

2016 Trial Examination

STUDENT
NUMBER

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Letter

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BIOLOGY

Units 3 & 4 – Written examination

Reading time: 15 minutes

Writing time: 2 hours and 30 minutes

QUESTION & ANSWER BOOK

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 permitted in this examination.

Materials supplied

- Question and answer book of 33 pages.

Instructions

- Print your name in the space provided on the top of this page.
- All written responses must be in English.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic communication 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

DNA is an example of an organic polymer. Which of the following is the monomer of DNA?

- A. A nucleotide
- B. Deoxyribose
- C. A nitrogenous base
- D. A phosphate group

Question 2

The following diagram shows a representation of a protein.



The large arrows in the diagram indicate:

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

Question 3

Eukaryotic cells contain a range of membrane bound organelles. This facilitates compartmentalisation of the cells. The purpose of membranous compartmentalisation of a eukaryotic cell is to:

- A. Increase the surface area to volume ratio of the cells.
- B. Prevent organelles from coming into contact with each other.
- C. Allow observers to differentiate between prokaryotic and eukaryotic cells.
- D. Allow different metabolic processes to occur simultaneously without interference.

SECTION A - continued

Use the following information to answer questions 4 and 5

Low-density lipoproteins (LDLs) are molecules that are a combination of lipids and proteins. As cholesterol is a lipid, it cannot be transported through blood on its own. The role of an LDL is to transport cholesterol through the bloodstream to somatic cells. LDLs are then taken up in bulk by the target cell.

Question 4

The process by which LDLs are taken up by target cells would be:

- A. Endocytosis.
- B. Signal transduction.
- C. Facilitated diffusion.
- D. Molecular transportation.

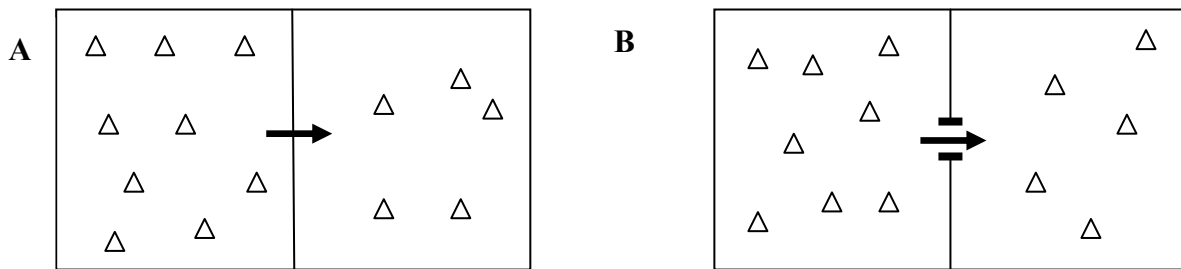
Question 5

The cholesterol transported by an LDL becomes associated with the plasma membrane. The role of this cholesterol is to:

- A. Increase the stability of the phospholipid bilayer.
- B. Bind to the phospholipids present in the plasma membrane.
- C. Form an attachment site for trans membrane protein receptors.
- D. Prevent the movement of water molecules across the plasma membrane.

Question 6

The diagrams below show the movement of a substance across the plasma membrane of a cell. The triangles indicate the substance and the arrows indicate the direction that the substance is moving in.



Which of the following statements is most accurate?

- A. Ions enter a cell by process A.
- B. Water molecules enter a cell by process B.
- C. Protein molecules enter a cell by process A.
- D. Glucose molecules enter a cell by process B.

SECTION A - continued
TURN OVER

Question 7

At the conclusion of an enzyme catalysed reaction the enzyme and substrate separate. Which of the following statements correctly describes what has happened to the enzyme and the substrate?

- A. Both enzyme and substrate are released unchanged.
- B. Both enzyme and substrate are changed upon release.
- C. The enzyme is unchanged and the substrate is changed.
- D. The enzyme is changed and the substrate is unchanged.

Question 8

Diagram 1 below shows a substrate molecule (S) binding to an enzyme (E). Diagram 2 shows a condition where the enzyme is unable to bind to the substrate.

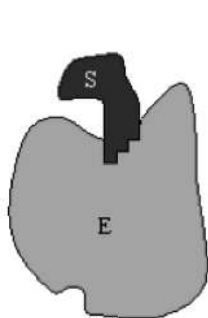


Diagram 1

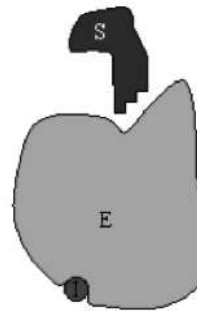


Diagram 2

The best explanation for this is:

- A. The enzyme has been denatured.
- B. The molecular shape of the substrate has been changed.
- C. A competitive inhibitor has changed the shape of the active site.
- D. A non-competitive inhibitor has caused the shape of the active site to change.

Question 9

An experiment is conducted in which the same volume of an enzyme is added to solutions that contain increasing amounts of a substrate. The results are recorded on a graph, with substrate concentration on the X-axis and the rate of the reaction in arbitrary units on the Y-axis. Which of the following would you expect to observe on the graph?

- A. The rate initially increases but then becomes constant.
- B. The reaction rate initially decreases and then increases.
- C. The rate of the reaction increases and then decreases, showing a bell curve.
- D. The rate of the reaction increases at a proportional rate, forming a straight line.

