



INSIGHT

YEAR 12 Trial Exam Paper

2013

BIOLOGY

Written examination

STUDENT NAME:

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

QUESTION AND 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 the following items into the examination: 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 provided

- Question and answer book of 47 pages.
- Answer sheet for multiple-choice questions.

Instructions

- Write your **name** in the box provided.
- 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.

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CONTINUES OVER PAGE

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.

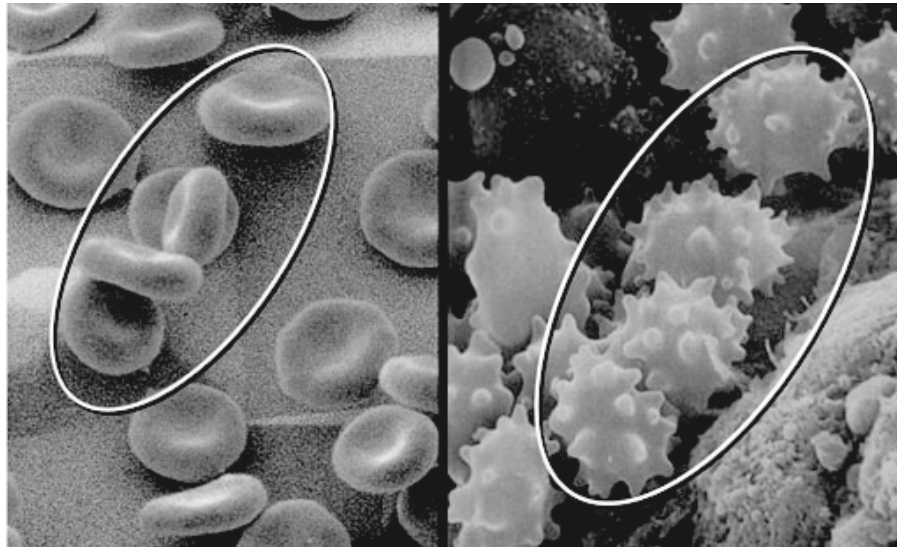
Question 1

Which of the following molecules would be most soluble in water?

- A. steroid hormone
- B. amino acid
- C. lipid
- D. cholesterol

The following information relates to Questions 2 and 3.

A sample of human blood cells is placed in a solution for 3 hours and once removed, the sample is immediately observed by a biologist under a light microscope. The images show the observations of the biologist.



Time = 0 hours

Time = 3 hours

Source: Modified from <<http://www.chemistryland.com/CHM151S/11-PropertiesOfSolutions/Hypertonic.jpg>>

Question 2

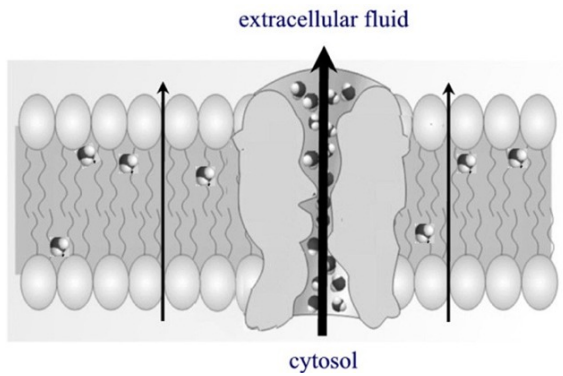
The name of the process that has occurred is

- A. active transport.
- B. cytolysis.
- C. plasmolysis.
- D. crenation.

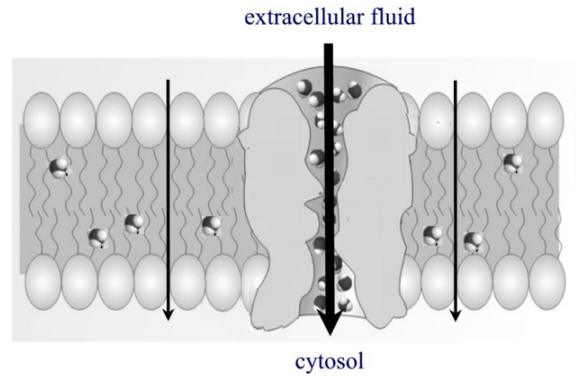
Question 3

Aquaporins are proteins that form channels in the lipid bilayer of the plasma membrane. If red blood cells were placed in a hyposaline solution for several hours, which diagram shows the process most likely to occur?

