

NAME: _____

PRACTICE EXAMINATION

VCE® BIOLOGY

QUESTION AND ANSWER BOOKLET

Reading time: 15 minutes

Writing time: 2 hours 30 minutes

Structure of book

<i>Section</i>	<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>
A	40	40	40
B	11	11	70
			Total 110

- 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 31 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 mobile phones and/or any other unauthorised electronic devices into the examination room.

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

Chia seeds are gluten free, high in dietary fibre and a good source of Omega 3, an essential fatty acid. Additionally they contain all 8 essential amino acids, that is, the amino acids the human body is unable to synthesise on its own.

Lipids and proteins are important in the human diet as they are used to produce polymers such as

- A. glycogen and protein based hormones
- B. phospholipids and steroid hormones
- C. cellulose and enzymes
- D. polypeptides and polysaccharides.

Question 2

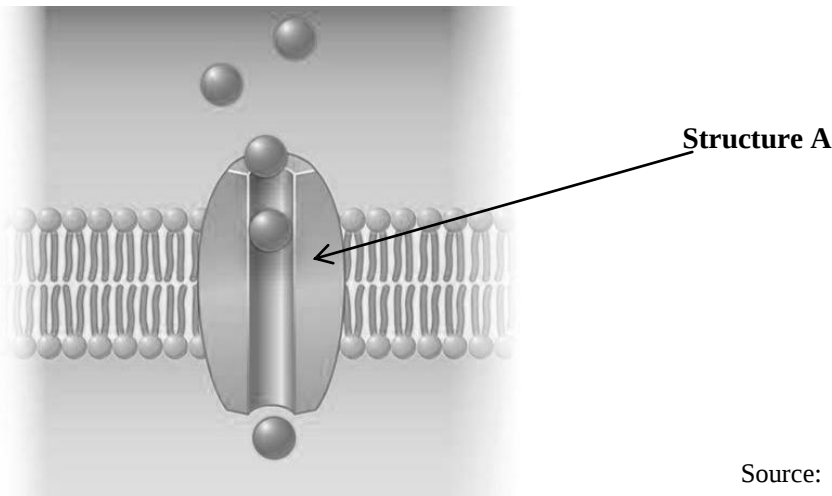
Chitin forms the structural exoskeleton of insects. It also forms the hard beaks of cephalopods such as the squid. It is a modified polysaccharide, with the addition of nitrogen. Although chitin is a polysaccharide, it could be compared with some proteins as it performs a similar function.

The protein that performs a similar function to chitin is

- A. immunoglobulins
- B. haemoglobin
- C. ATP synthase
- D. collagen.

Question 3

Examine the following diagram.



Source: <http://legacy.hopkinsville.kctcs.edu>

Without structure A, which of the following could **not** occur?

- A. Endocytosis
- B. Exocytosis
- C. Osmosis
- D. Facilitated diffusion

Question 4

Mis-folded proteins have been linked to a number of neurological, endocrine and age-related illnesses. Recent research is investigating the role of these proteins in developing heart disease. An accumulation of these mis-folded proteins causes cell stress and induces a death pathway within the cell. This process could also be known as

- A. Endoplasmic Reticulum Stress Syndrome
- B. Catabolism
- C. Apoptosis
- D. The proteome.

Question 5

Chloroplasts

- A. contain cellulose
- B. are found in all plant cells
- C. are found in photosynthetic bacteria
- D. contain internal membranes.

Question 6

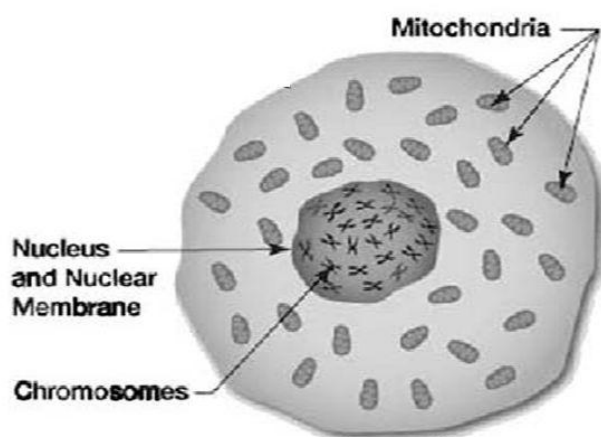
In the Krebs cycle, the electrons generated are transferred to Molecule X and then moved to Process Y.

- A. Molecule X is NADP and process Y is glycolysis.
- B. Molecule X is NAD⁺ and process Y is glycolysis.
- C. Molecule X is NADP and process Y is electron transport.
- D. Molecule X is NAD⁺ and process Y is electron transport.

Question 7

The number of ATP produced per glucose molecule in aerobic respiration include

- A. 2 ATP produced during fermentation
- B. 32 ATP produced during electron transport chain
- C. 32 ATP produced during Krebs cycle
- D. 36 ATP produced during glycolysis.

Question 8

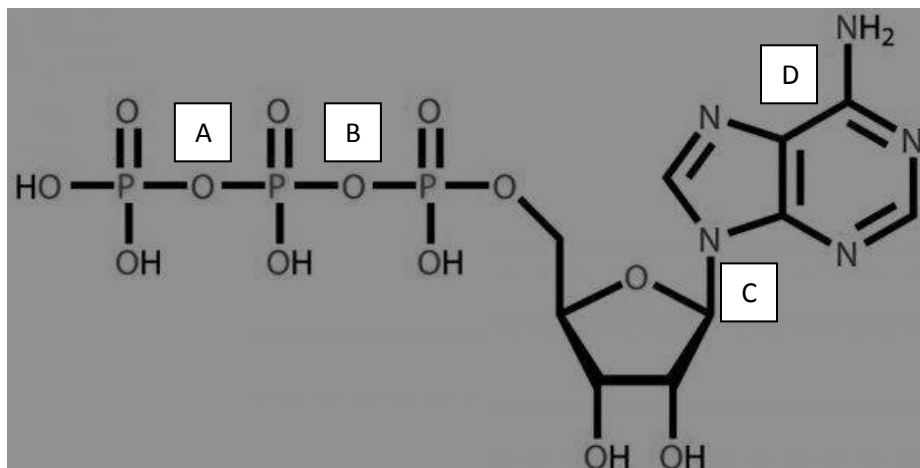
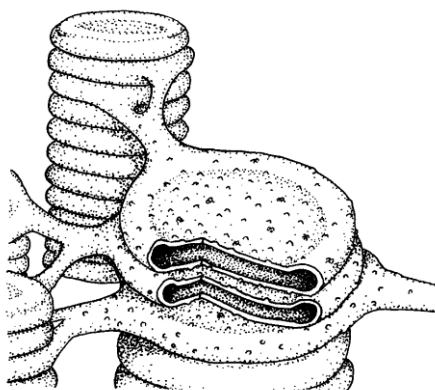
Source: <http://identifinders.files.wordpress.com>

From observing this cell and its internal structure it can be correctly stated that the cell

- A. must be undergoing mitosis
- B. could produce large amounts of carbon dioxide
- C. is able to produce large amounts of glucose
- D. is undergoing apoptosis.