Question 10

Which of the following compounds are required in order for glycolysis to occur?

- A. Oxygen and ATP.
- B. ATP and glucose.
- C. Pyruvate and oxygen.
- D. Glucose and carbon dioxide.

Question 11

Which of the following correctly identifies which loaded carriers are produced during the Krebs' cycle?

- A. NADH only.
- B. FADH₂ only.
- C. NADH and FADH₂.
- D. NADPH and FADH₂.

Question 12

Which of the following substances will be utilised in the light independent stage of photosynthesis?

- A. ATP and NADPH.
- B. Water and oxygen gas.
- C. Carbon dioxide and glucose.
- D. High-energy electrons and hydrogen ions.

Question 13

Some organisms that live in desert conditions have the ability to survive without drinking water. Instead they rely upon metabolic water. This water is obtained as:

- A. They produce it during the process of hydrolysis.
- B. It is a product of the breakdown of pyruvate in the mitochondria.
- C. It diffuses out of the cytosol when an individual becomes dehydrated.
- D. It was contained in the metabolism of the organisms that they consume.

Question 14

Corticosteroids are a type of steroid hormone. When they reach their target cell they will bind to:

- A. Receptors that are located within the cytosol.
- B. Receptors that extend across the plasma membrane.
- C. Receptors that are located within the plasma membrane.
- D. Receptors that are located on the external surface of the plasma membrane.

SECTION A - continued
TURN OVER

Question 15

When an action potential reaches the pre-synaptic terminal the next event will be:

- A. The release of neurotransmitters into the synapse.
- B. The movement of calcium ions into the pre-synaptic terminal.
- C. Neurotransmitters are broken down by acetyl cholinesterase.
- D. Sodium and potassium ions move across the membrane of the terminal.

Question 16

Insulin is a peptide-based hormone secreted by the pancreas that plays a role in glucose regulation by facilitating the uptake of glucose from the bloodstream. People with type 2 diabetes are able to produce normal amounts of insulin, but their cells do not detect and respond to it properly. Metformin is a medication commonly taken by people who have type 2 diabetes. The most likely role of drugs such as metformin is to:

- A. Facilitate the binding of insulin to the receptor of a target cell.
- B. Increase the rate of transduction that occurs within a target cell.
- C. Increase the number of second messengers that are activated after insulin binds to a target cell.
- D. Open protein channels, enabling glucose to diffuse into a cell and thus making insulin production irrelevant.

Question 17

The list below refers to the events that occur during the production and release of antibodies. They are not listed in the correct order.

- 1) Antibodies bind to and neutralise antigens.
- 2) B cells differentiate producing plasma and memory cells.
- 3) Antibodies are manufactured.
- 4) Antigenic fragments combine with the class 2 MHC marker.

Which of the following is the most correct sequence of events that occurs during this process?

- A. 4,3,1,2
- B. 3,1,2,4
- C. 4,2,3,1
- D. 3,2,1,4

Question 18

Which of the following is an example of passive immunity?

- A. A person has the flu and then recovers.
- B. A person is exposed to the varicella virus.
- C. A child receives breast milk from their mother.
- D. A person is given a vaccination against the measles.

SECTION A - continued

Question 19

A person takes an antihistamine after experiencing a hypersensitivity reaction. Which of the following are most likely to be affected as a result?

- A. The activation of NK cells.
- B. The production of B memory cells.
- C. The ability of macrophages to engulf allergens.
- D. The extent to which blood vessel dilation occurs.

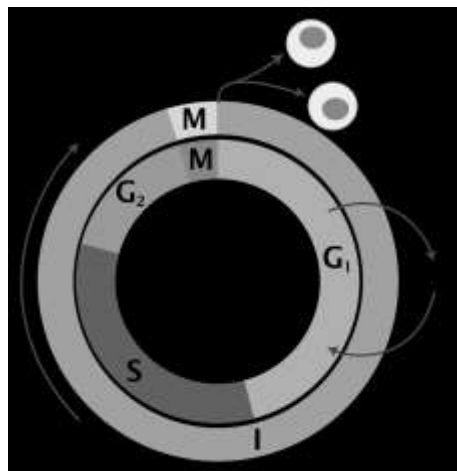
Question 20

The term clonal selection refers to the fact that:

- A. NK cells are able to detect cells that have been invaded by a virus.
- B. Stem cells are able to differentiate producing a large number of daughter cells.
- C. Exposure to an antigen enables a person to produce high levels of specific antibodies.
- D. All of the cells that are involved in carrying out an immune response must be genetically identical to each other.

Question 21

The diagram below shows an overview of the different stages of the cell cycle. Which of the following statements regarding the cell cycle is correct?



- A. Interphase is made up of several stages.
- B. All mutations occur during the G₂ stage.
- C. DNA replication occurs during the G₁ stage.
- D. The cells produced by process M are haploid.

Question 22

Where does transcription of genomic DNA occur?

- A. Cytosol.
- B. Nucleus.
- C. Chloroplast.
- D. Mitochondria.

