line.

Study Design Reference (for questions 37-40):

Independent, dependent and controlled variables

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

Ethics and issues of research including identification and application of relevant health, safety and bioethical guidelines

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

Web Link

<http://www.instructables.com/id/The-Scientific-Method/>

Answers to Short Answer Questions

Question 1 (7 marks)

Membrane structure and function and proteomics is the focus for this question. Examples need to be called on as well as stating some evidence that exists to support the fluid mosaic model of membrane structure

- a) The proteome is the entire set of proteins expressed by a genome, cell, tissue, or organism at a certain time. More specifically, it is the set of expressed proteins in a given type of cell or organism, at a given time, under defined conditions. **(1 mark)**
- b) The internal part of the phospholipid is hydrophobic and the outer part of the phospholipid is hydrophilic. A phospholipid bilayer is stable with water on either side yet forms a stable bilayer with the hydrophobic fatty acid tails on the inside. **(1 mark)**
The amino acids of membrane proteins facing the hydrophobic area of the membrane are hydrophobic themselves and the amino acids facing the water are hydrophilic **(1 mark)**
- c) Evidence of the fluid mosaic model
- Proteins can move laterally within a membrane, for example receptors may release G proteins that bind with other proteins within the cell
 - Mosaic of phospholipid heads on either side of the membrane revealed by microscopy
 - Presence of cholesterol maintains functionality in cold environments
 - Proteins dispersed amongst phospholipids
 - Cells move due to the flexibility of membranes

2 pieces of evidence needed **(2 marks)**

d)

Protein type	Protein function example	How protein structure suits its function
Signal cascade initiators	Receptor	Complementary shape to ligand allowing specificity
Ion transport	Protein channel	Specific shape to allow only certain chemicals to move across

All boxes correct for 2, at least 2 correct for 1 **(2 marks)**

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

Protein functional diversity and the nature of the proteome

Web Link

Fluid mosaic model: <http://www.susanahalpine.com/anim/Life/memb.htm>

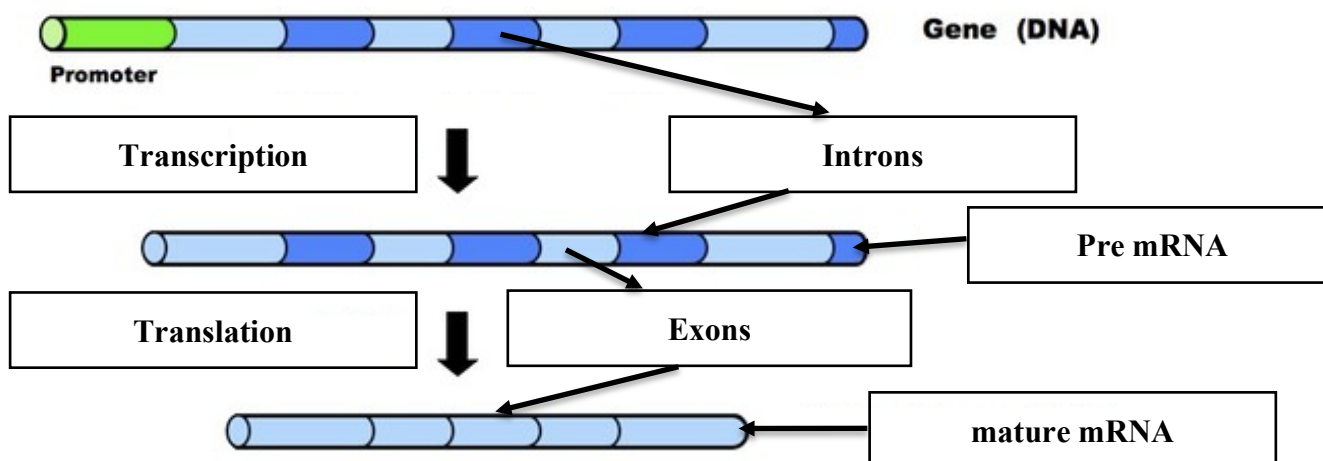
Proteome: <https://en.wikipedia.org/wiki/Proteomics>

Question 2 (8 marks)

The details of protein synthesis from DNA is the focus for this question. There are many terms that need to be consolidated here as well as details of the various processes that are involved

a)

The diagram below represents the process of transcription within a typical eukaryotic cell.



