Answer Summary for Multiple-Choice Questions
2022 Kilbaha VCE Biology Trial Examination

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

ONE ANSWER PER LINE

1.	A	B	C	
2.	A	B	C	
3.	A		C	D
4.	A	B	C	
5.		B	C	D
6.	A		C	D
7.		B	C	D
8.	A	B	C	
9.	A	B		D
10.		B	C	D
11.	A	B	C	
12.	A	B	C	
13.	A		C	D
14.	A	B	C	
15.		B	C	D
16.	A		C	D
17.	A	B		D
18.	A	B		D
19.	A		C	D
20.		B	C	D

ONE ANSWER PER LINE

21.	A	B		D
22.	A	B	C	
23.	A	B	C	
24.	A	B		D
25.	A		C	D
26.	A		C	D
27.	A	B	C	
28.		B	C	D
29.	A		C	D
30.		B	C	D
31.	A		C	D
32.		B	C	D
33.	A		C	D
34.	A	B		D
35.	A	B	C	
36.	A	B	C	
37.		B	C	D
38.	A	B	C	
39.	A	B		D
40.	A		C	D

Answer distribution: A: 9 B: 11 C: 7 D: 13

Section A

Question 1

Solution: D

Molecule 1 is mRNA, molecule 2 is rRNA that are part of a ribosome and molecule 3 is tRNA which clearly shows an anticodon as well as an amino acid

Study Design Reference

nucleic acids as information molecules that encode instructions for the synthesis of proteins: the structure of DNA, the three main forms of RNA (mRNA, rRNA and tRNA) and a comparison of their respective nucleotides
Link: https://www.britannica.com/science/RNA

Question 2

Solution: D

The primary level of protein arrangement is the amino acid sequence making each polypeptide. The secondary level of arrangement is the coiling and twisting of amino acids that give a more stable arrangement. The tertiary level of arrangement is the 3D shape of a single polypeptide. The quaternary level of arrangement involves the interaction between polypeptides making a functional protein. Rubisco functions at the quaternary level.

Study Design Reference

amino acids as the monomers of a polypeptide chain and the resultant hierarchical levels of structure that give rise to a functional protein
Link: https://www.khanacademy.org/science/biology/macromolecules/proteins-and-amino-acids/a/orders-of-protein-structure#:~:text=To%20understand%20how%20a%20protein,secondary%2C%20tertiary%2C%20and%20quaternary.

Question 3

Solution: B

Gene control involves part that RNA polymerase binds to called the promotor region. The factors preventing the expression of the gene involves interaction of various factors with the operator section of the same gene.

Study Design Reference

the basic elements of gene regulation: prokaryotic *trp* operon as a simplified example of a regulatory process
Link: https://www.khanacademy.org/science/ap-biology/gene-expression-and-regulation/regulation-of-gene-expression-and-cell-specialization/a/overview-of-eukaryotic-gene-regulation

Question 4

Solution: D

Students should be able to see that in the diagram there is a strand of mRNA moving through a ribosome. The process depicted is called translation.

Question 5

Solution: A

The process of translation involves the joining of amino acids (B) together to make a polypeptide chain (A). This is done using tRNA (C) that carries an anticodon (H) as well as a specific amino acid

Question 6

Solution: B

Degeneracy is in the genetic code meaning 64 different combinations of codons/anticodons are possible. Transcription occurs in prokaryotes as well as eukaryotes (making C incorrect). Ribosomes (I) are comprised of protein as well as rRNA.

Study Design Reference (for questions 4 to 6)

the genetic code as a universal triplet code that is degenerate and the steps in gene expression, including transcription, RNA processing in eukaryotic cells and translation by ribosomes
Link (for questions 4 to 6): https://learn.genetics.utah.edu/content/basics/transcribe/

Question 7

Solution: A

The fact that the DNA code is predictable in all living things makes it the focus of genetics and associated biochemistry. The code is referred to as being universal because of this.

Study Design Reference

the genetic code as a universal triplet code that is degenerate and the steps in gene expression, including transcription, RNA processing in eukaryotic cells and translation by ribosomes
Link: https://www.cpalms.org/PreviewResourceStudentTutorial/Preview/109648

Question 8

Solution: D

Photographs can be taken of the sections within a cell that radiation is concentrated in. For a protein to be secreted it would be expected that radioactive amino acids would be concentrated around the rough endoplasmic reticulum for the initial synthesis of the insulin.

Study Design Reference

the role of rough endoplasmic reticulum, Golgi apparatus and associated vesicles in the export of proteins from a cell via the protein secretory pathway
Link: https://study.com/academy/lesson/organelles-involved-in-protein-synthesis.html

Question 9

Solution: C

Proteins have a wide variety of functions. Their names vary from protein to protein, but enzymes often end with the suffix 'ase'. So, phenylalanine hydroxylase is an enzyme because it fits into that category.