**SECTION A - continued
TURN OVER**

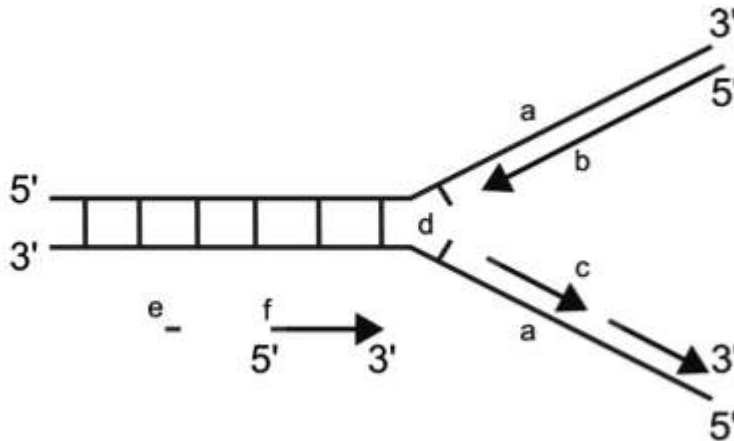
Question 23

Which of the following molecules is an anticodon associated with?

- A. DNA.
- B. Transfer RNA.
- C. Ribosomal RNA.
- D. Messenger RNA.

Question 24

The diagram below shows a brief overview of events that occur during DNA replication.



Where would the enzyme DNA helicase be acting?

- A. a
- B. b
- C. c
- D. d

Question 25

The method of DNA replication is the same in both humans and bacteria; however, the mechanism of chromosomal replication differs. This occurs because:

- A. Humans have genomic DNA, this is lacking in bacteria.
- B. Bacterial DNA polymerase acts at a faster rate in bacteria than in humans.
- C. There is only a single origin of chromosomal replication in bacteria, but many points of origin in human chromosomes.
- D. Human chromosomes are organised into homologous pairs and bacterial chromosomes are not. Homologous pairs of chromosomes replicate at different time periods, slowing the process down.

Question 26

The analysis of an electrophoresis gel may be used as a means of diagnosing genetic conditions. A mutation occurred that resulted in the production of an autosomal recessive allele (a) that causes a specific genetic condition. The mutation resulted in the removal of a restriction site. This mutation is not present in alleles that code for the normally functioning protein (A). If genetic samples were exposed to the restriction enzyme, which of the following statements correctly identifies the expected observation?

- A. All of the lanes containing samples from unaffected individuals would have the same pattern.
- B. The lane containing the sample from an individual with the Aa genotype would have four distinct bands.
- C. The lane containing the sample from an individual with the aa genotype would have three distinct bands.
- D. The lane containing the sample from an individual with the AA genotype would have two distinct bands.

Question 27

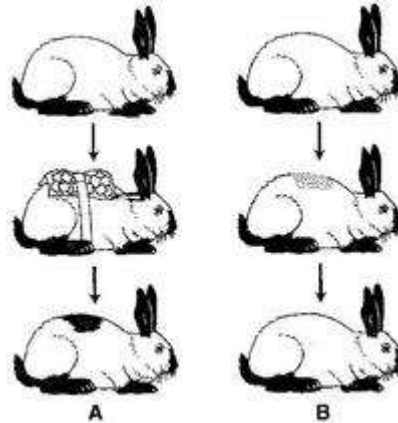
The enzyme DNA ligase is used during the production of a recombinant plasmid. Which of the following best identifies the purpose of using DNA ligase?

- A. Its presence enables recombinant plasmids to be identified.
- B. It is used to bind a specific gene of interest into a bacterial plasmid
- C. It is used to identify the sequence of DNA to be inserted into the plasmid.
- D. It lowers the activation energy required for DNA replication, increasing the rate at which recombinant plasmids are produced.

SECTION A - continued
TURN OVER

Question 28

The Himalayan rabbit is normally white in colour with black extremities. A scientist hypothesised that the black colouration occurred in areas of the rabbit that were exposed to cold conditions. The scientist carried out an experiment that involved shaving hair from the skin on the backs of two different rabbits. An ice pack was strapped to the back of rabbit A, but nothing was placed onto the back of rabbit B. The diagram below shows the process that occurred and the result of the experiment.



Which of the following statements is the most accurate?

- A. Any observations will be incorrect as the sample is too small.
- B. The change to the coat colour of rabbit A supports the hypothesis.
- C. Fur colouration in Himalayan rabbits is solely determined by genetic factors.
- D. This experiment is flawed because there was no independent variable being tested.

Question 29

The flowers of a type of pea plant can either be white or purple. Two plants with purple flowers were crossed. The offspring of this cross were then used to create another generation, the F₂ generation. Three quarters of the F₂ offspring also had purple flowers and the other quarter had white flowers.

Which of the following conclusions could be made regarding the plants in the F₂ generation?

- A. One third of the purple flowering offspring were homozygous.
- B. The gene that causes purple colouration in the flowers is dominant.
- C. All of the purple flowering offspring had the same genotype and phenotype as each other.
- D. The purple offspring all inherited one copy of the allele for purple colouration from each of their parents.

Question 30

Fruit flies can have either grey or black bodies and round or bar shaped eyes. The genes for body colour and eye shape assort independently during meiosis. This means that:

- A. The two genes will be inherited together.
- B. The genes are located on different chromosomes.
- C. The genes occupy different loci on the same chromosome.
- D. The genes can be subjected to crossing over during meiosis.

