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VICTORIAN CERTIFICATE OF EDUCATION
Year 2022

STUDENT NUMBER									Letter
Figures									
Words									

BIOLOGY

Trial Written Examination

Reading time: 15 minutes
Writing time: 2 hours 30 minutes

QUESTION AND ANSWER BOOK

Structure of book

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*
A	40	40	40
B	10	10	80
			Total 120

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners and rulers.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.
- No calculator is allowed in this examination.

Materials supplied
- Question and answer book of 34 pages.
- Answer sheet for multiple-choice questions.

Instructions
- Write your **student number** in the space provided above on this page.
- Check that your **name** and **student number** as printed on your answer sheet for multiple-choice questions are correct, **and** sign your name in the space provided to verify this.
- All written responses must be in English.

At the end of the examination
- Place the answer sheet for multiple-choice questions inside the front cover of this book.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

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VCE BIOLOGY 2022
Trial Written Examination

MULTIPLE-CHOICE ANSWER SHEET

Student Name _____

Student Number _____

Signature _____

If your name or number on this sheet is incorrect, notify the Supervisor.
Use a **PENCIL** for **ALL** entries. For each question, shade the box that indicates your answer.
All answers must be completed like **THIS** example.

A		C	D

Marks will **NOT** be deducted for incorrect answers.
NO MARK will be given if more than **ONE** answer is completed for any question.
If you make a mistake, **ERASE** the incorrect answer. **DO NOT** cross it out.

ONE ANSWER PER LINE

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

ONE ANSWER PER LINE

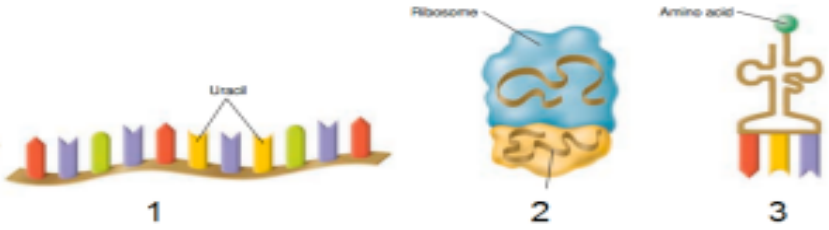
21.	A	B	C	D
22.	A	B	C	D
23.	A	B	C	D
24.	A	B	C	D
25.	A	B	C	D
26.	A	B	C	D
27.	A	B	C	D
28.	A	B	C	D
29.	A	B	C	D
30.	A	B	C	D
31.	A	B	C	D
32.	A	B	C	D
33.	A	B	C	D
34.	A	B	C	D
35.	A	B	C	D
36.	A	B	C	D
37.	A	B	C	D
38.	A	B	C	D
39.	A	B	C	D
40.	A	B	C	D

SECTION A – Multiple-choice questions

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.
Choose the response that is **correct** for the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Question 1

The diagram below represents different types of RNA



Link: https://jessicamillerblog.wordpress.com/2015/02/12/3-types-of-rna/

The correct description of 1, 2 and 3 is

	1	2	3
A.	mRNA	tRNA	rRNA
B.	rRNA	mRNA	tRNA
C.	rRNA	tRNA	mRNA
D.	mRNA	rRNA	tRNA

Question 2

RUBISCO is an important and very large photosynthetic protein that is composed of eight large subunits and eight small subunits. The large subunits are coded in the chloroplast itself, while the small units are coded in the nucleus of the cell. The level of arrangement that RUBISCO is functional at is at the

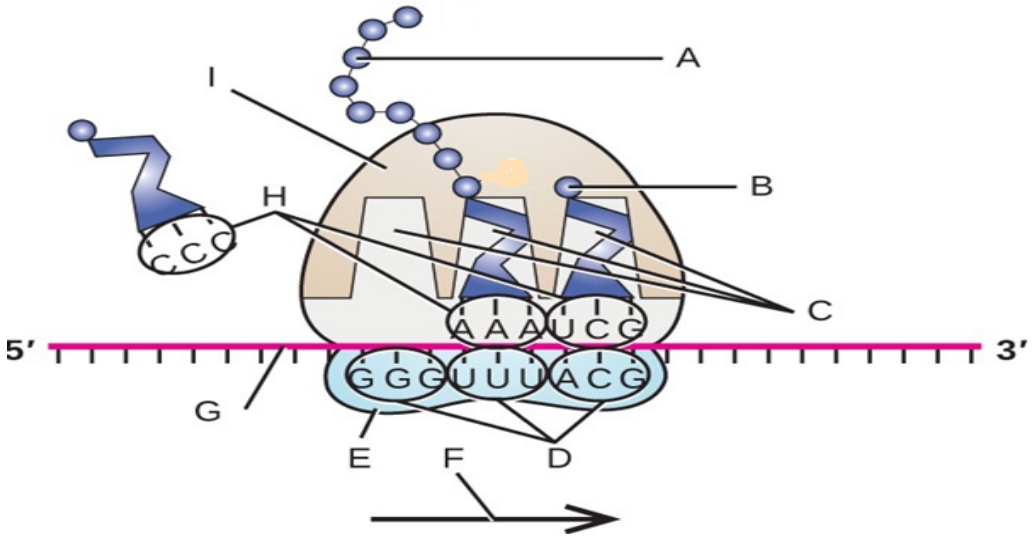
A. Primary.
B. Secondary.
C. Tertiary.
D. Quaternary.

Question 3

The promotor region on a gene

- **A.** is the area a repressor can bind to.
- **B.** is an area that RNA polymerase can bind to.
- **C.** is translated.
- **D.** binds to the operator to control gene expression.

The next 3 questions refer to the following process labelled with components A to I



Link: https://courses.lumenlearning.com/microbiology/chapter/protein-synthesis-translation/

Question 4

The process illustrated is

- **A.** Transcription.
- **B.** RNA processing.
- **C.** Alternative splicing.
- **D.** Translation.

Question 5

Amino acids are represented by

- **A.** Components A and B.
- **B.** Components D and H.
- **C.** Component G.
- **D.** Component C.

Question 6

It is appropriate to state that

A. there is degeneracy in the components represented by A.
B. there are 64 different combinations of component H.
C. process F does not occur in prokaryotes.
D. component I is comprised entirely of protein.

Question 7

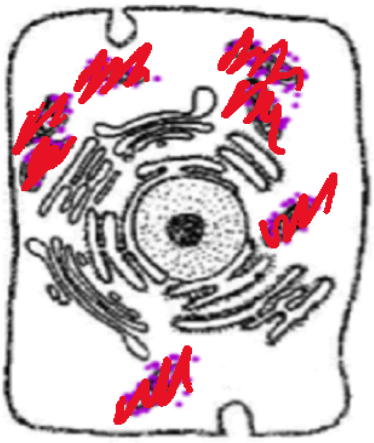
DNA is in neuron cells of whales, the phloem cells of Eucalyptus trees, unicellular yeast cells as well as bacteria such as *Thermus aquaticus.* The triplet ATG codes for tyrosine in all the organisms highlighted as well as any other living thing. From this information, it is reasonable to conclude that DNA is

A. universal.
B. important.
C. a double helix.
D. comprised of 4 nucleotides.

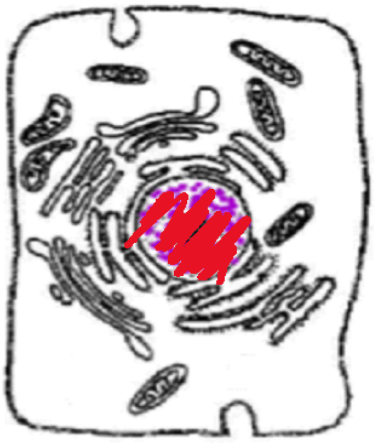
Question 8

Cells can be exposed to radioactive amino acids so that when photographed the distribution of the amino acids within the cell can be monitored. β cells in the Islets of Langerhans of the pancreas manufacture and secrete of insulin (a protein) when blood glucose levels are high. If a cell line of these cells was mixed with radioactive amino acids (shaded areas), the first place where evidence of them would be observed would be

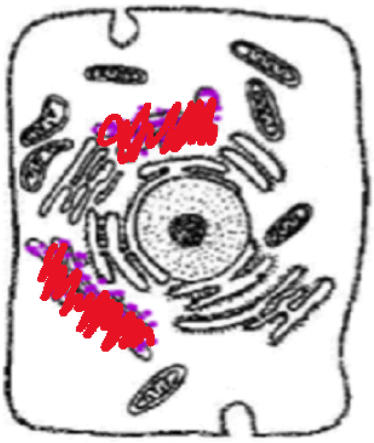
A.



