Quality Assessment Tasks

NAME: _____

VCE® BIOLOGY

UNITS 3 & 4 Practice Written Examination

FOR ADJUSTED STUDY DESIGN (2020 ONLY)

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

Structure of book

Section		*Number of Questions*	*Number of Questions to be answered*	*Number of Marks*
A B		40 10	40 10 Total	40 80 120

- 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 43 pages.
- Answer sheet for multiple-choice questions.

Instructions

- Write your **name** in the space provided above on this page.
- Detach the answer sheet for multiple-choice questions during reading time.
- Write your **name** on your answer sheet for multiple-choice questions.
- 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 into the examination room mobile phones and/or any other unauthorised electronic devices.

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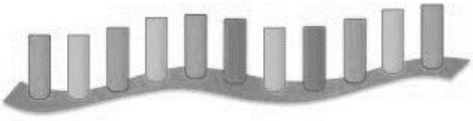
SECTION A - Multiple Choice Questions

Instructions for Section A
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

Molecule A, Molecule B and Molecule C shown below represent different molecules of RNA.



Molecule A

Molecule B

Molecule C

Source: https://ib.bioninja.com.au/

Which of the following is true of these molecules?

A. A, B and C are all required for transcription.

B. C binds to amino acids and DNA.

C. A is not needed for translation.

D. A can bind with both B and C.

Question 2

The properties of DNA include:

A. a negative charge.

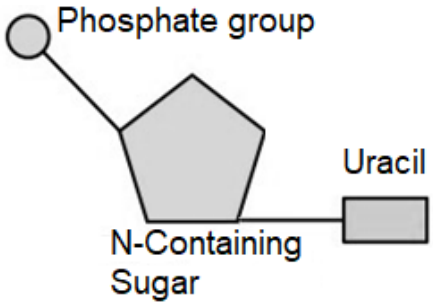
B. always being double stranded.

C. having strong hydrogen bonds between bases.

D. thymine pairing with cytosine.

Question 3

A student has drawn the following diagram showing a nucleotide.



Which of the following is correct about the diagram?

A. The sugar is correctly labelled and in the correct position.

B. The base is correctly labelled and in the correct position.

C. The phosphate is correctly labelled and in the correct position.

D. The molecule could be an RNA polymer.

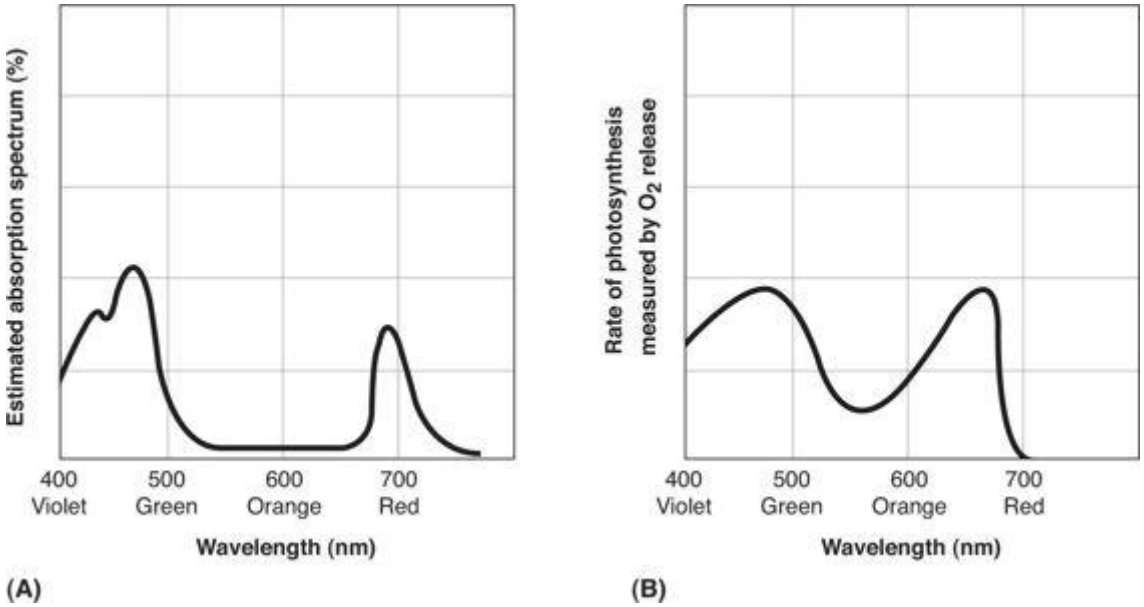
Question 4

Which of the following is true for the cell membranes?

	Embedded membrane structures	**Composed of**	**Model**
A	Can move laterally	Many components	Fluid mosaic
B	Include protein channels	Proteins	Lock and key
C	Include cholesterol channels	Protein channels	Fluid mosaic
D	Can move freely	Phospholipids only	Fluid mosaic

Question 5

Consider the following graphs.



Source: https://www.crackap.com

The graphs can be accurately compared by which of the following statements?

A. The amount of light absorption is indirectly proportional to the rate of light oxygen released.

B. The rate of photosynthesis increases as wavelength of light increases.

C. Oxygen release is greater when light absorption is highest.

D. Green light is absorbed between 500-600nm resulting in low oxygen release.

Question 6

The equation below represents an important biochemical reaction. X is used to represent water.

Source: https://brainly.com

The equation is best described as

A. Cellular respiration where W represents oxygen and Z represents carbon dioxide.

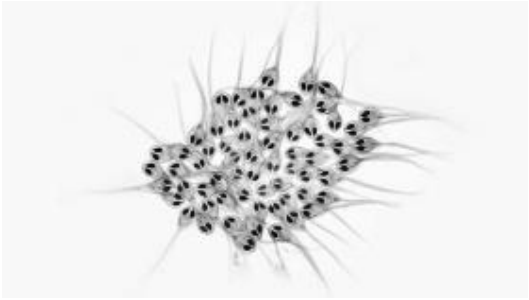
B. Photosynthesis, where W represents carbon dioxide and Y represents glucose.

C. Cellular respiration where W represents carbon dioxide and Z represents water.

D. Photosynthesis, where Y represents carbon dioxide and Z represents glucose.

Question 7

A parasitic species closely related to the jellyfish has lost its mitochondrial genome and is able to survive without this structure. It lives in low oxygen environments and it is thought that it may be able to obtain energy from its hosts – salmon and annelid worms.