Question 9

The molecule ATP is shown below. The bond that is broken to release energy for use by a cell occurs at the region closest to

**Question 10**

Source: biodidac.bio.uottawa.ca

The chloroplast is able to produce glucose from inorganic molecules. The diagram above depicts a close up sketch from inside a chloroplast. The inputs for this region would include

- A. water
- B. oxygen
- C. glucose
- D. carbon dioxide.

Question 11

A comparison of photosynthesis and aerobic respiration is made in the table below. The correct comparison between photosynthesis and aerobic respiration is

	Photosynthesis	Aerobic Respiration
A	Outputs include carbon dioxide	Inputs include carbon dioxide
B	Water is used as an input	Water is produced as a product
C	Is a catabolic reaction	In an anabolic reaction
D	Occurs in the mitochondria	Occurs in the chloroplast

Question 12

Cells that are able to recognise foreign antigens include

- A. T-helper cells
- B. complement protein
- C. erythrocytes
- D. cytokines.

Question 13

The avian bird flu is caused by a virus H5N1. It is thought to have spread to human populations from domesticated farm birds like chickens. One way which was thought to combat the disease was to infect horses with the disease. Once infected, extract blood from the horse would separate out the antibodies that it had produced to create an antibody serum. These could be injected into human patients to help them recover from the potentially fatal strain of influenza. This type of immunity is referred to as

- A. passive and natural
- B. passive and acquired
- C. active and natural
- D. active and acquired.

Question 14

An enzyme *Cbl-b* has a role in aiding immune function by removing a specific protein *Stat-6* which has a vital role in controlling the symptoms of allergic asthma. If *Stat-6* is present in the cell in high levels it can stimulate excessive inflammation in the lungs. This is supported by research in mice. Allergic asthma is the most common form of asthma, triggered by the inhalation of allergens.

From this research in mice it might indicate in humans that

- A. stat-6 is an allergen responsible for causing asthma
- B. a person with asthma may have a faulty gene that codes for Stat-6
- C. a person with asthma could be cured by giving them Stat-6
- D. a person with asthma may have a faulty gene coding for Cbl-b.

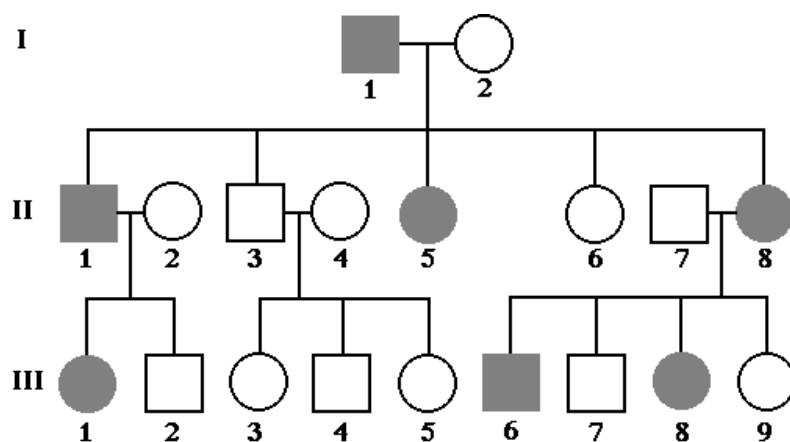
Question 15

The following cell type that is not part of the adaptive immune response is a

- A. memory- B cell
- B. plasma-B cell
- C. macrophage
- D. T-helper cells.

Question 16

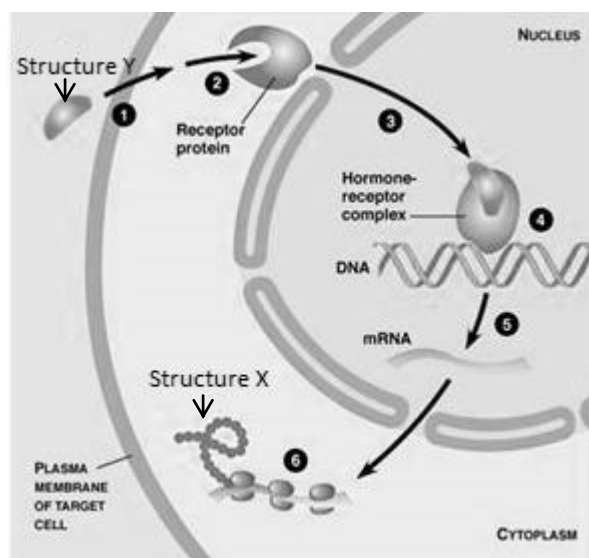
The following pedigree shows a family with hypercholesterolemia. People marrying into the family had no family history of the disease.



Source: <http://www.uic.edu/>

The mode of inheritance for hypercholesterolemia is likely to be

- A. autosomal dominant
- B. autosomal recessive
- C. X-linked dominant
- D. X-Linked recessive.

Question 17

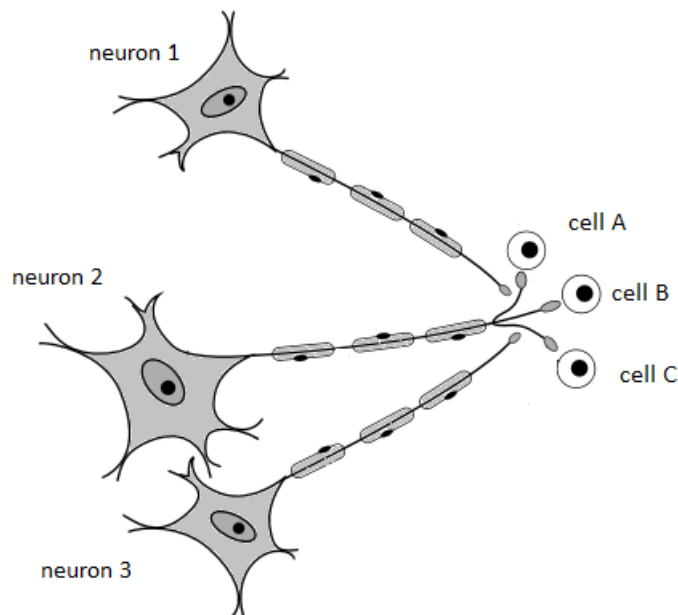
Source: <http://healyourselfathome.com>

Regarding structures X and Y it could be stated that

	Structure X	Structure Y
A	is a protein	is made of carbohydrate only
B	contains uracil	is made of amino acids
C	contains amino acid monomers	is non polar
D	is a neurotransmitter	is polar

Structure 18

The following diagram shows 3 neurons.



