



Units 3 and 4 Biology

Practice Exam Question and Answer Booklet

Duration: 15 minutes reading time, 2 hours and 30 minutes writing time

Structure of book:

Section	Number of questions	Number of questions to be answered	Number of marks
A	40	40	40
B	10	10	70
Total			110

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers 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:

- This question and answer booklet of 34 pages.

Instructions:

- You must complete all questions of the examination.
- Write all your answers in the spaces provided in this booklet.

Section A – Multiple-choice questions

Instructions

Answer all questions by circling your choice.

Choose the response that is correct or that best answers 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.

Questions

Question 1

The percentage of adenine in a template strand of DNA is 32%, whilst the percentage of cysteine is 12%. Which of the following is correct in relation to the complementary coding strand of the same sample of DNA?

- A. The percentage of adenine is 64%
- B. The percentage of guanine is 32%
- C. The percentage of guanine is 12%
- D. The percentage of thymine is 64%

Question 2

A small sample of eucalypt mesophyll cells were placed in concentrated salt solution for 24 hours. The cells would:

- A. Become turgid
- B. Lyse
- C. Crenate
- D. Plasmolise

Question 3

Glycosidic bonds are found in

- A. Glucose
- B. RNA
- C. Fibrous proteins
- D. Enzymes

Question 4

Amylase is a biological molecule that digests carbohydrates in the digestive tract for absorption and use as energy. It would be reasonable to assume that amylase is a:

- A. Fibrous protein
- B. Nucleic acid
- C. Globular protein
- D. Ribonucleotide

Question 5

A red blood cell was left in distilled water for 24 hours. The cell would:

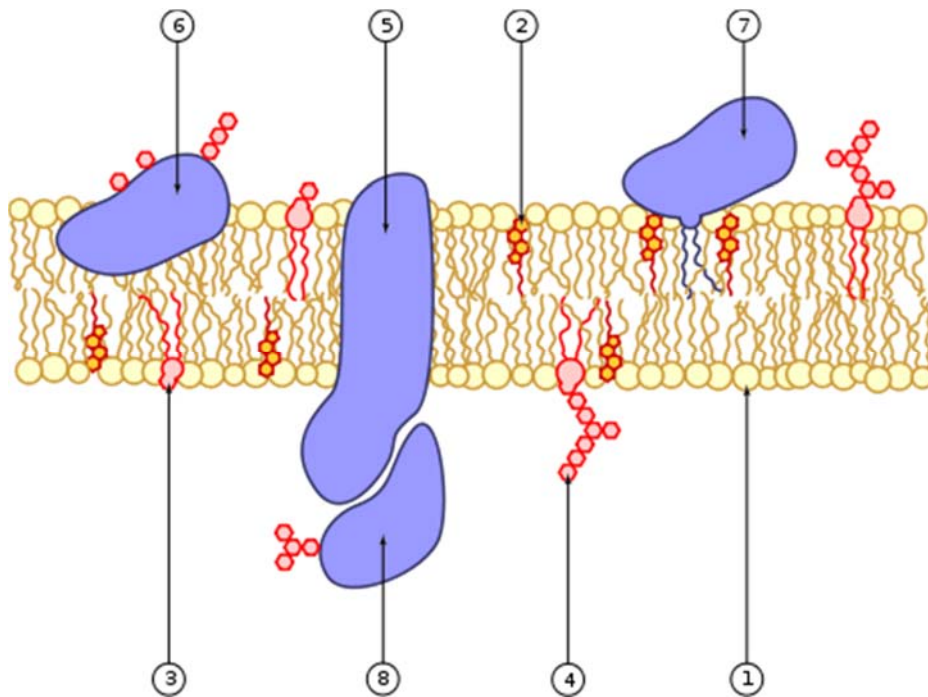
- A. Become turgid
- B. Lyse
- C. Crenate
- D. Plasmolise

Question 6

Synthesis of the phospholipid bilayer takes place in the:

- A. Golgi Apparatus
- B. Smooth Endoplasmic reticulum
- C. Lysosomes
- D. Ribosomes

Questions 7 and 8 refer to the following diagram:



Source: Wikimedia Commons

Question 7

An example of a glycopospholipid is:

- A. 5
- B. 6
- C. 2
- D. 4

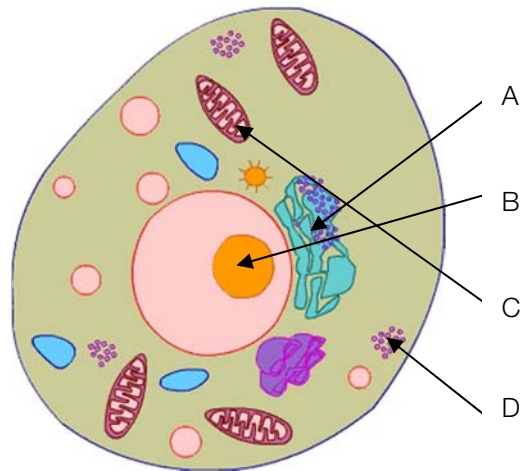
Question 8

Movement of a small, steroid hormone created by a cell with this fluid mosaic model into the extracellular space would occur via:

- A. 5
- B. 7
- C. 1
- D. 4

Question 9

Creation of the enzyme Hexokinase, used in the Glycolysis stage of cellular respiration would occur in:



- A. Organelle A
- B. Organelle B
- C. Organelle C
- D. Organelle D

Question 10

The electron transport chain is part of:

- A. Aerobic respiration and it occurs in the mitochondrial cristae.
- B. Photosynthesis and it occurs in the mitochondrial matrix
- C. Glycolysis and it occurs in the mitochondrial cristae
- D. Aerobic respiration and it occurs in the mitochondrial matrix.