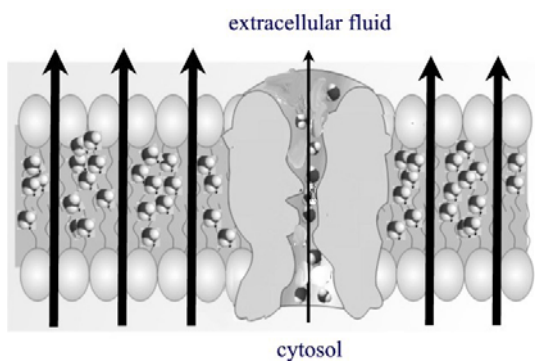
A.



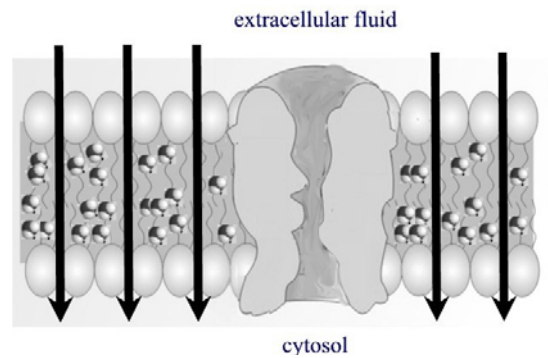
B.



C.



D.



Source: Opossum58, 2007. Modified from <http://en.wikipedia.org/wiki/Aquaporin>

Question 4

The majority of biomolecules are known to form polymers. The biomolecule which does NOT form a polymer is a

- A. lipid.
- B. fatty acid.
- C. monosaccharide.
- D. nucleotide.

**SECTION A – continued
TURN OVER**

Question 5

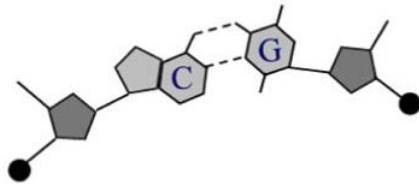
At a molecular level, the structure of proteins is determined using such techniques as X-ray crystallography, nuclear magnetic resonance (NMR) spectroscopy and dual polarisation interferometry. A structural biologist would expect that the secondary structure could be held together by

- A. β pleated sheets.
- B. disulfide bridges.
- C. ionic bonds.
- D. hydrogen bonds.

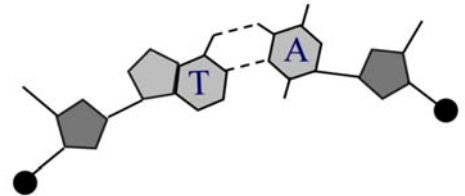
Question 6

Deoxyribonucleic acid (DNA) is comprised of a double strand of nucleotides linked in a specific bonding pattern. The bases of the nucleotides are attracted to each other and form hydrogen bonds. In the diagrams below, which representation shows the correctly bonded pair of complementary bases?

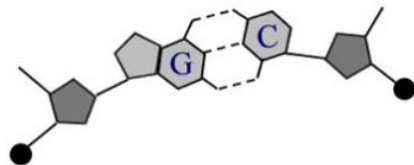
A.



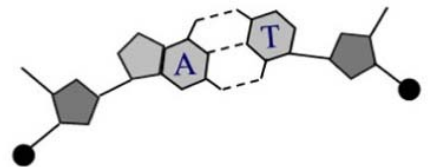
B.



C.

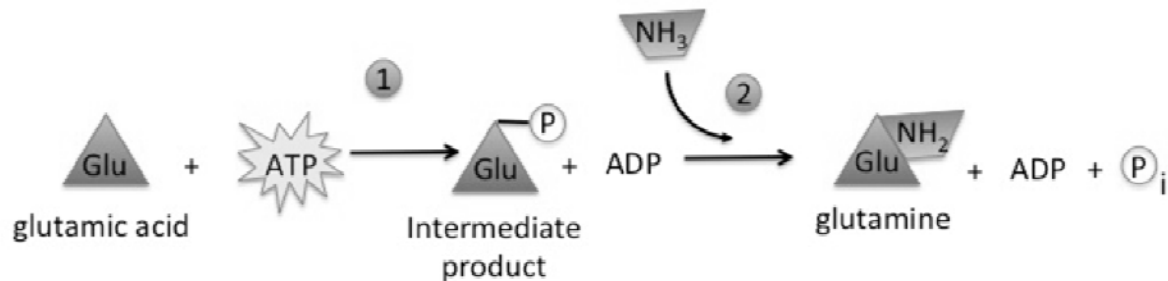


D.