Question 31

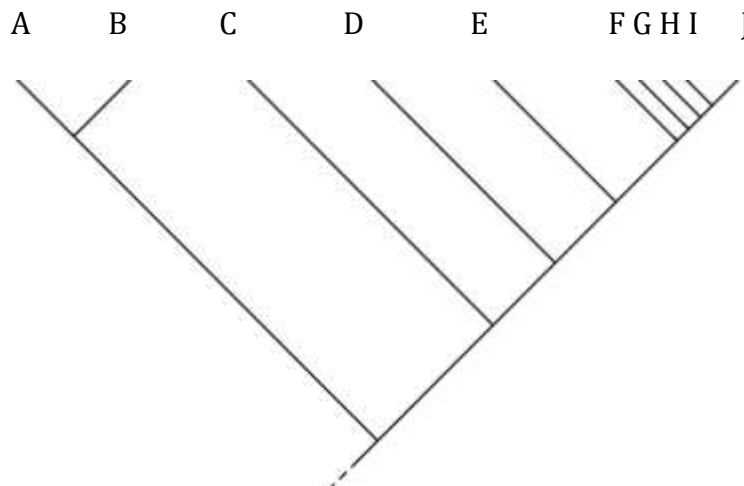
The theory of evolution by natural selection was initially proposed by Charles Darwin and Alfred Wallace in 1858. Which of the following are necessary for evolution to occur?

- A. Organisms are able to evolve when change occurs during their lifetime.
- B. There must be genetic variation in a population of organisms.
- C. Any trait that does not confer biological fitness will immediately disappear from a species.
- D. Natural selection occurs as the result of acclimatisation due to seasonal environmental changes.

Question 32

The diagram below shows a cladogram or phylogenetic tree.

One of the means of providing evidence that supports the theory of evolution is to carry out DNA hybridisation tests. The melting temperature (T_m) of a DNA hybrid is used to estimate the degree of relatedness between organisms from two different species.



Based on the information provided, which hybrid DNA would be expected to have the highest T_m ?

- A. I and J.
- B. A and J.
- C. A and B.
- D. B and C.

SECTION A - continued
TURN OVER

Question 33

Identify which of the following most correctly identifies a difference between natural selection and artificial selection.

- A. Natural selection only occurs within a single population of a species, artificial selection occurs in many different populations.
- B. Natural selection only occurs in populations that are genetically varied, artificial selection does not depend upon genetic variation.
- C. Natural selection will eventually cease occurring, but artificial selection will continue to occur because the perception of desirable traits keeps changing.
- D. In natural selection the environment determines which organisms are more likely to survive and breed, in artificial selection humans breed organisms with desired traits.

Question 34

Whilst studying wildlife on the Galapagos Islands Darwin noticed that the Galapagos finches showed wide phenotypic variations, particularly with regard to beak shape and size, from island to island. How might an evolutionary biologist explain why one species of finch evolved a larger beak size than others?

- A. Some of the ancestral population of birds had larger beaks than others. These were more likely to survive and reproduce.
- B. All of the birds in a single population underwent a mutation that resulted in the production of larger beaks in that population.
- C. Their ancestors encountered plants with larger seeds and a single generation developed larger beaks in order to be able to eat these seeds.
- D. Seeds come in a variety of sizes and some members of the population were able to stretch their beaks and ingest the larger seeds more efficiently than others of the same population.

Question 35

Which of the following is true of homologous structures? These structures:

- A. Develop in different species as a result of natural selection.
- B. Are present in two related species, but not in their common ancestor.
- C. Are present in two related species and should also be present in their common ancestor.
- D. Occur in non-related species as a result of being exposed to similar environmental conditions.

Question 36

Plants and animals living in New Zealand evolved in isolation for millions of years. It has been observed that no mammals, except two species of bat, are native to New Zealand and also New Zealand was home to the largest variety of flightless birds. Based upon the provided information, which of the following theories provides the best explanation for many species of native birds losing the ability to fly?

- A. A mutagen in the environment caused a decrease in wing size of birds.
- B. In the absence of mammalian predators, birds did not need the ability to fly.
- C. Only species that could fly or swim were capable of colonising New Zealand.
- D. There was a greater amount of food available on forest floors so many bird species took to foraging on the ground.

SECTION A - continued

Question 37

Genetic drift is one of the processes that may play a role in altering the allele frequencies of a population. Under which of the following conditions would genetic drift have the greatest impact on a population?

- A. After environmental changes occur.
- B. When individuals immigrate into the population.
- C. After a catastrophic event kills most of the population.
- D. When females select mates based upon their having a desirable phenotype.

Question 38

The remains of a human and a cat were found buried together in a 9,500-year-old grave site on the Mediterranean island of Cyprus. Seashells, polished stones, and other decorative artifacts were found nearby. Which of the following is a relative method of dating that could have been used to determine the order in which these objects were deposited?

- A. Stratigraphy.
- B. Fission tracking.
- C. Carbon-14 dating.
- D. Potassium to argon dating.

Question 39

The image shown below is that of a hominin species *Australopithecus africanus*, believed to live between two and three million years ago.



Which of the following correctly identifies an expected difference in the morphology of this skull compared to that of a modern human?

- A. The brow ridges would be less pronounced.
- B. The cranial capacity would be much smaller.
- C. The jaw would be comparatively smaller in size.
- D. The foramen magnum would be closer to the centre of the base of the skull.