Source: https://www.sciencenews.org/

This organism would be able to produce

A. 36 – 38 ATP during aerobic cellular respiration.

B. 4 ATP during glycolysis and Kreb's cycle.

C. Glucose during the Calvin cycle.

D. 2 ATP during glycolysis.

Question 8

Cyanide is an inhibitor of cytochrome c oxidase, a key enzyme in the electron transport chain. The bond between the two is very strong, and cannot be changed, even when more substrate is added.

Cyanide is

A. a competitive inhibitor.

B. a non-competitive inhibitor.

C. an enzyme.

D. an irreversible inhibitor.

Question 9

The main inputs of Kreb's Cycle (citric acid cycle) include

A. ADP and Pyruvate.

B. Water and Carbon Dioxide.

C. Co-Enzyme A and Pyruvate.

D. NAD and $FADH_2$.

Question 10

The reaction that produces Lactic Acid

A. is aerobic and occurs in animals.

B. is called Fermentation and occurs in plants.

C. does not produce a gas as an output.

D. uses the energy provided by ATP.

Question 11

Lipid soluble hormones, such as testosterone, enter a cell and trigger a response by

A. binding to extracellular receptors.

B. entering the cell via endocytosis.

C. receptors in the intracellular environment.

D. diffusing across the synaptic gap.

Question 12

A physical defence against pathogens in plants is

A. production of a gall.

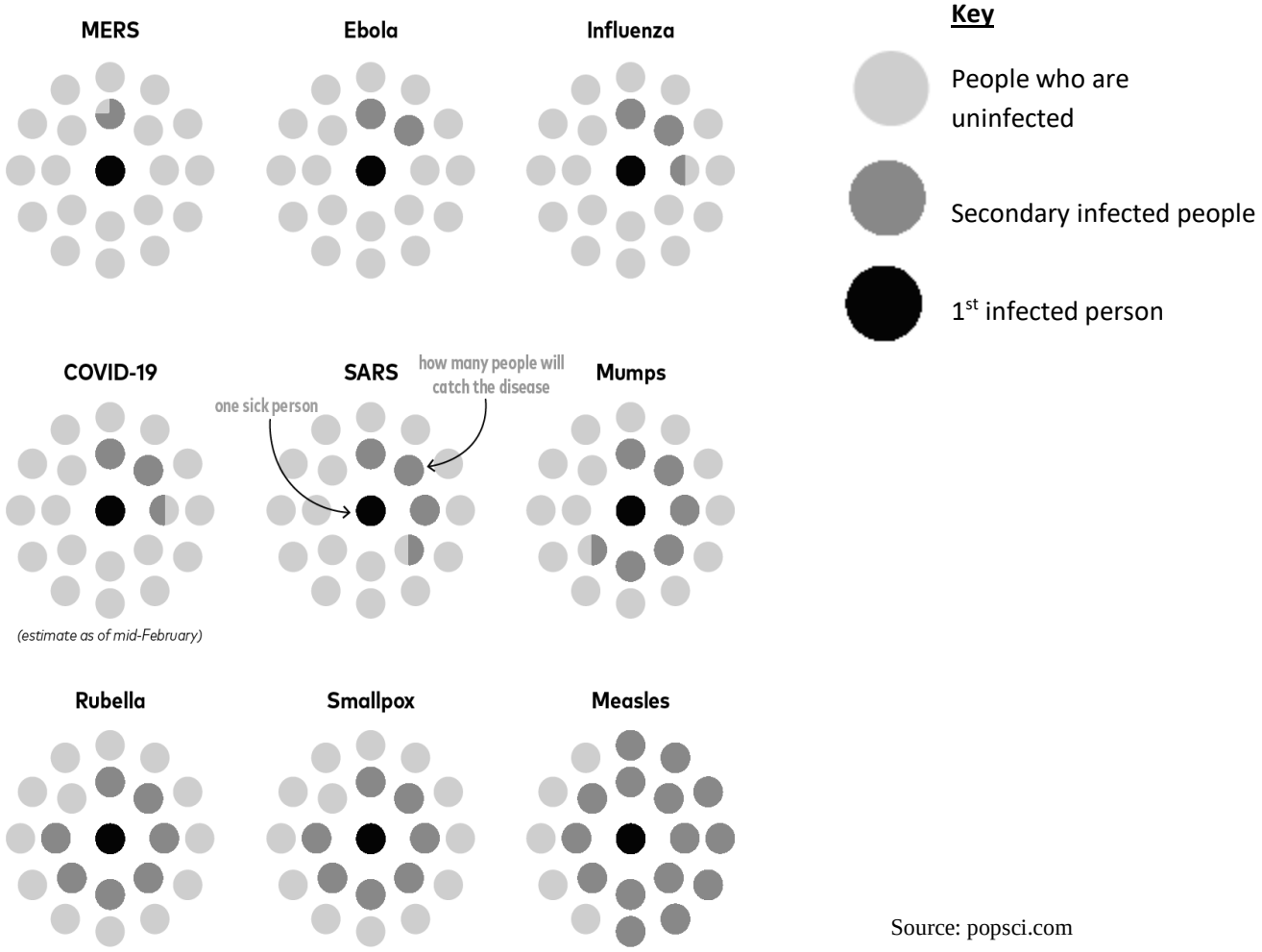
B. secretion of distasteful substances.

C. brightly coloured flowers.

D. mucous membranes.

The following information refers to Questions 13 and 14

R0 (pronounced R-naught) is a measure of how infectious a disease is. If R0 has a value greater than 1, then every infected person will infect at least 1 one other person and has the potential to spread throughout the population. Nine different diseases are shown. The first sick individual is shown in the middle (black) and the people that they will infect are shown in dark grey. Individuals who remain light grey are uninfected.



Source: popsci.com

Question 13

Which of the following statements is true?

A. MERS has an R0 value of zero.

B. Ebola can infect more people than mumps.

C. Measles has the highest R0 value.

D. COVID-19 (coronavirus) can spread more quickly than Influenza.

Question 14

Which would be most effective at reducing the spread of COVID-19 (the coronavirus)?