All 6 correct for full marks, 1 incorrect 2 marks, 2 incorrect 1 mark **(3 marks)**

b) There are only 4 different types of nucleotides that are found in DNA (or RNA) which would only provide enough specificity for 4 amino acids if read 1 nucleotide at a time and so this sequence cannot code for 12 amino acid **(1 mark)**

If the nucleotides are read in groups of 3 there are 64 different combinations allowing specificity for the 20 amino acids and so the particular sequence codes for only 4 amino acids **(1 mark)**

c)

Original sequence: **3' GGATTGCGATGA 5'**

mRNA: **5' CCUAACGCUACU 3'** **(1 mark)**

Protein: **proline-asparagine-alanine-threonine** **(1 mark)**

- d)** Promotor allows RNA polymerase to bind to it so the gene can be transcribed **(1 mark)**

Study Design Reference:

The genetic code as a degenerate triplet code and the steps in gene expression including transcription, RNA processing in eukaryotic cells and translation. The structure of genes in eukaryotic cells including stop and start instructions, promoter regions, exons and introns

Web Link

RNA processing: <https://www.dnalc.org/resources/3d/rna-splicing.html>

Gene control:

https://highered.mheducation.com/sites/9834092339/student_view0/chapter16/control_of_gene_expression_in_eukaryotes.html

Question 3 (8 marks)

Enzyme chemistry is a central topic because it makes a link between protein chemistry and metabolism. This section of the course usually has questions relating to enzymes you may never have heard of but don't panic, most of the questions are structured in a similar way

a) Ribosome

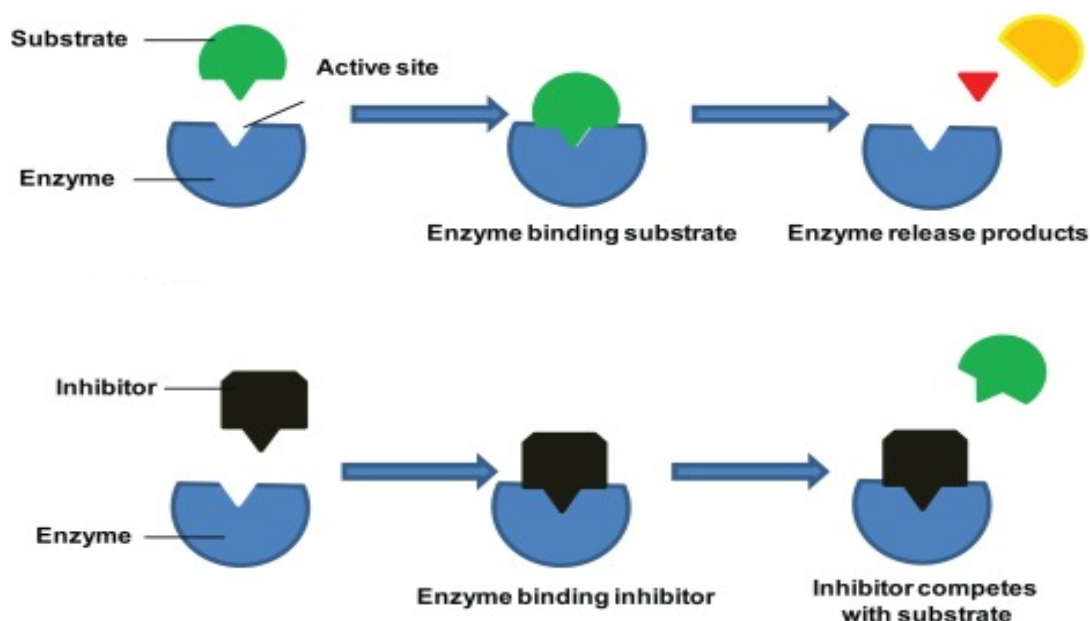
(1 mark)

b)

Condition	How the condition effects honey production. Choose from: (higher/lower/same)	In terms of enzyme chemistry why does the condition effect honey production?
A cold day falls in between several temperate days	Lower	Colder conditions lead to less kinetic energy available leading to reduced collisions between invertase and sucrose
Very little nectar is available on a particular day	Lower	Less sucrose substrate is available and so there will be less collisions between invertase and the substrate.