Study Design Reference

proteins as a diverse group of molecules that collectively make an organism's proteome, including enzymes as catalysts in biochemical pathways
Link: **https://learn-biology.com/ap-biology/module-6-menu-biochemistry/proteins-ap-interactive-tutorial/**

Question 10

Solution: A

Another word for cleaving is cutting and enzymes that cut DNA are called endonucleases or restriction enzymes. Ligase enzymes join DNA fragments together and polymerases as nucleotides to other nucleotides during replication.

Study Design Reference

the use of enzymes to manipulate DNA, including polymerase to synthesise DNA, ligase to join DNA and endonucleases to cut DNA
Link: **https://www.khanacademy.org/science/biology/biotech-dna-technology/dna-cloning-tutorial/a/restriction-enzymes-dna-ligase**

Question 11

Solution: D

Smal and *Rsal* cuts the DNA strand once each (yellow and red). *EcoRV* cuts the strand five times (blue). This means there are a total of 7 cuts on a linear strand which will liberate 8 fragments overall.

AGGCCGATCGCGAGGGAGATCTGATTCTGGATAAGGATCGTA

Study Design Reference

the use of enzymes to manipulate DNA, including polymerase to synthesise DNA, ligase to join DNA and endonucleases to cut DNA
Link: **https://dnalc.cshl.edu/resources/animations/restriction.html**

Question 12

Solution: D

When plasmids are modified, after their sequence is determined, they will be cut with a restriction enzyme (liberating sticky ends), which converts it into a linear fragment. The same occurs with the gene of interest and they are then mixed together with DNA ligase to form a recombinant plasmid.

Study Design Reference

the use of enzymes to manipulate DNA, including polymerase to synthesise DNA, ligase to join DNA and endonucleases to cut DNA
Link: https://www.khanacademy.org/science/ap-biology/gene-expression-and-regulation/biotechnology/a/overview-dna-cloning

Question 13

Solution: B

Once DNA is extracted, the PCR process starts with the denaturation of the strand. This is done with heat to break the H bonds between complementary nucleotides (but not too high to break the bonds holding the nucleotides together along each polynucleotide strand. Somewhere between 90 and 95°C is appropriate. Temperature needs to drop for the primer to anneal, this is usually less than 60°C. Then the optimal temperature for Taq polymerase (72°C) is used to replicate a new strand along each template.

Study Design Reference

amplification of DNA using polymerase chain reaction and the use of gel electrophoresis in sorting DNA fragments, including the interpretation of gel runs for DNA profiling
Link: https://dnalc.cshl.edu/resources/animations/pcr.html

Question 14

Solution: D

Enzymes are reusable which means they participate in more than 1 reaction. They denature at high temperatures and collide more frequently with increasing temperature. Even at high temperatures the substrate and enzyme will collide, but the enzymes active site may be different.

Study Design Reference

the general factors that impact on enzyme function in relation to photosynthesis and cellular respiration: changes in temperature, pH, concentration, competitive and non-competitive enzyme inhibitors
Link: https://ib.bioninja.com.au/standard-level/topic-2-molecular-biology/25-enzymes/models-of-action.html

Question 15

Solution: A

Catabolic reactions is a breakdown reaction which, in this situation converts ATP into ADP and Pi. This reaction is also endergonic, meaning it releases energy. This will occur when large molecules are being built such as during DNA replication.

Study Design Reference

the general role of enzymes and coenzymes in facilitating steps in photosynthesis and cellular respiration
Link: **https://study.com/academy/answer/is-dna-replication-endergonic-or-exergonic.html**

Question 16

Solution: B

Red and violet wavelengths of light carry the energy for the light independent reaction. Once the energy is absorbed the first step is to split water to release oxygen and hydrogen ions. These hydrogen ions move through ATPase to form ATP

Study Design Reference

inputs, outputs and locations of the light dependent and light independent stages of photosynthesis in C_3 plants (details of biochemical pathway mechanisms are not required)
Link:
https://biomanbio.com/HTML5GamesandLabs/PhotoRespgames/photointeractivehtml5page.html

Question 17

Solution: C

Oxygen usage is due to cellular respiration exceeding photosynthetic rate up to a light intensity of about 25 lux. With an increase in light intensity above 25 lux the production of oxygen increases due to photosynthesis being greater than respiration. The rate of photosynthesis levels as other factors such as carbon dioxide is limiting the reaction from increasing further. The rate of oxygen production is also explained with respiration

Study Design Reference

the factors that affect the rate of photosynthesis: light availability, water availability, temperature and carbon dioxide concentration
Link: **https://biomanbio.com/HTML5GamesandLabs/PhotoRespgames/photoresp.html**

Question 18

Solution: C

C3 plants are the typical temperate climate plant where CO2 is converted to G3P during the day. This is inefficient usage of CO2 compared to a C4 plant that converts the CO2 into a 4 carbon compound and then converts that 4 carbon compound back into CO2 during the day. C4 plant are better adapted for drier conditions. CAM plants separate the LDR (day) from the LIR (night), which suits desert plants.

