2019
VCE
Biology
Trial Examination

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VICTORIAN CERTIFICATE OF EDUCATION
Year 2019

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	11	11	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 35 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.

VCE BIOLOGY 2019
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

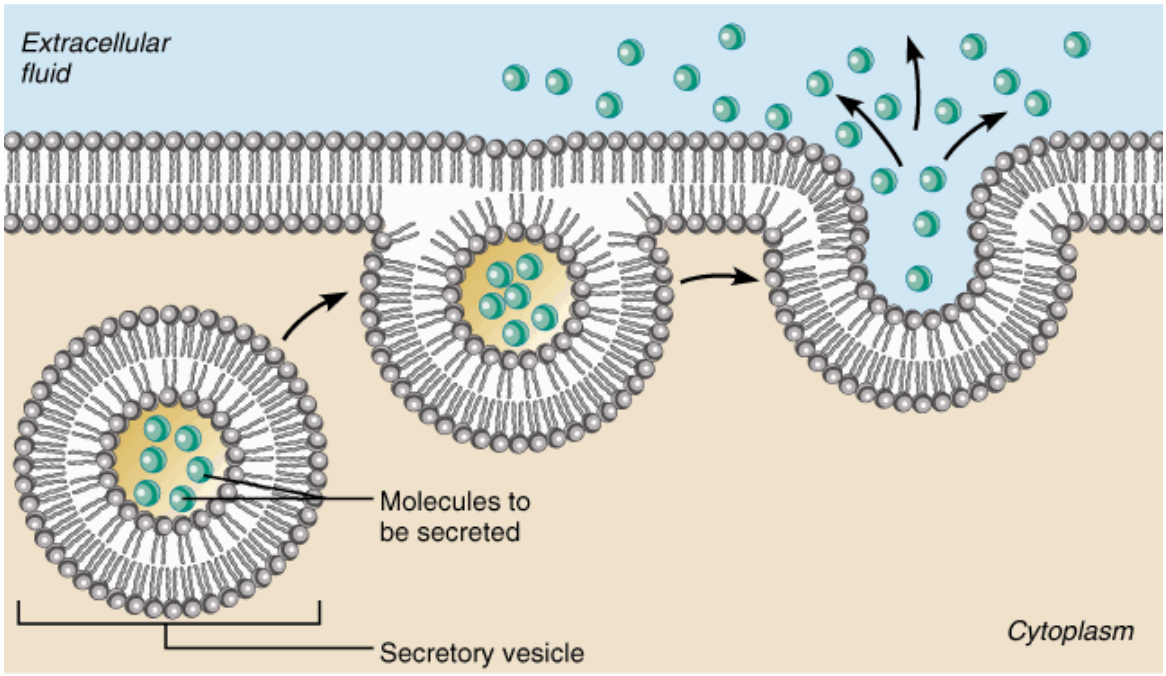
ONE ANSWER PER LINE

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.

The next 2 questions refer to the following diagram of a cellular process



From: https://biology.stackexchange.com/questions/21439

Question 1

The process depicted is

- **A.** Exocytosis
- **B.** Pinocytosis
- **C.** Endocytosis
- **D.** Osmosis

Question 2

The diagram supports the idea that

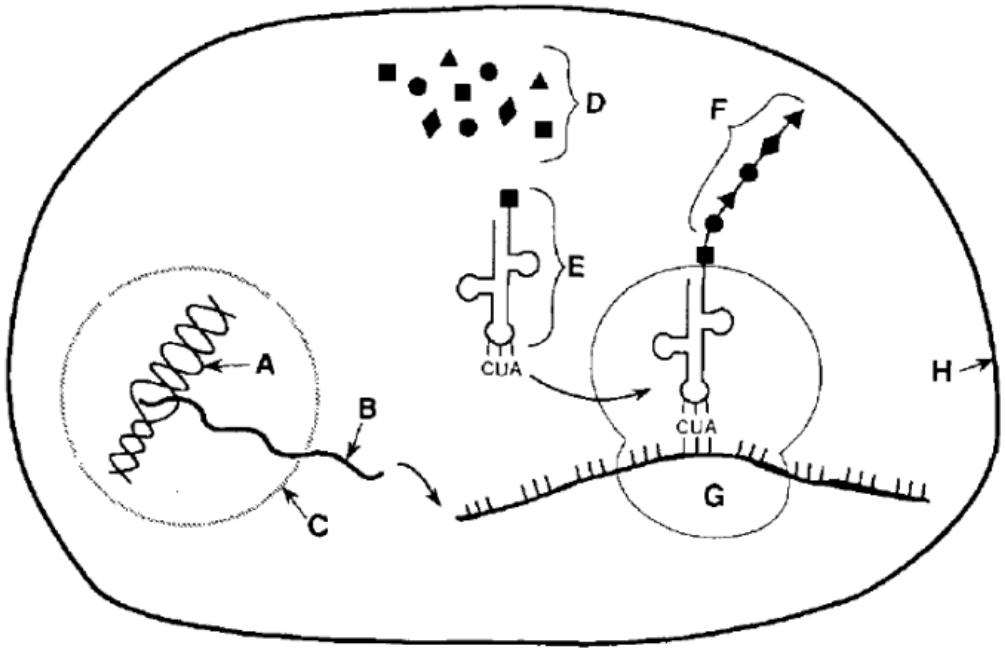
- **A.** The molecules to be secreted are hydrophobic
- **B.** The hydrophilic phospholipid tails are facing away from the cytoplasm because they are more stable in this configuration
- **C.** Phospholipids are not bonded to each other and so can mix together within the plasma membrane
- **D.** The secretory molecules have moved from a high concentration to a low concentration

Question 3

The 3 different types of Ribonucleic acid are called

- **A.** mRNA, rRNA and tRNA
- **B.** mRNA, cRNA and rRNA
- **C.** rRNA, tRNA and dRNA
- **D.** mRNA, tRNA and cRNA

The next 2 questions refer to the following diagram



From: https://vhs.valhallaschools.org

Question 4

Amino acids are located at

- **A.** B, C and D
- **B.** F, G and H
- **C.** D, E and F
- **D.** A, B, C, D, E, F, G and H

Question 5

It is appropriate to state that

- **A.** The codons on molecule B bind to anticodons on molecule A within structure G
- **B.** One of the polynucleotide strands along structure A is a template for the production of strand B
- **C.** Structures D are randomly joined together to form structure F
- **D.** Prior to the formation of strand B, exons are spliced out and introns are joined together

Question 6

Restriction endonucleases are manufactured

- **A.** Along the rough endoplasmic reticulum
- **B.** At ribosomes in some cells
- **C.** Within the cytosol of eukaryotic cells
- **D.** Within the nucleus of cells

Question 7

The lac operon is an example of gene control in bacteria. It explains how, in a changing environment, energy is not wasted on gene expression. The way the lac operon enables gene expression to be controlled is

- **A.** The repressor is bound to the operator region of the lac operon gene when lactose is not present preventing the expression of the gene
- **B.** When lactose is present, the repressor molecule detaches from the promotor region of the lac operon gene, enabling RNA polymerase to bind to the operator region of the gene enabling expression of the gene
- **C.** The presence of lactose binds to the repressor, changing its shape thus allowing it to bind to the operator region of the lac operon gene, leading to expression of the genes
- **D.** When RNA polymerase cannot bind to the operator region of the lac operon gene the repressor is detached from the promoter region of the gene, stopping the gene from being expressed

Question 8

The theory of endosymbiosis is supported by a large amount of evidence that explains the structure of mitochondria and chloroplasts including

	Membranes	DNA	Ribosomes	Independent Reproduction
A.	Two	Linear	Present	Yes
B.	One	Circular	Absent	No
C.	Two	Circular	Present	Yes
D.	One	Linear	Absent	No

Question 9

A factor that would increase the rate of biochemical reactions within a multicellular individual such as a human would be

- **A.** Increasing the temperature 10°C above normal
- **B.** Reducing the pH from 7 to 5
- **C.** Increase the concentration substrates available for particular reactions
- **D.** Increasing the light availability for the light dependent reactions

The next 2 questions refer to the following diagram

The diagram below is of the Krebs Cycle, an important biochemical process occurring in most eukaryotic cells. C2 to C6 represent organic molecules with a differing number of carbon atoms.

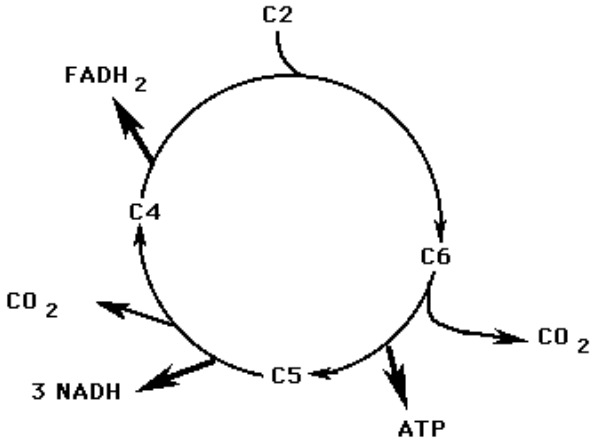


Diagram modified from: http://science.halleyhosting.com/sci/soph/energy/resp/notes/krebs.htm

Question 10

The cellular location of Krebs cycle is

- **A.** The lumen of the smooth endoplasmic reticulum
- **B.** The grana of the chloroplast
- **C.** The cytosol of an autotrophic cell
- **D.** The matrix of the mitochondria

Question 11

The biochemical process highlighted above undergoes 2 cycles to completely account for all the carbons from glucose. The total amount of products of this process would be

- **A.** CO_2, ATP, NADH and $FADH_2$
- **B.** $2CO_2$, ATP, 3NADH and $FADH_2$
- **C.** $4CO_2$, 2ATP, 6NADH and $2FADH_2$
- **D.** $6CO_2$ and 34-36ATP

Question 12

When bombykol is released by the female silkworm, it attracts mates for reproductive purposes. The sequence of events that leads this type of behaviour.