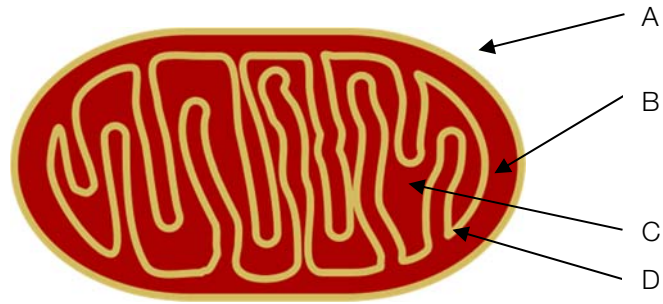
Question 11

Which of the following is not an input into the Calvin cycle?

- A. ATP
- B. H₂O
- C. NADPH
- D. CO₂

Question 12

The citric acid cycle occurs at which point in the diagram below?



Source: Wikimedia Commons

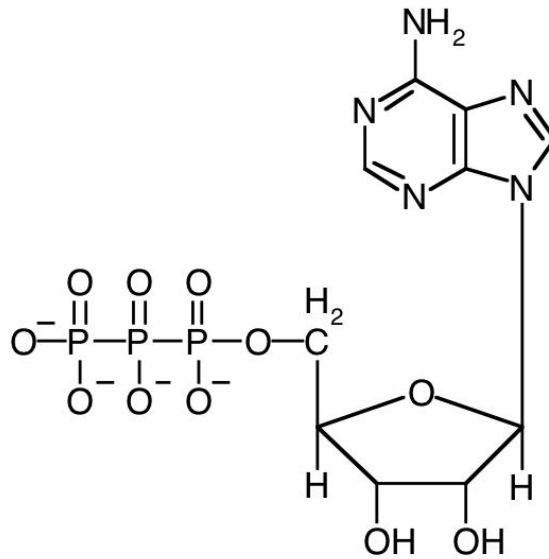
- A. A
- B. B
- C. C
- D. D

Question 13

CAM plants are commonly found:

- A. In cool, temperate regions
- B. In tropical, moist regions
- C. In arctic regions
- D. In arid, coastal regions

Question 14

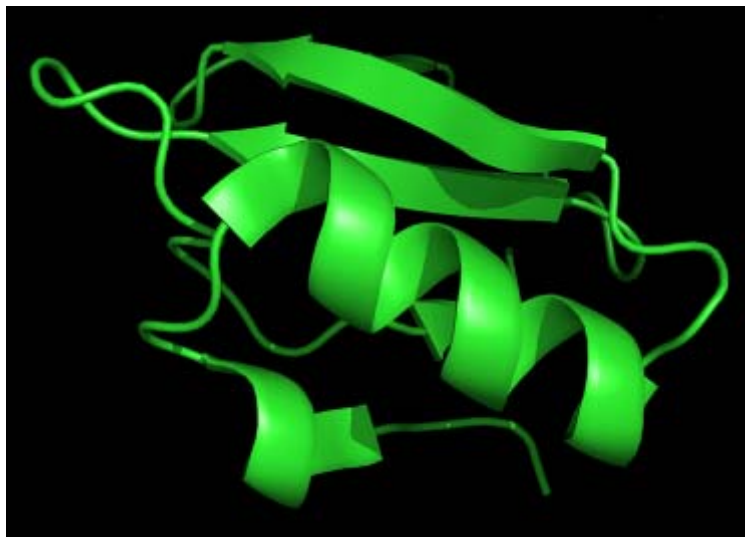


Source: Wikimedia Commons

The image shown above is of the ATP molecule. When ATP is converted to ADP, energy is released. This is an example of:

- A. A catabolic reaction
- B. An anabolic reaction
- C. A condensation reaction
- D. A mutation

Question 15



Source: Wikimedia Commons

The image above is depicting:

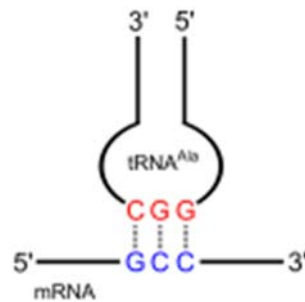
- A. A secondary protein composed of alpha helices and beta sheets
- B. A tertiary protein consisting of an alpha coil and two beta fibres.
- C. A tertiary protein consisting of alpha helices and beta sheets
- D. A secondary protein consisting of alpha coils and beta helices.

Question 16

Specific immunity involves the action of which cell group?

- A. Lymphocytes
- B. Macrophages
- C. White Blood cells
- D. Red Blood cells.

Questions 17 and 18 refer to the diagram below:



Source: Wikimedia Commons

Question 17

The diagram depicts:

- A. Translation, occurring in the nucleus
- B. Transcription, occurring in the cytosol
- C. Translational, occurring on the ribosomes
- D. Transcription, occurring on the ribosomes

Question 18

The DNA triplet that codes for Alanine (Ala) is:

- A. CGG
- B. GCC
- C. GGC
- D. CCG

Question 19

A bushwalker with a snake bite is administered some anti-venom. This is an example of:

- A. Natural, passive immunity
- B. Artificial, passive immunity
- C. Natural, active immunity
- D. Artificial, active immunity

Question 20

Anita, who has type O blood, was given a blood transfusion to help her cope with a round of chemotherapy. She had previously been administered the wrong blood type, so her doctor made certain to give her the correct blood this time.