The following information relates to Questions 7, 8 and 9.

Glutamine is a non-essential amino acid in the human body and is capable of crossing the blood–brain barrier. It is found circulating in the blood and stored in skeletal muscles. It becomes conditionally essential during illness or injury. Formation of glutamine will only occur in the presence of ATP.



Question 7

During shivering, the hydrolysis of ATP enables contraction of muscle fibres and releases heat to warm the body. Most cells do not use heat as a source of energy because

- A. heat is an inefficient form of energy.
- B. enzymes are denatured by heat.
- C. metabolism occurs without the energy derived from heat.
- D. it disperses rapidly from its source and is difficult to harness.

Question 8

The diagram shows the formation of glutamine in the presence of ATP. The process can be described as

- A. anabolic and endergonic.
- B. anabolic and exergonic.
- C. catabolic and endergonic.
- D. catabolic and exergonic.

Question 9

When ATP is available, the formation of glutamine is

- A. endergonic and does not occur spontaneously.
- B. endergonic and occurs spontaneously.
- C. exergonic and does not occur spontaneously.
- D. exergonic and occurs spontaneously.

Question 10

Prednisolone is a synthetic steroid hormone that can be used to treat inflammatory conditions such as croup, allergic disorders and cancer. It is administered in an inactive form, which is then converted to the active form, prednisolone, by 11 beta-hydroxysteroid dehydrogenase in the liver. Once it has been activated it travels via the bloodstream to the target cells.

Prednisolone is transported

- A. dissolved in the bloodstream.
- B. bound to a specific carrier protein.
- C. in peroxisomes.
- D. in lysosomes.

Question 11

The target receptors for prednisolone are found

- A. in the cytosol of target cells.
- B. on the plasma membrane of target cells.
- C. on the mitochondrial membranes of target cells.
- D. within the nucleus of target cells.

Question 12

Which of the following organelles is associated with the production of protein by a cell?

- A. nucleus
- B. ribosome
- C. cytoskeleton
- D. plasmodesmata

The following information relates to Questions 13 and 14.

A study published in 2010 that investigated egg allergy in 1-year-old children, found that introducing cooked egg to infants between 4 to 6 months of age may protect against developing egg allergy. This supported the idea of a 'critical window' between 4 to 6 months when exposure to potentially allergenic foods may induce immune tolerance and protect against food allergy.

The results of the study are summarised in the table. Duration of breastfeeding and age at which solid foods were introduced in the diet were not associated with egg allergy.

	Risk of allergy	
	Lower	Higher
First exposure to egg	cooked	uncooked
Age at first exposure	4–6 months	after 6 months

Question 13

The results of the study suggest that in order to reduce the risk of egg allergy in infants, it is best to introduce

- A. uncooked egg to infants between the ages of 4 and 6 months of age.
- B. uncooked egg to infants after 6 months of age.
- C. cooked egg to infants between the ages of 4 and 6 months of age.
- D. cooked egg to infants after 6 months of age.

Question 14

As part of the study, infants underwent skin testing and oral food challenges to establish the presence of immunoglobulin (IgE)-mediated egg allergy. Immunoglobulins are also known as

- A. anticodons.
- B. antigens.
- C. antidotes.
- D. antibodies.

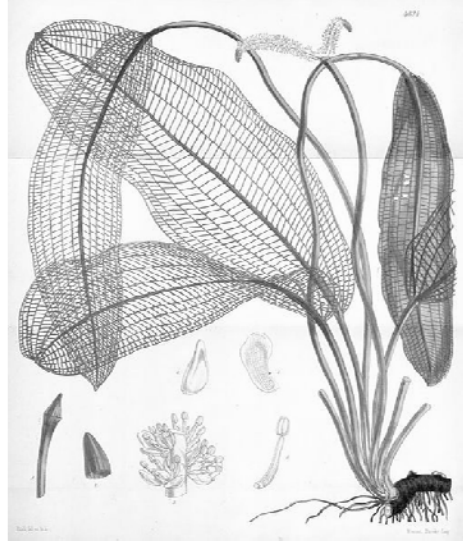
Question 15

Which summary is correct for immunoglobulins?