A. Having previously been exposed to influenza.

B. Having a clean water supply.

C. HERD immunity in a population.

D. People only going to work or school every second day.

Question 15

Multiple sclerosis is caused by the

A. production of autoantibodies by B plasma cells.

B. rapid response of T memory cells.

C. stimulation of the immune response by foreign antigens.

D. direct contact with an affected person.

Question 16

Pregnant women are advised to have a 'booster' vaccination during pregnancy to provide some level of protection to their newborn baby against whooping cough.
The types of acquired immunity in the mother and newborn baby, respectively, are:

A. active, natural and passive, natural

B. active, artificial and passive, natural

C. passive natural and active, induced

D. passive, induced and passive, natural

Question 17

Point mutations

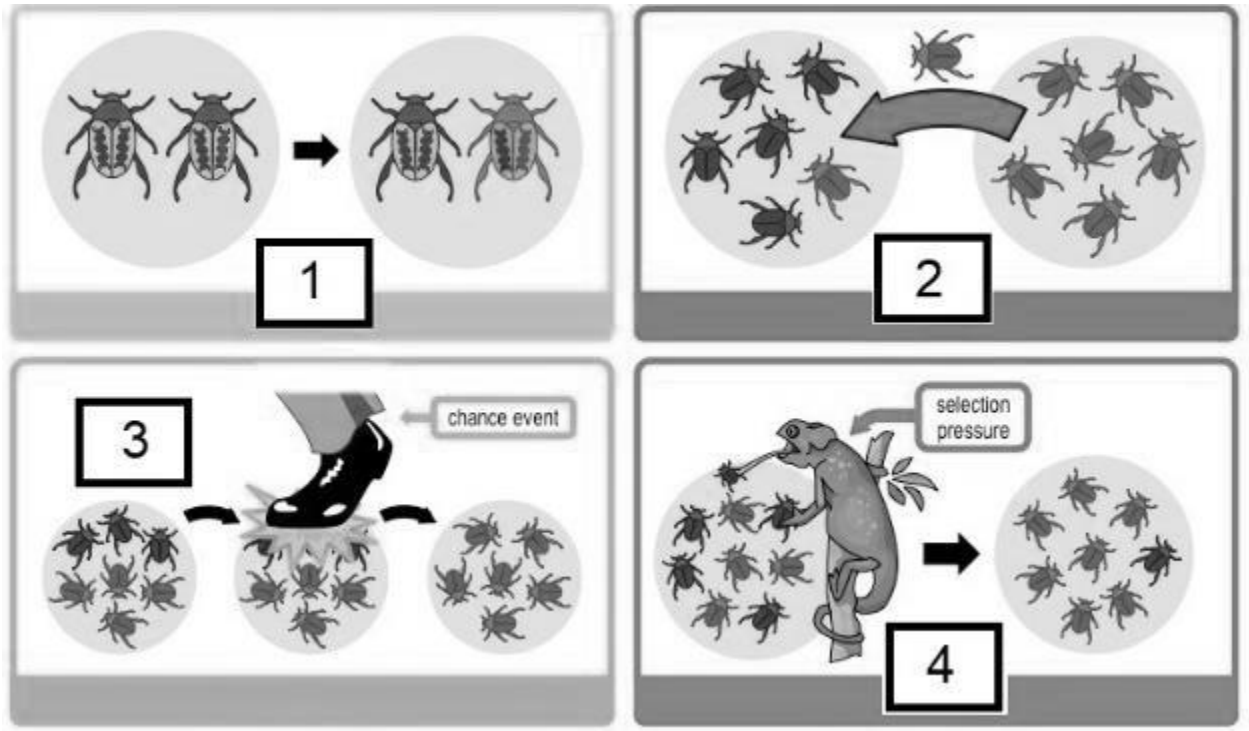
A. are always frameshift mutations.

B. could include a translocation mutation.

C. always result in changes to the structure of the protein.

D. could result in a STOP codon being formed.

Question 18



Source: bioninja.com.au

1, 2, 3 and 4 are diagrams best represented by;

A. 1 = Genetic Drift, 2 = Gene Flow, 3 = Natural Selection, 4 = Genetic fitness

B. 1 = Mutation, 2 = Founder Effect, 3 = Natural Selection, 4 = Genetic Drift

C. 1 = Speciation, 2 = Allopatric Speciation, 3 = Genetic Drift, 4 = Natural Selection

D. 1 = Mutation, 2 = Gene Flow, 3 = Genetic Drift, 4 = Natural Selection

Question 19

Finches that have been isolated from each other for many years on different islands show changes in their mating calls. This would likely lead to

A. mating that occurs only when sea levels are low, and the islands are connected.

B. an infertile hybrid as a result of the mating.

C. an inability for the two finches to mate due to different courtship behaviours.

D. an inability to interbreed due to different habitats being occupied.

Question 20

The introduced cane toad and the native endangered giant barred frog look very similar. Whilst trying to prevent the spread of the cane toad into New South Wales, many of the native species have been mistakenly captured or killed.

Source: abc.net.au

The two species looking alike is a result of

A. genetic drift.

B. similar selection pressure.

C. natural selection.

D. gene flow.

Question 21

Chytrid fungus has been detrimental for frog populations all around the world. In Panama, the frog population had been reduced by 75%, which consequently reduced both diversity and variation in body sizes of snake populations.

Argus goo-eater

Source: https://www.sciencenews.org

The most likely reason for the reduction in differing snake sizes, including the Argus goo-eater (pictured), is that

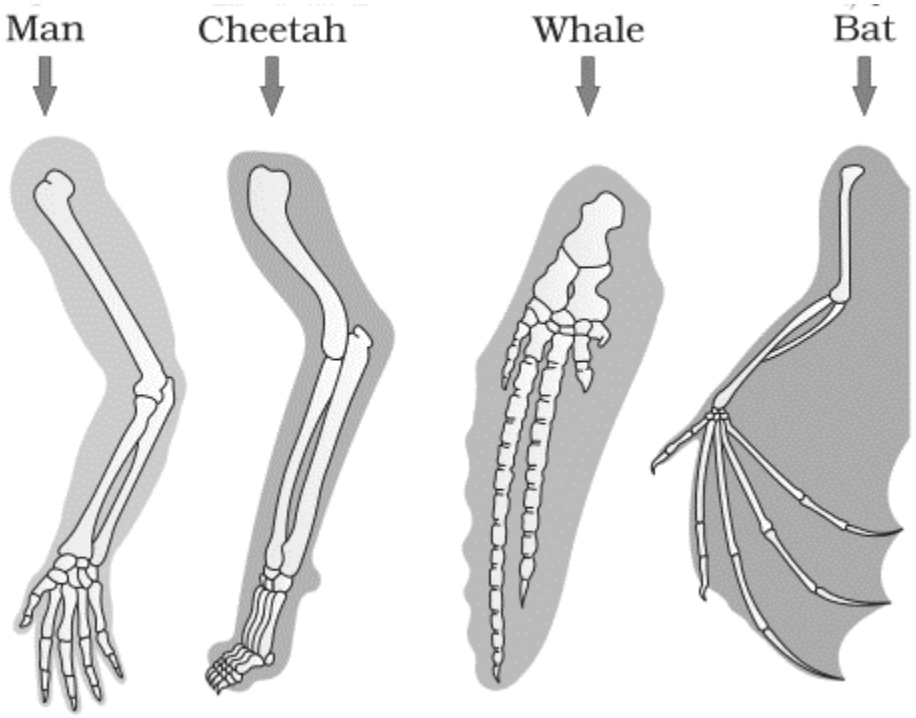
A. Chytrid fungus also affects snakes.