(4 marks)

c) (i)



1 mark for showing normal function with labelling of enzyme, substrates and reaction

1 mark for showing competitive inhibitor and how it stops the normal reaction from occurring.

(2 marks)

(ii) The most logical strategy bee farmers could would be to shifting hives so they are far from crops being sprayed.

(1 mark)

Bees less likely to be in contact with inhibitor. Therefore, increased honey yield.

(1 mark)

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://biomanbio.com/HTML5GamesandLabs/LifeChemgames/enzymatichtml5page.html>

Question 4 (7 marks)

This question is about signalling molecules and experiment design. Students don't need to have specific knowledge of particular signalling molecules; however, they should be able to apply knowledge when provided with second hand data/diagrams of specific signal pathways.

- a) (i)** Jasmonate is formed in a leaf as a result of damage by an herbivore (stimulus). The jasmonate is transported through the phloem and acts in areas away from the cell that formed the jasmonate, producing the protease inhibitor (response). **(1 mark)**

- (ii)** Jasmonate causes JAZ to be removed from the transcription factor, releasing the transcription factor into the cell cytosol. **(1 mark)**

Transcription factor binds to the protease inhibitor gene allowing the gene to be expressed and the inhibitor is formed as a response. **(1 mark)**

- b)** If the distance from the damaged section of the plant increases then the production of the protease inhibitor will decrease
NOTE: There are a variety of hypotheses possible but they should be written in the 'if...then...' format **(1 mark)**

- c) (i)** Validity: Make sure the experiment only has one independent variable being tested. All other factors should be the same **(1 mark)**

Precision: Ensure the experiment is repeated and that the data gained are similar to each other **(1 mark)**

- (ii)** If the level of protease inhibitor is less the further away from the herbivorous damage, then the hypothesis is supported **(1 mark)**

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 characteristics of scientific research methodologies, including laboratory work and/or fieldwork (geomorphology); precision, accuracy, reliability and validity of data; and minimisation of experimental bias

Web Link

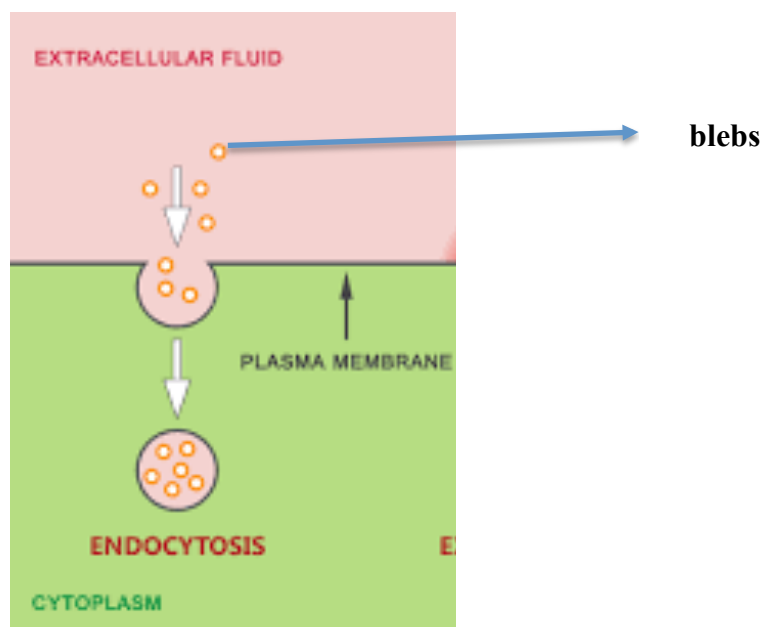
<http://slideplayer.com/slide/7020748/#>

Question 5 (9 marks)

Apoptosis is a new section to the course and students are expected to know the sequence of events that leads to cell death either extrinsically or intrinsically. The course design states the level of understanding required. The same applies with the use of monoclonal antibodies in the treatment of cancer.