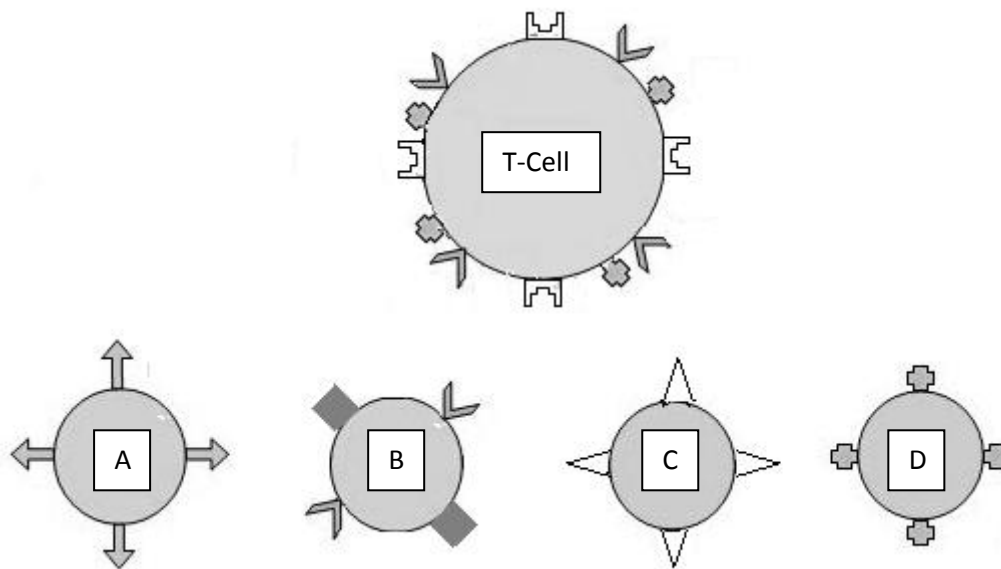
Neurons 1 and 2 are excitatory. Neuron 3 is inhibitory. If all neurons depolarised simultaneously and an action potential propagated along the axon of each, which cells would **not** receive the message?

- A. Cell A and B only
- B. Cell C only
- C. Cell B only
- D. All Cells.

Question 19

As part of the second line of defence in the human immune system, protection from invading pathogens includes

- A. intact skin
- B. clonal expansion of B-cells
- C. use of lysosomes on engulfed pathogens by phagocytes
- D. mucous membranes.

Question 20

Which cell could be correctly identified by the T-Cell as being self?

Question 21

In female silk moths a substance called bombykol was extracted from their scent glands. This substance is a powerful attractant of male silk moths. Bombykol could be called

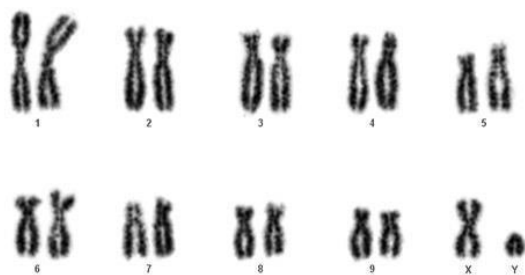
- A. a signalling molecule
- B. a steroid hormone
- C. an enzyme
- D. a neurohormone.

Question 22

Binary fission is similar to mitosis as both have

- A. chromosomes line up at the equator
- B. linear chromosomes
- C. spindle fibres that attach to a centriole
- D. two identical daughter cells produced.

Questions 23 and 24 refer to the following diagram of an Australian ring tailed possum.



Source: <http://blog.sandiegozooglobal.org>

Question 23

The number of chromatids present in the karyotype is

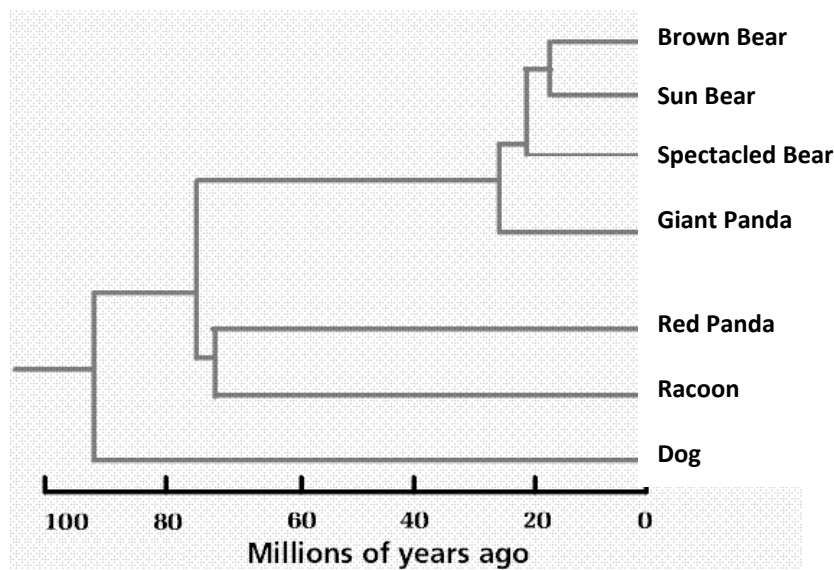
- A. 10
- B. 20
- C. 30
- D. 40

Question 24

From the karyotype it could be reasonably concluded that

- A. possums are marsupials
- B. possums have 18 autosomes
- C. the possum is a female
- D. no crossing over occurred between the sex determining chromosomes.