B. eating frogs affected by chytrid fungus is deadly to snakes.

C. fewer frogs have resulted in less food for snakes.

D. snakes are unaffected by disease in frog populations.

Question 22



Source: https://dragonflyissuesinevolution13.wikia.org

The forelimbs of the organisms shown above represent

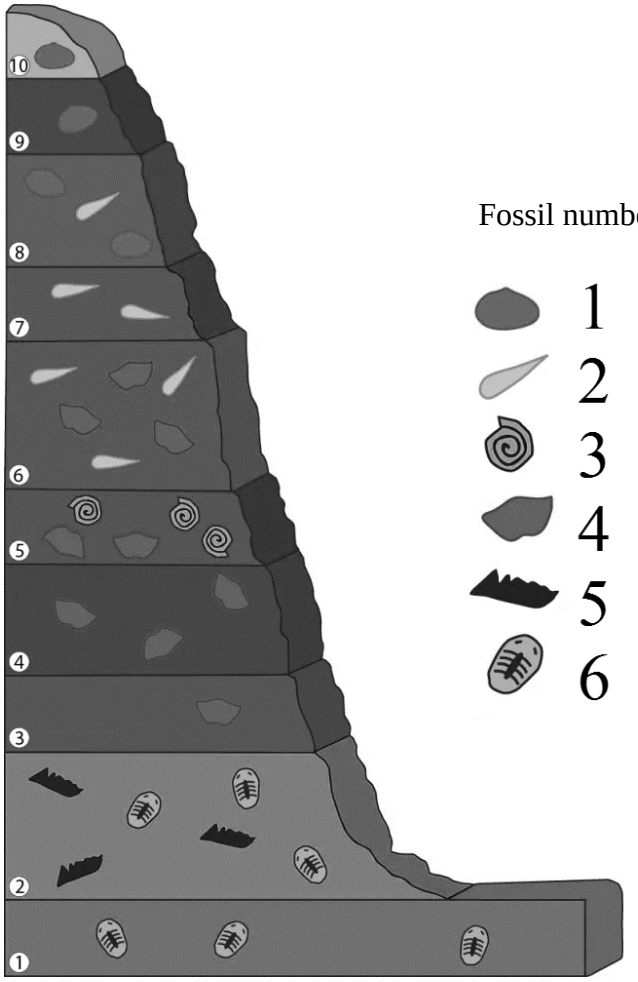
A. Analogous structures, due to a shared common ancestor.

B. Homologous structures, due to a relatively recent shared common ancestor.

C. Analogous structures, due to similar selection pressures.

D. Homologous structures, as a result of shared selection pressures.

Question 23



Source: https://timescavengers.blog

Relative dating of the specimens shown in the diagram above would suggest

A. Fossil 3 is older than Fossil 5.

B. Fossil 4 and Fossil 6 existed at the same time.

C. Fossil 6 is older than Fossil 3.

D. Fossil 4 could be used as an index fossil.

Question 24

Similarities in vertebrate embryos during early stages of embryonic development include

A. identical amino acids sequences.

B. similar forelimb anatomy.

C. presence of vestigial limbs.

D. pharyngeal arches.

Question 25

The now extinct volcano Budj Bim in Victoria's Southwest was thought to have last erupted 34,000 years ago. The volcanic rocks from these eruptions were used by the Gunditjmara people to make a complex agricultural system to construct the eel traps used in that area. These traps are believed to have been the earliest example of human aquaculture, nearly 7,000 years old. Sometime later in the 1940s a human made axe, called the 'Bushfield axe' was found buried in the volcanic ash. The axe is made of basalt, a dark coloured stone usually formed from lava flow.

Based on this information, it is reasonable to conclude that

A. the age of the Bushfield Axe was determined using carbon dating.

B. humans have been in Victoria for more than 34,000 years.

C. the Bushfield Axe must have been made from the most recent Budj Bim eruption.

D. the eel traps were made before stone axes.

The following information refers to Questions 26 and 27

Species	Sequence of Amino Acids in the Same Part of the Hemoglobin Molecules
Human	Lys–Glu–His–Iso
Horse	Arg–Lys–His–Lys
Gorilla	Lys–Glu–His–Lys
Chimpanzee	Lys–Glu–His–Iso
Zebra	Arg–Lys–His–Arg

Source: http://eewevolution.weebly.com

Question 26

The statement that most accurately describes the relatedness of species is

A. There is only one nucleotide different between human and gorilla.

B. Humans and chimpanzees are both closely related to the gorilla.

C. Humans and chimpanzees share all identical haemoglobin proteins.

D. The species in the table can all be described as primates.

Question 27

The analysis of this information is referred to as

A. Comparative anatomy.

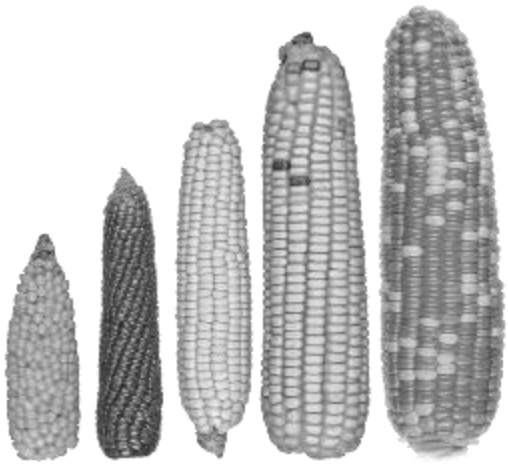
B. Molecular homology.

C. Phylogenetic tree.

D. Biomolecule morphology.

Question 28

The diagram below shows early varieties of corn and the transition to current varieties available in supermarkets.



Source: https://ediblebajaarizona.com

The variation observed in the corn varieties is due to

A. allopatric speciation.

B. different selection pressures.

C. artificial selection.

D. natural selection.

Question 29

Archaeologists have discovered pollen from the meadow flowers around 10 Neanderthal skeletons found in a cave in Iraq. The flowers included yarrow, cornflower, ragwort, grape hyacinth, and hollyhock.