- a) The cytochrome c will activate a caspase enzyme (1 mark)
 The caspase digests proteins within the cell (cytoskeleton) (1 mark)
 The cell falls apart forming blebs (1 mark)
 Also: Apoptotic bodies form, cells may release signals to attract phagocytes
NOTE: do not accept endocytosing the blebs as this is not part of apoptosis, just removal of the debris left over after apoptosis

b)



NOTE: 1 mark for diagram, 1 mark for labelling (2 marks)

- c) The rate of mitosis is greater than the rate of apoptosis (1 mark)
- d) Antigens unique to the cancer cell are isolated and injected into an animal such as a mouse to stimulate immunity against the antigen (1 mark)
 The specific B cell against the antigen is isolated and fused with a tumour cell producing a cell line that will produce an infinite supply of antibodies against the antigen (1 mark)
 The antibodies are administered to the person with cancer (probably by injection) so they bind to the antigens on the surface of the cancer cell and flag it for destruction. (1 mark)

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)

Malfunctions in apoptosis that result in deviant cell behaviour leading to diseases including cancer.

The use of monoclonal antibodies in treating cancer.

Web Link

<https://www.youtube.com/watch?v=8VSgOeJy4dQ>

Question 6 (5 marks)

Students need a thorough understanding of the immune system and in the case of this question the humoral response. This is a complicated process and the advice here is to keep it as simple as possible.

- a) Rhesus positive antigens come in contact with complementary receptors on the surface of a naïve B cell. **(1 mark)**
This naïve B cell clones and differentiates into plasma B cells that synthesise a specific antibody against the rhesus positive antigen. **(1 mark)**
- b) The antibodies against the rhesus positive antigens will bind to the antigens on the surface of the babies red blood cells which will lead to their destruction. **(1 mark)**
- c) Antibodies against rhesus positive antigens are produced and administered to the mother soon after birth **(1 mark)**
The antibodies will be present around the birth of the baby, which will bind to any antigens that may have been introduced. Destruction of the cells occurs before the immune system of the mother is activated. **(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.

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

Web Link

<https://www.youtube.com/watch?v=ho3mJMdZCOo>

Question 7 (7 marks)

Bacterial resistance to antibiotics is the focus of this question. The natural selection of the resistant strains as well as strategies we can implement to prevent this from happening. Most natural selection style questions will be of an applied nature and this is an example of that.

- a) There is variation in the original population of *staphylococcus aureus* bacteria. Some bacteria are sensitive to the antibiotic methicillin and some have genetic resistance. **(1 mark)**
The methicillin is the selective agent and the resistant bacteria are at a selective advantage over the non-resistant bacteria **(1 mark)**
Over many generations the proportion of resistant bacteria increases in the population as they are more likely to survive to breed. **(1 mark)**
- b) (i) 62% ($\pm 1\%$) **(1 mark)**
(ii) Hospitals **(1 mark)**
- c) There are several strategies such as
- Restrict the use of antibiotics in the animal industry (as a large amount of antibiotics are used)
 - Ensure doctors only prescribe antibiotics when necessary particularly the advanced penicillins
 - Public must finish the course of antibiotics prescribed such as beta-lactams
 - Hospitals to quarantine when MRSA outbreaks occur

NOTE: there may be other strategies but answers should use the data provided in the graph. 2 strategies required **(2 marks)**

Study Design Reference:

Environmental selection pressures on phenotypes as the mechanism for natural selection

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.