Question 25



From this information it is reasonable to conclude that

- A. red Pandas and Giant Pandas do not share a common ancestor
- B. red Pandas and Racoons are more closely related than brown bears and giant pandas
- C. the most recent group to evolve separately is the spectacled bear
- D. dogs are the oldest group in this evolutionary tree.

Question 26

The HBB gene controls the inherited disease known as sickle cell anaemia. One particular version of the gene causes abnormal haemoglobin to be produced. This abnormal haemoglobin causes the red blood cells to die prematurely. The genetics are summarised in the table below.

Number of abnormal alleles	Type of red blood cells produced
Two copies of abnormal allele	All sickle cell
One abnormal allele	Some normal and some sickle cell
No abnormal alleles	All normal

A child known to be a carrier of sickle cell anaemia

- A. must have both parents who are carriers
- B. must have both parents who have sickle cell anaemia blood
- C. could have two parents with normal blood
- D. could have one parent with normal blood.

Question 27

The mutation that initially caused sickle cell anaemia in the first person to have it, must have occurred in the

- A. bone marrow
- B. gonads
- C. stem cells
- D. thymus.

Question 28

Siamese cats are produced by an interaction of their genes and the environment. The Siamese cat pictured in this photo is called 'Eve'.



Source: <http://whyevolutionistrue.wordpress.com>

The Himalayan gene expression depends on the temperature of the skin in the cat while the fur is growing. This causes the fur that is exposed to cold regions like the ears, feet and nose to be darker in colour. Siamese cats are born all white. The letter 'E' could have been given to Eve by

- A. shaving a letter E into the cat then keeping it in a cold environment
- B. making a warm letter E that is strapped to the kitten for a period of time
- C. making a cold letter E that is strapped to a fully grown cat for a period of time
- D. denaturing the enzymes that cause the pigment expression.

Question 29

Gregor Mendel began experiments with peas to explore the workings of genetics. Two genes he investigated were for yellow and green peas, and wrinkled and smooth peas. Both of the genes for seed shape and seed colour are known not to be linked.

Trait	Dominant form	Recessive form
Seed shape	smooth 	wrinkled 
Seed color	yellow 	green 

If two peas plants were crossed, both heterozygous for seed shape and colour, you would expect that the offspring of seeds could include

- A. 4 different phenotypes
- B. more green seeds than yellow seeds
- C. no smooth and yellow peas
- D. 25% green and wrinkled peas.

Question 30

DNA profiling is a process involving the

- A. analysis of short repeating sequences of DNA
- B. organised arrangement of chromosomes based on size
- C. analysis of cells dividing during meiosis
- D. use of polymerase chain reactions to extract the DNA from the cell.

Question 31

A bacteria, *Escherichia.coli* (E.coli) is commonly found in the human gut. If a sample of human tissue of the intestines is taken that contains E.coli they could be distinguished from humans as their DNA would

- A. be single stranded
- B. be composed of double stranded DNA
- C. form structures of linear chromosomes
- D. form circular chromosomes.

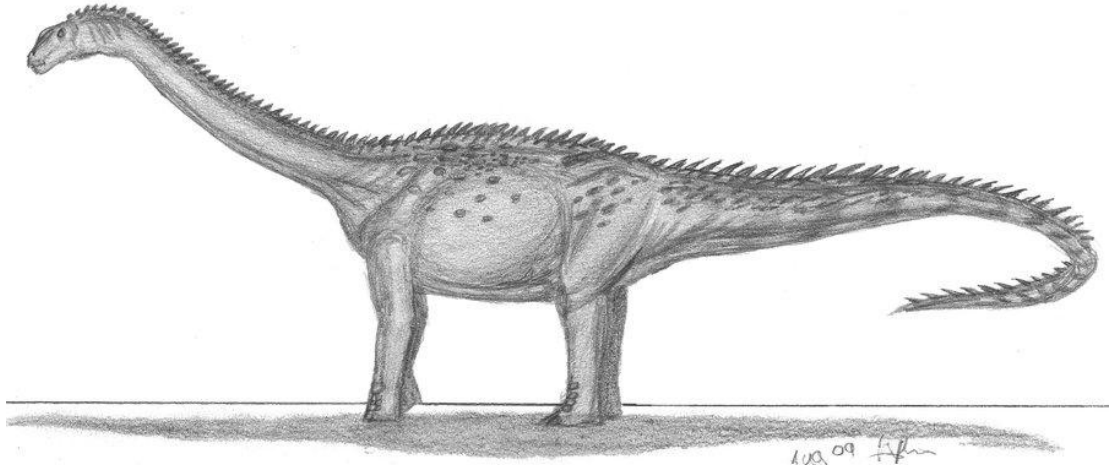
Question 32

The colour of corn kernels is under the control of a single gene. Purple is dominant to yellow. From this information which of the following statements is **not** correct?

- A. Yellow coloured corn must be homozygous.
- B. A heterozygous corn will have purple kernels.
- C. All homozygous corn will be yellow.
- D. If two yellow corn plants are crossbred, all offspring will be yellow.

Questions 33 – 35 relate to the following information.

Large dinosaur bones have been uncovered by palaeontologists near Winton in Queensland. The Wintonotitan, pictured below, stands at 4 metres tall. It is one of 3 dinosaurs recently found at this dig site along with many other more common species. One hundred million years ago when this creature is thought to have lived, the area was a large river plain. Its diet was thought to consist of plants including conifers and ferns.



Source: Googlestockphotos

Question 33

A factor that would favour fossilisation of Wintonotitan is

- A. the salt water of the swamp in which it lived
- B. its diet of plants including cones
- C. the large hard bones
- D. its size which meant that it was too large to be eaten by predators.

Question 34

The methods scientists would have used to estimate the age of the fossil is

- A. molecular clock
- B. carbon-14 Dating
- C. index fossils
- D. DNA-DNA hybridisation.

Question 35

Wintonotitan likely became extinct due to

- A. the environment changing rapidly due to climate change therefore changing selection pressures
- B. mutations in gametes, that increased genetic diversity
- C. walking on four legs that was an unsuitable way of life
- D. hatching large numbers of offspring from eggs.

Question 36

The process of Meiosis that produces a human ova cell

- A. results in 4 identical gametes for each cell that undergoes meiosis
- B. involves spindle fibres made of protein attached to centrioles
- C. produces 2 identical daughter cells
- D. undergoes crossing over between non-homologues.

Question 37

An example of human intervention in the evolutionary process could be

- A. feral pigs in the outback mating randomly
- B. a species that becomes separated by a physical barrier
- C. creating genetically modified crops of canola
- D. a family that have an arranged marriage for their children.