- **A.** Reception, response and transduction
- **B.** Response, reception and transduction
- **C.** Transduction, reception and response
- **D.** Reception, transduction and response

Question 13

The following diagram is of an interaction between 2 cells in the human body.

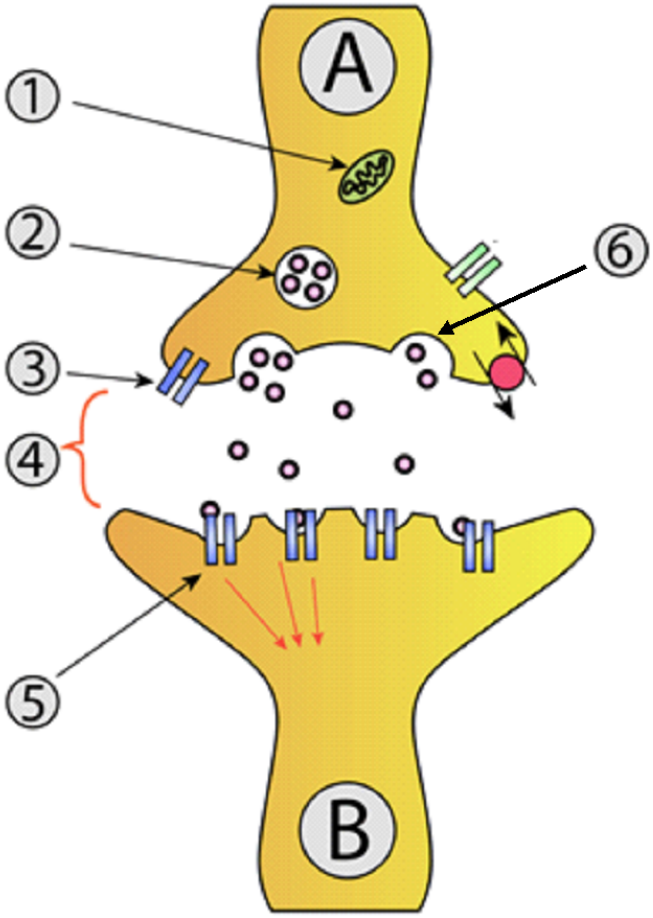


Diagram modified from: https://airfreshener.club/quotes/chemical-synapse-labeled.html

If A is a motor nerve, then

A. The label number 1 is a vesicle with neurotransmitter inside
B. Label number 6 represents endocytosis
C. Label number 5 represernts a post synaptic receptor
D. The area labelled number 4 is a hydrophobic environment

Question 14

If the rate of apoptosis within a multicellular invididual is either too high or too low then

A. Cancer could occur if the rate of apoptosis is too high
B. Multiple sclerosis could occur if the rate of apoptosis is too low
C. HIV could occur if the rate of apoptosis is too high
D. Tumors could develop if the rate of apoptosis is too low

Question 15

A pathogen contained nucleic acid, a protein shell and was encapsulated by a membrane that was present after being released from the host. This type of pathogen is

- **A.** Prokaryotic
- **B.** Non cellular
- **C.** A prion
- **D.** Multicellular

Question 16

Flowering plants are very vulnerable to herbivory and as a result have developed various natural defenses against them. The defenses are extremely variable and can be catagorised as either physical or chemical. An example of a chemical barrier to herbivores would be

- **A.** The presence of spines that deters herbivores from attatching to their stems
- **B.** A thick waxy cuticle on the upper epidermis of some leaves to prevent sucking insects inserting thier probiscus into them
- **C.** That certain alkaloids, if consumed by herbivores, interferes with their DNA replication and death results
- **D.** That some plant leaves have structures on their leaves that look like butterfly eggs, disuading other female butterflies to lay their eggs on that leaf

Question 17

The immune system is very good at distinguishing between self and non self antigens. An appropriate way for the body to respond would be

- **A.** For the non self antigens on the surface of the transplanted cells of a donor to become self antigens when placed into the recipient, meaning the immune system will not be activated
- **B.** That all somatic cells within an individual display self markers, which does not activate an immune response against them
- **C.** The self antigens on the surface of a pathogen are removed when neutrophils recognise them, leaving the pathogen harmless
- **D.** The body can change their non self markers into self markers to reduce the immune systems response against individuals with multiple sclerosis

Question 18

The lymphatic system includes

- **A.** A two way system that transports antigens to lymph nodes and then returns them to the site of infection
- **B.** A one way system that transports antigens from lymph nodes to the site of infection
- **C.** A two way system that transports antigens to lymph nodes with the use of one way valves
- **D.** A one way system that transports antigens to lymph nodes with the use of one way valves

The next two questions refer to the following information

When faced with challenges such as a bacterial infection, the body has a way of responding that usually eradicates the infection. Both a humoral and cellular response are activated and the diagram below summarises this. Cells 1 is the pathogen activating the response and cells 2 to 6 are involved in the immune response.

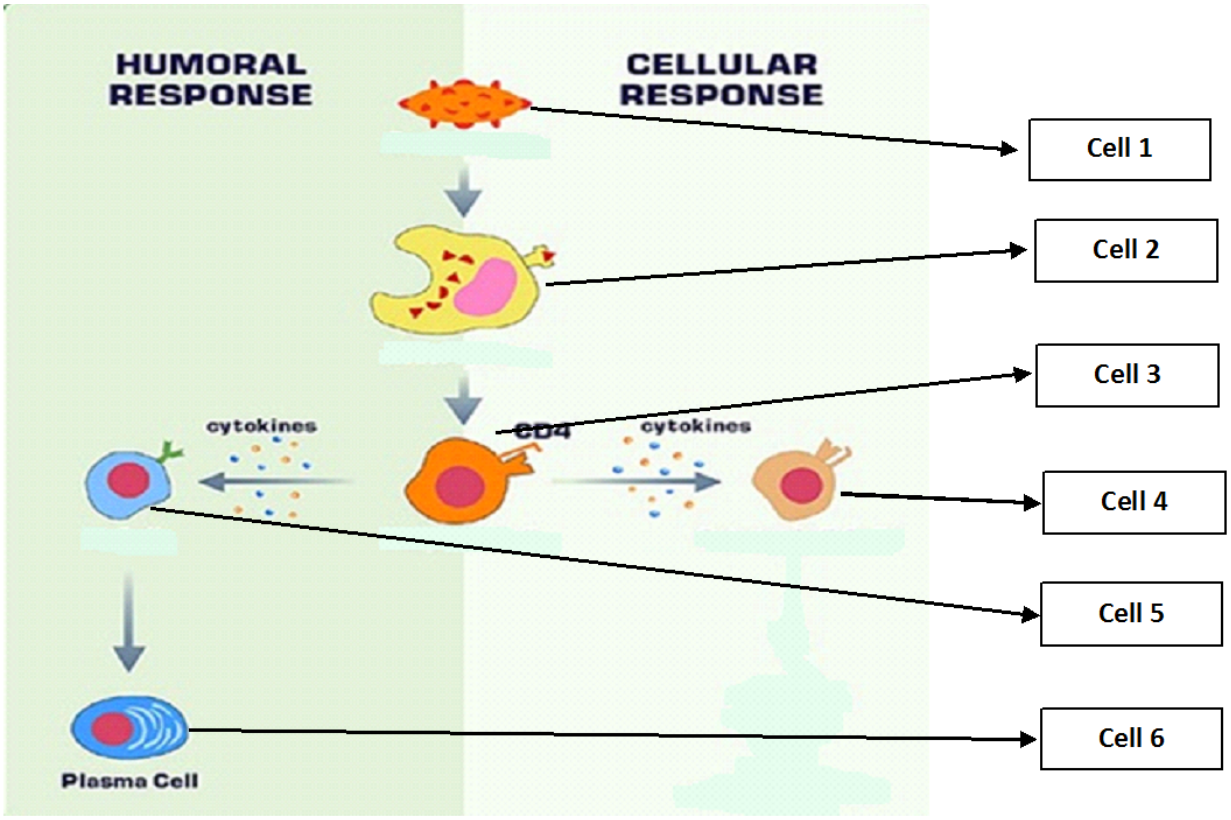


Diagram modified from: https://www.pinterest.com.au/pin/356417757982739912/?lp=true

Question 19

The cell(s) that are part of the innate immune response are

- **A.** Cells 3, 4 and 5
- **B.** Cells 2 and 6
- **C.** Cells 2 and 4
- **D.** Cell 2

Question 20

The cytotoxic cell is represented by

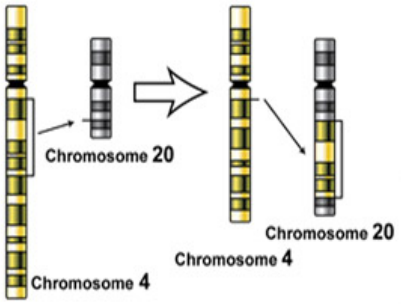
- **A.** Cell 3
- **B.** Cell 4
- **C.** Cell 5
- **D.** Cell 6

Question 21

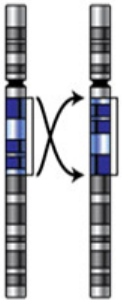
The following chromosomal mutation would be referred to as an inversion mutation

From: https://microbenotes.com/types-of-mutations/

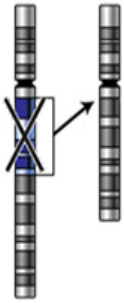
A.