To decide Anita's blood type, the doctor took a sample and determined which blood types her blood would agglutinate with. He would have found agglutination when mixing Anita's blood with:

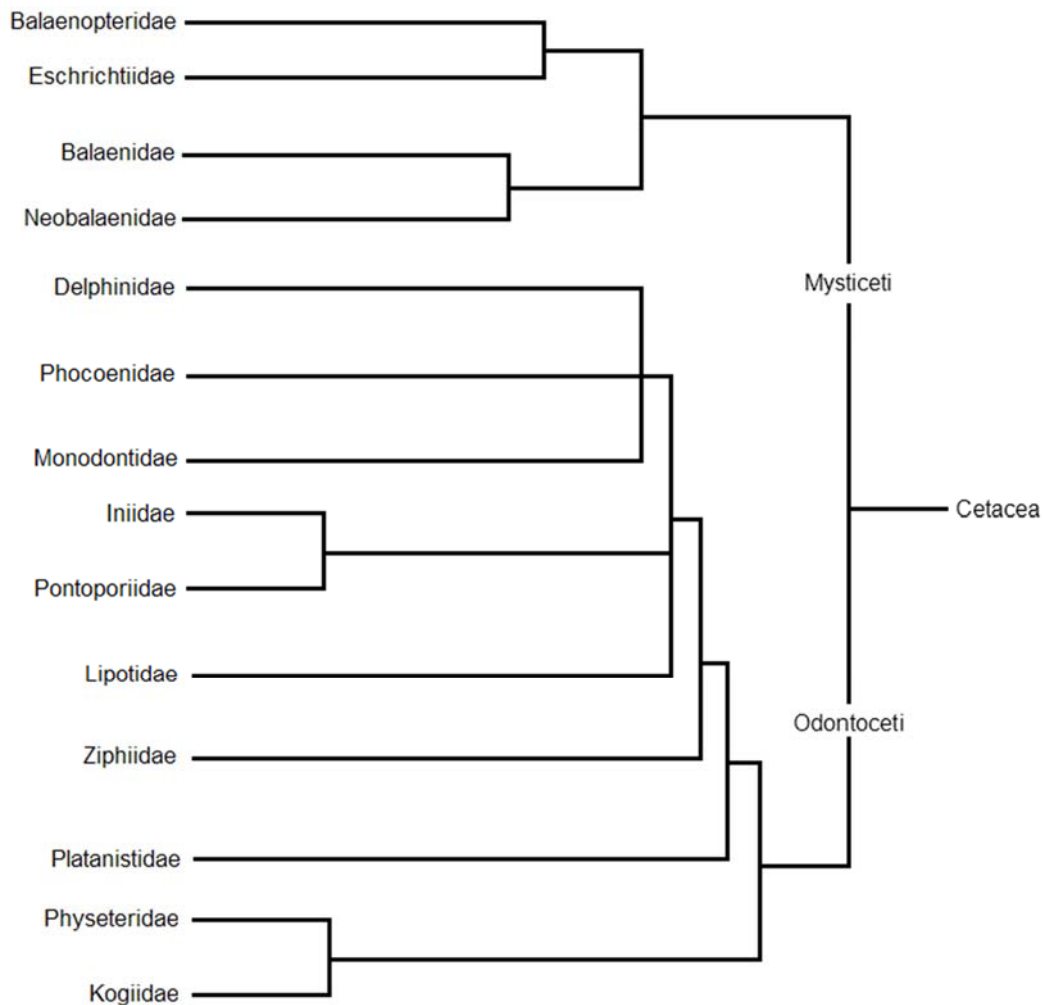
- A. Type B only
- B. Type A only
- C. Type O
- D. Type A and B

Question 21

The half life for the radioactive carbon-14 is 5730 years. If a fossil is discovered that has 1/8 of its original proportion of carbon-14, how many years since it was buried?

- A. 5730×8 years
- B. 5730×4 years
- C. 5730×2 years
- D. 5720×3 years

Question 22 refers to the following phylogenetic tree, which represents the evolution of carnivorous marine mammals:



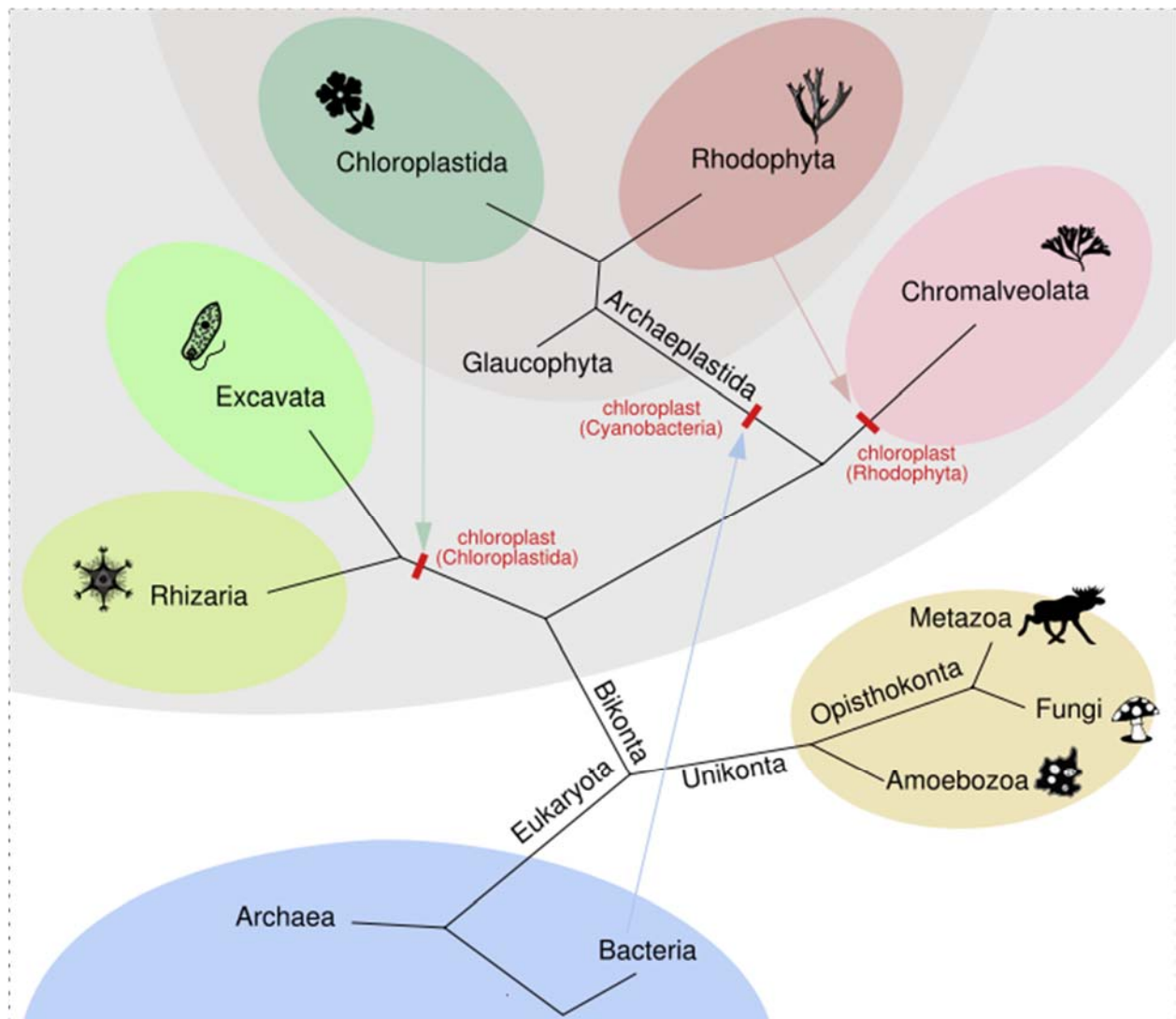
Source: Wikimedia Commons

Question 22

Which of the following is correct?

- A. Kogiidae is not descended from Cetacea
- B. Iniidae is more closely related to Monodontidae than Pontoporiidae
- C. Balaenidae and Neobalaenidae became separate species more recently than Balaenopteridae and Eschrichtiidae
- D. Ziphiidae is more closely related to Lipotidae than Lipoditae is to Pontoporiidae

Questions 23 and 24 refer to the following phylogenetic tree, which represents the evolution of chloroplasts from bacteria:



Source: Wikimedia Commons

Question 23

According to the phylogenetic tree, which of the following is **incorrect**?

- A. Rhizaria and Excavata are descended from the Chloroplastida chloroplast
- B. Fungi and Metazoa evolved after chloroplasts
- C. Metazoa descended from Eukaryota
- D. Unikonta and Bikonta are descendants of Eukaryota

Question 24

Chloroplasts are not cells in their own right, but rather organelles. What further piece of evidence regarding chloroplasts does NOT support the theory that they evolved from bacteria?

- A. Chloroplasts contain a single circular piece of DNA
- B. Chloroplasts are morphologically similar to bacteria
- C. Chloroplasts contain many genes similar to genes carried by bacteria
- D. Chloroplasts reproduce via binary fission, as do bacteria.

Question 25

Which of the following is an absolute dating technique?

- A. Radiative dating
- B. Comparative anatomy
- C. Homologous features
- D. Stratigraphy

Question 26

The wing of a bat and the wing of a butterfly are examples of:

- A. Homologous features
- B. Analogous features
- C. Vestigial structures
- D. Comparative embryology

Question 27

Source: Wikimedia Commons

The coat pattern on the cows in the image are a result of:

- A. Incomplete dominance
- B. Co-dominance
- C. Albinism
- D. A Genetic mosaic

Question 28

X-linked recessive disorders always display

- A. Mother to daughter inheritance patterns
- B. Father to son inheritance patterns
- C. Father to daughter inheritance patterns
- D. Mother to son inheritance patterns

Question 29

Unlike eukaryotes, prokaryotes contain genetic material contained in:

- A. A diploid number of plasmids
- B. A circular chromosome and plasmids
- C. A haploid number of plasmids
- D. A circular chromosome and small, linear plasmids

Question 30

In order for two populations to be declared separate species they must:

- A. Be geographically isolated
- B. Have a different skeletal structure
- C. Be unable to interbreed and produce viable offspring
- D. Have different physiological processes

Questions 31 and 32 refer to the following table:

A cow breeding stud has horses of the following colours:

Colour	Allelic symbols	Number of cows
White cows	WW	10
Roan cows	RW	10
'Red' cows	RR	30

Question 31

What is the frequency of the 'R' allele in the population of the stud?

- A. 0.3
- B. 0.7
- C. 0.6
- D. 0.5

Question 32

What is the frequency of the 'W' allele in the population of the stud?

- A. 0.2
- B. 0.1
- C. 0.4
- D. 0.3

Question 33

A phenotypically normal couple has a child with red green colour blindness, an X-linked recessive trait. What is the chance that their next child will be a boy and have red green colour blindness?