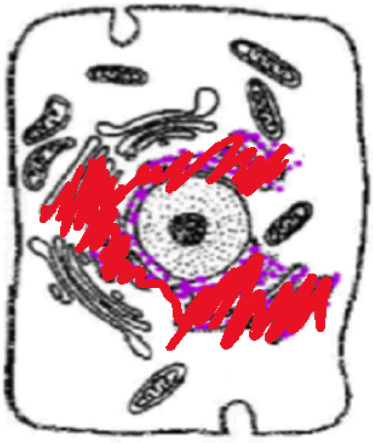
B.



C.



D.



Question 9

Which of the following compounds is an example of a protein?

A. ATP
B. NADPH
C. Phenylalanine hydroxylase
D. Pyruvic acid

Question 10

A molecule that cleaves DNA is known as

- **A.** Restriction endonuclease.
- **B.** DNA ligase.
- **C.** RNA polymerase.
- **D.** *Taq* polymerase.

Question 11

The following restriction enzymes have the following target sequences (read from left to right)

SmaI	**CCC/GGG**
RsaI	**GT/AC**
EcoRV	**GAT/ACT**

The following sequence of DNA is mixed with all three restriction enzymes

AGGCCGATTGCGAGGGAGATCTGATTCTGGATAAGGATCGTA

The number of fragments produced would be

- **A.** 5
- **B.** 6
- **C.** 7
- **D.** 8

Question 12

To form a recombinant plasmid the enzymes to be used in order are

- **A.** ligase then polymerase.
- **B.** restriction enzymes then polymerase.
- **C.** polymerase then restriction enzymes.
- **D.** restriction enzymes then ligase.

Question 13

Kary Banks Mullis is a Nobel Prize-winning American biochemist who helped bring the concept the polymerase chain reaction (PCR) technique to the laboratory workbench. This enabled biotechnologists to amplify sections of DNA much more easily. The conditions required per PCR cycle for the successful amplification of a target DNA sample is

A. denaturation temperature of 72˚C, annealing temperature of 95˚C, Extension temperature of 60˚C.
B. denaturation temperature of 95˚C, annealing temperature of 60˚C, Extension temperature of 72˚C.
C. denaturation temperature of 95˚C, annealing temperature of 72˚C, Extension temperature of 60˚C.
D. denaturation temperature of 60˚C, annealing temperature of 95˚C, Extension temperature of 72˚C.

Question 14

An enzyme such as isocitrate dehydrogenase that is involved in cellular respiration within human body cells would

A. be denatured at low temperatures.
B. remain actively steady with an increased level of substrate.
C. collide less frequently with substrates at higher temperatures.
D. be able to carry out more than 1 reaction before being replaced.

Question 15

ATP catabolism is likely to occur

A. while DNA is being copied.
B. during glycolysis.
C. during facilitated diffusion.
D. during the electron transport chain.

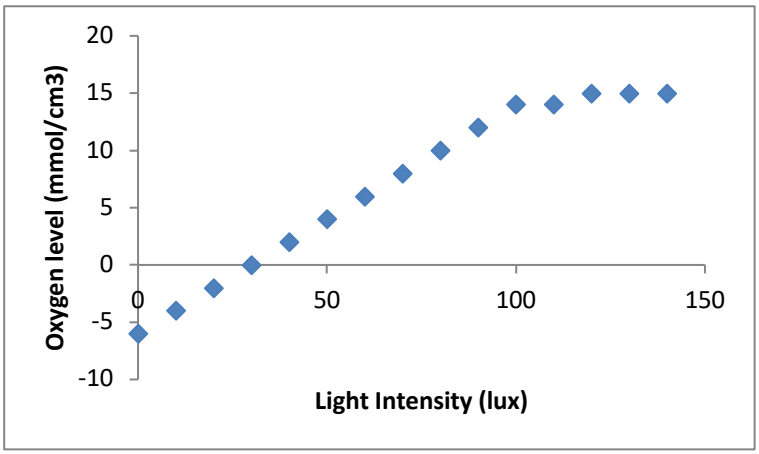
Question 16

The first response when chloroplasts are exposed to red and violet wavelengths of light is the

A. conversion of CO2 into glucose.
B. splitting of water.
C. formation of ATP.
D. production of oxygen gas.

Question 17

The following graph was produced as the results of an experiment on a group of tomato plants, each placed in a Perspex container and exposed to differing light intensities. The change oxygen gas around the plant was measured after 60 minutes and the difference (compared to the original level of oxygen gas) graphed against the light intensity



The following conclusion could be made based on the presented data.

A. There is no photosynthesis occurring at a light intensity of 10 lux.
B. Photosynthesis never produces more than 15 mmol/cm^3 of oxygen.
C. At light intensity of 25 lux the rate of respiration is equal to the rate of photosynthesis.
D. At as light intensity of 150 lux, the tomato plants are no longer respiring.

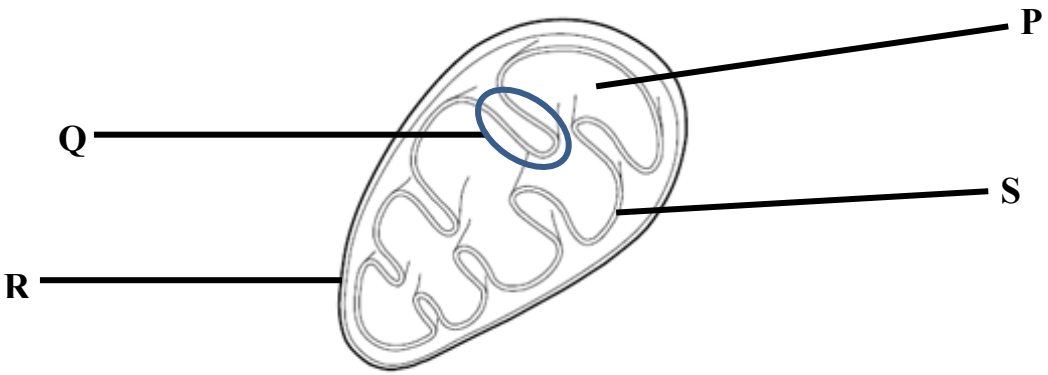
Question 18

Plants can be categorised as C3, C4 or CAM plants. A plant has a thick cuticle, reduced leaves with a low surface-area-to-volume ratio and stomata sunken into pits. The stomata are open at night to permit entry of CO_2 to be fixed and stored. Then, during the day the CO_2 is released for use in the Calvin cycle. In this way, the rubisco is provided with high concentration of CO_2 while the stomata are closed during the hottest and driest part of the day to prevent the excessive loss of water.
The type of plant described is

A. a C3 plant.
B. a CAM plant.
C. a C4 plant.
D. either a C3 or C4 plant.

The next 2 questions refer to the following information.

The following diagram is of a mitochondrion. Areas/structures **P, Q, R** and **S** are all important for the functioning of this very important organelle.



Modified from: http://clipart-library.com/clipart/67902.htm

Question 19

The names of areas/structures P, Q, R and S respectively are

- **A.** matrix, cristae, inter-membrane space, outer membrane.
- **B.** matrix, cristae, outer membrane, inter-membrane space.
- **C.** cristae, inter-membrane space, outer membrane, matrix.
- **D.** inter-membrane space, outer membrane, matrix, cristae.