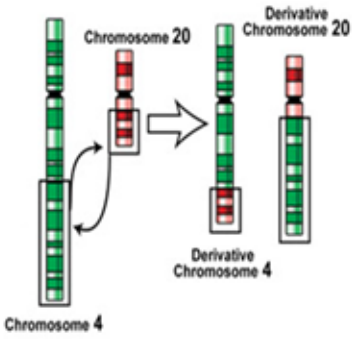
B.



C.



D.



Question 22

The type of single gene mutation that would most likely lead to a very different polypeptide chain would be

A. A single nucleotide substitution
B. A three nucleotide insertion
C. A single nucleotide deletion
D. The addition of six nucleotides just after the start codon

Question 23

The northern elephant seal was almost hunted to extinction in the late 1900's. The current population of northern elephant seals is in excess of 30,000 seals and their gene pool shows less variety than a population of southern elephant seals that were not hunted to near extinction. This is an example of

A. A population bottleneck
B. The founder effect
C. Artificial selection
D. Gene flow

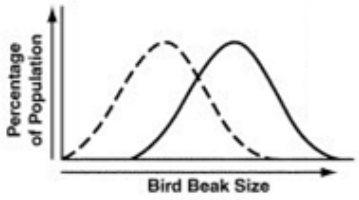
Question 24

In a given population of Darwinian finches where, members within the population in their different niches, begin specialising in eating two types of foods (hard large seeds and small insects) would, over time, have what final distribution compared to the original population?

NOTE: - - - - - - - - original distribution of phenotypes
——————— Final distribution of phenotypes

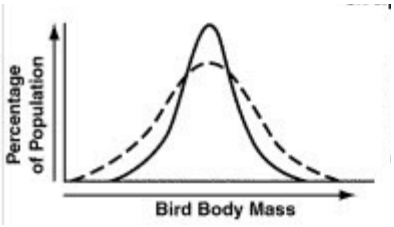
Diagrams From: https://brainly.com/question/3290820

A.

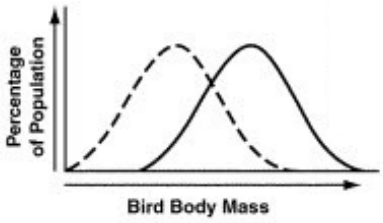


B.

C.



D.



Question 25

The three conditions that would lead to the best chance for fossilisation would be

	Burial	Temperature	Decay
A.	Rapid	Low	Slow
B.	Rapid	Moderate	Fast
C.	Rapid	High	Slow
D.	Slow	Low	Fast

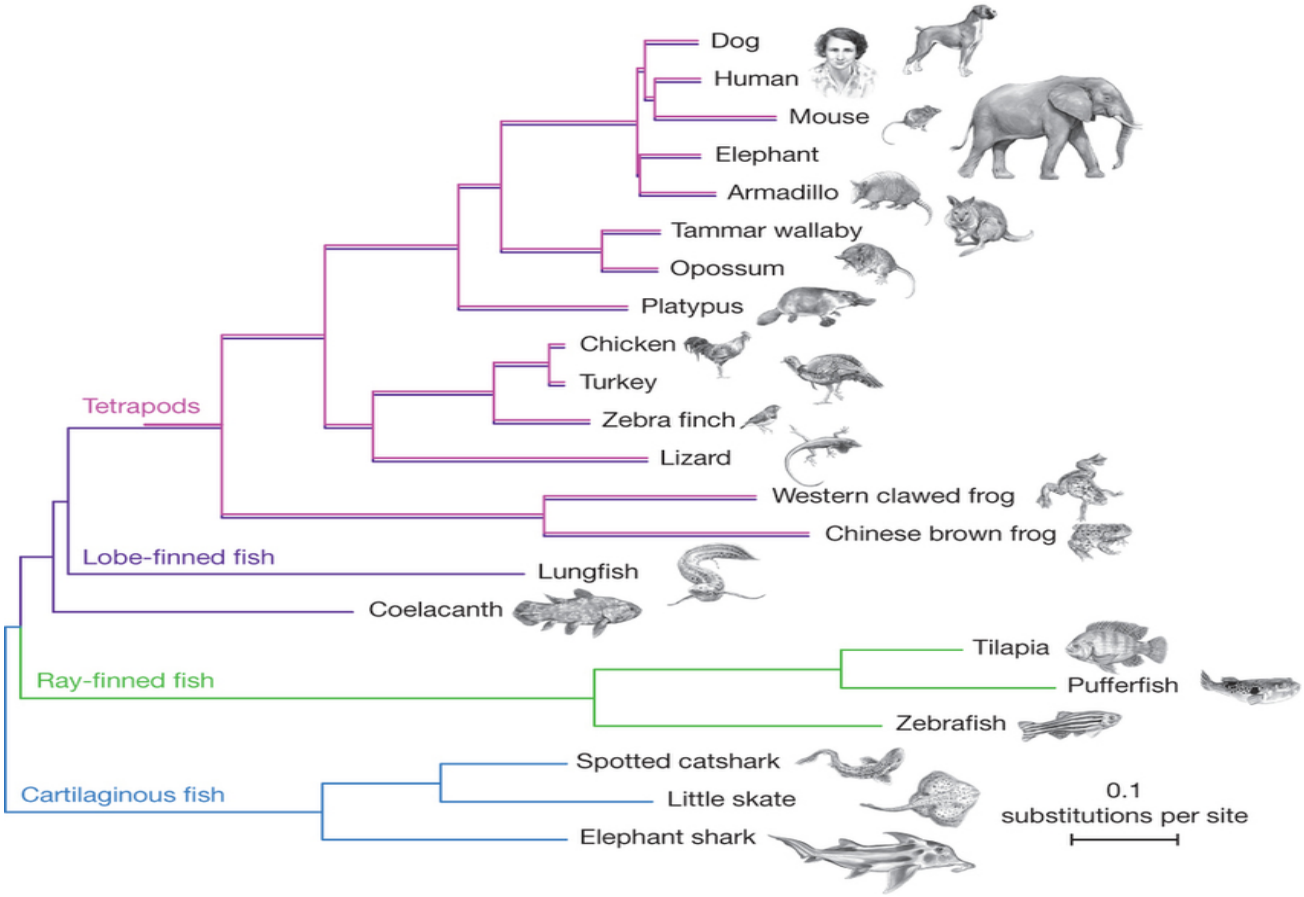
Question 26

An unclassified fossil was found within some sedimentary rock sandwiched between volcanic rock containing traces of potassium that was used to determine the fossils age. It existed between 345 million years ago and 300 million years ago. This is an example of

A. Relative dating
B. Stratigraphic correlation
C. Absolute dating
D. Carbon dating

Question 27

The following phylogenetic tree shows the relationships between a number of jawed vertebrates



From: https://www.researchgate.net/figure/A-phylogenetic-tree-of-a-broad-selection-of-jawed-vertebrates-shows-that-lungfish-not_fig3_236227537

Based on this phylogenetic tree it is reasonable to conclude that

A. The tilapia is more closely related to cartilaginous fish than they are to a zebra finch
B. The elephant and the mouse are the most closely vertebrates depicted in this phylogenetic tree
C. The lobe-finned fish probably lost their appendages due to environmental pressures
D. The tammar wallaby and opossum emerged as a result of convergent evolution

Question 28

All hominins

A. Were also primates
B. Were not classified hominoids
C. Were bipedal
D. Were culturally equally advanced

Question 29

The major evolutionary trends observed from the genus *Australopithecus* to the genus *Homo* are

A. *Australopithecines* had a more central foreman magnum that found in *Homo*
B. *Australopithecines* had a more bowl shaped pelvis that found in *Homo*
C. *Australopithecines* had a smaller cranial capacity that found in *Homo*
D. *Australopithecines* had an arm to leg ratio closer to 1:1 than that found in *Homo*

Question 30

Genomics has given greater resolution of the evolution of modern humans. The traditional view has clear cut linear branches with distinct speciation. This view is becoming blurred with greater technology and evidence. The horizontal lines represent gene flow between the various Homo genera that coexisted as well as the latest times these events occurred.