	Location	Number of polypeptide chains	Description
A.	B cells	4	2 heavy chains, 2 light chains
B.	B cells	2	1 α chain, 1 β chain
C.	T cells	4	2 heavy chains, 2 light chains
D.	T cells	2	1 α chain, 1 β chain

Question 16

The aquatic lace plant (*Aponogeton madagascariensis*) is endemic to Madagascar and is recognised by a characteristic regular pattern of holes in the leaves. These holes appear as a result of a process that occurs in all animals and plants as part of normal development and in response to the environment.



Source: Modified from James Hooker, 1956.

<http://en.wikipedia.org/wiki/File:Aponogeton_madagascariensis.jpg>

The process that gives rise to this leaf morphology is

- A. necrosis.
- B. chemiosmosis.
- C. meiosis.
- D. apoptosis.

The following information relates to Questions 17 and 18.

When the wild tobacco plant *Nicotiana attenuata* (*N. attenuata*) grows in its natural habitats in North America it is attacked by the larvae of the tobacco hornworm *Manduca sexta*. In response to being attacked by the larvae, the plant emits substances that attract *Geocoris* bugs, which are predators of the larvae. In *N. attenuata* the **lox3** gene is essential for the production of jasmonic acid, the substance which enables the activation of defence against herbivores.

Question 17

The jasmonic acid emitted by *N. attenuata* acts as a plant pheromone. A plant pheromone is a chemical that is capable of

- A. acting externally of the secreting organism to affect the behaviour of the receiving individual.
- B. acting within the secreting organism to affect the behaviour of the receiving individual.
- C. triggering a response but only in members of different species.
- D. triggering a response but only in members of the same species.

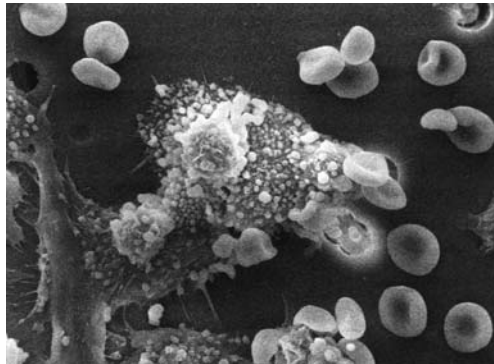
Question 18

When researchers from the Max Planck Institute for Chemical Ecology used transgenic *N. attenuata* plants in field experiments, they noticed that these plants became heavily infested with *M. sexta*. The most reasonable conclusion would be that the

- A. hormonal signalling cascades of the *Geocoris* bugs had been interrupted by the introduction of transgenic *N. attenuata*.
- B. hormonal signalling cascades of the *M. sexta* larvae had been interrupted by the introduction of transgenic *N. attenuata*.
- C. *lox3* gene had been switched off, preventing the production of jasmonates.
- D. *M. sexta* larvae were attacking and eating the *Geocoris* bugs.

Question 19

This image shows a cancer cell.



The cells fused to the cancer cell are most likely to be

- A. erythrocytes.
- B. macrophages.
- C. mast cells.
- D. dendritic cells.

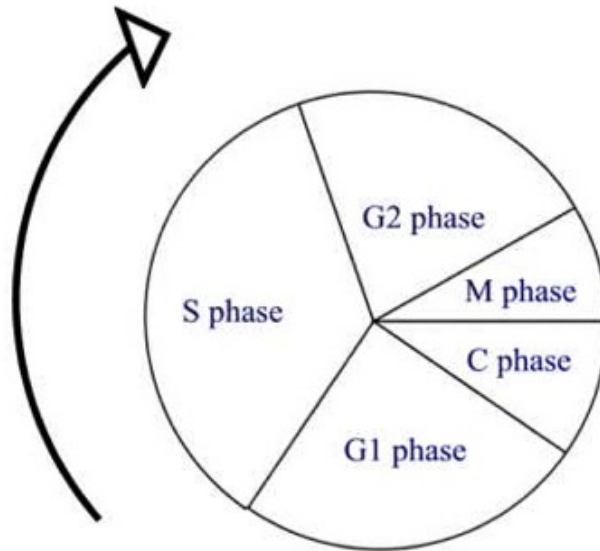
Question 20

An epitope is the accessible region of an antigen that binds with the

- A. antigenic determinant.
- B. antibody tail.
- C. antibody binding site.
- D. antigen binding site.