Question 38

Recent studies have compared the amount of pigment in the skin of modern Europeans with the genomes found in ancestral Europeans. What the scientists have found is that the ancestral people would have had more pigment in their skin, and modern Europeans have less.

A possible explanation for this might include

- A. modern Europeans had a selective advantage by having lighter coloured skin
- B. interbreeding occurred between ancestral Europeans and Neanderthals
- C. ancestral Europeans existed during much colder conditions
- D. frequent immigration and emigration in ancestral populations.

Question 39

Which of the following observations is not an example of cultural evolution in humans?

- A. Primitive cave paintings.
- B. Stone axes found around a campsite.
- C. Evidence of burying the dead.
- D. Tattoos found on mummified remains.

Question 40

Which statement correctly classifies a species as a primate, hominoid or hominin?

- A. Apes are primates but not hominoids.
- B. Australralopithines are not hominoids, but are hominins.
- C. Chimpanzee's are hominoids but not hominins.
- D. Humans and orangutans are hominins.

SECTION B – Short Answer Questions**Instructions for Section B**

Answer this section in **pen**.

Answer **all** questions in the spaces provided.

Question 1 (12 marks)

In 2013-4, the Essendon Football Club was embroiled in a drug investigation saga. The drug central to the controversy was (anti-obesity drug) AOD-9604, a drug which the captain Jobe Watson says he believed he had taken. Although AOD-9604 is not directly classified as a banned substance, it falls under the section of the World Anti Doping Authority (WADA) code which classes drugs which are not yet commercially available. AOD-9604 can be taken as an injection or used as a transdermal cream. The WADA code does not discriminate on the mode of entry for this particular substance.

- a.** Explain why the penalties for drug use would be the same regardless of whether it is taken as a cream or injected. 1 mark

AOD-9604 is 16 amino acids long, and is identical to a small portion of the Human Growth hormone. It is thought to convey the fat reducing properties of the larger polymer. The amino acid sequence is listed below

Tyr-Leu-Arg-Ile-Val-Gln-Cys-Arg-Ser-Val-Glu-Gly-Ser-Cys-Gly-Phe

- b.** How many base pairs of DNA would be needed to synthesise this sequence? (The region of the gene that produces it contains no non-coding regions). 1 mark

- c. Obesity management experts suggest that AOD-9604 may have no beneficial qualities in reducing fat or building muscle mass.
Design an experiment to test the effects of AOD-9604 and its use in weight loss. Include a hypothesis in your design.

Hypothesis

1 mark

3 marks

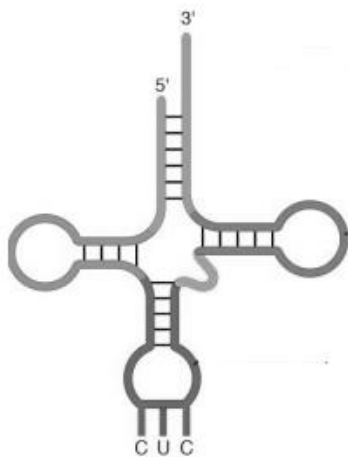
- d. Would you expect AOD-9604 and Human Growth Hormone to have the same effect in the body?
Explain your answer.

2 marks

- e. Describe how Human Growth Hormone could bring about a response within a cell, as it attaches to the receptor. Include where the receptor is located as part of your answer.

2 marks

f. Describe the difference between the secondary and tertiary structure of a protein. 2 marks

Question 2 (4 marks)

Source:
http://biology.about.com/od/molecularbiology/ss/rna_2.htm

a. Where in the cell would the molecule be found?

1 mark

b. Explain the specific role of the molecule above in the synthesis of a protein.

3 marks

Question 3 (3 marks)

Many elite sporting bodies are using altitude training to improve the performance of their athletes. Training in an environment where the oxygen is less, forces additional changes on the body to adapt. A douglas bag can be used to collect the expired gas as a result of breathing. The subject breathes through a valve, taking in ambient air, and collecting all of the expired air in the bag. The expired gas may then be sampled and the relative concentrations of O₂ and CO₂ can be measured. Comparisons can be made between the carbon dioxide concentrations between the inspired and expired air.

Source: <http://www.sportsci.org/jour/9903/dje.html>

- a. After a period of testing, predict how the concentrations of carbon dioxide would be (higher, the same or less) for the ambient air compared to the air collected inside the douglas bag? Explain the reasoning behind your prediction.

1 mark

Prediction: _____ (for the ambient air)

- b. Briefly explain each stage of the process by which cells are able to produce carbon dioxide from glucose.

2 marks

Question 4 (4 marks)

Allergic reactions in children in response to food are increasing in frequency among Australians. 90% of food allergies are made up of the following foods: milk, eggs, peanuts, tree nuts, fish, shellfish, soy and wheat. Scientists are unsure why the number of allergies among children are increasing although some theories include being ‘too clean’, changes in breast feeding frequency, and preservatives and other chemicals found in food.

Source: <http://www.mayoclinic.org/diseases-conditions/food-allergy/in-depth/food-allergies/art-20045949>

- a.** When a child is first exposed to peanuts they experience only a very mild allergic reaction. Should the parents be concerned if the child was to eat peanuts in the future? 1 mark

- b.** Explain how the immune system responds to a child with a peanut allergy. The following words must appear in your response. 3 marks

Mast Cell Allergen IgE Histamine Antibody Antigen

Question 5 (9 marks)

Research has been conducted on which colour horse, horseflies prefer to land on. The research indicates they prefer to land on black horses instead of white. Gabor Horvath, in his recent study, investigated how the horseflies would react to black-and-white specimens, such as zebras. Real zebras, insist on moving around and swishing their tails. The team therefore conducted their study using boards that were painted uniformly dark or uniformly light, and some had stripes of various widths. The boards were then covered in glue to trap the insects that landed there. “The first thing they found was that just as light patches attracted fewer flies than dark, striped patches attracted even fewer than solid colours. And the striped pattern that had the fewest flies had stripes the width of zebra stripes. This suggests that zebra stripes may be especially good at keeping the flies off.”

Source: <http://blogs.discovermagazine.com/80beats/2012/02/10/zebra-stripes-fashion-statement-or-fly-repellant>.