The flowers around the Neanderthal fossils

A. likely poisoned the Neanderthals.

B. could be dated by carbon-14 dating,

C. can be dated using radiometric dating techniques.

D. provide evidence for biological evolution in humans.

Questions 30 and 31 relate to the following information

Source: https://commons.wikimedia.org

The fossil above shows a Seymouria, a 60cm long amphibian from the early Permian era, 260 million years ago. It was first found in Seymour, Texas, but has since been found to be widespread around the world.

Question 30

An important step that aids in fossils forming from an animal's remains is

A. lack of oxygen.

B. colder temperature.

C. bacteria quickly decomposing the flesh and skin.

D. slowly being covered by sediment.

Question 31

Conditions that would make Seymouria suitable as an index fossil include

A. living in ponds

B. being found in many locations

C. being widely found over many time periods

D. being larger than other amphibians

Question 32

Structural changes associated with modern human evolution include

A. teeth that are more similar in size.

B. burying the dead.

C. longer arms compared to the legs.

D. pronounced brow ridges.

Question 33

The following shows examples of how the understanding of human evolution of the pelvis and cranial size has changed with the discoveries of new fossils. The ilium is the 'wing' at the top of the pelvis and the ischium forms the 'ring shape' at the bottom of the pelvis.

old model		new discoveries			
Australopithecus	*Homo*	*A. sediba*	*H. erectus* Gona	*H. floresiensis*	*H. naledi*
flared ilium	nonflared ilium	nonflared ilium	flared ilium	flared ilium	flared ilium
long ischium	short ischium	short ischium	short ischium	long ischium	short ischium
small brain	large brain	small brain	large brain	small brain	small brain

Source: https://www.americanscientist.org/

From this information it would be reasonable to conclude that

A. the *Homo genus* have both flared and nonflared ilium.

B. *Australopithecus* could be identified by their large brains.

C. the *Homo genus* had both large and small ischium.

D. the birth canal space is a selection pressure for the pelvis shape.

Question 34

Aboriginal artwork in the Kimberley's has been estimated to be 12,000 years old. Scientists have determined the age of the paintings by analysing the age of wasp nests found with the paintings at 14 different sites.

Source: https://www.sciencenews.org

The method of dating used to determine the age is most likely

A. potassium-argon dating.

B. stratigraphy.

C. carbon 14 dating.

D. analysis of index fossils.

Question 35

Plasmids are best described as

A. vectors for pathogens.

B. eukaryotic chromosomes.

C. circular molecules of DNA.

D. endonucleases.

Question 36

Reverse transcriptase

A. breaks down the product of transcription.

B. is used in the formation of DNA.

C. forms mRNA from DNA.

D. works best in an extracellular environment.

Questions 37 and 38 relate to the following information

Bt cotton make up much of the cotton planted in Australia. They are genetically modified and contain a gene from a bacterium *Bacillus thuringiensis*, which allows them to produce a protein that is toxic to insects.

Question 37

A question that could be raised regarding the biological implication of using GM corn is:

A. What are the effects on native insect species?

B. What are the effects on cotton production to society?

C. Are there additional costs to the farmers who use this type of cotton?

D. Could the money be better spent elsewhere?

Question 38

A social implication of Bt corn could be

A. a politician, who gives their opinion of genetic modification.

B. the extent of testing for the safe use of crop products for human consumption.

C. the ability of all farmers to afford the seeds for the crops.

D. the potential risk to the ecology of the environment.

Question 39

Animal biotechnology uses genetic manipulation techniques to modify the genome of various livestock, including cattle and sheep, to improve various aspects of farming these organisms. The improvements can include improved reproductive performance, growth rate and milk production as well as resistance to disease.

One particular example is the modification of pigs to incorporate elevated levels of omega-3 fatty acids in pork products, by adding in an omega-3 fatty acid gene from fish.

These pigs could be described as

A. transgenic but not genetically modified.

B. both transgenic and genetically modified.

C. genetically modified but not transgenic.

D. a product of artificial selection.

Question 40

By mid-2020, COVID-19 had spread to several countries around the world, with governments enforcing restrictions and community lockdowns to limit the spread and devastating consequences of the disease. The COVID-19 spread can be described as a

A. Pandemic.

B. Epidemic.

C. Isodemic.

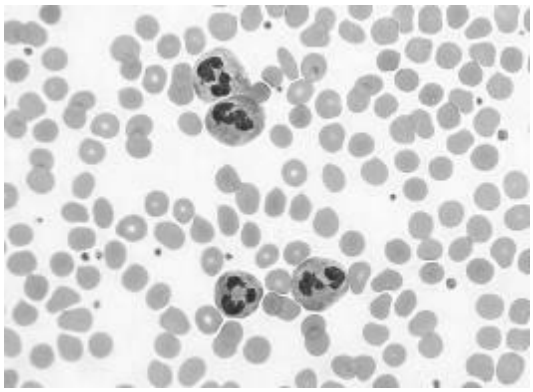
D. Virulent disease.

SECTION B – Short Answer Questions

Instructions for Section B
Answer this section in **pen.**
Answer **all** questions in the spaces provided.

Question 1 (7 marks)

Phagocytes are white blood cells that have an important role in removing foreign material.



Source: https://teachmephysiology.com

a. Describe the process that phagocytes use to engulf foreign material. 2 marks

_____

_____

b. Phagocytes are able to produce a particular enzyme essential to their primary action. Name this enzyme and explain its role. 2 marks

_____

_____

c. Outline the chemical reaction that occurs to produce the molecule named in (b). 3 marks

_____

_____

_____

Question 2 (5 marks)

Australian scientists are working to increase the rate of photosynthesis as a way of increasing the overall yield and safeguarding against food shortages due to climate change. Wheat covers more land than any other crop and makes up 20% of the world's kilojoules, making it a vital food source. Rubisco, an enzyme in photosynthesis, is being investigated in various wheat varieties as it has an important role in attaching a carbon dioxide into the growing sugar molecule.

Rubisco, however, is very inefficient and slow. 20 to 40 percent of the time it picks up oxygen molecules, rather than carbon dioxide molecules, adding them into the reaction and resulting in a non-functioning molecule.

Wheat varieties growing in laboratory conditions at Australian National University in Canberra.

Source: https://www.nytimes.com/

a. Name the stage of photosynthesis where Rubisco is involved. 1 mark

_____

b. Describe why Rubisco might be very inefficient at the molecular level. 2 marks

_____

_____

_____

c. Describe how water could be better conserved by improving the efficiency of the Rubisco enzyme. 2 marks

_____

_____

_____

Question 3 (9 marks)

Pheromones produced by the Australian native honeybees (*Austroplebeia cincta)* have a role in stimulating and suppressing reproduction. A single genetic region is responsible for the *'gemini'* transcription factor that controls gene expression. This results in the production of 'mandibular gland pheromones' in the honeybees, which function as alarm pheromones.