SECTION A - continued
TURN OVER

Question 40

There are currently more than 7500 different species of apple trees. The ancestry of all modern species can be traced back to a single ancestral species, *Malus orientalis*, which is native to the Middle East and Central Asia. Which of the following is most likely to have led to the development of different species of apple?

- A. Artificial selection carried out by humans.
- B. Adaptive radiation as apple trees spread to different continents.
- C. Natural selection due to being exposed to different environments.
- D. Genetic changes accumulated after plants were geographically isolated from each other.

END OF SECTION A

SECTION B – Extended response questions**Instructions for Section B**

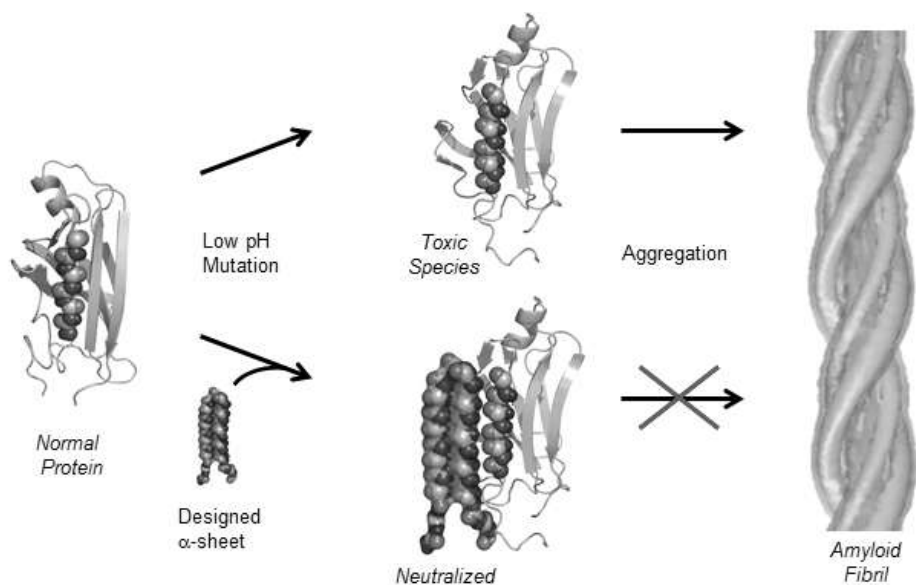
Answer this section in pen.

Answer all questions in the spaces provided.

Question 1 (6 marks)

Under certain conditions proteins transform from their normal conformation into abnormally folded toxic proteins, which then group into larger structures called amyloid fibrils. This process is called aggregation and is shown in the diagram below. Aggregation happens naturally as we age, however, a group of diseases known as amyloid diseases occur when aggregation happens at a greater than normal rate.

A group of scientists have designed an alpha sheet that binds to the toxic species preventing aggregation from occurring as shown in the diagram below.



- a. Identify the highest level of structure in the normal protein and in the alpha sheet.

2 marks

- b. The team of scientists were able to produce the alpha sheet by studying proteins and their interactions. What term is given to this field of study?

1 mark

**SECTION B - continued
TURN OVER**

- c. Discuss why adding the alpha sheet to the toxic species prevents the toxic proteins from aggregating.

2 marks

- d. Explain why changing the pH causes the normal protein to become the toxic species.

1 mark

Question 2 (9 marks)

Cellular respiration is a process that occurs in many stages.

- a. Complete the table below identifying how much of each substance is produced (is an output) of each stage of the process per molecule of glucose input.

3 marks

Substance	Glycolysis	Kreb's cycle	Electron Transport Chain
Pyruvate			
ATP			
Water			
Carbon Dioxide			

SECTION B - continued

Electron transport inhibitors act by binding to one or more electron carriers, preventing electron transport directly. Some inhibitors are more effective than others. Rotenone is a toxin that blocks the action of a mitochondrial enzyme called NADH reductase, which facilitates the conversion of NADH to NAD^+ and H^+ ions. It is commonly used to kill fish, but generally takes at least 24 hours to accomplish this purpose.

- b.** Discuss how the use of rotenone is likely to affect the Krebs's cycle. Provide a reason to support your answer.

2 marks

- c.** Provide a plausible reason to explain why the effect of rotenone is not immediate.

1 mark

- d.** Oxygen is an input to the electron transport chain, but is not directly involved in the Krebs's cycle. Despite this the Krebs's cycle is still considered to be an aerobic process. Explain why this is the case.

1 mark

SECTION B - continued
TURN OVER

- e. Identify two reasons to explain why the use of rotenone is eventually fatal.

2 marks

Question 3 (8 marks)

Many human hormones are produced by glands, however some hormones are produced by the hypothalamus and secreted by the pituitary gland. These hormones are transported down the axon of neurons and then released into the blood stream through capillaries located at the end of the axon.