- a.** Why would it be an advantage for horses or zebras to have stripes? Explain. 2 marks

- b.** Using your knowledge of natural selection, explain how populations of zebra came to have stripes of a specific width. 3 marks

- c.** If there were suddenly no horseflies present on the plains of Africa, how would you expect the colour of the zebras to evolve? Explain. 2 marks

- d. The Cape Mountain Zebra (*Equus zebra zebra*) pictured below has gone through a severe bottleneck. Explain what is meant by 'genetic bottleneck' and what evidence scientists may have to support this claim. 2 marks

Meaning:	Evidence:
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Cape Mountain Zebra

Source: <http://www.nigeldennis.com/stock/images/mammals/species/zebra/25499.jpg>

Question 6 (17 marks)

Recent evidence exists that early humans interbred with Neanderthals. Some of the alleles that are shared between the human genome and the Neanderthal genome include those assisting to help fight viruses such as Epstein-Barr Virus (EBV). This particular allele for resistance is found only in humans with a European background.

Source: <http://discovermagazine.com/2013/dec/22-20>

- a.** What is a genome? 1 mark

- b.** What conclusion can be made about the origin of the Epstein-Barr virus? 1 mark

Below is a simplified diagram of EBV. The genome of the EBV DNA is 192,000 base pairs long.



- c.** Name the structures contained within the virus that would contain the following macromolecules. 3 marks

Macromolecule	Name of structure
Protein	
Nucleic Acid	
Lipids	

It is thought that Neanderthals also had medicine. Traces of chamomile and yarrow, two anti-inflammatories, have been detected in the plaque on Neanderthal teeth.

- d.** Explain why inflammation is important for maintaining health? 1 mark

Now that the whole Neanderthal genome has been sequenced, it is possible a clone could be gestated in a human surrogate mother. It could even be beneficial, because the Neanderthal mind might be able to solve problems we cannot.

- e.** Explain how a genetic clone could be produced. 3 marks

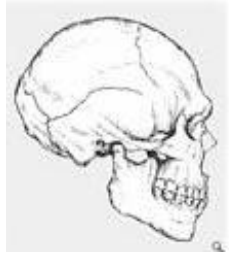
- f.** Even though it might be possible, what ethical considerations should be made before we attempt to make such a clone? 2 marks

The process of apoptosis makes DNA studies of Neandertals very difficult. Within hours of death, cells begin to break down. The dying cells release enzymes that chop up DNA into tiny pieces. In a human cell, this means that the entire three-billion-base-pair genome is reduced to fragments of about 50 base-pairs long.

Source: <http://blogs.discovermagazine.com/80beats/2010/02/10/could-we-clone-neanderthals-soon-probably-yes-should-we-no/>

- g.** Explain how Apoptosis is initiated by cells. 2 marks

- h.** Examine the human skull below. Describe the differences in the features compared to ancestral Homo species and state the significance of each difference. 4 marks



Feature	Difference	Significance of difference
Position of foramen magnum		
Size of cranial cavity		

Question 7 (6 marks)

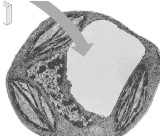
- a.** Mitosis occurs in 4 distinct phases. Describe what happens to the chromosomes in each of those phases. 4 marks

Phase 1 - Prophase	
Phase 2 - Metaphase	
Phase 3 - Anaphase	
Phase 4 - Telophase	

- b.** Discuss two ways in which mitosis might help the functioning of an organism. 2 marks

Question 8 (5 marks)

Define the function of the following cell structures: Choose 1 (one) only function that best matches the description. Not all numbers are needed. 5 marks

CELL STRUCTURE	PICTURE	FUNCTION match numbers (1-9) from one of the functions listed below
Vacuole		
Chloroplast		
Lysosome		
Golgi Body		
Mitochondria		

Source: http://www.biologyjunction.com/cell_functions.htm

Functions of cell structures

1. A catalyst for cellular metabolism.
2. Break down of larger molecules into smaller molecules.
3. The site where protein synthesis occurs.
4. Where proteins are modified and packaged for export.
5. Controls movement of materials in and out of the cell.
6. The site where ATP is produced aerobically.
7. Storage of wastes and materials.
8. Uses energy from the sun to form glucose.
9. Makes ribosomes.

Question 9 (3 marks)

Hair colour is controlled by many genes. The colour in your hair is caused by a pigment called melanin. There are two forms of melanin called eumelanin and phomelanin. Eumelanin controls the brown/black coloured pigment, phomelanin controls the red. Absence of both results in blonde.

Eumelanin in high quantities causes your hair to be black/dark brown; in low quantities your hair will be blonde. There are 4 genes that control the production of eumelanin that can either be switched on or off. They are found on (chromosomes 3, 4, 10, and 18). When a gene is switched on – it causes eumelanin production – thus the more that are switched on, the more black (darker) the hair colour will be.

Phomelanin works in a similar way, but for a red pigment being produced. When there is a low amount of phomelanin hair colour is a yellow/blonde colour, and high amounts are a dark red. A lot of eumelanin can mask the phomelanin.

Source: <http://www.madsci.org>

- a. Explain the possible hair colours of offspring from a couple both with brown hair, who both have exactly half of their genes switched on for each type of melanin production.

3 marks

Hair colour in offspring	Possible / Not Possible	Explanation of genetics
Blonde		
Brown		
Red-hair		

Question 10 (2 marks)

Explain convergent evolution and divergent evolution. (Use terms such as ‘no/common ancestor’ and ‘similar/different selection pressures’.)

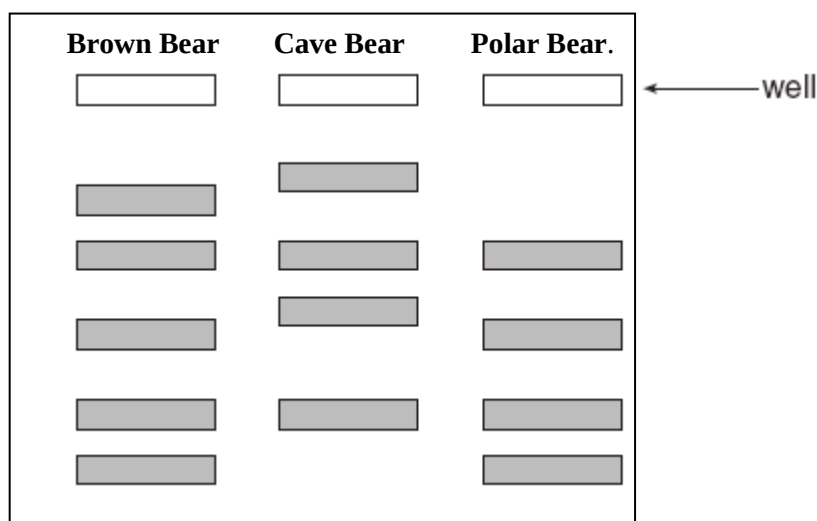
2 marks

Convergent

Divergent

Question 11 (5 marks)

The diagram below shows the results of a gel electrophoresis that was used to study the mitochondrial DNA samples of 3 different species of bear. The brown bear, cave bear and polar bear. Each DNA sample was incubated with a specific restriction enzyme and placed in the wells as indicated. The DNA fragments separated as a result of the gel electrophoresis.