Study Design Reference

the role of Rubisco in photosynthesis, including adaptations of C_3, C_4 and CAM plants to maximise the efficiency of photosynthesis
Link: https://www.youtube.com/watch?v=HbLg4lMpUa8

Question 19

Solution: B

Mitochondrial structure and how it relates to function is an important visual aid to a deeper understanding of the respiration process. The organelle has 2 membranes, an outer membrane (R) and an inner membrane (S) that has inner folding's called cristae (Q) that are the site of the ETC. The matrix (P) is the site of the Krebs's cycle.

Question 20

Solution: A

Area P is the matrix and the site for Kreb's cycle. This biochemical process converts pyruvate, that is converted into acetyl CoA, into carbon dioxide, ATP and NADH.

Study Design Reference (for questions 19 and 20)

the main inputs, outputs and locations of glycolysis, Krebs Cycle and electron transport chain including ATP yield (details of biochemical pathway mechanisms are not required)
Link: https://www.britannica.com/science/mitochondrion/Role-in-disease

Question 21

Solution: C

Microbiota are living things. They inhabit in a range of locations in or on our body and usually function symbiotically with the body that enhances the survival of the body as well as the living things (usually bacteria). *Staphylococcus aureus* are skin bacteria that preventing opportunistic infections such as fungal growths. Mucus forms a physical layer and lysozyme a chemical barrier.

Study Design Reference

physical, chemical and microbiota barriers as preventative mechanisms of pathogenic infection in animals and plants
Link: https://learn.genetics.utah.edu/content/microbiome/ecosystem/

Question 22

Solution: D

A cellular pathogen is (obviously) a cell of some type. This can be a bacterium, or a eukaryotic cell. An allergen is a chemical, a prion is a protein and a virus is a non cellular pathogen.

Study Design Reference

initiation of an immune response, including antigen presentation, the distinction between self antigens and non-self antigens, cellular and non-cellular pathogens and allergens
Link: https://www.healthline.com/health/what-is-a-pathogen#types

Question 23

Solution: D

White blood cells are only a small proportion of the blood volume. Within that volume some white blood cells are more prolific than others. Cells that are available for an initial response in an innate way would be expected to be quite concentrated. Neutrophils are the most prolific and comprise about 50% of the white blood cell volume. Lymphocytes are about 20% of the blood volume.

Question 24

Solution: C

Mast cells are specialised to respond to invading pathogens and respond by releasing histamines. This inflames the area but enables more white blood cells to the site of entry. Allergens use this same process but stimulating an antibody response (involving B cells) that bind to mast cells and respond more aggressively with subsequent exposures.

Study Design Reference (for questions 23 and 24)

initiation of an immune response, including antigen presentation, the distinction between self-antigens and non-self antigens, cellular and non-cellular pathogens and allergens
the characteristics and roles of the components of the adaptive immune response against both extracellular and intracellular threats, including the actions of B lymphocytes and their antibodies, helper T and cytotoxic T cells
Link: https://www.youtube.com/watch?v=Tdx-U8S6ZMk

Question 25

Solution: B

Lymph nodes have lymphatic fluid passing through them, which often contain antigenic fragments. The lymph nodes have immature B and T cells present that have a higher chance of meeting each other. If the right connection occurs (selection) then clonal expansion may also occur there.

Study Design Reference

the role of the lymphatic system in the immune response as a transport network and the role of lymph nodes as sites for antigen recognition by T and B lymphocytes
Link: https://www.visiblebody.com/learn/lymphatic

Question 26

Solution: B

To solve this problem the flow chat should be followed sequentially. A positive result with catalase, coagulase negative, mannitol negative and glucose OF F.

Study Design Reference

scientific and social strategies employed to identify and control the spread of pathogens, including identification of the pathogen and host, modes of transmission and measures to control transmission
Link: https://media.hhmi.org/biointeractive/vlabs/bacterial_id/index.html

Question 27

Solution: D

4 different antibodies against 4 different venoms. When administered into the body there should be short term protection against any of the venoms due the antibody presence. B cells (humoral) response triggers the production of specific antibodies. If the 4 antigens are injected into the same horse, 4 different antibodies should result. A higher concentration of antibody in a monovalent serum would be more effective.

Question 28

Solution: A

The introduction of antibodies into the body is an artificial means of getting the antibody. The antibody will bind to the toxin if it present in the body, which leads to its neutralisation. This is a passive from of immunity because the immune system has not been activated.

Study Design Reference

the difference between natural and artificial immunity and active and passive strategies for acquiring immunity
Link: https://www.historyofvaccines.org/content/articles/passive-immunization

Question 29

Solution: B

The stem of the question illustrates that smallpox had already killed 30% of infected Europeans. The remainder were either unaffected or had some inherent resistance against the disease. It may have been endemic in the community. In 1789, some Europeans brought the smallpox virus with them and this got into the indigenous community and decimated the population in a similar way to what happened earlier in the 18th century in Europe. Lack of medical help meant the mortality rate was even higher

Study Design Reference

- the emergence of new pathogens and re-emergence of known pathogens in a globally connected world, including the impact of European arrival on Aboriginal and Torres Strait Islander peoples

Link: https://australian.museum/about/history/exhibitions/indigenous-australians/

Question 30

Solution: A

For the production of specific antibodies within an individual (in this case a rabbit), the individual should be exposed to antigens. After the immune system has reacted against the antigen, there should be specific B cells (plasma cells) that produce an antibody against the antigen. The B cells are isolated and combined with a cancer cell so the resultant hybridoma can divide to produce more hybridomas and a large quantity of the specific antibody to be used for immunotherapy.