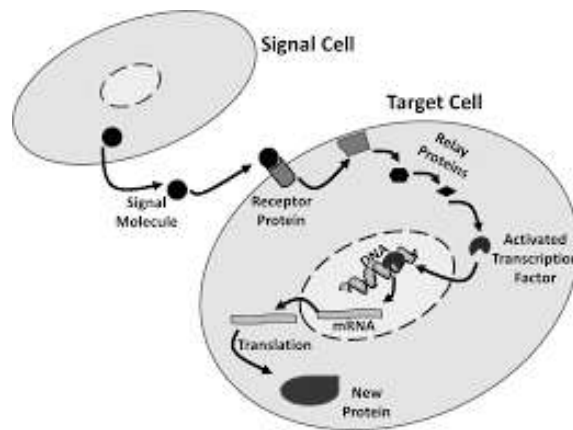
- a. What term is used to describe hormones secreted and released by the central nervous system?

1 mark

- b. Neurons are also able to produce neurotransmitters. Discuss one similarity and one difference between the role or mechanism of action played by hormones produced by the central nervous system compared to neurotransmitters.

2 marks

The diagram below shows a signaling molecule released by a cell and its effect on a target cell.



- c. What class of biological molecule does the signaling molecule belong to? Provide a reason to support your answer.

2 marks

- d. Identify the three stages of the stimulus-response model that are occurring and state what is happening in each stage in the example supplied.

3 marks

SECTION B - continued
TURN OVER

Question 4 (7 marks)

Lysozyme is an enzyme that is abundant in a number of secretions, including tears, saliva, breast milk, and mucus. It is also present in cytoplasmic granules of the macrophages, where it facilitates the destruction of bacterial cell walls.

- a. Humans have several levels of immune responses. Which level/s does the action of lysozyme belong to? Provide a reason to support your answer.

2 marks

Some species of staphylococcus bacteria have a protein called O-acetyltransferase (oatA) embedded in their cell wall. A mutation in this protein was hypothesised to confer resistance to lysozyme.

A scientist performed an experiment that occurred in two stages. In the first stage DNA that coded for the mutated protein was inserted into a bacterium that was susceptible to lysozyme. In the second stage the mutated gene was removed from a bacterium that was resistant to lysozyme and a gene for the normal functioning protein was inserted. Both types of modified bacteria were then exposed to lysozyme.

- b. Explain why it was necessary to perform both stages in order to generate data to support the hypothesis.

2 marks

SECTION B - continued

- c. Explain why the staphylococcus bacteria which have the mutation have the greatest ability to colonise and remain persistent in areas such as the skin and mucosal surfaces of humans.

1 mark

- d. Discuss how the action of lysozyme can assist in the processes that result in a specific immune response.

2 marks

Question 5 (10 marks)

A genetic condition known as methaemoglobinaemia (or met-H) reduces a person's ability to carry oxygen in their blood, leaving it darker than the colour typically found in veins. As a result the affected individuals develop blue coloured skin. A man with blue skin was one of the few settlers who colonised the area in 1820. As there were only 3 families in the area, all of whom intermarried, the incidence of blue skin became extremely high within two generations and remained high for a total of six generations. All blue skinned individuals were able to trace their ancestry to the initial blue skinned male.

- a. Identify the term used to describe genetic events in populations like the one described.

1 mark

**SECTION B - continued
TURN OVER**

- b.** Explain why the incidence of the blue skinned trait increased during the first six generations.

1 mark

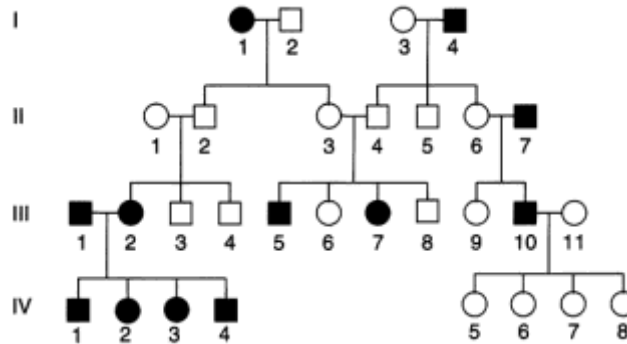
- c.** In the 1930s new roads allowed greater access to the area. Within twenty years the incidence of blue children being born decreased and currently the incidence of this trait in the population is described as being “statistically insignificant”. Discuss why the incidence of the trait changed.

1 mark

SECTION B - continued

- d. The pedigree chart shown below shows the incidence of the trait over a period of four generations. Identify the mode of inheritance of this trait. Use the information provided to give two reasons to support your answer.

3 marks



- e. What is the probability that individual III-3 is homozygous?

1 mark

- f. Individual IV-8 has a partner with normal coloured skin, whose father also had blue skin. Determine the phenotypic and genotypic ratios of their offspring. Show all working in your answer.

3 marks

SECTION B - continued
TURN OVER

Question 6 (4 marks)

Deer mice have the ability to produce an agouti protein that affects the colour of their fur. Increasing the expression of this gene decreases colouration, resulting in mice that are lighter in colour. Approximately 10000 years ago an environmental change began in which sand dunes gradually replaced a forest environment. Initially the majority of the population of deer mice had dark coloured fur, but over time the incidence of having light coloured fur increased.

- a.** Identify and explain the process that resulted in the change in fur colour of the population of mice.

3 marks

- b.** Discuss what is likely to happen to the mice from the sand dune area if they migrate into the surrounding forest.

1 mark

SECTION B - continued

Question 7 (4 marks)

Tar pits are one of the best-known sources of fossils. Tar pits form when a sticky substance known as asphalt or tar seeps up from the ground and accumulates in pools. The best-known area that this has occurred is the La Brea tar pits found in Los Angeles. Over a long period of time many organisms became stuck in the tar and their remains were preserved. To date more than 1 million fossils representing more than 600 species have been found and it is believed that there are at least that many more to be discovered.