Question 20

Area P is important as it

- **A.** completely converts pyruvate into carbon dioxide.
- **B.** provides a concentration gradient for hydrogen ion movement.
- **C.** is the site of the electron transport chain.
- **D.** is where pyruvate is formed.

Question 21

An appropriate microbiota barrier that could reduce the entry of pathogens into the body to cause disease could include

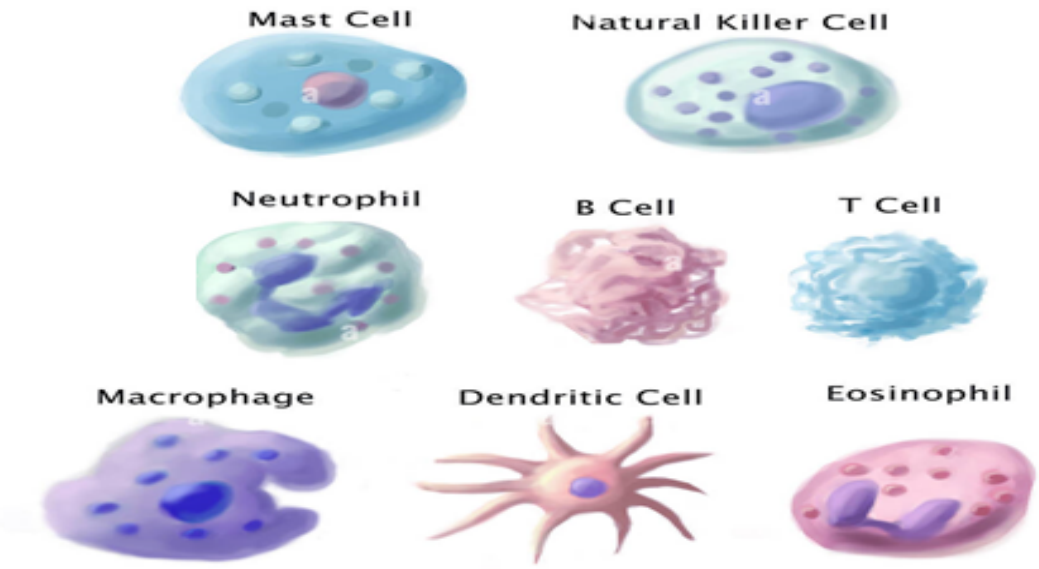
- **A.** a mucus layer along the lining of the respiratory tract.
- **B.** lysozyme with antibiotic properties secreted in tears.
- **C.** *staphylococcus aureus* inhabiting the skin preventing opportunistic infection.
- **D.** presence of thick head hair that reduces the chances of ectoparasites getting a blood meal.

Question 22

A cellular pathogen would be

- **A.** an allergen within a peanut.
- **B.** a virus.
- **C.** a prion.
- **D.** the bacteria that causes salmonella disease.

The next 2 questions refer to the following cells.



Link: https://www.alamy.com/stock-photo-immune-cells-from-top-left-to-bottom-right-mast-cell-basophil-natural-103992160.html

Question 23

The most prolific cell in a human body of the ones illustrated are

- **A.** Macrophage.
- **B.** Eosinophil.
- **C.** Natural Killer Cell.
- **D.** Neutrophil.

Question 24

The cells involved in an allergic response would include

- **A.** Dendritic Cell and T Cell.
- **B.** Mast Cell and T Cell.
- **C.** B Cell and Mast Cell.
- **D.** Macrophage and B Cell.

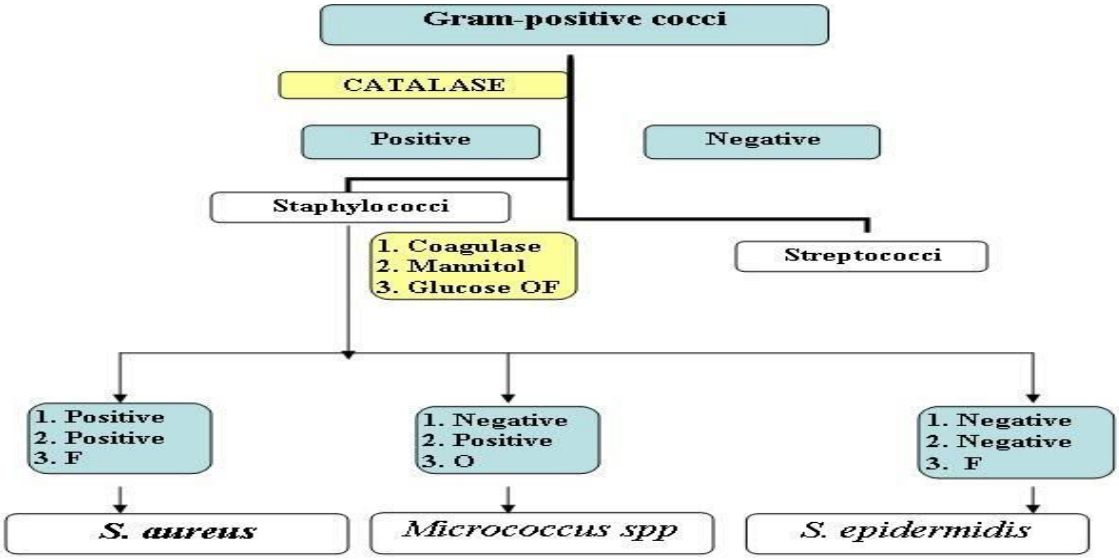
Question 25

The main function of the lymph nodes would be

- **A.** to provide an area for macrophages to secrete pyrogens so that the stimulated fever will be disadvantageous to pathogenic infection.
- **B.** as a site where antigen presenting cells have a greater chance of coming in contact with the appropriate naïve T cell.
- **C.** the part of the body where non-self antigens are discovered on the surface of an invading pathogen.
- **D.** to store complement proteins so they can be released into the bloodstream when an allergen enters the interstitial fluid of the body.

Question 26

The following flow chart can be used to distinguish between a *Streptococcus* bacterial infection and the different genera of a *Staphylococcus* bacterial infection.



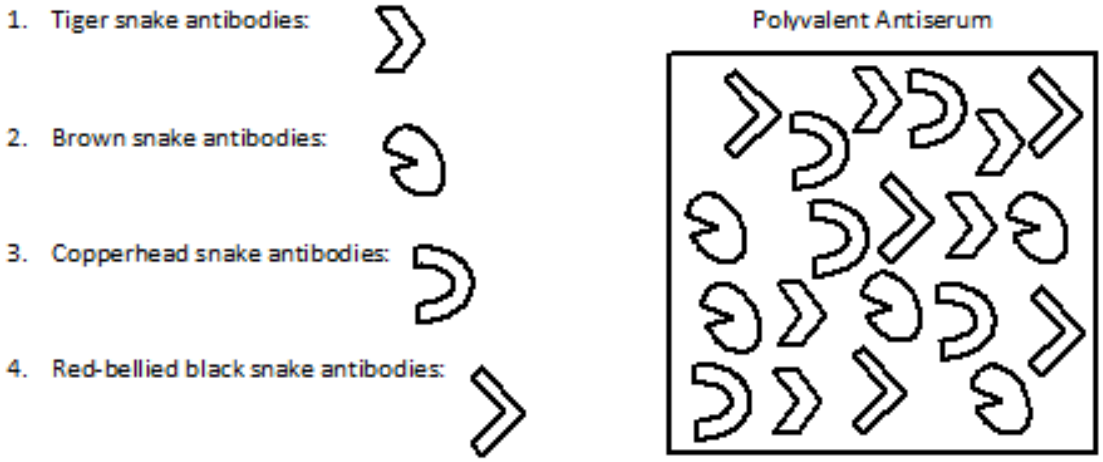
Link: https://co.pinterest.com/pin/301107925089453021/?send=true

The test results evident with an individual who is diagnosed with a *Staphylococcus epidermidis* infection would be

Test	Catalase	Coagulase	Mannitol	Glucose OF
A.	Negative	Negative	Negative	O
B.	Positive	Negative	Negative	F
C.	Positive	Positive	Positive	F
D.	Negative	Positive	Negative	O

The next 2 questions refer to the following information

If a human is bitten by a snake but the type of snake is unknown, a polyvalent antiserum is used to neutralise the snake toxin (compared to a monovalent antiserum when the type of snake is known). Horses are often used to generate the antibodies used in the antiserum. The diagram below illustrates the different antibodies in the polyvalent antiserum as well as a diagram of what the polyvalent antiserum looks like in solution.