Web Link

<https://www.reactgroup.org/toolbox/understand/antibiotic-resistance/mutation-and-selection/>

Question 8 (7 marks)

Morphological change can occur due to different reasons. This question displays gradualism and punctuated equilibrium. It is not important to know these models for evolutionary change; however, providing evidence about fossils and explaining how it might support a model is.

a)

Form of speciation supported	Fossil evidence	Explanation how the evidence supports the model
Gradualism	Gradual morphological changes in ancestral fossils	A single event separated the ancestors but it took time for the changes to accumulate
Gradualism	A small number of fossils of similar age that are morphologically similar	Each change could be linked together through time showing gradual changes
Punctuated	Sudden morphological changes in ancestral fossils	A single event led to the separation of a common ancestor into 2 groups
Punctuated	A large number of fossils with different ages but with similar morphology	That organism has existed without change for a long time

NOTE: 2 pieces of evidence needed, 2 marks for the evidence, 2 marks for the explanation **(4 marks)**

- b)** The original population displayed variation within the group and was geographically separated into 2 different populations. **(1 mark)**

Each population was exposed to different selection pressures and so phenotypic change rapidly occurred in each population due to natural selection, leading to different phenotypes in each population.

(1 mark)

Speciation has occurred when the 2 populations, when in contact with each other, no longer successfully breed. **(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
The use of phylogenetic trees to show relatedness between species

Web Link

<https://www.youtube.com/watch?v=qWUqQyVa5ts>

Question 9 (Total 9 marks)

This question is about using molecular differences between organisms to determine evolutionary relationships and some of the techniques used to determine these relationships.

- a)** Molecular homology are the similarity in the molecules of inheritance (DNA or polypeptide chains) between 2 or more species. The greater the similarity the closer the common ancestor between the 2 species. **(1 mark)**
- b)**

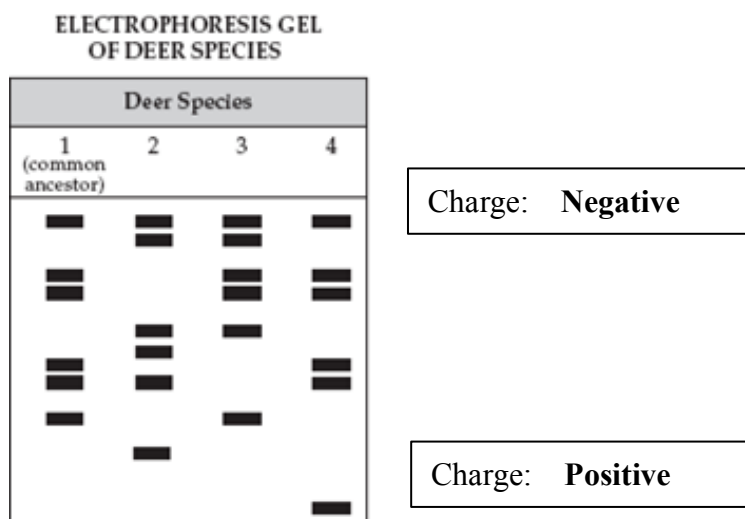
NOTE: 1 mark for each correct section

(4 marks)

	Structural homology	Molecular homology
Advantage	Clear to observe that the structure has a similarity and the use of the structure may be different, inferring common ancestry	Quantitative measure of similarity and so regarded as a more accurate measure
Disadvantage	Qualitative measure and so is subject to opinion	Molecules do not fossilize very well and so comparisons are (usually) made with currently living organisms

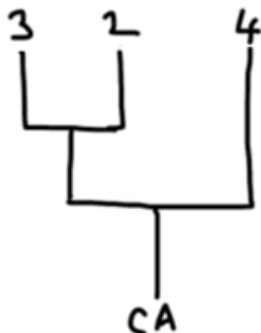
- c) The gorilla and the horse have 2 differences and the zebra and chimpanzee have 3 differences so the statement is untrue (1 mark)

- d) (i)**



(1 mark)

(ii)



NOTE: all numbers need to be in correct position but 3 and 4 can change positions. Logic: 4 has the most similarity to CA (1)

(2 marks)

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

The use of phylogenetic trees to show relatedness between species

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

Web Link

Homology: <https://prezi.com/delbyba88vjj/anatomical-and-molecular-homologies/>

Question 10 (Total 5 marks)

The use of plasmids, bacteria, restriction enzymes and PCR is an integral part of biotechnology. An in depth understanding of how each step works is important as well as some of the issues surrounding these technologies. This question uses a mouse as the animal model for these technologies and so students need to apply their knowledge to a new situation.