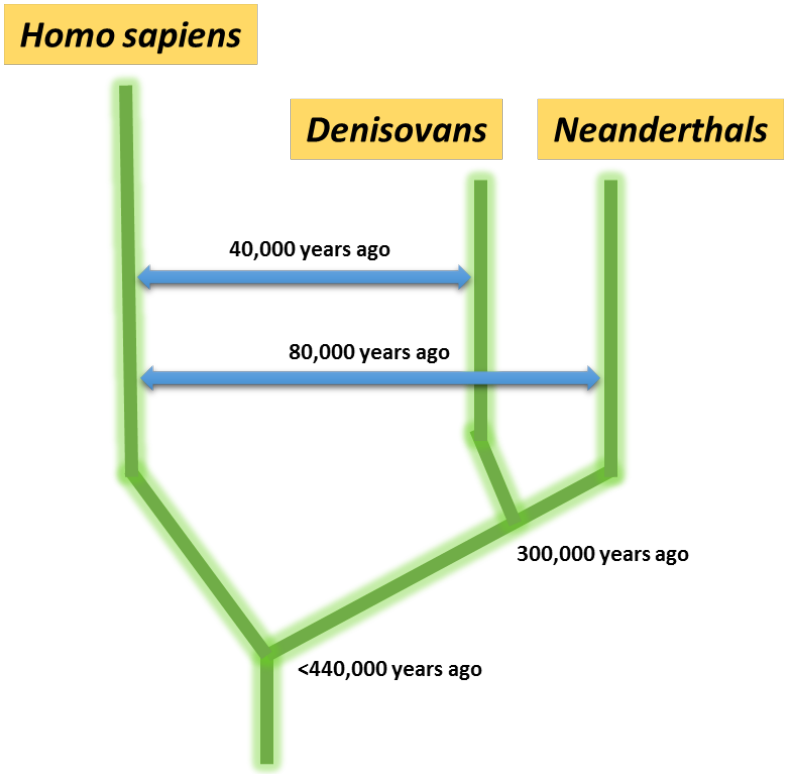


Diagram from: https://blogs.ncl.ac.uk/react/how-genomics-reshaped-our-understanding-of-human-evolution/

Based on this information as well as your knowledge it would be reasonable to conclude

A. *Homo sapiens*, *Neanderthals* and *Denisovans* all existed for the same amount of time
B. That some groups of *Homo sapiens* would have more homology in their genomes with *Denisovan* than with *Neanderthals* inferring a more recent gene flow event between them
C. That *Neanderthals* and *Denisovans* were never found in the same geographic area
D. That *Homo sapiens*, *Neanderthals* and *Denisovans* were the only three groups to have existed that have contributed to the evolution of modern humans

Question 31

The following restriction enzymes and recognition sites are given in the table below

Restriction Enzyme	Recognition Site
AluI	AGCT
BamHI	GGATCC
HaeIII	GGCC
PstI	CTGCAG

For the following linear DNA template strand

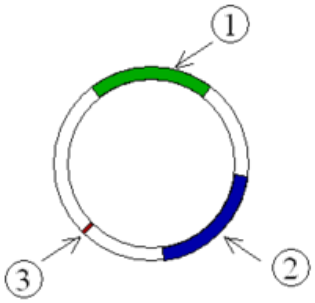
TATGCCGATGCTAGCTACCTAGCTATGCTAGGCCAGACTGCAGTAGATCGAT

The number of strands liberated when the strand is exposed to restriction enzymes would be

A. 1 if the template strand was mixed with PstI
B. 2 if the template strand was mixed with AluI
C. 3 if the template strand was mixed with BamHI and HaeIII
D. 5 if the template strand was mixed with all of the restriction enzymes listed

Question 32

The plasmid below shows 2 antibiotic resistant genes (region 1 provides resistance to ampicillin and region 2 provides resistance to tetracycline). Region 3 is the cutting site for a particular restriction endonuclease. A gene of interest was inserted into the plasmid and the recombinant plasmid was added to a bacterial culture, transferring one recombinant plasmid into each bacterium. The bacteria were plated out into 4 different agar plates (1 to 4) containing different combinations of antibiotics and incubated at 37°C for 3 days.



From: https://en.wikipedia.org/wiki/Plasmid-mediated_resistance

It would be expected to observe the following results after 3 days

	1: control	2: tetracycline	3: ampicillin	4 tetracycline and ampicillin
A.	No growth	Growth	No growth	Growth
B.	Growth	Growth	Growth	Growth
C.	Growth	Growth	Growth	No growth
D.	No growth	No growth	No growth	Growth

The next 2 questions refer to the following information regarding PCR

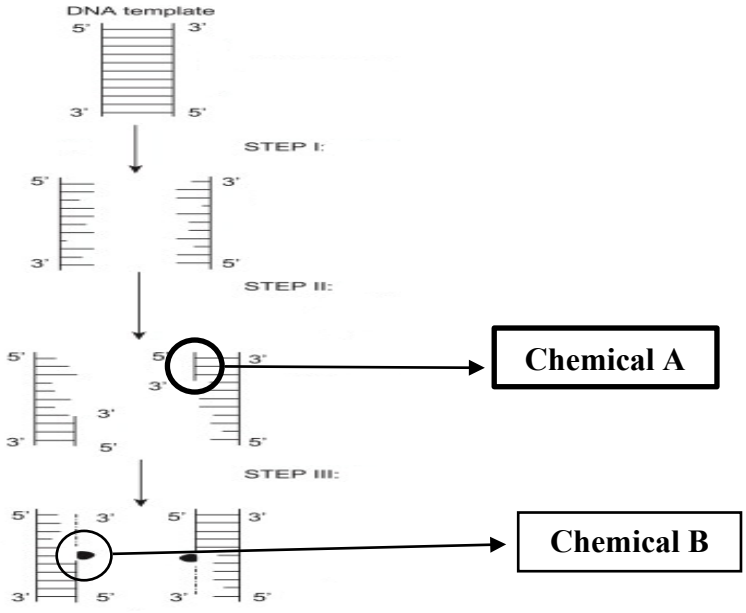


Diagram modified from: https://www.sciencedirect.com/topics/materials-science/polymerase-chain-reaction

Question 33

Steps I, II and III are

	Step I	Step II	Step III
A.	Denaturation at 95°C	Annealing at 60°C	Extension at 72°C
B.	Annealing at 60°C	Denaturation at 95°C	Extension at 72°C
C.	Denaturation at 95°C	Extension at 72°C	Annealing at 60°C
D.	Denaturation at 65°C	Annealing at 95°C	Extension at 72°C

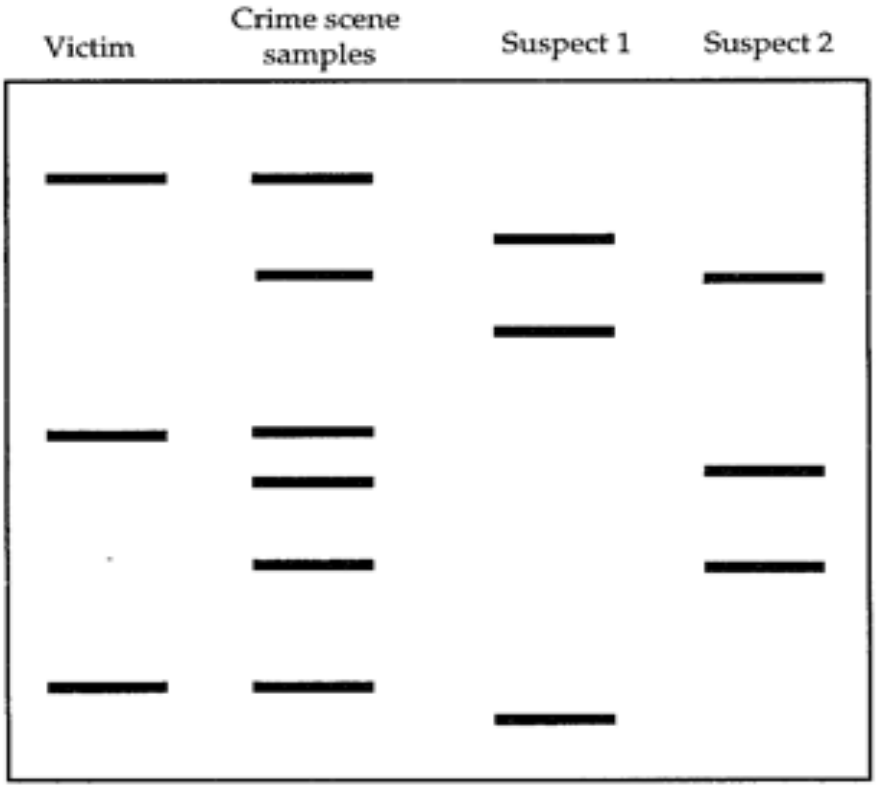
Question 34

Chemical A and chemical B are respectively

A. *Taq* polymerase and a primer
B. Primer and *Taq* polymerase
C. DNA ligase and primer
D. Reverse transcriptase and RNA polymerase

The next 2 questions refer to the following information

A crime was committed and blood samples from the victim, crime scene and 2 suspects was obtained. The diagram below shows the genetic profile produced