The gene for the '*gemini´* transcription factor can also result in the production of a pheromone with a different function, which is to regulate (suppress) ovary activation in worker honeybees.

a. What is meant by the term pheromone? 1 mark

Consider the image of the protein structure - the gemini transcription factor.

Source: https://en.wikipedia.org/

b. Circle one secondary structure on the diagram and name the secondary structure. 1 mark

c. Explain the importance of this to the function of the protein. 2 marks

d. Outline the process of translation for the *'gemini'* transcription factor. 3 marks

e. Describe an event that could occur to account for the synthesis of different proteins from a single gene, such as the different pheromones in honeybees. 2 marks

Australian native honeybees

source: https://www.wheenbeefoundation.org.au/

Question 4 (8 marks)

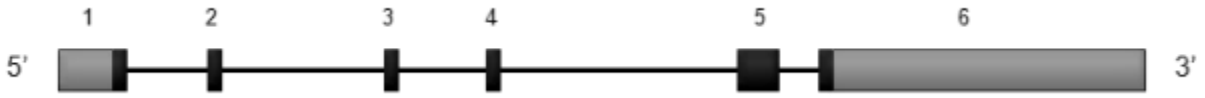
African killifish (*Nothobranchius furzeri*) embryos can delay their own development for up to two years, which is significantly longer than the average lifespan of an adult killifish. The embryos are in diapause, and do not 'age' during this stage of suspended development. This is inspiring scientists to explore this activity to seek ways to treat human age related disorders.

Despite having a functioning heart, muscle and brain tissue prior to diapause, the embryos are able to 'switch off' the genes that control further growth and cell division. Regulatory genes, such as the chromobox 7 gene (CBX7), are more likely to be 'switched on' at diapause.

Killifish embryo

Source: https://www.sciencenews.org/

Cbx7 Gene



Source: http://atlasgeneticsoncology.org/Genes/GC_CBX7.html

a. Explain the role of structural and regulatory genes in the embryonic development of the African Turquoise Killifish. 2 marks

When the CBX7 gene expression is changed as a result of mutation, it has been linked to a role in causing cancer.

b. Explain how such changes in CBX7 expression could result in causing cancer. 2 marks

c. Describe how the CBX7 gene mRNA transcript that is 3964 base pairs long and arranged into 6 exons, produces a protein that is 251 amino acids long. 2 marks

d. A model of gene regulation in prokaryotic cells is the lac operon. Explain how the presence of lactose affects gene expression. 2 marks

Question 5 (6 marks)

Supercentenarians, that is people who are aged 110 or older, are extremely rare in the population. To put it into perspective, Australia has about 25 million people, and there are 3 supercentenarians. Studies have found that these people are relatively immune to illness such as infections and cancers throughout their lifetimes. In a study of the supercentenarians, the following results were obtained.

Age Group	Total number of cells used	B cells	T cells	
			Total	Cytotoxic T
Supercentenarians	5,887	2%	40%	32%
Younger Controls	3,999	11%	40%	4%

a. Compare the different cells associated with cell-mediated immunity for the different age groups. 1 mark

_____

_____

b. Explain at the cellular level how Cytotoxic T Cells would work to lead to an increased lifespan. 3 marks

_____

_____

_____

_____

_____

c. What doubts might be cast over the validity of this study? 2 marks

_____

_____

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_____

Question 6 (7 marks)

A new marsupial lion Lekaneleo (*Lekaneleo roskellyae)* has been discovered in Queensland in the Riversleigh world heritage area. It was previously believed to be a part of a different genus *Priscileo* due to the similar teeth arrangements.

Species Name	Size	Teeth arrangement	Bony head crest
Lekaneleo	Small cat	Three premolars and four molars	Absent
Priscileo	Small cat	Three premolars and three molars	Present
Wakeleo	Large Dog	Three premolars and One molar	Present
Thylacoleo	Panther	Three premolars and One molar	Present

a. Describe what structural morphological evidence would be used for this original classification. 2 marks

_____

_____

_____

_____

Source: abc.net.au

Lekaneleo, along with all of the other marsupial lions, have a very large and long premolar tooth. It is unique among carnivorous mammals in that such teeth could cut straight through bones. It is thought that Lekaneleo had a diet consistent of small birds, reptiles, and other rat like marsupials. The larger marsupial lion relatives were able to take down bigger game, such as the 1.8 metre tall diprotodon or giant wombat.

b. Explain how the oversized pre-molar came to be inherited by all the marsupial lions, even though their diets were quite different. 3 marks

_____

_____

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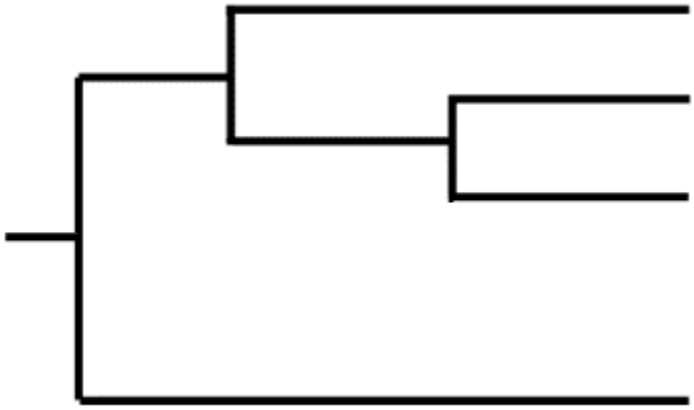
_____

_____

_____

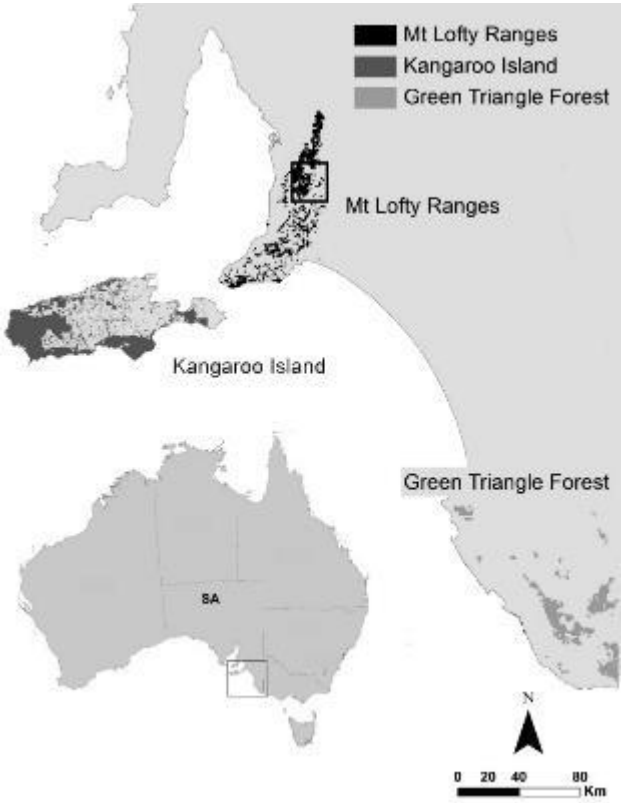
c. Complete the phylogenetic tree to show the relationship between Lekaneleo, Wakale, Priscileo and Thylacoleo. 2 marks