Study Design Reference

the development of immunotherapy strategies, including the use of monoclonal antibodies for the treatment of autoimmune diseases and cancer.
Link: https://www.antibodies-online.com/resources/16/1209/monoclonal-antibodies/

Question 31

Solution: B

Ancestral plants that offered an advantage in society were grown on farms. The seeds of the best plants were then used rather than allowing random growth. The next seasons crop may have had features that were better than the original. If this was continued over many generations the resultant plants could look very different to the ancestral plant. This is an example of artificial selection.

Study Design Reference

manipulation of gene pools through selective breeding programs
Link: https://media.hhmi.org/biointeractive/click/Selection/01.html

Question 32

Solution: A

A gust of wind relocating a small unrepresentative sample of a larger population into a new environment is a phenomenon known as genetic drift (founder effect specifically). The new environment may have different selection pressures on the individuals, which may lead to rapid phenotypic change.

Study Design Reference

causes of changing allele frequencies in a population's gene pool, including environmental selection pressures, genetic drift and gene flow; and mutations as the source of new alleles
Link:
https://www.whfreeman.com/BrainHoney/Resource/6716/SitebuilderUploads/Hillis2e/Student%20Resources/Animated%20Tutorials/pol2e_at_1502_genetic_drift_simulation/pol2e_at_1502_genetic_drift_simulation.html

Question 33

Solution: B

When antibiotics are administered to treat infection, the intent is to kill all the bacteria. Bacteria have genetic variation within the population as a result of mutation. Some variants may have antibiotic resistance. In an antibiotic rich environment (selective pressure), they are more likely to survive. Antibiotic resistant bacteria are starting to become more prominent.

Study Design Reference

consequences of bacterial resistance and viral antigenic drift and shift in terms of ongoing challenges for treatment strategies and vaccination against pathogens
Link: https://www.brainpop.com/health/diseasesinjuriesandconditions/antibioticresistance/

Question 34

Solution: C

The streamlined shape would help the organisms move through the water. The ancestral dolphin was terrestrial and would be expected to possess features suitable for land living. By moving into the water the variants that would be at an advantage would be those that are more streamlined (among other features).

Study Design Reference

evidence of relatedness between species: structural morphology – homologous and vestigial structures; and molecular homology – DNA and amino acid sequences
Link: https://www.biologysimulations.com/evolutionsimulation

Question 35

Solution: D

The *Howea* plants began as 1 ancestral species on Lord Howe Island. The wind dispersed the seeds to a range of locations including volcanic soil as well as basaltic soils. These micro habitats are sporadically dispersed on the island. Due to the differences in the soil, certain variants were more suited and eventually new species emerged. This is called sympatric speciation.

Study Design Reference

evidence of speciation as a consequence of isolation and genetic divergence, including Galapagos finches as an example of allopatric speciation and *Howea* palms on Lord Howe Island as an example of sympatric speciation
Link: https://www.biotopics.co.uk/A17/Sympatric_speciation.html

Question 36

Solution: D

Question 37

Solution: A

Question 38

Solution: D

Phylogenetic trees show relationships between organisms along an evolutionary linage. They usually have a scale with them so times of divergence can be calculated. The most recent divergence is the most recent branch. They are developed using evidence, which can be structural, as is provided with this evolutionary tree.

Study Design Reference (for questions 36-38)

the use and interpretation of phylogenetic trees as evidence for the relatedness between species
Link: https://learn.genetics.utah.edu/content/evolution/tree/

Question 39

Solution: C

Hominins include modern humans and all their bipedal ancestors. The hominins are a subset of the order of primates. All primates have an opposable 5th digit, forward facing eyes and a higher level of intelligence due to a large cranial capacity.

Study Design Reference

the shared characteristics that define mammals, primates, hominoids and hominins
Link: https://media.hhmi.org/biointeractive/click/human-origins/

Question 40

Solution: B

The 3 graphs illustrated show there is a distinction in the hybridisation data between the species compared. If there is no overlap then this provides evidence of speciation between the primates measured, making 3 species of primates being case studied.