Question 27

The following statement that is most appropriate with respect to the production or the action of the antibodies would be

- **A.** Only one type of naïve B cell would be activated for the production of the antibodies illustrated.
- **B.** Four different horses would be required to produce the four different types of antibodies.
- **C.** A cell mediated response would be more appropriate than a humoral response within the horse producing the antibodies.
- **D.** If the type of snake was known the action of the antibodies within a monovalent antiserum would be more effective compared to a polyvalent antiserum.

Question 28

When given to a human who has been bitten by a snake, the antivenom serves as a form of

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

Question 29

Smallpox was a leading cause of death in the 18th century. It killed an estimated 400,000 Europeans each year in the 18th century. Most people became infected during their lifetimes, and about 30% of people infected with smallpox died from the disease. This left many people with a level of resistance against the disease. In April 1789, 15 months after the First Fleet arrived to establish a penal colony in NSW, a major smallpox epidemic devastated Aboriginal clans around the New South Wales colony. It has been estimated that somewhere between 50 and 70 per cent of the Aboriginal population in the Sydney area died within two years of the British arrival.

The best explanation for this information would be

A. a lack of memory cells in the indigenous population meant they more were vulnerable.
B. some Europeans may have carried the disease without displaying the symptoms and unwittingly spread it into the indigenous population.
C. Europeans were vaccinated and the indigenous Australians were not
D. smallpox was not a pathogen the indigenous Australians were able develop an immune response against.

Question 30

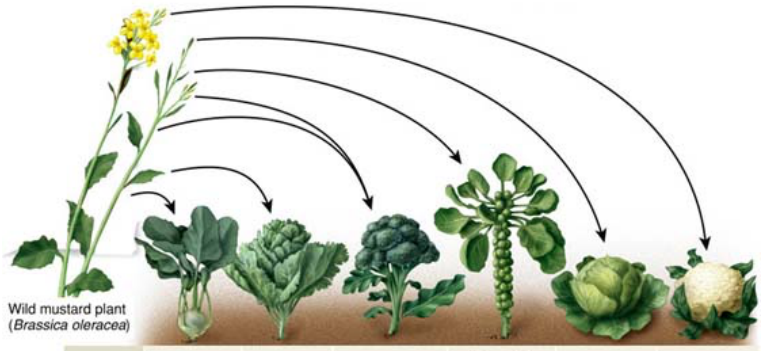
Immunotherapy is a rapidly growing diagnostic field, particularly with the treatment of cancer. One type of immunotherapy involves the use of monoclonal antibodies that can help fight cancer in different ways. For example, they can be used to block the activity of abnormal proteins in or on cancer cells, which targets the cancer as opposed to the traditional less-targeted therapies (chemotherapy and radiotherapy)

To produce monoclonal antibodies, the following conditions would need to be met.

	Condition 1	**Condition 2**	**Condition 3**
A.	Antigens are injected into an animal such as a rabbit.	Specific B cells extracted from the rabbit.	B cells are fused with tumour cells.
B.	Antibodies are injected into an animal such as a rabbit.	Specific B cells extracted from the rabbit.	B cells are fused with tumour cells to form hybridoma cells.
C.	Antigen injected into the individual with cancer.	B cells extracted from the rabbit.	B cells are fused with tumour cells to form hybridoma cells.
D.	Specific B cells extracted from the rabbit.	B cell is fused with the original antigen for stimulation.	B cell secretes antibodies to be isolated for immunotherapy.

Question 31

The wild mustard plant has been used to produce a variety of edible vegetable such as those illustrated in the diagram below



Strain	Kohlrabi	Kale	Broccoli	Brussels sprouts	Cabbage	Cauliflower
Modified trait	Stem	Leaves	Flower buds and stem	Lateral leaf buds	Terminal leaf bud	Flower buds

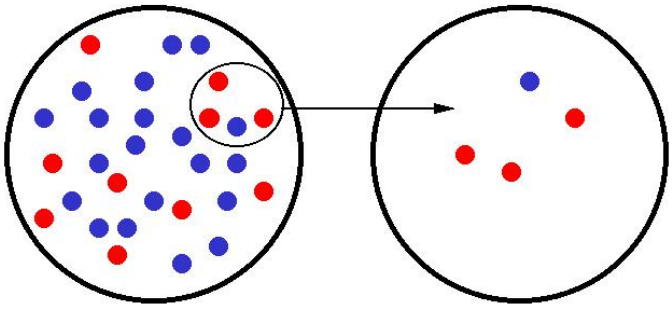
From: https://sites.google.com/site/selectivebreedingofplants/

This is an example of

A. natural selection.
B. artificial selection.
C. genetic transformation.
D. genetic engineering.

Question 32

A small group of beetles were blown to a new location from an original large population of beetles in a woodpile the result of this phenomenon is illustrated below. The beetles showed 2 distinct colour phenotypes as illustrated by the blue and red coloured dots.



This phenomenon is known as

A. genetic drift.
B. mutation rate.
C. gene flow.
D. speciation.

Question 33

Antibiotic resistant bacteria are becoming more prominent in society and as a result, bacterial disease is becoming more difficult to treat. With respect to the evolution of antibiotic resistant bacteria is could be said that

- **A.** when bacteria are exposed to antibiotics, they develop a resistance to them.
- **B.** the selective pressure driving the evolution of antibiotic resistant bacteria is the use of antibiotics.
- **C.** if a new antibiotic was developed, the bacteria would no longer evolve.
- **D.** bacteria that are not resistant to antibiotics are at a selective advantage over the bacteria that are resistant in an environment of antibiotics.

Question 34

The shark and the dolphin (pictured below) both have a streamlined body. The shark is one of the first vertebrates to have evolved but the dolphin's ancestor was a terrestrial mammal.

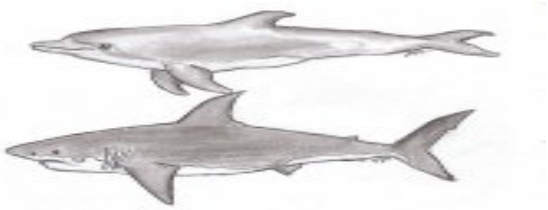


Diagram from: http://anagarauz.blogspot.com.au/2011_05_01_archive.html

The dolphin and the shark provide an example of convergent evolution because of their streamlined shape, which is

- **A.** a structural homology as their ancestors possessed this feature.
- **B.** demonstrating the different environmental pressures placed on the 2 different organisms.
- **C.** demonstrating the similar environmental pressures placed on the 2 different organisms.
- **D.** a vestigial structure serving no biological purpose to either organism but shows evidence of their ancestral past.