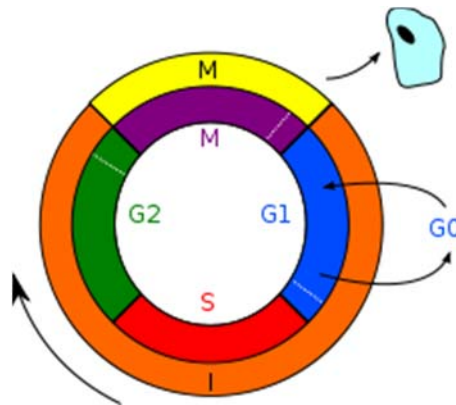
- A. 0.25
- B. 0.5
- C. 0.125
- D. 0.0

Question 34

What is the chance that the couple from Question 33 has a daughter that has red green colour blindness?

- A. 0.25
- B. 0.5
- C. 0.125
- D. 0.0

Questions 35 and 36 refer to the diagram below:



Source: Wikimedia Commons

Question 35

At the beginning of the G1 phase of the cell cycle shown above, the cell is:

- A. Diploid, with double chromosomes
- B. Diploid, with single chromosomes
- C. Haploid, with double chromosomes
- D. Haploid, with single chromosomes

Question 36

Upon the completion of the G2 phase, the cell is:

- A. Diploid, with double chromosomes
- B. Diploid, with single chromosomes
- C. Haploid, with double chromosomes
- D. Haploid, with single chromosomes

Question 37

Histones are:

- A. Small proteins that help keep chromatin coiled up.
- B. Proteins that hold DNA strands together at the centromere
- C. Proteins that allow DNA to be transcribed
- D. Small proteins that are involved in cell support and structure

Question 38

Which of the following does **not** occur to pre-mRNA before it becomes post-transcriptional mRNA and enters the cytosol to undergo translation?

- A. Introns are removed
- B. A methyl cap is added
- C. Thymine residues are replaced with Uracil residues
- D. A poly'A tail is added

Questions 39 and 40 refer to the following information:

In humans, the presence of freckles is dominant (FF or Ff) and not having freckles (ff) is recessive. Having an oval face is dominant (OO or Oo) and a square face (oo) is recessive.

Question 39

A couple, both with oval faces and freckles, have a child with a square face and without freckles.

The probability that their next child will have a oval face and no freckles is:

- A. 3/16
- B. 1/16
- C. 9/16
- D. 15/16

Question 40

The probability that their next child will have freckles is:

- A. 3/16
- B. 8/16
- C. 9/16
- D. 12/16

Section B – Short-answer questions

Instructions

Answer all questions in the spaces provided.

Unless otherwise indicated, the diagrams in this book are not drawn to scale.

Questions

Question 1

Sickle cell anemia is an inherited disease where the red blood cells of the sufferer have a 'sickled shape', making them less efficient at carrying oxygen, which leads to a host of symptoms such as jaundice of the skin, rapid heart rate, fatigue and shortness of breath.

The most common mutation causing sickle cell anemia is a single amino acid change as a result of the mRNA codon being changed from GAG to GUG.

		2nd base					
		U	C	A	G		
1st base	U	UUU Phenylalanine UUC Phenylalanine UUA Leucine UUG Leucine	UCU Serine UCC Serine UCA Serine UCG Serine	UAU Tyrosine UAC Tyrosine UAA Stop UAG Stop	UGU Cysteine UGC Cysteine UGA Stop UGG Tryptophan	U C A G	3rd base
	C	CUU Leucine CUC Leucine CUA Leucine CUG Leucine	CCU Proline CCC Proline CCA Proline CCG Proline	CAU Histidine CAC Histidine CAA Glutamine CAG Glutamine	CGU Arginine CGC Arginine CGA Arginine CGG Arginine	U C A G	
	A	AUU Isoleucine AUC Isoleucine AUA Isoleucine AUG Methionine (Start)	ACU Threonine ACC Threonine ACA Threonine ACG Threonine	AAU Asparagine AAC Asparagine AAA Lysine AAG Lysine	AGU Serine AGC Serine AGA Arginine AGG Arginine	U C A G	
	G	GUU Valine GUC Valine GUA Valine GUG Valine	GCU Alanine GCC Alanine GCA Alanine GCG Alanine	GAU Aspartic Acid GAC Aspartic Acid GAA Glutamic Acid GAG Glutamic Acid	GGU Glycine GGC Glycine GGA Glycine GGG Glycine	U C A G	

Source: Wikimedia Commons

- a. What amino acid change has occurred? Use the codon table above.

1 mark

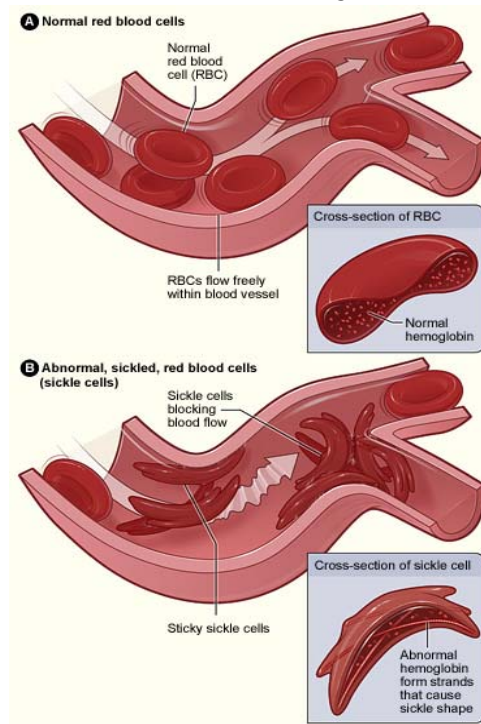
- b. What type of mutation is this?