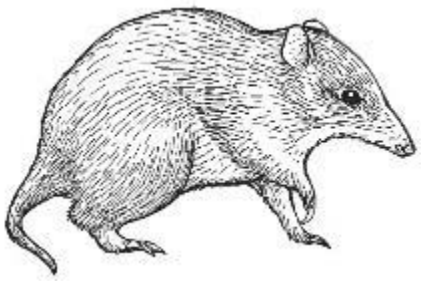


Question 7 (9 marks)

The Southern Brown Bandicoot (I*sodon obesulus*) is an endangered marsupial that inhabits three small regions in South Australia. These bandicoots have been analysed to look for common genetic markers in their alleles between different populations.

Mt Lofty Ranges	Green Triangle Forest	Kangaroo Island
This population lives near an urban environment within 14 kms of Adelaide to the North. There are small isolated pockets surrounded by farm land and housing.	Live to the South in the Mount Burr mountain ranges.	Live mainly in the bushland areas on the Western side of the island.





Source: https://vnpa.org.au/

a. Explain what relationships scientists might expect to find when comparing alleles of the three different populations. 2 marks

b. What is meant by the term 'gene flow'? Explain if you would expect it to occur between each bandicoot population. 3 marks

c. Using your knowledge of evolution, explain how the recent Kangaroo Island bushfires might put the Kangaroo Island population of bandicoots at risk of extinction. 2 marks

d. Compare the selection pressures of the Mt Lofty and Green Triangle bandicoot populations. 2 marks

Question 8 (10 marks)

Haemophilia is a genetic disorder that occurs due to a mutation in the factor IX gene, which produces a protein involved in coagulation of blood. In 2017, the Haemophilia Foundation Australia announced that some experimental gene therapy programs had given successful results and hope for a cure.

a. Explain how gene therapy could be used to treat an individual with haemophilia. 2 marks

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b. Haemophilia can be caused by a nonsense mutation in the gene on the X chromosome. Explain the effect of a nonsense mutation on the gene sequence. 1 mark

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c. If the normal gene and mutated haemophilia gene were isolated then run through an electrophoresis gel, explain the differences that would be observed in the results. 1 mark

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d. Define vector in this context. 1 mark

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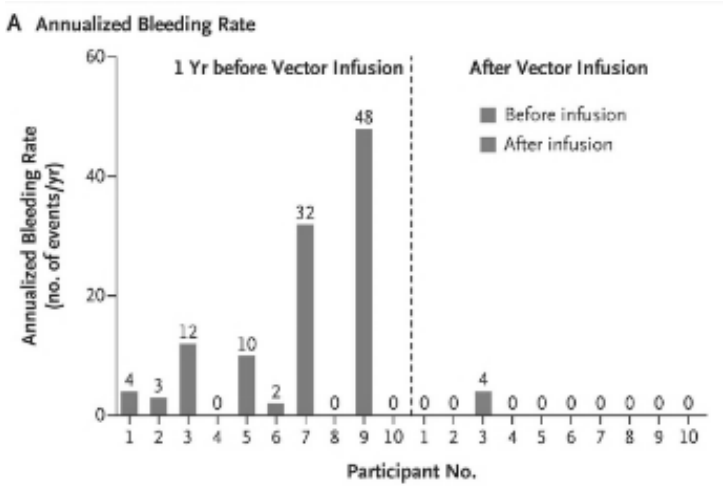
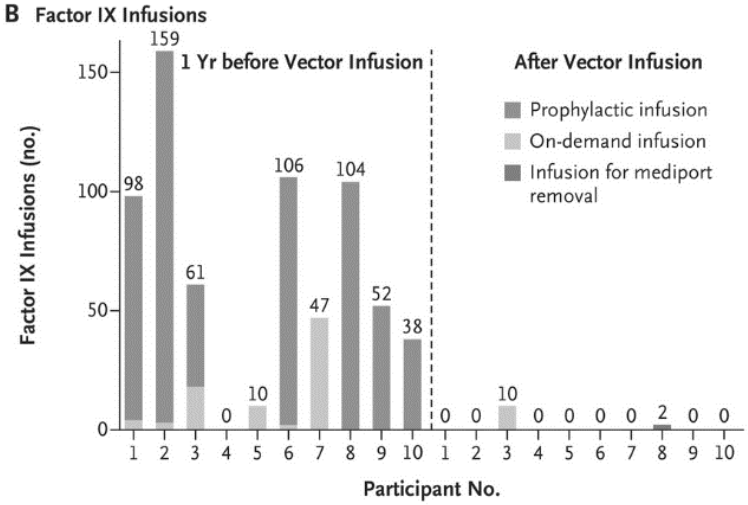
Graph A Shows the rate of 'bleeding events' in 10 participants one year prior to gene therapy compared to post treatment.



Source: https://www.nejm.org

Graph B shows the number of factor IX infusion treatments that patients required compared to post treatment.



Source: https://www.nejm.org

e. Outline the trends that can be observed in the two graphs. 2 marks

f. Explain the role of the following elements with regards to gene therapy as treatment for haemophiliacs. 3 marks

Restriction enzymes	
DNA ligase	
Polymerase chain reaction	

Question 9 (10 marks)

Tool use in early hominins is a controversial topic and scientists are questioning the evolution of tool making and use in early hominins. *Paranthropus boisei* lived in Africa between 2.3 and 1.2 million years ago, which was significantly earlier than *Homo erectus*, who appeared about 2.8 million years ago. Palaeontologists have analysed the first hand, arm and shoulder fossil that was recently excavated in Africa from *P boisei*. Although this species had powerful arms suited for climbing trees, it lacked a thick, gripping thumb which has been observed in fossils of other tool using hominins. Despite the lack of a powerful thumb, the hand bones suggest that *P boisei* was able to grasp well enough to be able to make and use simple tools.