From:
http://www.angelfire.com/super2/biochristenson/Assignments/visual_learning_molecular_bio.htm

Question 35

The steps in the processes leading to the genetic profile includes (in order)

- **A.** gel electrophoresis, DNA purification, PCR
- **B.** DNA purification, PCR, gel electrophoresis
- **C.** PCR, DNA purification, gel electrophoresis
- **D.** DNA purification, gel electrophoresis, PCR

Question 36

The following conclusion can be made regarding the profile

- **A.** The crime scene sample includes DNA from the blood of the victim, suspect 1 and suspect 2
- **B.** The crime scene sample includes DNA from the blood of the victim and suspect 1 thus eliminating suspect 2 from the crime scene
- **C.** The crime scene sample includes DNA from the blood of the victim and suspect 2 thus eliminating suspect 1 from the crime scene
- **D.** Neither suspects left DNA from their blood at the crime scene thus eliminating both as possible perpetrators of the crime

Question 37

Roundup Ready Soybean has had a bacterial gene, viral gene and petunia gene inserted into its genome from a bacterium *Agerobacterium tumefaciens.* The modification allows the soybean plant to survive in an environment of herbicide sprays such as Roundup; hence the name Roundup Ready Soybean. Over 90% of the soybean crops worldwide are of this type. This is an example of

A. A transgenic organism that is not genetically modified
B. A genetically modified organism that is not transgenic
C. Neither a genetically modified or transgenic organism
D. A genetically modified organism that is also transgenic

Question 38

An experiment was conducted on a cell line investigating the antiviral drug Acyclovir on varicella (chicken pox virus). Five cell lines infected with the same amount of chicken pox virus were exposed to varying amounts of Acyclovir and the amount (%) of surviving cells were observed.

Cell Line	Level of Acyclovir (arbitrary units)	Amount of surviving cells (%)
1	0	0
2	10	20
3	20	60
4	30	100
5	40	100

Based on the data provided it is appropriate to state that

A. The data is quantitative
B. There is no dependent variable
C. The data is invalid
D. The data measured is qualitative

Question 39

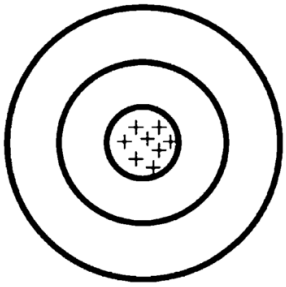
An experiment was constructed that investigated the mitochondrial DNA differences and human migration patterns. Samples of mtDNA were collected from 1000 individuals that were indigenous to the areas that they lived in. The samples were analysed using a bioinformatics computer program. Based on your knowledge as well as the information above, a suitable hypothesis for this experiment would be

A. The effect of mitochondrial DNA differences on human migration patterns
B. As the indigenous group gets further away from Africa, the greater the number of mtDNA differences within the group would be found
C. The closer the indigenous group is to Africa, the greater the number of mtDNA differences within the group would be found
D. mtDNA differences could be used to determine the distance the indigenous group is from Africa

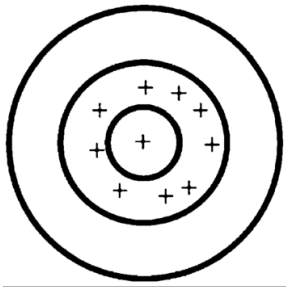
Question 40

The model below using a target to demonstrate the effect of precision and accuracy on an experiment repeated ten times. The data that is imprecise but accurate would be

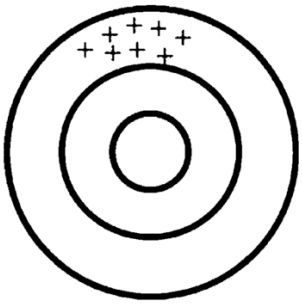
A.



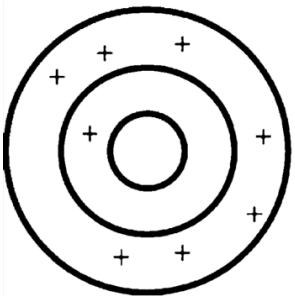
B.



C.



D.



Short Answer Questions

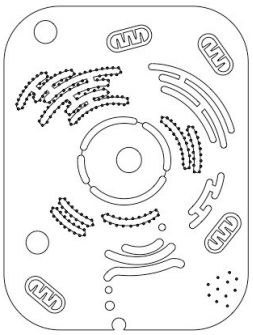
Question 1 (Total 3 marks)

Radioactive amino acids can be mixed with eukaryotic cells to explore the organelles that are involved in the synthesis and secretion of biomolecules. A cell line (involved in the synthesis and secretion of a biomolecule) was grown in a dish and then exposed to the radioactive amino acids. At different times (0, 10 and 15min) cells are removed and photographed. A shaded region will occur where there is a larger amount of radioactivity compared to non-radioactive.

a) For each cell below, which was removed and photographed after a certain amount of time, shade the region that would be higher in radioactivity (compared to other areas). Your series of diagrams should show a clear order of action of cellular organelles specifically involved in the synthesis and secretion of the biomolecule. Justify your choice.

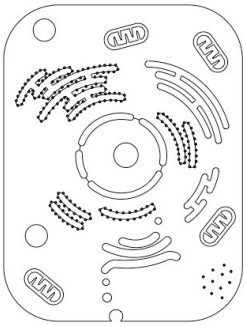
Diagram from: http://ib.bioninja.com.au

(i) After 5 minutes



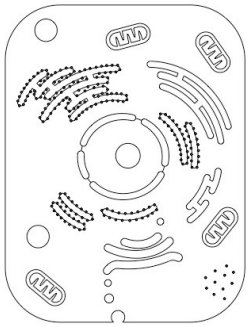
Justification: _____

(ii) After 10 minutes



Justification: _____

(iii) After 15 minutes



Justification: _____

(1 + 1 + 1 marks)

Question 2 (Total 8 marks)

Antibodies are proteins involved in the humoral immune response. There are only a few genes in the human genome that code for antibodies but there are potentially up to 10^{10} specific antibodies that can be produced by 1 individual.

a) A strand of a template DNA strand coding for an antibody polypeptide had the sequence illustrated below. Complete the diagram by showing the complementary mRNA sequence of the template strand.

Template DNA	**G**	**C**	**T**	**T**	**A**	**T**	**A**	**C**	**G**	**A**	**T**
Complementary mRNA											

(1 mark)

Part of each antibody contains a variable region and this is where the functional diversity of each specific antibody is located. There are about 60 exons that are part of the genetic material that code for antibodies.

b) Use this information to describe how RNA processing of the antibody genes could give rise to 2 different specific antibodies.

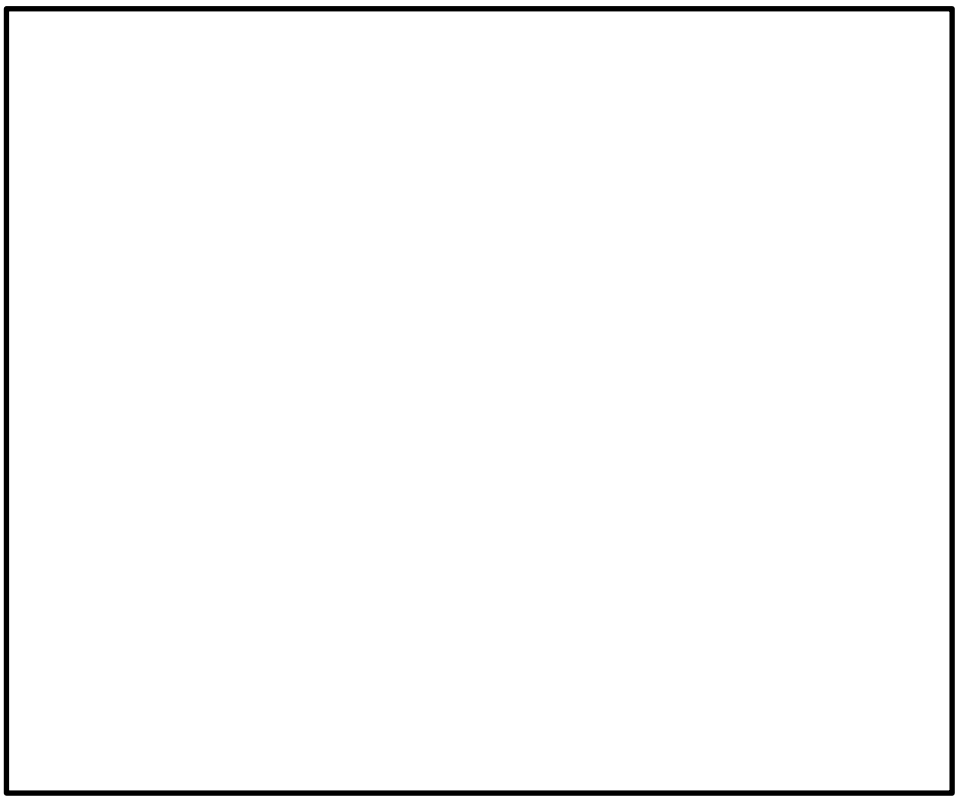
_____
_____
_____
_____**(2 marks)**

c) Describe how a functional antibody protein could form by using the following words to structure your answer.

primary, tertiary and quaternary level of arrangement

_____
_____
_____
_____
_____
_____
_____**(3 marks)**

d) Draw a labelled diagram of an antibody in the space below



(2 marks)

Question 3 (Total 8 marks)

Carbon dioxide levels have been steadily increasing in the atmosphere since the industrial revolution. This is causing a large number of changes in weather patterns that has significantly affected biodiversity.

a) Explain how plant growth may have been effected over time with increased levels of atmospheric carbon dioxide.