Study Design Reference

ways of using fossil and DNA evidence (mtDNA and whole genomes) to explain the migration of modern human populations around the world, including the migration of Aboriginal and Torres Strait Islander populations and their connection to Country and Place.
Link: https://en.wikipedia.org/wiki/Interbreeding_between_archaic_and_modern_humans

End of answers to Section A

Section B

Question 1 (Total 7 marks)

a) **(i)** Nucleus **(1 mark)**
(ii) pre mRNA **(1 mark)**

b) Convert the template strand into a mRNA strand
5'CCUAUGCUAGUC3' **(1 mark)**
Codons are a group of 3 mRNA nucleotides read from the 5 to 3 direction and each one codes for a specific amino acid, which can be looked up in the codon table **(1 mark)**

c) Step 2 is RNA processing **(1 mark)**
Area 1 is an exon, that is kept after processing Area 2 is an intron that is cleaved out during processing **(1 mark)**
The final mRNA can have different sequences of mRNA providing different translated polypeptides, which may conserve energy as well as provide more variety **(1 mark)**

Study Design Reference

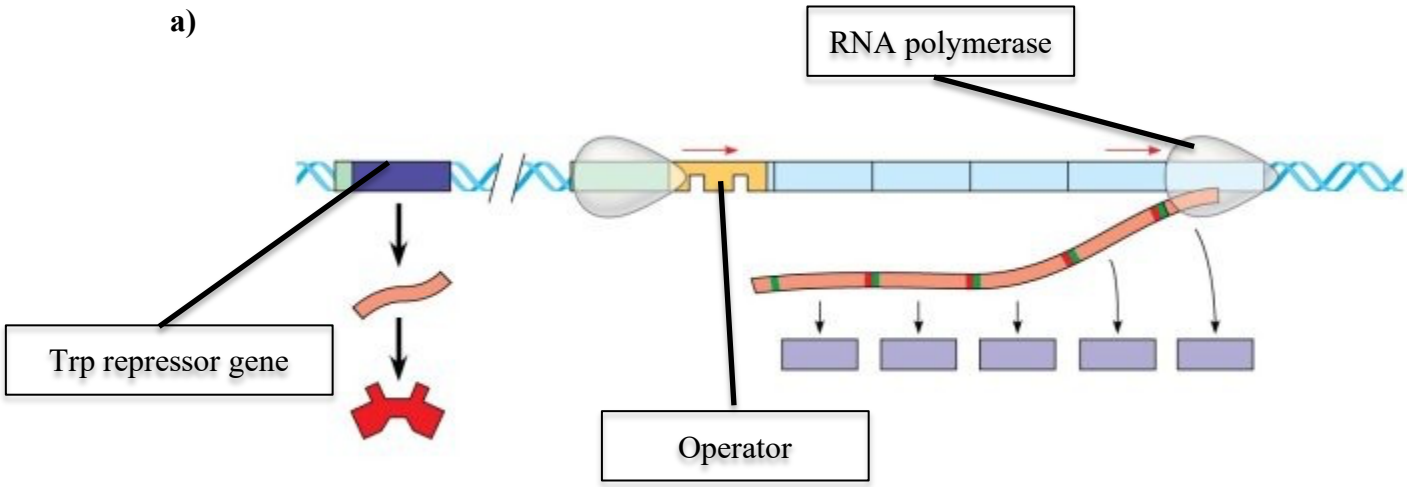
- the genetic code as a universal triplet code that is degenerate and the steps in gene expression, including transcription, RNA processing in eukaryotic cells and translation by ribosomes
- the structure of genes: exons, introns and promoter and operator regions

Web Link

https://dnalc.cshl.edu/resources/3d/rna-splicing.html

Question 2 (Total 9 marks)

a)



(3 marks)

b) Diagram 2 **(1 mark)**
Presence of tryptophan binds to the repressor, changing its shape so that it now fits on the operator enabling it to bind to the operator thus stopping the transcription of the structural genes
(1 mark)

c) Repressor genes produce proteins that control the activation of structural genes
(1 mark)
Structural genes control the activity of various metabolic activities within a cell such as enzymes
(1 mark)

d) Regulatory genes may activate or deactivate more than 1 structural gene (or cluster of structural genes)
(1 mark)
If different combinations of structural genes are activated by a regulatory gene, the structural proteins produced may change the type of cell that cell specialises into (B or T cells)
(1 mark)

Study Design Reference

- the basic elements of gene regulation: prokaryotic *trp* operon as a simplified example of a regulatory process

Web Link

Trp operon:
https://www.labxchange.org/library/items/lb:LabXchange:6d81ca25:lx_simulation:1
Gene control: https://phet.colorado.edu/en/simulations/gene-expression-essentials

Question 3 (Total 7 marks)

a) Clustered Regularly Interspaced Short Palindromic Repeats **(1 mark)**

b) Guide RNA is comprised of Spacer RNA and Scaffold RNA **(1 mark)**
Guide RNA is held onto Cas 9 by the scaffold **(1 mark)**
Spacer RNA binds to target DNA in a complementary fashion **(1 mark)**
Cas 9 cleaves (cuts) the middle part of the target DNA **(1 mark)**
NOTE: all words should be used correctly, any missing or error subtract a mark for each error

c) Once the target DNA is cleaved, the DNA is repaired naturally within the cell to reform the DNA strand. The repair involves the insertion of nucleotides within the target gene rendering it non functional. **(1 mark)**
To insert a new gene between the cleavage requires a new gene to be added that needs to be inserted between the cleavage points. This is more difficult as there is an extra step in the process. **(1 mark)**