Question 21

The cell cycle describes the continuous sequence of events that takes place from one cell division to the next. The following diagram represents the life cycle of a cell.



It would be expected that the mass of a single cell will have decreased by around fifty per cent by

- A. S phase.
- B. G1 phase.
- C. G2 phase.
- D. M and C phase.

Question 22

When a eukaryote cell prepares to divide, it duplicates each of its chromosomes.



How many homologous chromosomes are present in this diagram?

- A. 0
- B. 1
- C. 2
- D. 3

Question 23

During anaphase I of meiosis

- A. homologous pairs of chromosomes are drawn apart to opposite sides of the dividing cell.
- B. homologous pairs of chromosomes are assembled together on the spindle of the dividing cell.
- C. sister chromatids separate and are drawn apart to opposite sides of the dividing cell.
- D. sister chromatids are still connected and assemble together on the spindle of the dividing cell.

Question 24

The image shows the short-beaked echidna *Tachyglossus aculeatus*.



Source: Skyring, 2005. Modified image from <<http://en.wikipedia.org/wiki/File:EchidnainCanberra.JPG>>

In the short-beaked echidna the diploid number is 64 in females and 63 in males. Sex determination in the short-beaked echidna follows the XY system. In addition, the short-beaked echidna has a system of multiple sex chromosomes, in which males have four Y chromosomes and five X chromosomes.

The number of autosomes present in a single normal spermatocyte could be

- A. 26
- B. 27
- C. 28
- D. 29

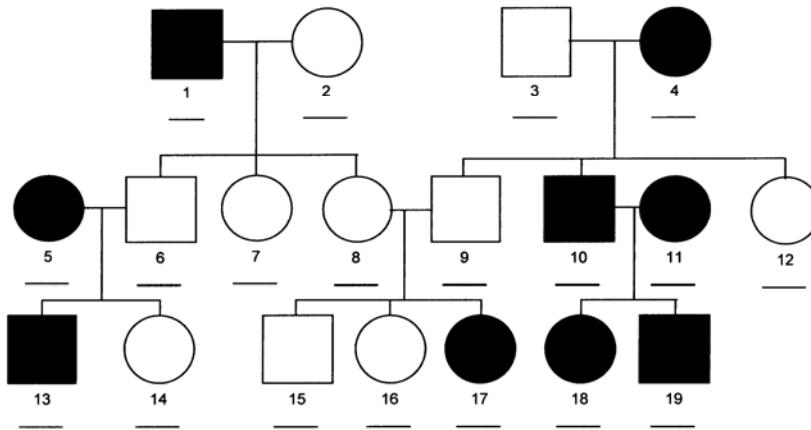
Question 25

There are many levels of organisation in a chromosome. In eukaryotes, the DNA molecule coils around interacting proteins, forming a supercoiled structure that is also known as

- A. chromatin.
- B. a histone.
- C. a nucleosome.
- D. a centromere.

The following information relates to Questions 26, 27 and 28.

In the following human pedigree, the shaded individuals have the trait being investigated.



Question 26

The mode of inheritance of the trait is

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

Question 27

For the trait shown in the pedigree, Individual 15 can only be

- A. homozygous recessive.
- B. heterozygous.
- C. homozygous dominant or heterozygous.
- D. heterozygous or hemizygous.

Question 28

If Individual 5 and Individual 6 have a third child, what is the chance the child will be recessive for the trait?

- A. 25%
- B. 50%
- C. 75%
- D. 100%

SECTION A – continued
TURN OVER

Use the following information to answer Questions 29 and 30.

The image shows a green anole lizard.



Source: Paul Hirst, 2006. Modified from
<http://upload.wikimedia.org/wikipedia/commons/4/4a/Anole_Lizard_Hilo_Hawaii_edit.jpg>

In the breeding season, male anole lizards court females by bobbing their heads up and down while displaying a colourful throat patch. Both males and females bob their heads and have coloured throat patches. Lizards that bob their heads fast (F) and have red throat patches (R) have greater mating success.