_____
_____ **(1 mark)**

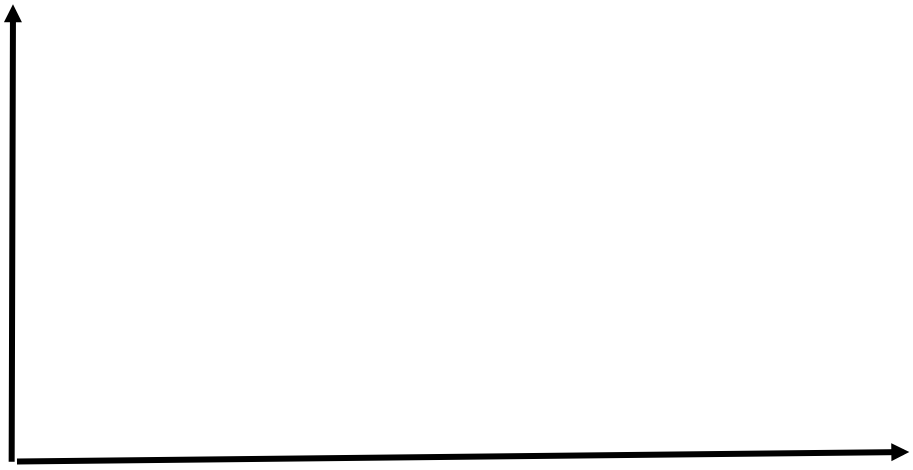
The biochemical reactions within plants that are affected by increased levels of carbon dioxide also require other factors for them to proceed. For example, temperature, pH, water and chlorophyll levels need to be optimal.

b) What coloured light is reflected by chlorophyll?

_____ **(1 mark)**

Atmospheric carbon dioxide levels are currently at about 0.4%

c) On the axis below, draw a line graph that would show how temperature effects the biochemical reactions that are affected by this increased level of carbon dioxide.



(2 marks)

There are 2 main reactions that are affected by increased levels of atmospheric carbon dioxide. This is because the reactants of one are the products of the other.

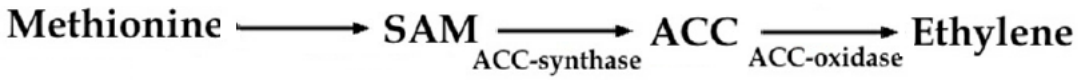
d) Complete the following table stating the reactants, products and cellular location of each reaction.

Reaction	Specific Location	Reactant(s)	Product(s)
Light dependent		1. 2. 3.	1. 2. 3.
Light independent		1. 2. 3.	1. 2. 3.

(4 marks)

Question 4 (Total 9 marks)

Ethylene gas is naturally produced by ripening fruit to promote ripening. It is synthesised by a pathway that is simplified below and is stimulated by unripe fruit starting to develop



a) Some plants lack ACC-oxidase. Explain how this would effect the ripening of fruit?

_____

_____ **(1 mark)**

The ethylene is a gas that then can travel to neighbouring cells or fruit to stimulate their ripening, which involves promoting cellular respiration in the ripening fruit.

b) How can an ethylene molecule that bind to plasma membrane receptors stimulate the response of cell respiration in a fruit cell?

_____

_____ **(1 mark)**

The diagram below illustrates the effect an increased rate of respiration has on ripening fruit

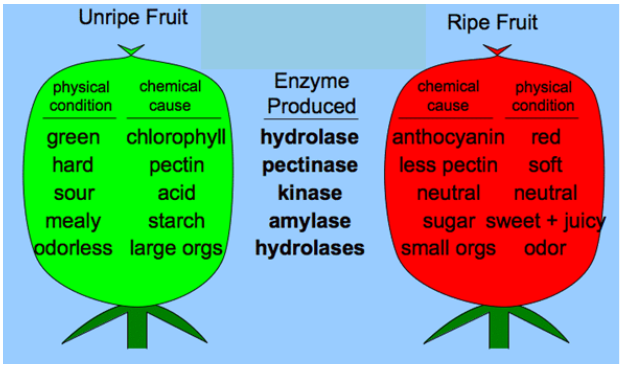


Diagram from: http://plantphys.info/plant_physiology/ethylene.shtml

c) How could an increase in respiration assist in the production of the ripening enzymes such as pectinase?

_____

_____

_____ **(1 mark)**

It is important for the fruit industry to get ripe fruit to the consumer all year round. This means that often, unripe fruit is harvested and an artificial environment is set up in large cool rooms to control the rate of ripening. The artificial environment that keeps the fruit unripe is temperature controlled.

d) What temperature (either 5°C, 15°C or 25°C) would be appropriate to ensure fruit ripening is at a minimum. Use the terms ACC and ACC oxidase to structure your answer

_____

_____

_____

_____**(2 marks)**

At appropriate times, the artificial environment can be changed to promote fruit ripening.

e) Design an experiment that would find the optimal level of ethylene required for fruit ripening. In your answer show an understanding of independent, dependent, controlled variables as well as a control. You may use a labelled diagram to answer the question.

_____

_____

_____

_____

_____**(4 marks)**

Question 5 (Total 6 marks)

Adrenalin (AKA epinephrine) is an animal hormone that can be manufactured in the laboratory and used to treat allergic reactions such as anaphylaxis. It is referred to as a monoamine because it is produced within the adrenal glands from the amino acid tyrosine via a series of biochemical steps. When in the bloodstream, it acts rapidly by binding to specific target cells, which then leads to a response.

The action of adrenalin includes

- Constriction of peripheral blood vessels
- Relaxation of smooth muscle in the lungs

a) Why are some cells sensitive to adrenalin yet others are not?

_____

_____ **(1 mark)**

When some people eat peanuts they develop an allergic response to chemicals within the peanut. After several exposures to the peanut chemicals, there can be a hypersensitivity reaction that can be extremely dangerous.

b) Describe the events that can lead to a hypersensitive reaction in people who have an allergy to peanut chemicals, after several exposures to the peanut chemicals

_____

_____

_____

_____

_____

_____

_____ **(3 marks)**

To treat this type of reaction to allergens such as peanut chemicals, injections of adrenalin via an Epipen may be a lifesaving solution. the symptoms of this type of reaction are

- Difficulty breathing
- Red, inflamed, itchy skin

c) Use the information provided in this question to describe how the action of adrenalin could be used to reduce the symptoms of a hypersensitive reaction to peanut chemicals.

_____

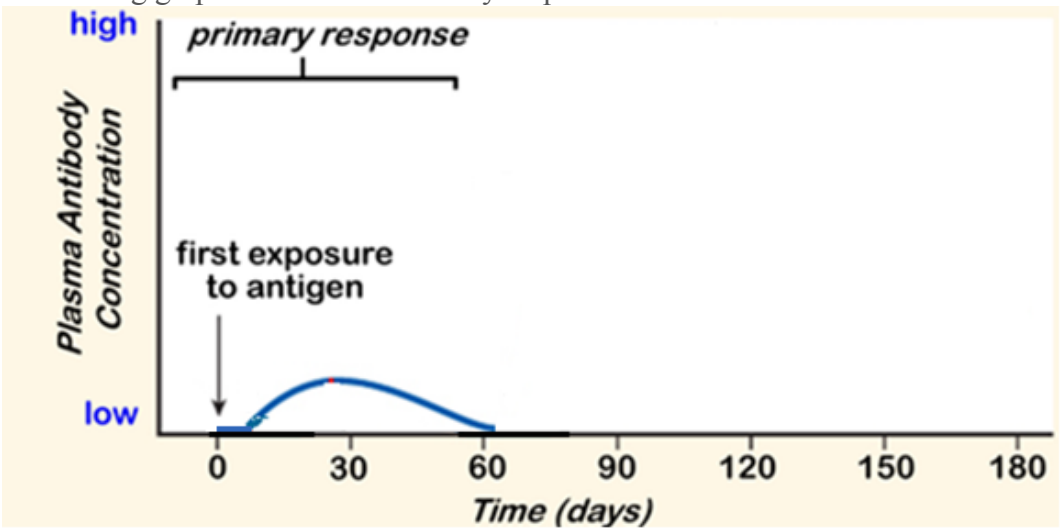
_____

_____

_____ **(2 marks)**

Question 6 (Total 10 marks)

The following graph shows how the body responds to the influenza vaccine



Modified from: https://pmgbiology.com/2014/04/07/immunity-a-understanding-for-biology-igcse/

a) **(i)** Show on the diagram where plasma B cells would be at their highest concentration after the exposure to the influenza antigen for the first time **(1 mark)**

(ii) Show on the diagram where memory B cells would be at their highest concentration after the exposure to the influenza antigen for the first time **(1 mark)**

(iii) If the vaccinated person was exposed to the influenza virus at day 90, complete the graph through to day 180. **(2 marks)**

b) Describe the role Helper T cells play in the immune response as a result of the exposure to the 'live' form of the influenza virus at day 90.