Study Design Reference

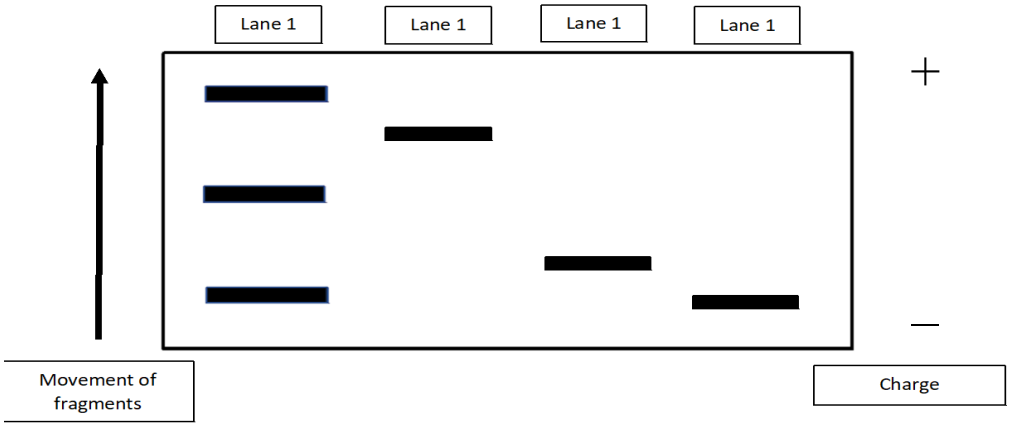
- the function of CRISPR-Cas9 in bacteria and the application of this function in editing an organism's genome

Link: https://media.hhmi.org/biointeractive/click/CRISPR/

Question 4 (Total 9 marks)

a) The number of restriction sites on both the plasmid and the gene to be inserted: preferably 1 cutting site on the plasmid and 2 on the gene to be inserted **(1 mark)**
The cutting site on the plasmid should not be in the middle of an antibiotic resistance gene and the cutting sites ion the gene should be at either end of the gene **(1 mark)**
The types of cuts should be sticky because then there is a likely chance of the restricted fragment annealing with the 2 ends of the restricted gene making a recombinant fragment **(1 mark)**

b)



NOTE: The stem states in order from top to bottom so 1 penalty if this is not followed.

NOTE: 1 mark for movement direction, 1 mark for charge, 1 mark for each lane and 1 mark penalty for any error made

(4 marks)

c) The main method is that the plasmids have an antibiotic resistance gene along it and if the recombinant plasmid is present in the bacteria it will be resistant to that antibiotic **(1 mark)**
By exposing all bacteria to the antibiotic in a culture medium only the bacteria with the recombinant plasmid will grow and colonies of them will be able to be selected from those without the recombinant plasmid which cannot grow in the presence of the antibiotic **(1 mark)**

Study Design Reference

- amplification of DNA using polymerase chain reaction and the use of gel electrophoresis in sorting DNA fragments, including the interpretation of gel runs for DNA profiling
- the use of recombinant plasmids as vectors to transform bacterial cells as demonstrated by the production of human insulin

Links:

Transformation:
https://www.labxchange.org/library/items/lb:LabXchange:b4d9f467:lx_simulation:1

Gel electrophoresis: https://learn.genetics.utah.edu/content/labs/gel/

Question 5 (Total 8 marks)

a) there are various differences including (students need 2 of)

- Mitochondria have cristae whereas chloroplasts have grana
- Mitochondria found in all eukaryotic cells whereas chloroplasts are located only in eukaryotic autotrophic cells
- Mitochondria undergo cellular respiration whereas chloroplasts undertake photosynthesis
- Mitochondria rod shaped whereas chloroplast are disc shaped

(2 marks)

b)

Organelle	Chemical exposure combination	Justification
Mitochondria	Oxygen and pyruvic acid	Pyruvic acid an input into Krebs cycle Oxygen an electron acceptor in the ETC
Chloroplast	Carbon dioxide and water	Carbon dioxide as an input for carbon fixation Water as a substrate to be split in the LDR

NOTE: 1 mark for each correct cell **(4 marks)**

c) 2 of

- Temperature
- pH
- Availability of inputs (no need to state them)
- Availability of enzymes

(2 marks)

Study Design Reference

- inputs, outputs and locations of the light dependent and light independent stages of photosynthesis in C_3 plants (details of biochemical pathway mechanisms are not required) the main inputs, outputs and locations of glycolysis, Krebs Cycle and electron transport chain including ATP yield (details of biochemical pathway mechanisms are not required)

Link:

https://owlcation.com/stem/Comparison-and-Contrast-Between-Chloroplasts-and-Mitochondria