1 mark

- c. Explain the process that occurs in the nucleus before a protein can be synthesised in the cytosol.

3 marks

- d. Examine the image below showing the physical differences between a sickled cell and a normal red blood cell. Explain, in terms of the interactions between structural proteins in the cell, how one amino acid change could create such a different looking cell.

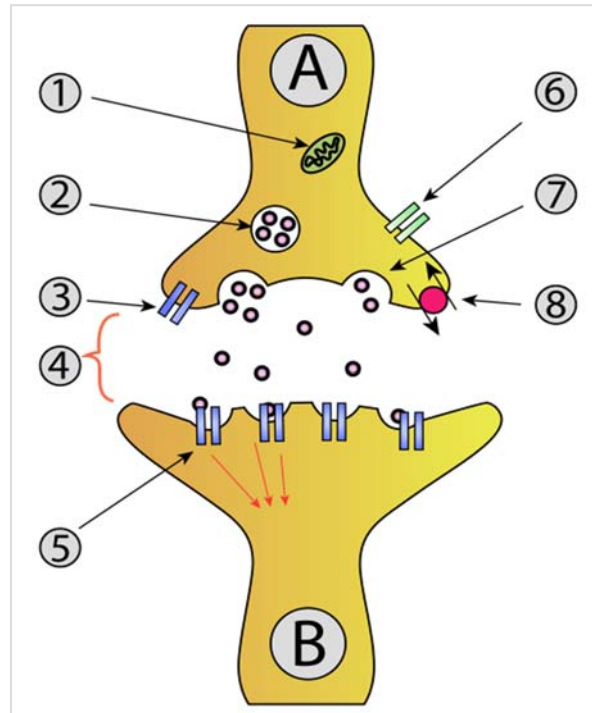


Source: Wikimedia Commons

2 marks

Total: 7 marks

Question 2



Source: Wikimedia Commons

- a. Examine the image above. What do the following numbers represent?

1:

2:

3:

4:

4 marks

- b. The image depicts a section of a nervous response. What are three differences between nervous and endocrine responses?

	Nervous responses	Endocrine Responses
1.		
2.		
3.		

3 marks

Total: 7 marks

Question 3

- a. Terry is allergic to pollen. He develops extremely watery eyes when exposed to pollen, and has visited you, his doctor, for an explanation. Explain, using scientific terms, what happens to Terry's eyes when he is exposed to pollen.

3 marks

The molecule TSLP (thymic stromal lymphopoietin) is associated with allergies. It activates and regulates the immune system. It is thought that low levels of TSLP may trigger the immune system to become overactive and cause allergies to occur.

You are a researcher trying to prove this. You have: mice, common allergens to mice such as dust and chemicals, and TSLP molecule in a form that you can administer to the mice.

- b. Provide a hypothesis for your experiment.

1 mark

c. Briefly outline the method of your experiment

3 marks

d. What results would support your hypothesis?

1 mark

Total: 8 marks

Question 4

Examine the image below of enzyme activities at differing pH levels.

- a. Annotate on the graph which curve represents pepsin, which is produced in the stomach, and which curve represents salivary amylase, produced in the mouth.



Source: Wikimedia Commons

2 marks

- b. On the axes provided, draw an activity curve for the enzyme pepsin as its temperature is raised from zero to forty degrees Celsius. Label the axes and provide a title.



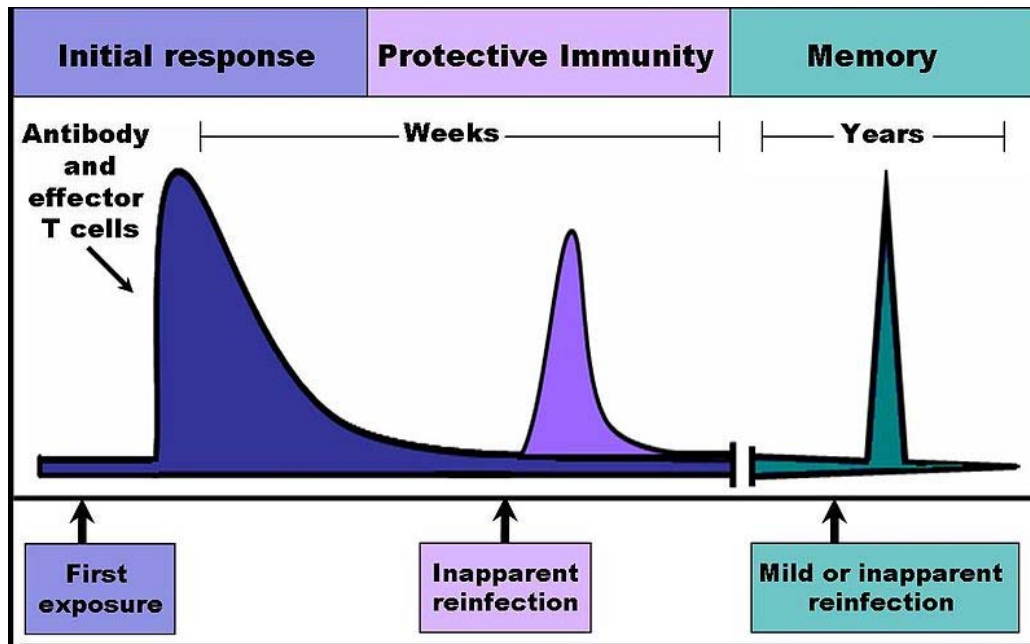
1 mark

- c. Describe in detail what happens to the structure and function of an enzyme when it is heated past its optimum temperature.