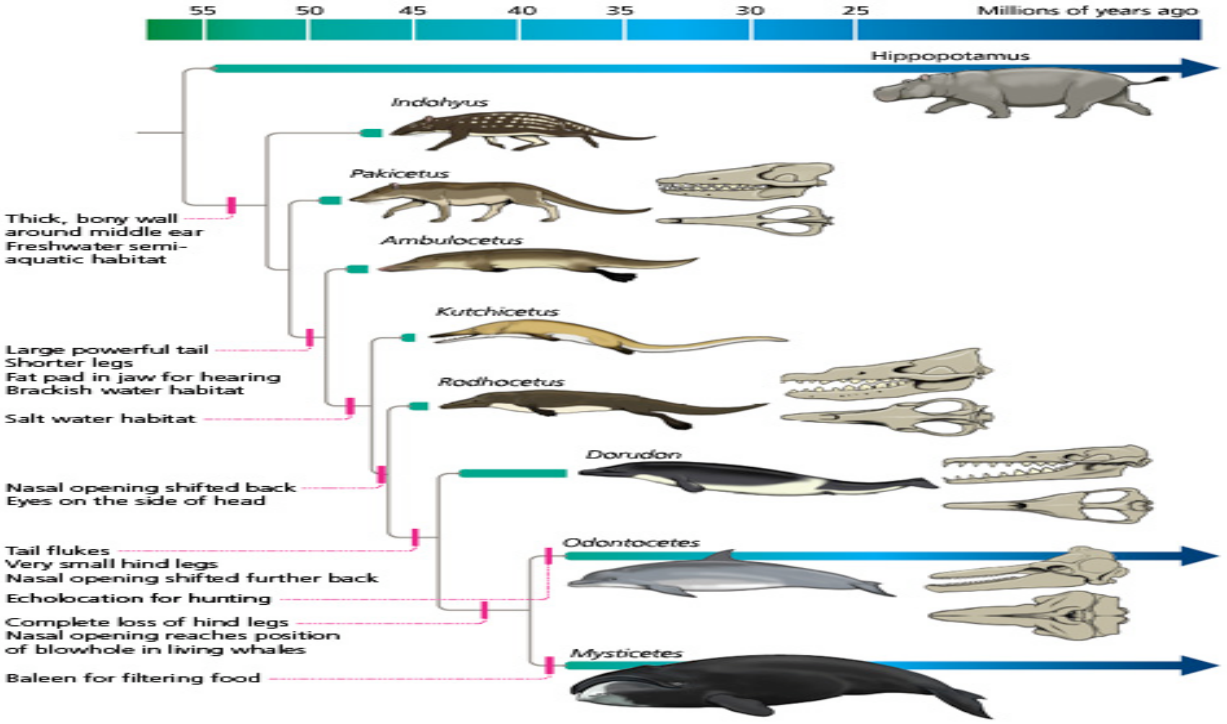
Question 35

The *Howea* palms from Lord Howe Island have speciated on the same island due to different environmental niches compared to the finches on the Galapagos Islands that speciated on different islands due to geographic isolation. The type of speciation that has led to the different species of *Howea* palms is called

- **A.** allopatric speciation.
- **B.** selective speciation.
- **C.** artificial speciation.
- **D.** sympatric speciation.

The next 3 questions refer to the following information

The cladogram below links hippopotomus to whales and dolphins. Key events in the path from the common ancestor to the modern whales and dolphins are shown



Question 36

The most closely related organism to Mysticetes is

- **A.** Hippopotamus.
- **B.** Kutchicetus.
- **C.** Doruden.
- **D.** Odontocetes.

Question 37

Ambulocetus existed

- **A.** for about 1 million years.
- **B.** 45 million years ago.
- **C.** at the same time as Dorudons.
- **D.** but was outcompeted by Kutchicetus.

Question 38

An organism with a thick bony wall around the middle ear, short legs, a powerful tail as well as lives in a salt water habitat could be

- **A.** Hippopotamus.
- **B.** Indohyus.
- **C.** Pakicetus.
- **D.** Rodhocetus.

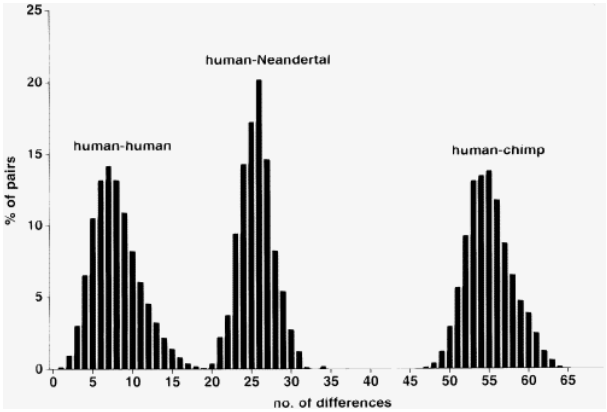
Question 39

Features that can distinguish a hominin from the order of primates is that

- **A.** all primates have an opposable 5th digit on all appendages whereas all hominins only have an opposable 5th digit on their front appendages.
- **B.** all primates have stereoscopic vision whereas only hominins use tools to enhance their survival.
- **C.** all primates have a large brain volume to body mass ratio whereas all hominins are bipedal.
- **D.** all primates are arboreal whereas all hominins have a more central foramen magnum.

Question 40

The graph below was produced by analysing the number of nucleotide differences in a particular mitochondrial DNA locus in a large sample of chimpanzees, Neanderthals and humans. Once the mtDNA was amplified, DNA hybridization was used to compare the different organisms.



From: http://en.wikipedia.org/wiki/Molecular_anthropology

Based on the evidence provided it could be concluded

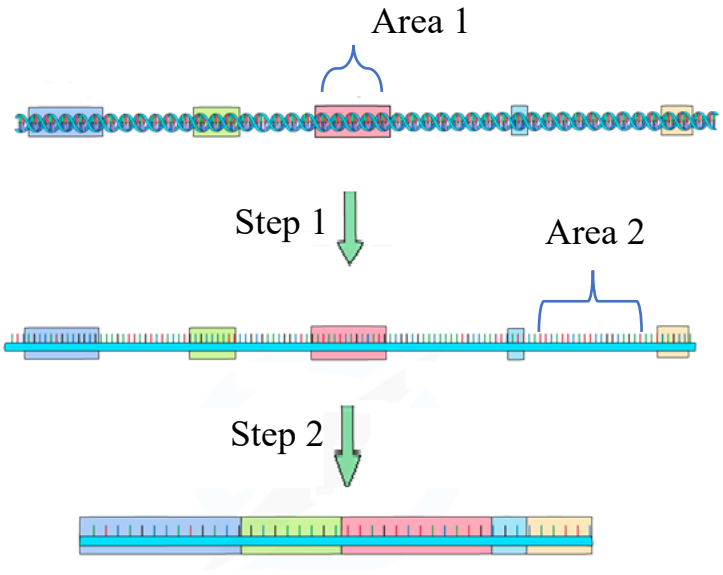
- **A.** chimpanzees and humans are more closely related to each other compared to a Neanderthal and a chimpanzee.
- **B.** there are 3 species of organisms presented here.
- **C.** 10% of the human-human pairs investigated had 11 nucleotide differences in the mtDNA loci being investigated.
- **D.** more humans were used in the study compared to Neanderthals and chimpanzees.

END OF MULTIPLE CHOICE QUESTIONS

SECTION B – Short Answer Questions

Question 1 (Total 7 marks)

The diagram below is of a process occurring in eukaryotic cells. Step 1 and Step 2 are parts of this process. Area 1 and area 2 are specific sections of the molecules undergoing the process.



Modified from:

https://www.savemyexams.co.uk/notes/as-biology-aqa/4-genetics-variation-interdependence-as/4-1-dna-genes-chromosomes-as/4-1-7-non-coding-dna-as/

a) (i) Name the cellular location of the process illustrated in the diagram

_____ (1 mark)

(ii) Name the product of step 1

_____ (1 mark)

b) Molecule 1 has the following sequence along its template

3'GGATACGATCAG5'

If you were provided with a list of codons, how could you use the above sequence to determine the polypeptide sequence this template codes for.

_____

_____

_____

_____(2 marks)

Question 1 (continued)

c) Explain why area 1 is part of the product of step 2, but area 2 is not and how this can be advantageous to the survival of the organism.