- a. Explain why tar pits are a good environment for fossilization to have occurred.

1 mark

- b. The oldest specimens that have been retrieved have been dated at 55 000 years old. Identify an absolute dating technique that could have been used to establish the age of these fossils.

1 mark

Trilobites were a group of ancient arthropods. They were known to have a hard exoskeleton and their thorax was segmented as shown in the picture below.



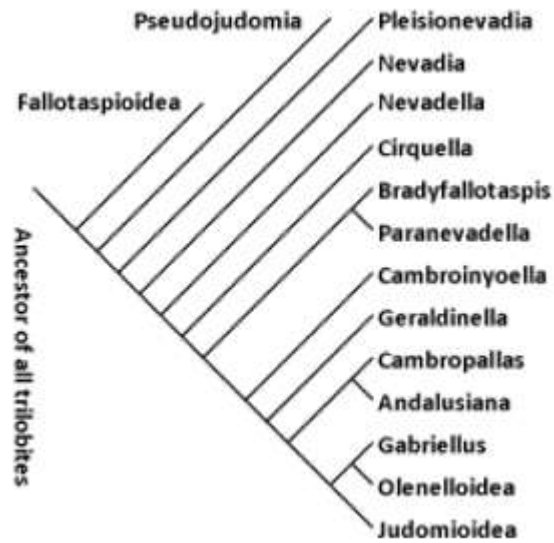
Trilobites first appeared approximately 520 million years ago and flourished for a long period of time before finally disappearing in a mass extinction about 250 million years ago. They were considered to be highly successful as more than 20000 species of trilobite are currently recognised.

- c. The fossil record indicates that shortly after their appearance they rapidly diversified, with the surviving species developing thicker cuticles. What advantage would the thicker cuticles provide?

1 mark

SECTION B - continued
TURN OVER

Following is a cladogram showing the relationship between several different species of trilobite.



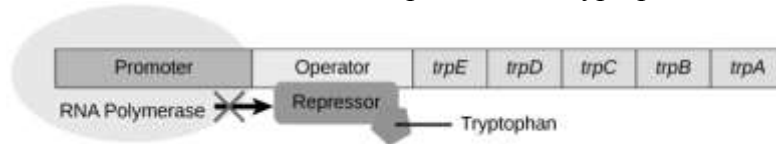
- d. Identify a conclusion that could be made regarding the Fallotaspioidea compared to the other species of trilobite.

1 mark

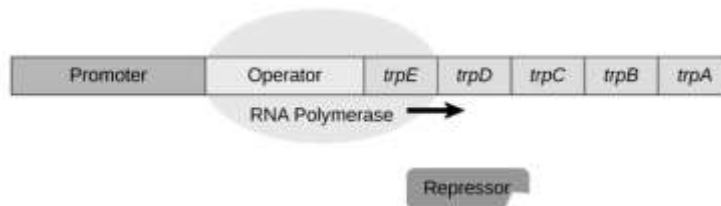
Question 8 (5 marks)

Bacteria have a system called the trp operon, which produces enzymes that are used to manufacture an amino acid, tryptophan. The diagram below shows the events that occur in the presence and absence of tryptophan.

Events that occur in the presence of tryptophan.



Events that occur in the absence of tryptophan.



- a. Explain how the trp operon is used to control the production of enzymes.

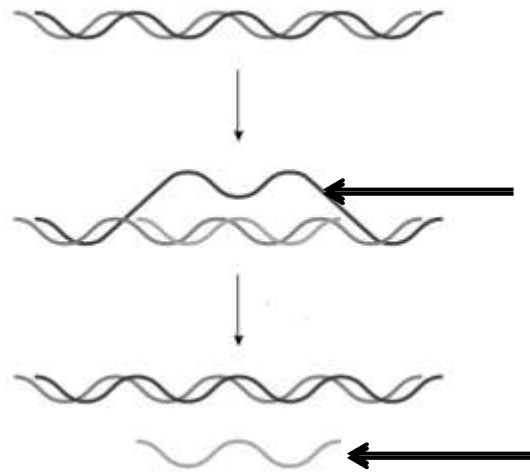
1 mark

- b. Explain how the bacteria benefits by being able to regulate the production of enzymes that enable them to produce tryptophan.

1 mark

SECTION B - continued
TURN OVER

The following process occurs in the absence of tryptophan.



- c. Identify the process being shown in the diagram above.

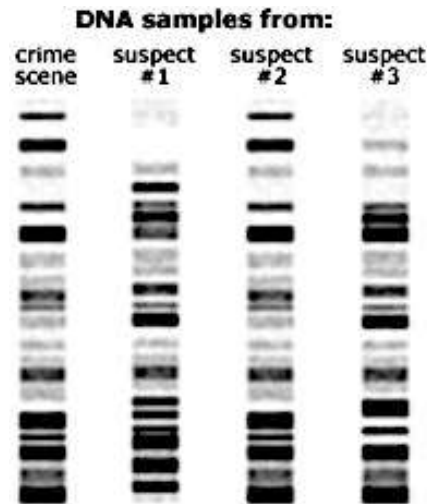
1 mark

- d. Identify two modifications that have occurred as the first substance indicated by the arrow is converted into the second substance indicated.