Question 6 (5 marks)

a) (i) 1, 4, 3, 2 **(1 mark)**

(ii) Cell 1: allergen (triangle) comes in contact with complementary receptors on the surface of a naïve B cell **(1 mark)**
Cell 2: allergen binds in a complementary fashion with antibodies on the surface of a mast cell which degranulates and releases histamine **(1 mark)**
Cell 3: specific antibody complementary to the allergen binds to receptors on the surface of a mast cell **(1 mark)**
Cell 4: B plasma cell clones and forms a B plasma cell that releases specific antibodies complementary to the allergen **(1 mark)**

Study Design Reference

- the innate immune response including the steps in an inflammatory response and the characteristics and roles of macrophages, neutrophils, dendritic cells, eosinophils, natural killer cells, mast cells, complement proteins and interferons
- initiation of an immune response, including antigen presentation, the distinction between self-antigens and non-self antigens, cellular and non-cellular pathogens and allergens
- the characteristics and roles of the components of the adaptive immune response against both extracellular and intracellular threats, including the actions of B lymphocytes and their antibodies, helper T and cytotoxic T cells

Link:

https://www.edumedia-sciences.com/en/media/656-allergy

Question 7 (Total 10 marks)

a)

Event occurring in the antibody response graph	Number
Exposure to COVID-19 virus	**4**
Primary immune response	**2**
Secondary immune response	**5**
Administration of the COVID-19 vaccination	**1**
Presence of B memory cells remain in the body for an indefinite time period	**3**

NOTE: Any in an incorrect position incur a 1 mark penalty for each error **(3 marks)**

b) Many Plasma B cells are formed after the COVID exposure that produce a high level of antibodies. **(1 mark)**
Once the antigen is eradicated, there is no longer a need for Plasma B cells to make antibodies and so they are (apoptosed) destroyed, lowering the number of antibodies over time. **(1 mark)**

c) Antigenic drift consists of small changes (or mutations) in the genes of corona viruses that can lead to changes in the surface proteins of the virus. **(1 mark)**
The new virus is similar to the original variant but the change will initiate a new immune response against it. **(1 mark)**

d) Less virulent: the virus does not kill as many people as other strains
More contagious: the virus can spread from person to person more easily **(1 mark)**
This means more people will be in the community with the virus **(1 mark)**
This is a selective advantage to the strain as this strain becomes more prevalent **(1 mark)**

Study Design Reference

- the characteristics and roles of the components of the adaptive immune response against both extracellular and intracellular threats, including the actions of B lymphocytes and their antibodies, helper T and cytotoxic T cells
- the difference between natural and artificial immunity and active and passive strategies for acquiring immunity
- consequences of bacterial resistance and viral antigenic drift and shift in terms of ongoing challenges for treatment strategies and vaccination against pathogens

Link:

https://www.astrazeneca.com/what-science-can-do/topics/disease-understanding/the-natural-evolution-of-sars-cov-2.html

Question 8 (Total 10 marks)

a) Conditions for fossilisation include (3 of)

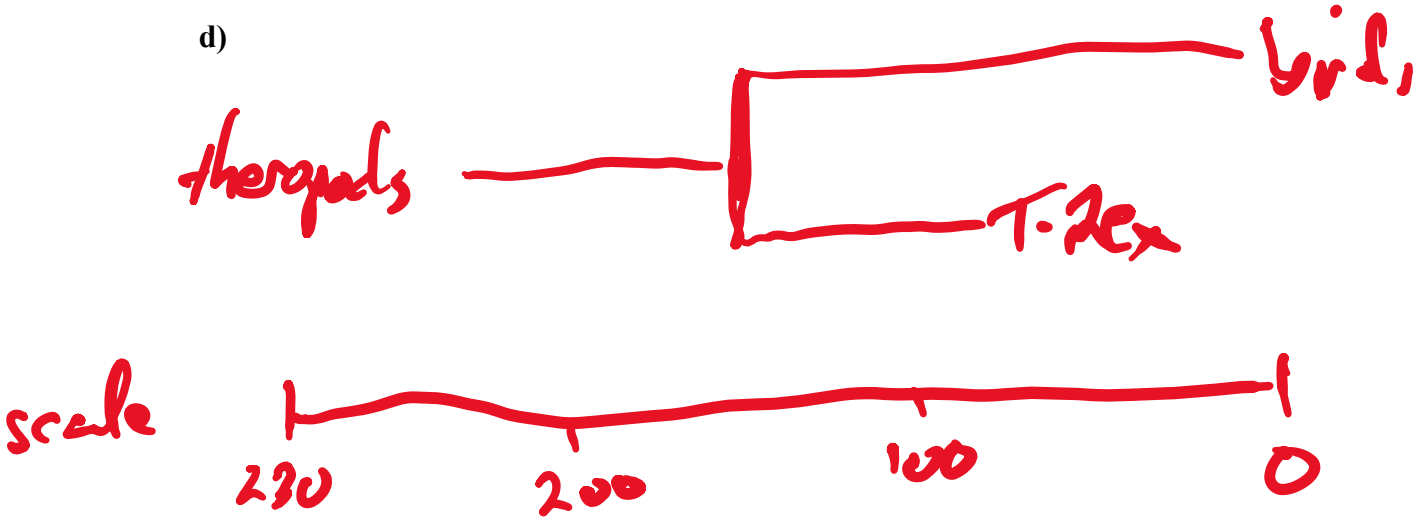
- Rapid burial (cannot be seen by scavengers)
- Undisturbed (no scavengers to destroy the organism)
- Cold environment
- Low decomposition rate (organism remains not destroyed)
- Downward pressure (promotes mineralisation of remains)