3 marks

Total: 6 marks

Question 5



Source: Wikimedia Commons

Examine the image above depicting the specific immune response.

- a. What is meant by 'memory'? Where is 'memory' stored?

2 marks

- b. Describe the sequence of events occurring involving B lymphocytes at the point 'Inapparent reinfection'

2 marks

- c. B Plasma lymphocytes have been shown to have large amounts of rough endoplasmic reticulum and Golgi bodies in their cytosol. Why would this be the case?

1 mark

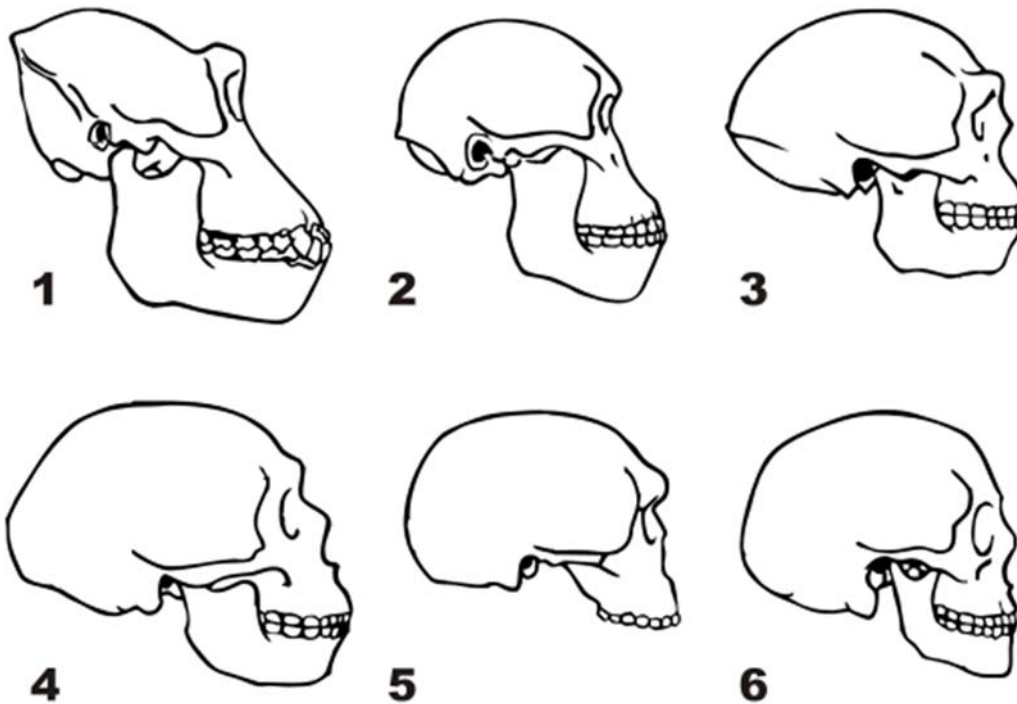
- d. Describe a form of active immunity (natural or artificial) where the graph shown above would be applicable.

2 marks

Total: 7 marks

Question 6

Examine the six skulls from the *Homo* line below.



Source: Wikimedia Commons

- a. Describe two features that differentiate the first ape-like skull and the last, Homo Sapiens Skull. Give reasons for the development of these features.

Feature one:

Feature two:

4 marks

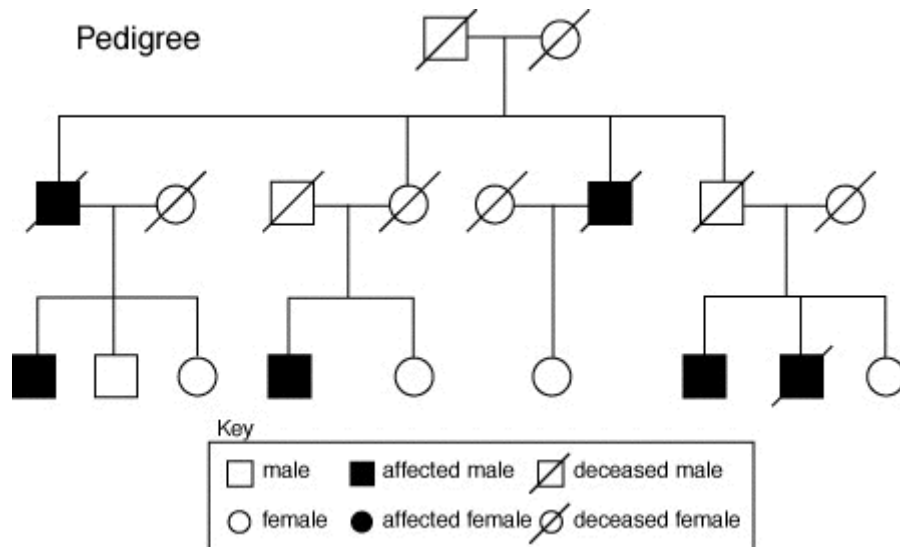
- b. Describe the process of Charles Darwin's speciation through natural selection using a feature in the anatomy of the human skull as an example.

3 marks

Total: 7 marks

Question 7

Examine the following pedigree for the **autosomal** trait of albinism.



Source: Wikimedia Commons

- a. Assign a correct numbering system to all individuals in the pedigree.