- a) Restriction enzymes cut DNA at specific sites. In this case, the same restriction enzyme should be used to cut the plasmid (once) with sticky ends and the modified gene twice (on either side off the target). **(1 mark)**
Ligase enzymes anneal the restricted fragments together by forming covalent bonds between the plasmid and the gene of interest so one larger modified plasmid is formed. **(1 mark)**
- b) Yes the complementary sections are able to anneal to the DNA on either end of the target genes. **(1 mark)**
Primers have complementary band sequences to the sections of DNA on either end of the target DNA for the process of PCR. **(1 mark)**
- c) Answers could either agree or disagree
Agree:
- It takes a lot longer in time spent as well as money spent to gain results
 - More embryos need to be sacrificed to gain the same result that could be gained if the success rate was higher

Disagree:

- Any result that can learn more about the function of genes is worthy research
- The technology used for 20% success will logically improve over time

NOTE: agree or disagree with a logical argument

(1 mark)

Study Design Reference:

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

Amplification of DNA using the polymerase chain reaction

Web Link

<https://www.youtube.com/watch?v=PooN1OvgDKE>

Question 11 (9 marks)

This question is primarily about experimental design with a metabolism context. Students should be able to read information about experiments conducted and apply their experience to the situation in front of them.

- a) Low carbon dioxide levels infers photosynthesis rate is higher than respiration removing carbon dioxide from solution making the solution more purple **(1 mark)**
High carbon dioxide levels infers respiration rate is higher than photosynthesis putting carbon dioxide into the solution making it more red **(1 mark)**

- b) (i) So the effect of the independent variable (light) on the dependent variable (pH change) can be determined. The same initial colour is a controlled condition **(1 mark)**

(ii)

Distance from light source (cm)	Initial buffer solution colour	Final buffer solution colour	Change in pH (+ve, -ve, nil)
10	Yellow-orange	Purple	+ve
20	Yellow-orange	Orange	+ve
30	Yellow-orange	Yellow-orange	nil
40	Yellow-orange	Yellow	-ve
50	Yellow-orange	Yellow-red	-ve

(1 mark)

- c) Experiments are always subject to error and any error will compromise accuracy. In this experiment the following errors could be discussed
- Lack of repetition: anomalous results can be seen and potentially removed or their impact reduced by conducting more trials
 - Only 1 cube used per distance: if more cubes were used more surface area of chlorella would be available giving better resolution of results
 - A quantitative pH measurement could be given rather than qualitative: pH changes may not be seen with a subtle colour change and may be better resolved with a measured pH of the solution
 - More independent variables could be used: trends may be more apparent with more light distances used

NOTE: error and explanation on how the error improves accuracy needed

(2 marks)

d) There are 3 parts that must be discussed in this experiment

A less acidic pH: light source is far from the chlorella (more than 30cm) meaning the rate of photosynthesis is less than the rate of respiration putting more carbon dioxide into the solution making it more acidic (1 mark)

A more acidic pH: light source is close to the chlorella (less than 30cm) meaning the rate of photosynthesis is greater than the rate of respiration taking more carbon dioxide from the solution making it more alkaline (1 mark)

No change in pH: light source is 30cm from the chlorella meaning the rate of photosynthesis is equal to the rate of respiration leaving the same amount of carbon dioxide in the solution not changing the pH. (1 mark)

Study Design Reference:

The biological concepts specific to the investigation and their significance, including definitions of key terms, and biological representations

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

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

Web Link

<http://thebiologyprimer.com/introduction-to-the-scientific-method/>

End of 2018 Kilbaha VCE Biology Trial Examination Units 3 and 4 Detailed Answers to Short Answer Questions

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