_____

_____

_____

_____

_____

_____(3 marks)

Question 2 (Total 9 marks)

The diagrams below are a representation of the trp operon.

Diagram 1

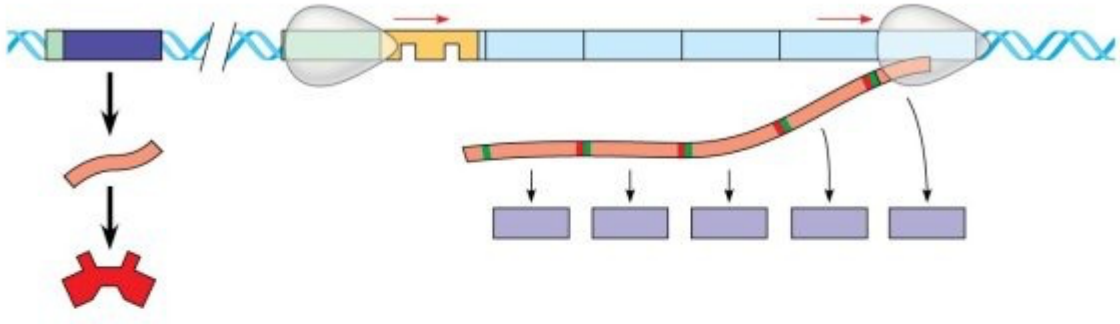
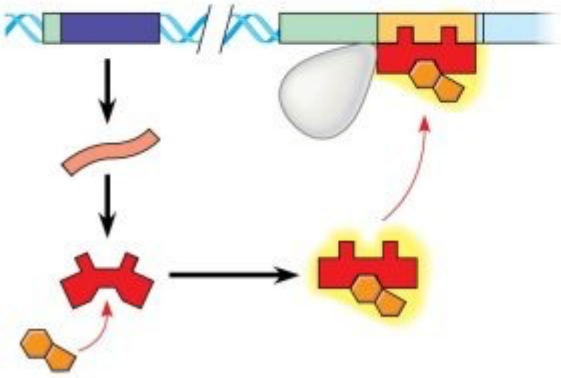


Diagram 2



Link: https://quizlet.com/374733818/trp-operon-diagram/

a) Label on the diagram 1 the operator, RNA polymerase and trp repressor gene. (3 marks)

b) Explain which diagram (1 or 2) is active when tryptophan levels are high

_____

_____

_____

_____(2 marks)

Question 2 (continued)

In eukaryotic cells, it is hypothesised that up to 40% of the genes are regulatory and the other 60% are structural.

c) What is the difference between a regulatory gene and a structural gene?

_____

_____

_____

_____(2 marks)

d) Stem cells are undifferentiated cells that have the capacity to differentiate into a variety of specialised cells. For example, bone marrow stem cells can differentiate into lymphocytes (B and T), mast cells and macrophages. Describe how regulatory genes could play a role in the specialisation of these types of cells.

_____

_____

_____

_____

_____

_____

_____(2 marks)

Question 3 (Total 7 marks)

Developed as a technique for genetic editing since 2012, CRISPR-Cas9 provides an exemplar case of emerging technology.

a) What does the CRISPR stand for?

_____(1 mark)

b) Describe how CRISPR-Cas9 works by using the terms listed below.

Target DNA, Cas 9, Spacer RNA, Guide RNA, Scaffold RNA, Cleavage

_____

_____

_____

_____

_____

_____

_____

_____(4 marks)

c) Explain why it is an easier process to disable a gene in the cell undergoing the CRISPR-Cas9 technology rather than adding a new gene into the genome of the cell.

_____

_____

_____

_____(2 marks)

Question 4 (Total 9 marks)

When a plasmid was chosen for the insulin gene to be inserted, there were a range of reasons for the selection.

1. The number of restriction sites on both the plasmid and the gene to be inserted
2. The location of restriction sites on both the plasmid and the gene to be inserted
3. The ends of the fragments produced (sticky or blunt)

a) Justify the choice of plasmid by discussing each reason listed above.

_____

_____

_____

_____

_____

_____(3 marks)

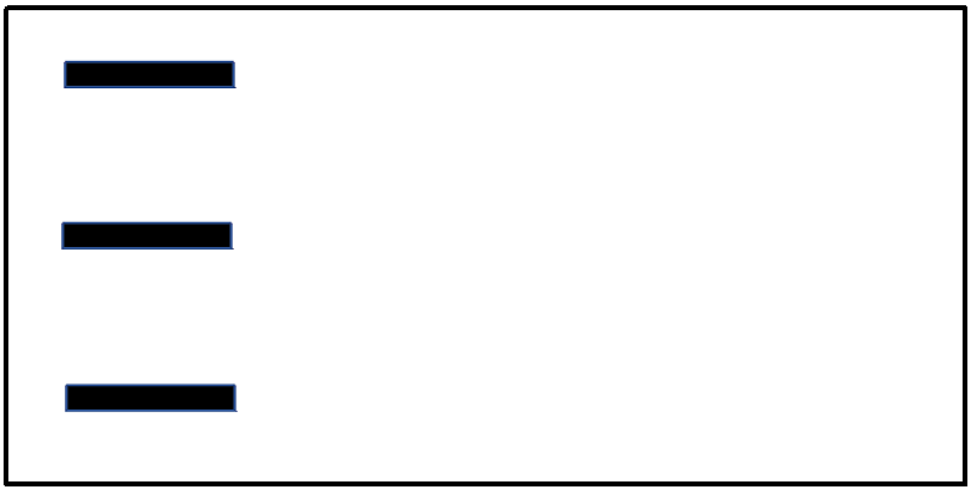
b) Assume the plasmid selected is 6kb in size and the insulin gene to be inserted is 1.5kb in size. Draw a labelled gel profile below for each lane that includes (the direction of movement and the charge should also be shown)

Lane 2: The insulin gene

Lane 3: The plasmid

Lane 4: The recombinant plasmid

Note: Lane 1 is a standard lane including fragments (from the top) of 1, 3.5 and 7kb in size.



(4 marks)

Question 4 (continued)

Once the correct recombinant plasmid is formed it can be inserted and grown in bacteria; however not every bacterium is transformed. To select the transformed bacteria from the untransformed bacteria, several methods can be used. Discuss one of these methods.

_____

_____

_____

_____(2 marks)

Question 5 (Total 8 marks)

Both mitochondria and chloroplasts can be isolated from total plant extracts by differential centrifugation. The purpose of doing this is to investigate the processes occurring within them in more detail.

a) State 2 differences in the structure/location/function of a mitochondria compared to a chloroplast.

_____

_____

_____(2 marks)

Once the organelles were exposed to optimal conditions, they were both exposed to a variety of chemicals. The chemicals they were both exposed to included

- oxygen and water
- oxygen and glucose
- oxygen and pyruvic acid
- carbon dioxide and water
- carbon dioxide and glucose
- carbon dioxide and pyruvic acid

b) In the table below, choose the combination of chemicals that would be most beneficial for the functioning of the organelle. Justify the choice in the space provided.