(3 marks)

b) Radio isotopic dating (not carbon dating) **(1 mark)**
Determine the quantity of a radioisotope in volcanic rock near the fossil and compare this to the quantity of the same radioisotope in fresh rock and use the known half life value of the radioisotope to determine the age of the fossil **(1 mark)**

c) The archeopterxy would display features of a bird (feathers) as well as a dinosaur (teeth) it to be classified as a transition fossil **(1 mark)**
It would also need to be dated to have existed before the earliest bird and after the latest theropod for it to be a transition fossil **(1 mark)**

d)



NOTE: Assessment: Scale provided 1 mark
Theropods at 230mya, birds diverging 150mya and TRex living to 67mya 2 marks (1 mark for each)
(3 marks)

Study Design Reference

- changes in species over geological time as evidenced from the fossil record: faunal (fossil) succession, index and transitional fossils, relative and absolute dating of fossils
- the use and interpretation of phylogenetic trees as evidence for the relatedness between species

Link:

https://ib.bioninja.com.au/standard-level/topic-5-evolution-and-biodi/51-evidence-for-evolution/fossilisation.html

Question 9 (Total 7 marks)

a) **(i)** Between 3.5 million years to present, the cranial capacity has increased from about 400ml to about 1200 ml **(1 mark)**
(ii) 2.3 mya the capacity was about 500ml and 1.4 mya the capacity was about 550ml so the change is an increase of about 50ml. **(1 mark)**

NOTE: students should bring a ruler to the exam so that graphs can be analysed properly

b) Bipedalism can be inferred from (2 of)

- A more central foreman magnum
- A bowl-shaped pelvis
- Forward facing toes (and big toe) in line with each other
- Pronounced foot arch
- Vulgus angled so knees are closer to each other than the hip connection of the femur

(2 marks)

c) **(i)** To infer different species based on fossil evidence would include consistent structural differences between the different fossils grouped as different species (for example the cranium of a Neanderthal is different to a Sapien cranium) **(1 mark)**
The location of fossils classified as different species would probably be different compared to other groups (for example Neanderthals were in Europe and Denisovans in Russia)
(1 mark)

(ii) If there are consistent differences in the sequence of nucleotides in a particular genetic location between members of 1 species of hominin compared to another suggests they have been isolated for an amount of time, which is consistent with them being different species.
(1 mark)

Study Design Reference

- the human fossil record as an example of a classification scheme that is open to differing interpretations that are contested, refined or replaced when challenged by new evidence, including evidence for interbreeding between *Homo sapiens* and *Homo neanderthalensis* and evidence of new putative *Homo* species
- evidence of relatedness between species: structural morphology – homologous and vestigial structures; and molecular homology – DNA and amino acid sequences

Link:

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

Question 10 (Total 9 marks)

a) The absorption of carbon dioxide creates a negative pressure in the respirometer, which draws the coloured liquid along the scale enabling a measurement to be made. **(1 mark)**

b) 2 of
- Number of maggots (10)
- Mass of soda lime
- Pressure inside the respirometer
- Initial carbon dioxide and oxygen level in the respirometer

(2 mark)

c) The optimum temperature for the maggots is 40 degrees because this is the temperature that has the highest rate of oxygen absorption **(1 mark)**
The low temperature of 17 degrees gives low oxygen absorption because the enzymes involved in respiration are colliding less frequently with substrates **(1 mark)**
The high temperature of 45 degrees gives low oxygen absorption because the enzymes involved in respiration are denatured and are unable to function **(1 mark)**
The result at 30 degrees is probably an error because the results on either side (26 and 40 degrees) show a significant level of oxygen absorption **(1 mark)**

d) **(i)** Precision is achieved through repetition of each experiment. The experimental data shows one measurement per independent variable and so the experiment has no precision. **(1 mark)**
(ii) Reproduction of experiments occurs when different experimenters complete the experiment using the same equipment and method. The experiment has not been reproduced. **(1mark)**

Study Design Reference

- characteristics of the selected scientific methodology and method, and appropriateness of the use of independent, dependent and controlled variables in the selected scientific investigation
- techniques of primary quantitative data generation relevant to the selected scientific investigation
- the accuracy, precision, reproducibility, repeatability and validity of measurements

Link:

https://www.labster.com/simulations/experimental-design/ (sign up is free)

End of 2022 Kilbaha VCE Biology Trial Examination Units 3 and 4 Detailed Answers

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