- a. Describe the properties of the DNA fragments that allow them to move through the gel.

1 mark

- b.** Explain why the DNA fragments would move through the gel at differing speeds.

1 mark

- c.** Which bears are most closely related? Justify your answer.

2 marks

- d.** How is mitochondrial DNA inherited?

1 mark

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

SOLUTION PATHWAY**Answers to Section A: Multiple choice**

Question	Correct Answer	Explanation
1	B	All other answers contain glucose monomers and therefore have at least one carbohydrate in the answer. Answer B does not contain any protein polymers, but does have two lipid based polymers.
2	D	Collagen is structural protein, as chitin is also structural.
3	D	A protein channel is needed for facilitated diffusion to occur.
4	C	A death pathway or initiated cell death is called apoptosis.
5	D	Chloroplasts are not found in all plant cells, for example, they are not found in the root cells, making B incorrect. Although some bacteria can photosynthesise they do not contain chloroplasts. They do contain thylakoid membranes making D correct.
6	D	NAD is a carrier molecule in Krebs cycle and the electron is ultimately transferred to cytochromes as part of electron transport.
7	B	2 ATP are formed in glycolysis, 2 ATP are formed in Krebs cycle, and 32 ATP are formed as part of electron transport chain.
8	B	The cell may be undergoing Mitosis, but it could also be undergoing Meiosis, making A incorrect. With large numbers of mitochondria present, the cell is capable of producing large amounts of carbon dioxide through cellular respiration.
9	A	The bond between the 2 nd and 3 rd phosphate is broken to release the energy in ATP.
10	A	Water is an input for the light-dependant phase of photosynthesis, which occurs in the grana.
11	B	The other options are all in the opposite column.
12	A	B and D are not cells. Red blood cells do not have a role in the immune system.
13	B	It is passive immunity as no memory B cells are formed. As it is injected it cannot be natural.
14	D	The faulty gene for Cbl-b would not produce the correct enzyme needed to break down the Stat-6.
15	C	The others are part of the 3 rd line of defence or specific immunity.
16	A	It is extremely unlikely that all individuals marrying into the family were carriers. Autosomal dominant is the most likely.
17	C	Structure Y is a steroid hormone that is non-polar, structure X is a polypeptide, made of amino acids.
18	B	Cell C is the only cell that would not receive the message.
19	C	The action of phagocytes is part of the second line of defence. Intact skin and mucous are 1 st line and B-cells form part of the 3 rd line.
20	D	The T-cell has receptors for self and non self. The self-antigens that it displays are matched by cell D – making itself.
21	A	More specifically it is a pheromone, which is a class of signalling molecule.
22	D	The other examples occur in mitosis, but not in binary fission.
23	D	As it is taken during replication there are 40 chromatids.
24	B	Possums are marsupials, but this can't be determined by a Karyotype. The possum is Male and has 18 autosomes, with 2 sex-determining chromosomes.
25	D	Dogs diverged from the bear and racoon line much earlier than

		other species.
26	D	A carrier must have one normal and one abnormal copy of the gene. The 'must' statements of A and B are incorrect as there are other options. If two parents are both homozygous and the same genotype they must have all children with the same phenotype as them.
27	B	It is inherited, so must have initially occurred in a mutation in the sex cells of one of the parents of the first affected individual.
28	A	The colour change occurs while the fur is growing. Putting a cold patch on a grown cat, while the fur is already grown will not cause a colour change. Shaving the cat will cause the hair to regrow – allowing the cold temperature to have an effect.
29	A	The offspring will result in 9 Smooth Yellow: 3 Smooth Green: 3 Wrinkled Yellow: 1 Wrinkled Green. That is 4 different phenotypes.
30	A	Short tandem repeat sequences are analysed and used to create unique genetic fingerprints. This technique is useful in identifying individuals in forensics, for example.
31	D	The distinguishing feature is that bacterial chromosomes are circular and eukaryotic DNA is linear.
32	D	As yellow is recessive, it will be have a homozygous genotype, and if crossed will have all yellow offspring as well.
33	C	Hard parts like bones increase the chances of fossilisation.
34	C	The other methods involve DNA analysis. Carbon dating is useful for less than 50,000 years.
35	A	Due to the swamps drying up, wintonotitan experienced different selection pressures and did not survive.
36	B	1 ova is produced and 3 cell bodies during meiosis. Spindle fibres are needed during Anaphase and Metaphase.
37	C	The transformation of a canola plant and subsequent propagation is an example of human intervention.
38	A	The lighter skin tone is an example of natural selection.
39	B	Stone Axes are an example of technological evolution
40	C	Hominin refers to humans and their immediate ancestors. Hominoid is a broader term and refers to humans, their ancestors and the great apes as well. Primates are an even broader classification still to include other species such as lemurs.

Answers to Section B: Short Answer**Question 1**

- a. WADA would be concerned that the drug has been taken as both methods allow for it to enter the athletes' body.
- b. 51 would be needed. 3 base pairs for each amino acid, and an additional three base pairs for the stop codon.
- c. Hypothesis: That regular injections of AOD-9604 will cause weight loss in humans. (1 mark)

Place subjects randomly into two groups called Group A and Group B. The subjects (if students give numbers must be greater than 10 in each group) should be roughly the same age, health status, given the same diet and environmental conditions. (1 mark) Only Group A will be given injections of AOD-9604. Group B will be given a placebo. (1 mark). After a period of time, if the drug is successful, we would expect that Group A subjects have lost weight, while Group B subjects should weigh about the same. (1 mark)

- d. Yes. AOD-9604 is acting as a hormone if it has the same binding site. Then it could bind with the same complementary receptors as HGH (1 mark) and cause the same response. (1 mark)