Organelle	Chemical exposure combination	Justification
Mitochondria		
Chloroplast		

(4 marks)

c) State three of the optimal conditions that each organelle would need to be exposed to

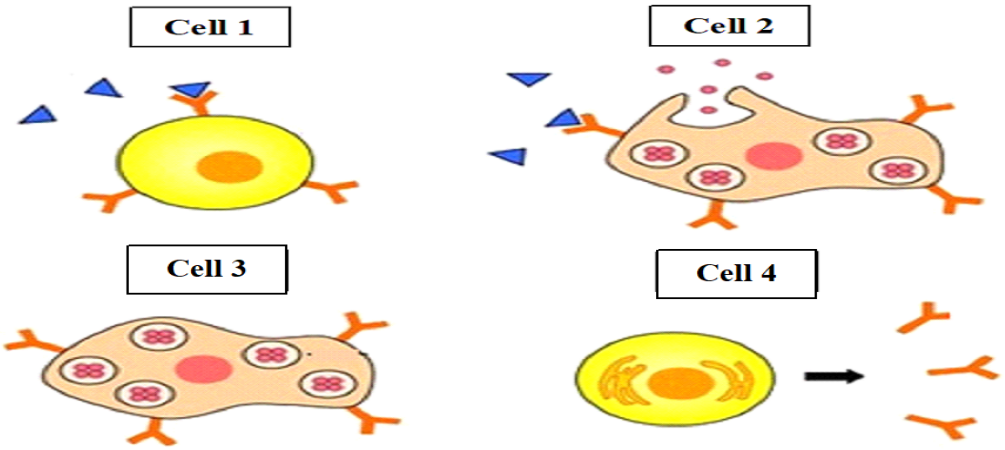
_____

_____

_____(2 marks)

Question 6 (Total 5 marks)

The cells 1 to 4 illustrated below are those that are involved in developing an allergic response



Link modified from:

http://www.vce.bioninja.com.au/aos-2-detecting-and-respond/defence-against-disease/disorders-of-the-immune.html

a) List the order of cells 1 to 4 in their involvement in an allergic reaction

_____ (1 mark)

b) Describe the role of each cell in developing an allergy against an allergen in peanuts.

Cell 1: _____

_____

_____

Cell 2: _____

_____

_____

Cell 3: _____

_____

_____

Cell 4: _____

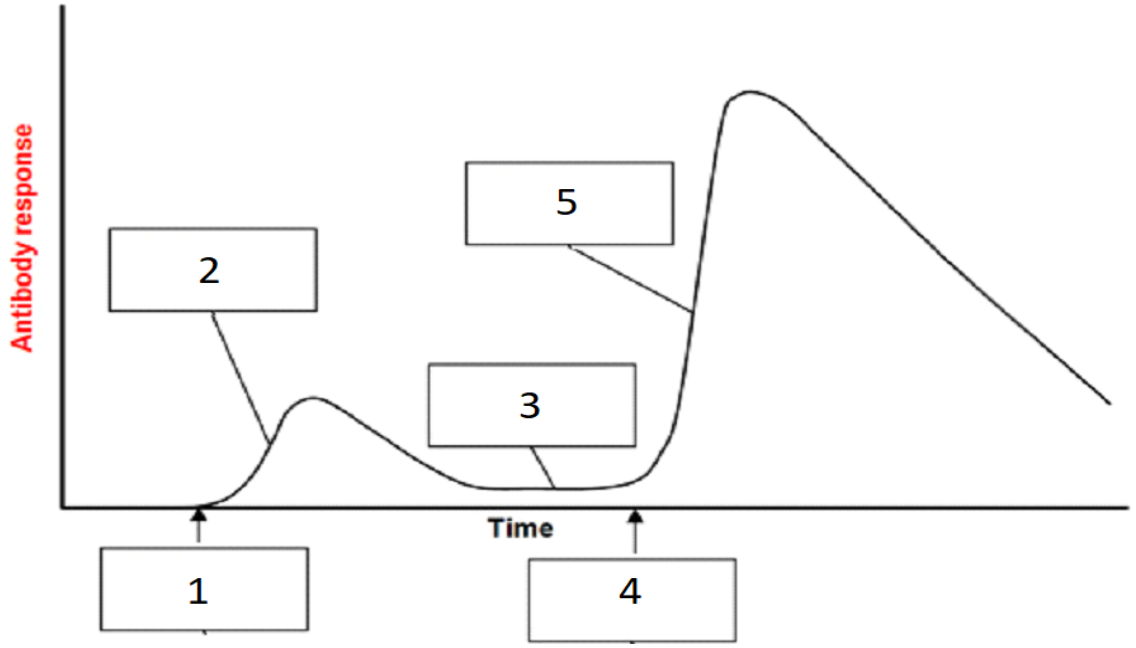
_____

_____

(4 marks)

Question 7 (Total 10 marks)

The following graph shows an antibody response in an individual who was initially vaccinated against COVID-19, but later was exposed to the live form of the virus. Positions 1-5 are events that occur during the response.



Link (modified): https://www.saburchill.com/IBbiology/chapters04/011.html

a) Complete the table below by adding the appropriate number (1 to 5) from the antibody response graph shown above.

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

(3 marks)

b) Explain why the antibody response decreases dramatically towards the end of the graph.

_____

_____

_____(2 marks)

Question 7 (continued)

Since the initial COVID-19 virus started spreading around the world, there have been 2 other variants of concern, the Delta strain and the more recent Omicron strain.

c) Describe how antigenic drift can lead to new variant strains of the Corona virus.

_____

_____

_____(2 marks)

d) How could the less virulent but more contagious Omicron strain be of a selective advantage to the virus?

_____

_____

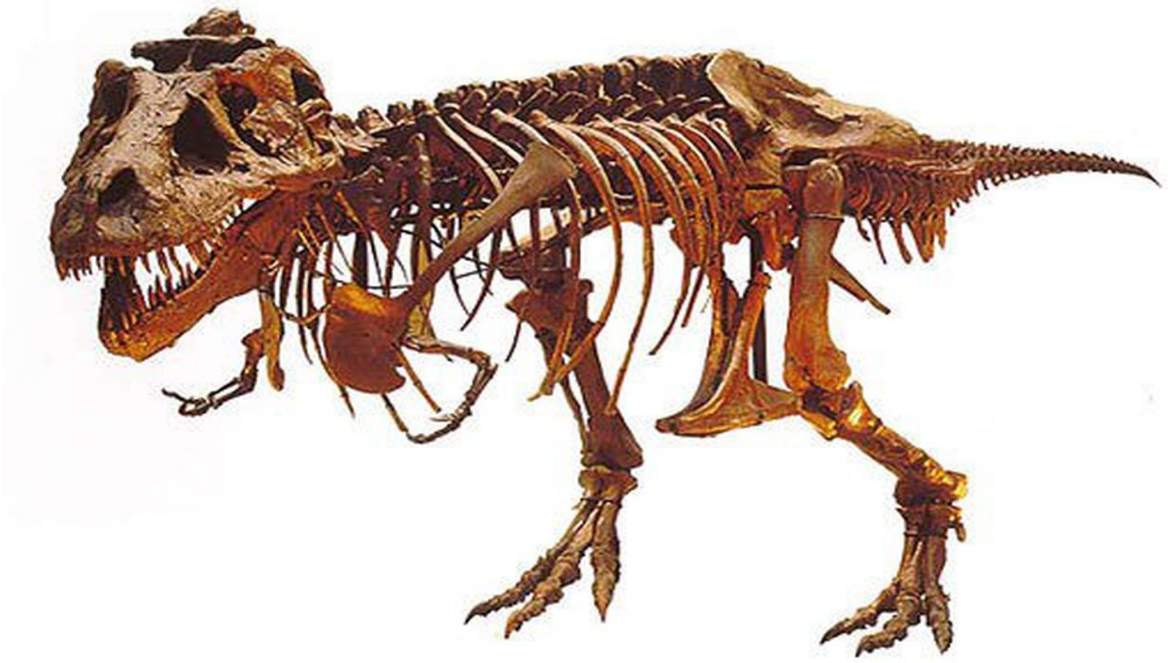
_____

_____

_____(3 marks)

Question 8 (Total 10 marks)

Sue is the nickname given to FMNH PR 2081, which is one of the largest, most extensive, and best preserved *Tyrannosaurus rex* specimens ever found, at over 90 percent of the skeleton was painstakingly recovered from sedimentary rock. Sue is now a permanent feature at the Field Museum of Natural History in Chicago and a photograph of the reconstruction is shown below.



Link:https://www.al.com/entertainment-times/2011/05/new_us_space_and_rocket_center.html

a) Describe the conditions required to fossilise a dinosaur like Sue.