_____

_____

_____

_____

_____

_____ **(2 marks)**

Some strains of influenza can be life threatening and so, in environments where there is a recent outbreak of a virulent form of the virus, antiviral medication can be provided to the community

c) Name and describe the action of an antiviral against influenza

_____
_____
_____
_____
_____**(2 marks)**

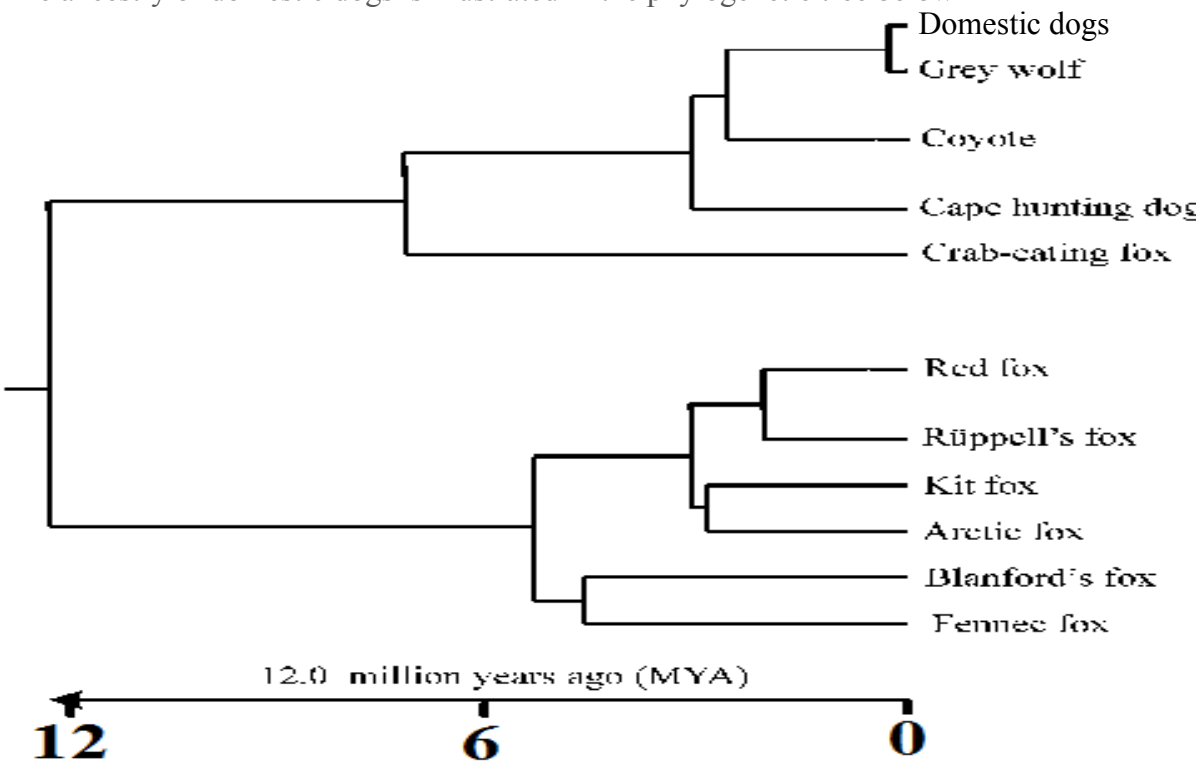
William stated to Ibrahim that taking the antiviral medication against influenza was all that was required for the body to fight against influenza and that a vaccine was not required. Ibrahim told William that this was nonsense and that the vaccine was really important to get.

d) Discuss why Ibrahim's argument was more valid than William's.

_____
_____
_____
_____**(2 marks)**

Question 7 (Total 8 marks)

The ancestry of domestic dogs is illustrated in the phylogenetic tree below



Modified From: https://www.researchgate.net/figure/A-phylogeny-of-fox-like-and-wolf-like-canids-Numbers-represent-branch-lengths-in_fig1_9047227

a) **(i)** How long ago did the coyote and the crab-eating fox have a common ancestor?

_____ **(1 mark)**

(ii) Describe an event that occurred about 12 million years ago that led to the evolutionary tree depicted above.

_____

_____

_____

_____ **(2 marks)**

(iii) State the type of evolution demonstrated in the evolutionary tree above.

_____ **(1 mark)**

Domestic dogs first appear in the fossil record about 200,000 years ago, which coincides with the emergence of *Homo sapiens*. Domestic dogs have diversified very rapidly as illustrated in the diagram below

From: https://depositphotos.com/177682292/stock-illustration-dog-breeds-cartoon-icons-in.html

b) Explain how domestic dogs diversified so rapidly

_____

_____

_____

_____ **(2 marks)**

Traditionally domestic dogs were scientifically named *Canis familiaris* and the grey wolf was *Canis lupus*. There have been many instances of cross breeding between domestic dogs and grey wolves that almost always produce fertile hybrid offspring.

c) How does this information effect the traditional view of the evolution of domestic dogs and how should evolutionary biologists use this evidence?

_____

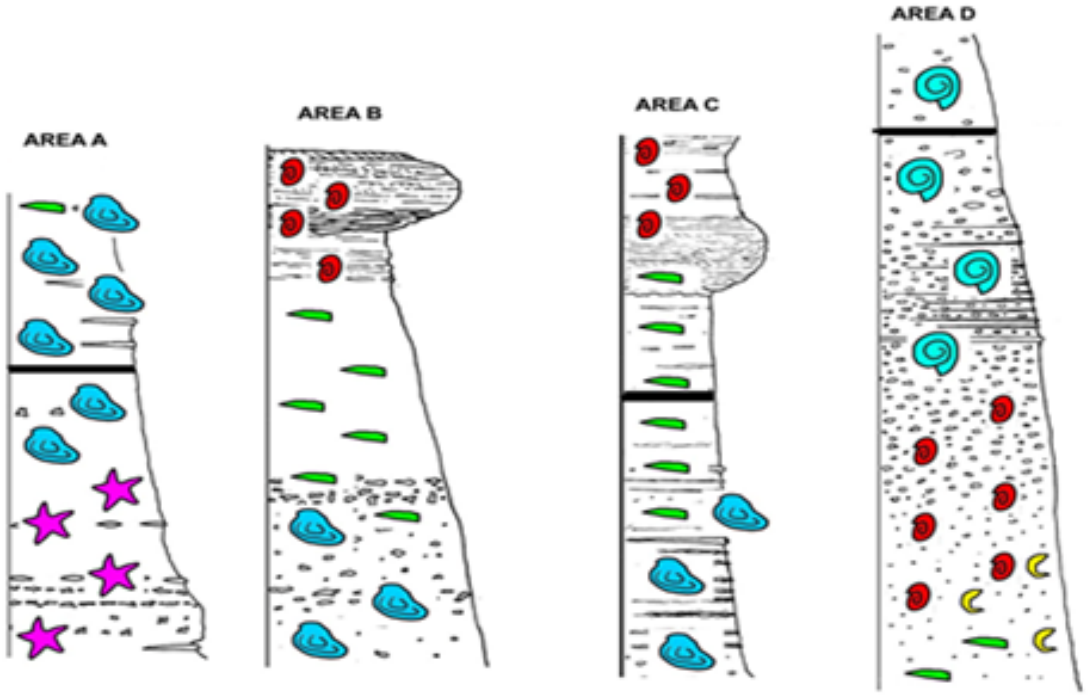
_____

_____

_____ **(2 marks)**

Question 8 (Total 8 marks)

The 4 areas in the diagram below represent cross sections of strata containing fossils embedded in sedimentary rock. The areas were separated by large distances but can be used for stratigraphic correlation purposes. Area B, C and D had a thin volcanic layer (thick black lines) within the strata that could be used for absolute dating and, as a result, the age ranges of fossils can be determined.



From:
http://www.labspaces.net/blog/1169/Reconstructing_the_History_of_Life_Part_III___Absolute__Age_Dating

a) Justify which of the 4 areas contain the oldest fossils

_____

_____

_____

_____ **(2 marks)**

b) Why are the volcanic layers able to be dated to give an age range of the fossils whereas the actual fossils cannot be accurately dated?

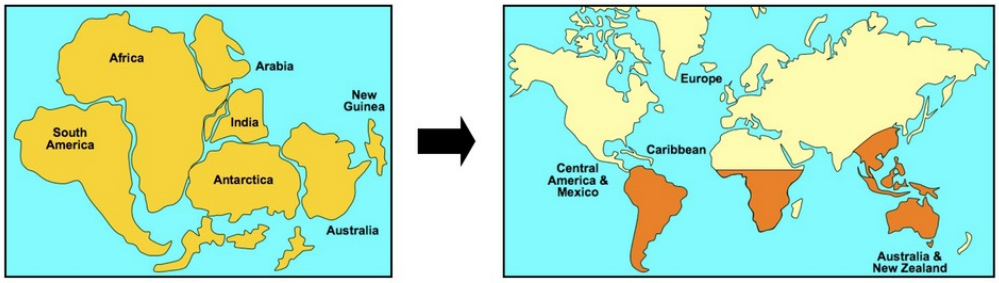
_____

_____

_____

_____ **(2 marks)**

The current distribution of *Proteacease* plants is illustrated in the diagram below, which provides evidence for evolution



Gondwana (125 million years ago)

Distribution of the Plant Species, *Proteaceae* (Present Day)

From: http://www.vce.bioninja.com.au/aos-4-change-over-time/evolution/evidence-for-evolution.html

c) Explain how the current distribution of *Proteacease* plants provides evidence for evolution.