These findings suggest that *P boisei* fashioned and used tools, and that it was not the only species from the *Homo* genus – direct ancestors of homo sapiens – that were able to make and use tools. *H erectus* had a brain capacity approximately twice the size of *P boisei*, leading scientists to question the capacity of *P boisei* to possess the ability to plan and create tools such as double edged axes, compared to *H erectus.* Scientists need to find evidence of tools that are directly associated with *P boisei* for evidence to further doubt the superior tool making ability of *H erectus*.

Fossil analysis of the skull of 'Nutcracker Man,' the best known *P boisei* fossil, suggests that they may have consumed a diet consisting of grasses and flowering plants. Fossils of a finger bone from an earlier *Paranthropus* species have also been thought to support tool making, with the recent fossil discovery offering scientists a look at the most complete set of forelimb bones.

At fossils sites, such as those in Ethiopia, where *H erectus* have been found, there have also been a range of stone artefacts, suggesting frequent use and a greater reliance on tools, compared to *P boisei*. These artefacts include tools with a single or double sharpened edge, and other tools such as pear shaped hand axes. *H erectus* incorporated meat into their diets.

Elbow

Protruding elbow joint

Thumb

Relatively long

Ulna

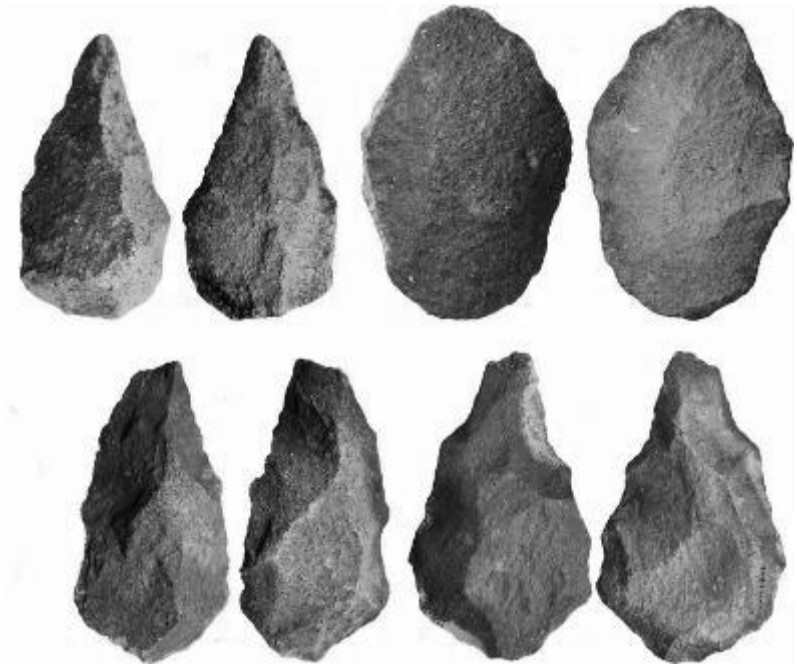
Australopithecus-like curvature

Hand

Short and curved fingers

***P Boisei* arm fossils**

Source: https://ars.els-cdn.com/



H. erectus Tool Artefacts

Source: https://www.smithsonianmag.com/

a. Considering the text and images, evaluate the evidence.

i. Identify two pieces of evidence for tool making/using in *Homo erectus* and justify how the evidence supports the suggestion.

4 marks

Evidence	Justification

ii. Identify two pieces of evidence for tool making/using in *Paranthropus boisei* and justify how the evidence supports the suggestion.

4 marks

Evidence	Justification

b. What future paleontological discoveries would support the hypothesis that *P boisei* were frequent and skilled tool users? 2 marks

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Question 10 (9 marks)

Chlorella is a single celled organism that is part of the green algae classification. They can be grown in alginate balls, which is a type of jelly that allows them to be easily moved. The alginate does not inhibit their growth and they are still able to photosynthesise. The chlorella contained within the alginate balls are added to a test tube with a pH indicating solution. The pH solution will change colour depending on the amount of carbon dioxide that is present. The colour changes occur due to changes in CO_2 levels in the indicator solution. As carbon dioxide is removed from the solution it becomes more basic and changes from magenta to purple. As the solution gains more carbon dioxide it becomes more acidic and turns yellow.

pH	Colour of solution	Carbon Dioxide Levels
7.6	Yellow	High
8.2	Orange	Medium
8.8	Pink	Low
9.0	Magenta	Very Low
9.2	Violet	None

Three groups of students each added 20 alginate balls to a test tube and placed them at different distances from the light source. Each test tube contained the indicator solution and a carbon source that was added to the solution.

Group 1		
Distance from light source (cm)	Colour at start of experiment	Colour at end of experiment
0	Yellow	Magenta
50	Yellow	Pink
100	Yellow	Orange

Group 2		
Distance from light source (cm)	Colour at start of experiment	Colour at end of experiment
0	Yellow	Violet
50	Yellow	Pink
100	Yellow	Yellow

Group 3		
Distance from light source (cm)	Colour at start of experiment	Colour at end of experiment
0	Yellow	Purple
50	Yellow	Pink
100	Yellow	Orange

a. Each group had exactly the same result at 0 cm. Describe the type of data being collected and what might account for each group having recorded a slightly different colour. 2 marks

b. The expected results were confirmed later by the students after researching the practical from others using professional lab equipment. The experiment should give pH values of (100cm = 9.1, 50cm = 8.8, 0cm = 7.8). Give a definition of accuracy and describe which distance had the most precise results. 3 marks

c. Give a hypothesis for this experiment. 1 mark

d. Describe what would be needed to create a 'control' test tube. 1 mark

e. Describe how the respiration rate of the chlorella could affect the results of the experiment. 2 marks

END OF QUESTION AND ANSWER BOOK

MULTIPLE CHOICE ANSWER SHEET Name:……

Instructions: Shade the letter corresponding to the correct response for each question

Question 1	A	B	C	D
Question 2	A	B	C	D
Question 3	A	B	C	D
Question 4	A	B	C	D
Question 5	A	B	C	D
Question 6	A	B	C	D
Question 7	A	B	C	D
Question 8	A	B	C	D
Question 9	A	B	C	D
Question 10	A	B	C	D
Question 11	A	B	C	D
Question 12	A	B	C	D
Question 13	A	B	C	D
Question 14	A	B	C	D
Question 15	A	B	C	D
Question 16	A	B	C	D
Question 17	A	B	C	D
Question 18	A	B	C	D
Question 19	A	B	C	D
Question 20	A	B	C	D
Question 21	A	B	C	D

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