1 mark

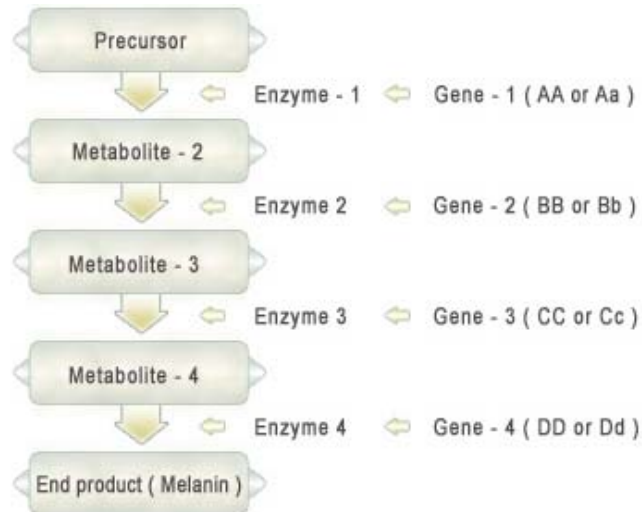
- b. Is albinism a dominant or recessive trait? Provide an example which justifies your answer.

2 marks

- c. According to your numbering system from part a, locate individual III9. If III9 has a child with an affected male, what would be the chance that their child would be albino? Justify your answer. There may be more than one possibility; include all chances.

2 marks

Albinism develops due to lack of a pigment called melanin. Melanin is produced through a complex pathway, as shown below involving several enzymes. Lack of just one of the enzymes or signalling molecules involved in the pathway can prevent production of melanin. As can be seen, being homozygous recessive for gene 1, 2, 3 or 4 will ultimately lead to no production of melanin and thus, Albinism.



Source: Agricos.com

- d. Two individuals, both heterozygous for Gene 1 and Gene Two, decide to have a child. What is the probability that the child will be albino? Justify your answer. Punnet squares may be useful.

3 marks

Total: 8 marks

Question 8

A small sample of DNA is extracted from a hair left at a murder crime scene. As is practice with small fragments of DNA, it was amplified using PCR.

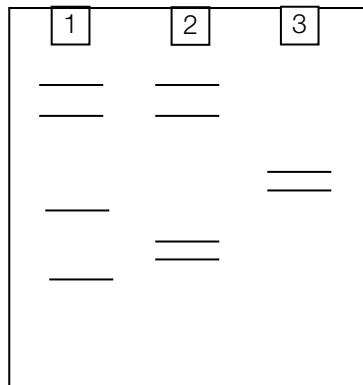
- a. What does PCR stand for?

1 mark

- b. Describe, using a diagram in the space provided, how PCR works.

4 marks

The product of the PCR was subject to gel electrophoresis, and the DNA hair sample was compared with hair samples of two suspects. The results of the gel are as follows:



1: Hair Sample, 2: Suspect One, 3: Suspect Two

c. Which suspect was at the crime scene? Explain your answer.

2 marks

Total 7 marks

Question 9

The Afrikaner population located in South Africa is descended from a small number of Dutch colonists. Huntington's disease, which affects cognitive and neuromuscular function, is particularly prevalent among the Afrikaner population.

- a. What type of genetic drift has occurred? Justify your response.

2 marks

- b. As a population geneticist, what would be your advice to the Afrikaner population to reduce the risk of Huntington's disease in future generations? Why would you give this advice?

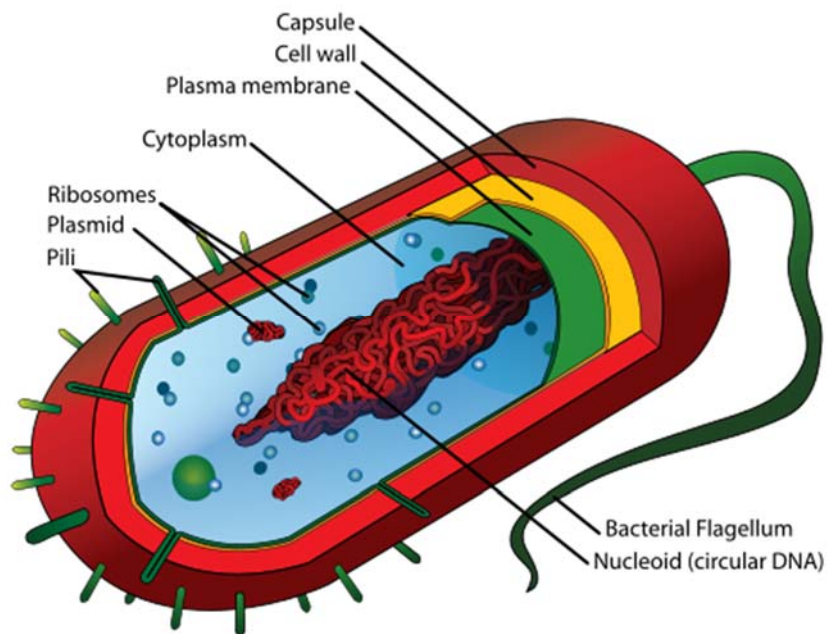
2 marks

- c. Are there any social or ethical factors involved in giving this advice?

1 mark

Total: 5 marks

Question 10



Source: Wikimedia Commons

- a. Which part of the bacterial cell shown above has been an indispensable tool in gene transformation development in recent years?

1 mark

- b. Describe two characteristics of this biological molecule that have enabled its use as a gene transformation vector.

2 marks

- c. Provide an example of a gene technology where ethical issues are present. What are two ethical arguments for and against this technology?

Technology:

1 mark

Ethical arguments for use of technology

Ethical arguments against use of technology

4 marks

Total: 8 marks

End of Booklet

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