OR

No. AOD-9604 peptides have different structures as they are different lengths to HGH. (1 mark) It is therefore unlikely that they will have the same binding site and be unable to bind with the same receptors as HGH and be unable to cause the same response. (1 mark)

- e. When HGH binds to the receptor on the cell surface (1 mark) secondary messengers can be activated inside of the cell, to bring about a response. (1 mark)
- f. The secondary structure is a coiled or pleated structure. (1 mark) The tertiary structure is the 3-dimensional folded structure that can include secondary structures such as alpha helices and B-pleated sheets. (1 mark)

Question 2

- a. In the cytoplasm.
- b. The tRNA will bind to a specific amino acid that is free in the cell (1 mark). The anticodon on the tRNA will bind with a complementary codon on the mRNA. This occurs at the ribosome (1 mark). The amino acid will be joined onto the polypeptide chain, where the tRNA will leave to find another specific amino acid. (1 mark)

Question 3

- a. Prediction: Lower
As the subjects are exercising, they would be exhaling carbon dioxide into the douglas bag, making the concentration of carbon dioxide higher in the bag. (1 mark)
- b. Glycolysis: Glucose is broken down into pyruvate, which is a 3 carbon sugar. (1 mark)
Krebs Cycle: the pyruvate is an input of Krebs cycle, that is broken down into individual carbons, that combine with oxygen to produce carbon dioxide. (1 mark)

Question 4

- a. *The reaction in the child may be greater a second time as a second response may be greater.*
- b. *The allergen is the peanuts, which contain foreign antigens on their cell surface. (1 mark)*
IgE is an antibody that is located on the surface of the Mast Cell . (1 mark)
When the IgE on the mast cells comes into contact with the peanuts, they burst open releasing histamine, which causes the allergic reaction. (1 mark)

1 mark should be awarded for correct use of every two words; answers do not need to be set out exactly as above.

Question 5

- a. *The stripes reduce the chances of flies landing on them (1 mark), when compared to solid colours. Flies could bite or carry disease, so it is an advantage for the zebra not to have flies landing on them (1 mark).*
- b. *Variation existed within the population of ancestral zebras with regard to stripe width. (1 mark)*
The selection pressure of flies landing on the zebras caused some to be more susceptible to disease than others. (1 mark)
Over time, the zebras that had less flies on them reproduced more, and passed on the genes for the ideal stripe width to the next generation. (1 mark)
- c. *The zebras may evolve to have colours that help them to be better camouflaged (1 mark), as this could be another selection pressure. (1 mark)*
- d.

Meaning: A genetic bottleneck is caused by a dramatic reduction in numbers of the population (can be caused by a natural disaster) and with the reduced numbers a very low genetic variation is caused.

Evidence: A small amount of genetic (either chromosomal or Mitochondrial) variation (few genetic differences) among populations of cape mountain zebra.

(2 marks)

Question 6

- a. *The genome is the total genetic content in one set of chromosomes. (1 mark)*
- b. *Epstein-Barr originated in Europe OR EBV originated in Neanderthals and was then passed on (as well as the resistance gene). (1 mark)*

c.

Protein	<i>Protein Coat or hemagglutinin or neuraminidase</i>
Nucleic Acid	<i>DNA</i>
Lipids	<i>Lipid envelope or lipid bilayer</i>

(3 marks)

- d. *Inflammation allows more phagocytes to the site of infection – so that they can engulf pathogens or infected cells. (1 mark)*
- e. *A human egg is removed and the cell is enucleated. (1 mark)*
The DNA from the cell of a Neanderthal is removed, and inserted into the nucleus of the human egg cell (1 mark).
The cell is 'shocked' to stimulate cell division, it is then implanted.
- f. *What quality of life would it have? For example who would look after it and what scientific experiments would be allowed.*
- g. *The mitochondria release cytochrome C (1 mark) – which activates caspase into its active form. (1 mark)*

h.

Feature	Difference	Significance of difference
Position of foramen magnum	<i>Humans have the foramen magnum further underneath the base of the skull.</i>	<i>This allows the head to be positioned for more upright walking.</i>
Size of cranial cavity	<i>Humans have a larger cranial cavity than ancestral species.</i>	<i>This allows for protection of a larger brain.</i>

(4 marks)

Question 7**a.**

Phase 1 - Prophase	<i>Chromosomes become visible.</i>
Phase 2 - Metaphase	<i>Chromosomes attach to spindle fibres and line up on the equator</i>
Phase 3 - Anaphase	<i>Spindle fibres shorten and chromatids pull apart towards each pole</i>
Phase 4 - Telophase	<i>Nuclear membrane reforms around the two groups of chromosomes.</i>

(4 marks)

- b.** *Mitosis is important for growth (human, plant etc) or Mitosis can produce cells needed for the immune system to help protect against pathogens or Mitosis can be used to repair and replace damaged or infected cells.*

(2 marks)

Question 8

ORGANELLE	FUNCTION
Vacuole	7
Chloroplast	8
Lysosome	2
Golgi Body	4
Mitochondria	6

(5 marks)

Question 9

Hair colour in offspring	Possible / Not Possible	Explanation of genetics
Blonde	<i>Possible</i>	<i>Both would need to pass on the majority of the 'switched off' alleles for eumelanin and phomelanin genes.</i>
Brown	<i>Possible</i>	<i>The children need to inherit roughly equal numbers of switched on and switched off genes from their parents for eumelanin. (Phomelanin doesn't matter as it is masked).</i>
Red-hair	<i>Possible</i>	<i>The children would need to inherit most of the switched off genes for eumelanin and switched on for phomelanin.</i>

- 1 mark for each correct horizontal row. Both possibility and genetics need to be correct.
- Award 1 mark total if student has correctly stated that all hair types are 'possible' but the genetics explanation column is incorrect.

(3 marks)

Question 10

Convergent - The two species have no common ancestor, but have evolved in a similar way due to similar selection pressures.

Divergent - The two species have a common ancestor, but different selection pressures have increased their differences.

(2 marks)

Question 11

- The DNA is slightly negatively charged and will move towards the positively charged end of the gel. (1 mark)*
- Larger fragments move more slowly than smaller fragments, as they cannot weave through the gel matrix as fast. (1 mark)*
- Brown Bears and Polar Bears are more closely related (1 mark) this is because they have the highest number of identical length fragments/ higher number of cutting sites for the enzyme. (1 mark)*
- Mitochondrial DNA is passed on from mothers unchanged to all of her offspring.*

(5 marks)