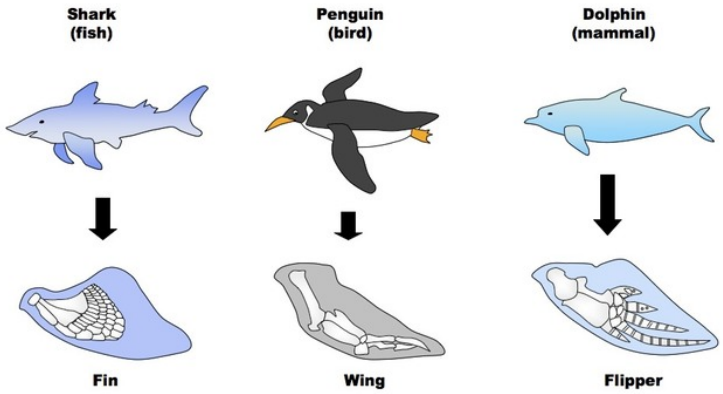
_____

_____

_____

_____ **(2 marks)**

Some organisms inhabit the same areas yet are not closely related in an evolutionary sense as illustrated with the 3 organisms in the diagram below



From: http://www.vce.bioninja.com.au/aos-4-change-over-time/evolution/evidence-for-evolution.html

d) Describe how unrelated organisms such as sharks, penguins and dolphins can appear similar phenotypically.

_____

_____

_____

_____ **(2 marks)**

Question 9 (Total 6 marks)

Synthetic Biology OR Natural Biology

Products like beer and yoghurt would not be possible without microorganisms. Increased knowledge of microbes has allowed scientists to manipulate organisms (sometimes controversially) for use in the biotechnology industry. Advancements in these areas have paved the way for synthetic biology. Synthetic biology aims to synthesise DNA artificially and to then program organisms to make products they don't make in nature. Hence, these organisms become living factories that produce commercially valuable products.
There is extensive research activity in the area of Paclitaxol production. Paclitaxel is extracted from the bark of the pacific yew trees and is used in chemotherapy treatment. The trees take 200 years to grow and one tree yields 0.5g of Paclitaxel. 3g of this drug is required for a single cancer treatment. A Paclitaxel coding section of DNA has been produced successfully using a synthetic biology approach. It promises a cheaper and more efficient alternative to the traditional methods of Paclitaxel manufacture currently employed in the industry, which often have significant environmental impacts, are inefficient and take a long time.

Extracted with permission from: https://www.thenakedscientists.com

a. How could an organism such as yeast be part of the recipe that is used to make beer, which usually has an ethanol concentration of about 5%

_____
_____(1 mark)

b. How could the 'increased knowledge of microbes' be used to synthesise DNA artificially?

_____
_____
_____
_____(2 marks)

c. Discuss whether an organism with synthetic DNA inserted into its genome would be regarded as genetically modified, transgenic or both.

_____
_____
_____(1 mark)

d. In the table below list an advantage and a disadvantage from the article of using Natural Biology or Synthetic Biology to solve problems commercially.

	Advantage	Disadvantage
Natural Biology		
Synthetic Biology		

(2 marks)

Question 10 (Total 7 marks)

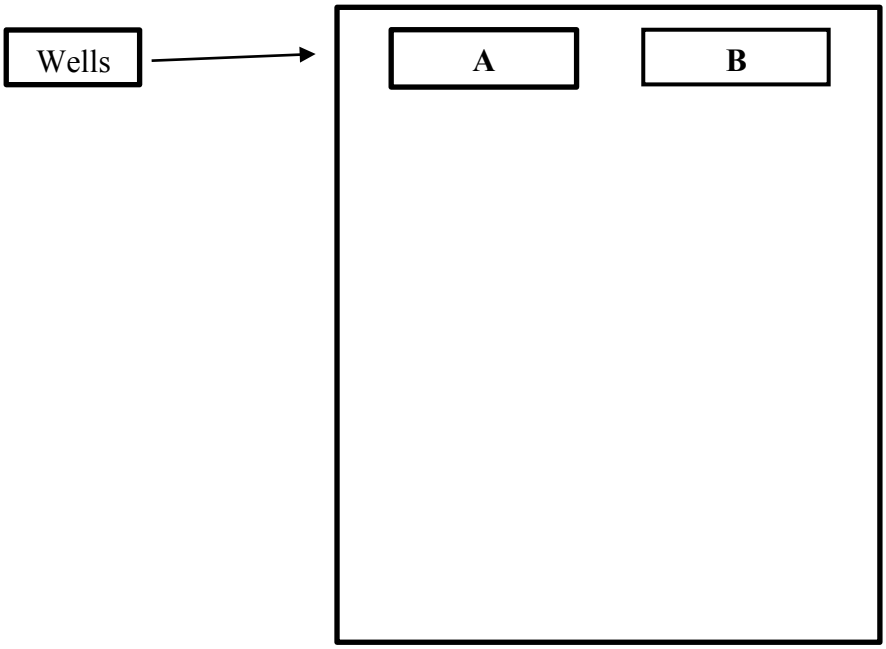
The restriction enzyme HaeIII cuts DNA at the recognition site 5'GGCC3'. 2 strands of DNA from a specific loci were extracted and amplified from two individuals (individual A is the father of individual B) was mixed with HaeIII. The 2 strands of DNA are shown below

Individual A:
5'ACGTAGCTAGCTACGGCCGCAGCCGGATGCTAGGCCGATCCATCCCGGA3'
3'TGCATCGATCGATGCCGGCGTCGGCCTACGATCCGGCTAGGTAGGGCCT5'

Individual B:
5'ACGTAGCTAGCTACGCCCGCAGCCGGATGCTAGGCCGATCCATCCCGGA3'
3'TGCATCGATCGATGCGGGCGTCGGCCTACGATCCGGCTAGGTAGGGCCT5'

a) Show on the DNA strands where HaeIII will bind to the DNA strands and cut them **(1 mark)**

The samples were then added to wells in an agarose gel and subject to electrophoresis. A diagram of the gel is shown below



b) **(i)** Show on the gel where the negative and positive end of the gel electrophesis tank would have been located **(1 mark)**

(ii) Show on the gel the band pattern expected to be seen from both individual A and individual B **(2 marks)**

(iii) Describe a specific event that occurred in the production of the gametes of individual A that gave rise to the DNA sequences apparent in individual B.

_____
_____ **(1 mark)**

Question 10 (continued)

The loci in question is a small section of the genome that shows variability in many individuals and can, apart from showing relatedness, also be used for genetic profiling where the identification of deceased individuals, criminals or paternity disputes are warranted.

c) State 2 reasons why the genetic profile of individual A and individual B as illustrated by the gel pattern on the previous page would **not** be regarded as conclusive evidence if these individuals were subjected to identification testing.

_____
_____
_____
_____ **(2 marks)**

Question 11 (Total 7 marks)

Ebola is an emerging disease that has had sporadic outbreaks in the Democratic Republic of Congo over the last few years. The disease spreads easily but the mortality rate is so high it has been restricted to that area. There is fear that if a disease such as this spread the Ebola virus could become a world-wide problem

a) What is the difference between a pandemic and an epidemic with respect to the Ebola virus?

_____

_____

_____ **(1 mark)**

Developing effective treatments against the Ebola virus is important. A vaccine is available, but the protection gained is inconsistent against the different strains of Ebola. Antiviral drug development against Ebola is a line of research currently being undertaken. A drug called Toremifene citrate (TC) could be administered to people in high risk areas. An experiment was set up using monkey kidney cell lines, which were exposed to the Ebola virus. Four researchers followed the same method (trials 1 – 4) and the survivability of the cell lines (%) was measured. The data gained is illustrated below.

	Monkey cell line cells exposed to Ebola surviving after 2 days (%)			
Concentration of TC (mmol)	Trial 1	Trial 2	Trial 3	Trial 4
0	0	5	2	0
5	10	13	25	19
10	68	75	71	67
15	75	82	78	90

b) By using the data provided, comment on

(i) Why the precision of the data was high:

_____

_____

_____ **(1 mark)**

(ii) Why the reproducibility of the data was high:

_____

_____

_____ **(1 mark)**

c) One researcher suggested the data gained were not valid for human treatment. State 2 reasons why this may be the case.

_____

_____

_____

_____ **(2 marks)**

Question 11 (continued)

Vaccines as well as TC are expensive

d) Considering the information available about vaccinations as well as TC, justify the type of medical intervention needed in an area just prior to its inevitable exposure to the Ebola virus.

_____
_____
_____
_____ **(2 marks)**

End of questions for the 2019 Kilbaha VCE Biology Trial Examination Units 3 and 4

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