2 marks

Question 9 (6 marks)

The image below represents genetic fingerprints taken from a crime scene and those of three suspects. These fingerprints are generated by using the process of electrophoresis.



- a. Which of the individuals committed the crime? Provide a reason to support your answer.

1 mark

The crime scene sample was generated from a follicle attached to a single eyelash found at the crime scene. This was insufficient to generate the genetic fingerprint.

- b. Identify name of the process that would need to be carried out in order to produce sufficient DNA to generate a genetic fingerprint.

1 mark

- c. Explain how the process identified in part b is carried out. Include all of the important stages in your answer.

2 marks

SECTION B - continued
TURN OVER

2016 BIOLOGY EXAM

Some genetic diseases are caused by single alleles: however, there are a range of diseases that are caused by having an unstable number of DNA repeat sequences.

Examples include:

CONDITION	NORMAL NUMBER OF REPEATS	NUMBER OF REPEATS IN AFFECTED INDIVIDUALS
Fragile X	6 to 54 CGG repeats	200 to 1000 CGG repeats
Myotonic dystrophy	5 to 37 CTG repeats	50 to 10000 CTG repeats
Spinocerebellar ataxia	4 to 17 CAG repeats	19 to 33 CAG repeats

- d. Explain how electrophoresis could be used to diagnose these conditions.

2 marks

Question 10 (5 marks)

The cabbit is currently considered to be a fictional cross between a domestic cat (*Felis catis*) and a rabbit (*Oryctolagus cuniculus*). Although it is not uncommon to see mating occurring between male rabbits and female cats, there is currently no evidence that cabbits exist. Cats have a diploid number of 38 and rabbits have a diploid number of 44.

- a. A number of people claim to have seen cabbits or even own them, however there is still no proof. What proof would be required?

1 mark

SECTION B - continued

The table below identifies a range of species capable of producing hybrid offspring, their diploid numbers and the identification of their hybrid offspring.

Parent 1	Parent 2	Offspring
Zebra (<i>Equus quagga</i>) $2n = 44$	Donkey (<i>Equus africanus asinus</i>) $2n = 62$	Zonkey
Cow (<i>Bos Taurus</i>) $2n = 60$	Yak (<i>Bos grunniens</i>) $2n = 60$	Dzo
Camel (<i>Camelus dromedarius</i>) $2n = 74$	Llama (<i>Lama glama</i>) $2n = 74$	Cama
Lion (<i>Panthera leo</i>) $2n = 38$	Tiger (<i>Panthera tigris</i>) $2n = 38$	Liger
Horse (<i>Equus caballus</i>) $2n = 64$	Donkey (<i>Equus africanus asinus</i>) $2n = 62$	Mule
Goat (<i>Capra aegagrus hircus</i>) $2n = 60$	Sheep (<i>Ovis aries</i>) $2n = 54$	Geep

- b. When asked for an opinion, a professional stated that the production of cabbits is not possible, “because the egg and sperm must match with respect to chromosome number and other factors shared only by members of the same species or closely related species.” Is this correct? Use the information provided to support your answer.

2 marks

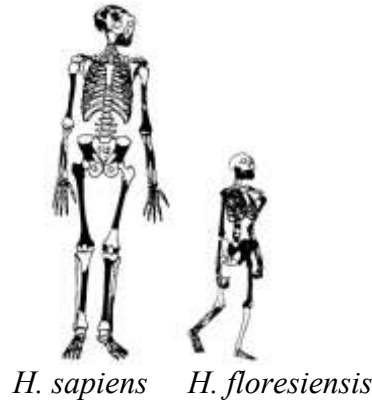
- c. With reference to the two parent species, discuss why the production of hybrids such as zonkies and mules is possible, but the production of cabbits would be impossible.

2 marks

SECTION B - continued
TURN OVER

Question 11 (6 marks)

In 2003 some hominin bones were found on a remote Indonesian island. This species was later named *Homo floresiensis*. The image below compares the skeletal structure of *Homo sapiens* to that of *Homo floresiensis*. *Homo floresiensis* has been found to have some features in common with *Homo sapiens*, such as having a foot where all toes aligned and the big toe pointed in the forward direction. However, it was found that they lack features that evolved with the ancestors of modern humans at least about 800,000 years ago, and are more similar to *Australopithecus afarensis* and *Homo erectus*.



- a. Identify one way in which *Homo sapiens* are more advanced than *Homo floresiensis*. Discuss how *Homo sapiens* benefit from having this trait.

2 marks

- b. Explain the significance of the information relating to the similarities and differences between *Homo floresiensis* and *Homo sapiens*.

2 marks

SECTION B - continued

- c. Stone tools including points and blades were found in a number of different layers dating from 90,000 to 13,000 years ago. Most of these came from the same location as the remains of the extinct pygmy elephant *Stegodon*. Identify a conclusion that could be made based upon this information.

1 mark

- d. The *Homo floresiensis* remains that were found are relatively young and unfossilised. Researchers had hoped to find mitochondrial DNA, but their initial efforts were unsuccessful. Mitochondrial DNA is used as evidence of human evolution. Identify a reason why mitochondrial DNA is useful for this purpose.

1 mark

END OF QUESTION AND ANSWER BOOK