_____

_____

_____

_____

_____(3 marks)

b) Sue was dated to be about 67 million years old. Describe the technique that would be used to determine this age.

_____

_____

_____

_____(2 marks)

Question 8 (continued)

Birds evolved from a group of meat-eating dinosaurs called theropods that first appeared in the fossil record about 230 million years ago. That's the same group that *Tyrannosaurus rex* belonged to, although birds evolved from small theropods, not huge ones like T. rex. The oldest bird fossils are about 150 million years old.

c) A fossil called *archaeopteryx* was discovered that displayed the features expected of a transition fossil between birds and dinosaurs. Describe the features a transition fossil would display.

_____

_____

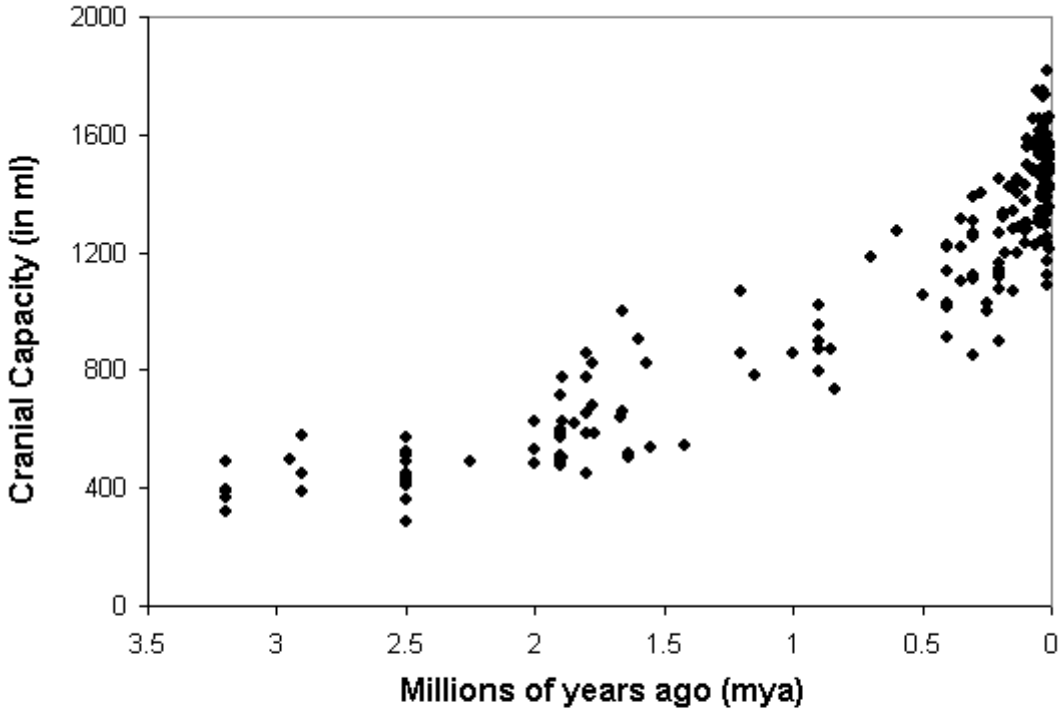
_____(2 marks)

d) Draw a phylogenetic tree showing the evolutionary relationships between theropods, *Tyrannosaurus rex* and birds.

(3 marks)

Question 9 (Total 7 marks)

From skeletons to teeth, early human fossils have been found of more than 6,000 individuals. With the rapid pace of new discoveries every year, this impressive sample means that even though some early human species are only represented by one or a few fossils, others are represented by many more fossils. The scatter plot below shows the relationship between cranial capacity and time with the fossils that could be analysed for that feature



Link: https://pandasthumb.org/archives/2006/09/fun-with-homini.html

a) **(i)** Describe the general trend seen in the graph.

_____

_____(1 mark)

(ii) *Homo habilis* lived between 1.4 – 2.3 million years ago. Based on the scatter plot, what was the change in cranial capacity of *H. habilis* during that time?

_____(1 mark)

Based on fossil evidence, bipedalism first appeared about 4 million years ago.

b) What fossil evidence would imply bipedalism?

_____

_____

_____(2 marks)

Question 9 (continued)

The last 200,000 years has seen a dramatic increase in hominin fossils, however anthropologists have concluded that there were several species that were coexisting from that time. *Homo Denisovan. Homo neanderthalensis, Homo sapiens* and *Homo heidelbergensis* are some examples.

c) (i) What fossil evidence would exist that enables these hominins to be classified into 4 distinct species?

_____

_____

_____

_____(2 marks)

(ii) How could molecular homology evidence support or reject the way these hominins have been classified?

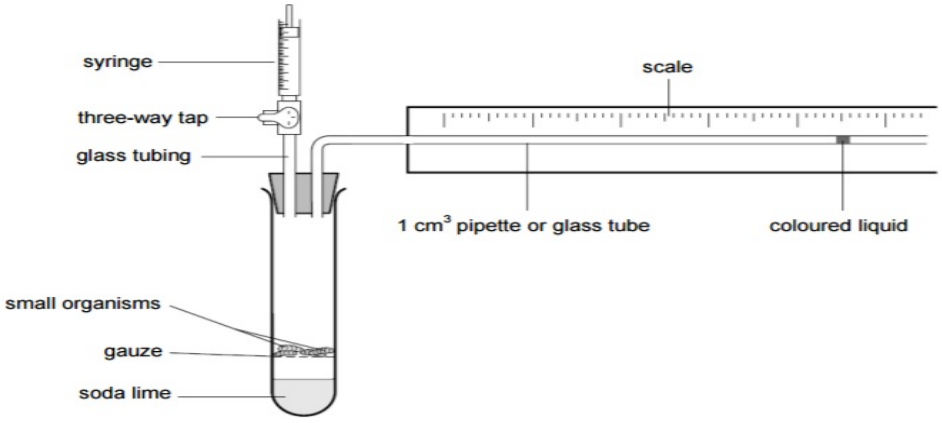
_____

_____

_____(1 mark)

Question 10 (Total 8 marks)

A respirometer can be used to determine rates of respiration in small organisms. A diagram of the device is shown below



Link:https://tbrann.weebly.com/biology-blog/core-practical-9-investigate-factors-affecting-the-rate-of-aerobic-respiration-using-a-respirometer

The method to use the respirometer is shown below.

- Set up the respirometer as illustrated in the diagram above.
- Place a known mass of one type of organism into the boiling tube (10 maggots).
- Place a drop of coloured fluid at the open end of the glass tube using the dropping pipette.
- Open the connection between the syringe and the respirometer Use the syringe to draw the fluid onto the scale at the end furthest from the respirometer.
- Mark the starting position of the fluid.
- Close the tap to isolate the respirometer from the atmosphere and the syringe and start the stop clock immediately.
- Note the position of the fluid at one-minute intervals for at least five minutes.
- Work out the distance travelled by the liquid during each minute.

a) The soda lime absorbs any excess carbon dioxide and by doing this, the amount of oxygen gas used for respiration can be calculated. Describe how this measurement would be made.

_____

_____

_____(1 mark)

Question 10 (continued)

An experiment was conducted by a student completing an EPI that measured the effect of temperature on the respiration rate in maggots. The data gained is shown below

Temperature °C	Rate of Oxygen absorption mm/min
17	**0.4**
26	**1.9**
30	**0**
40	**11.65**
45	**0.1**

b) State 2 controlled variables in this experiment.

_____

_____(1 mark)

c) Analyse the results obtained.

_____

_____

_____

_____

_____

_____

_____

_____

_____(4 marks)

Question 10 (continued)

d) Based on the information provided

(i) Is there any precision in the data?

_____

_____(1 mark)

(ii) Has the experiment been reproduced?

_____

_____(1 mark)

End of questions for the 2022 Kilbaha VCE Biology Trial Examination Units 3 and 4

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