Gene for head bobbing	F	fast	Gene for throat patch colour	R	red
	f	slow		r	yellow

Question 29

These genes assort independently, which suggests that both traits are

- A. controlled by a single locus on separate chromosomes.
- B. controlled by several loci on the same chromosome.
- C. found on homologous chromosomes.
- D. considered to be linked.

Question 30

A fast-head-bobbing, red-throated male mates with a fast-bobbing, yellow-throated female. The F₁ offspring produced from this mating are shown in the table.

Fast-bobbing, red-throated	Slow-bobbing, red-throated
12	4

Respectively, the genotypes of the male and female are

- A. *FfRR, Ffrr*.
- B. *FfRr, Ffrr*.
- C. *FfRr, FfRr*.
- D. *FFRR, FfRr*.

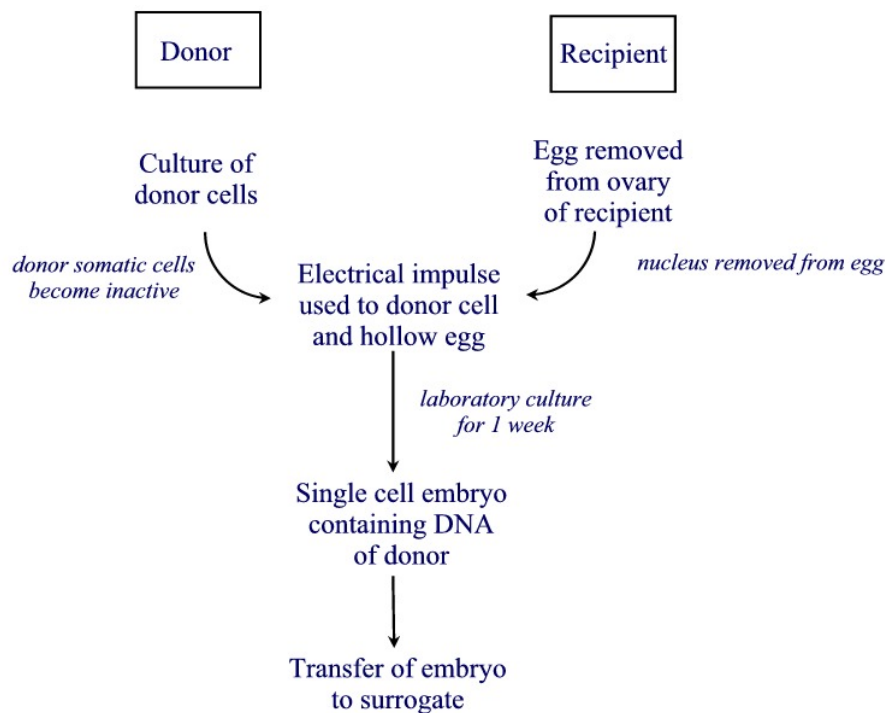
Question 31

Recently a human skeleton with a misshapen spine was found under a car park in Leicester in the United Kingdom. On the basis of a mitochondrial DNA (mtDNA) match, a team of scientists conclusively proved these were the remains of King Richard III. Crucially for genealogists the mtDNA sequence is

- A. identical to the nuclear DNA of a cell.
- B. combined with the nuclear DNA of a cell.
- C. passed down the maternal line almost unchanged across many generations.
- D. passed down the paternal line almost unchanged across many generations.

Question 32

The diagram shows the steps involved in the technique of animal cloning by nuclear transfer.



The chromosomes of the embryo will be

- A. identical to those of the recipient.
- B. a hybrid of those from the donor and the recipient.
- C. a haploid arrangement of those from the donor.
- D. identical to those of the donor.

Question 33

Examine the following diagram.



Source: Brian Derksen, 2006. Modified from

<http://commons.wikimedia.org/wiki/File:EcoRI_restriction_enzyme_recognition_site.svg>

This diagram is a representation of

- A. DNA sequencing.
- B. polymerase chain reaction.
- C. gel electrophoresis.
- D. a restriction enzyme producing a DNA fragment.

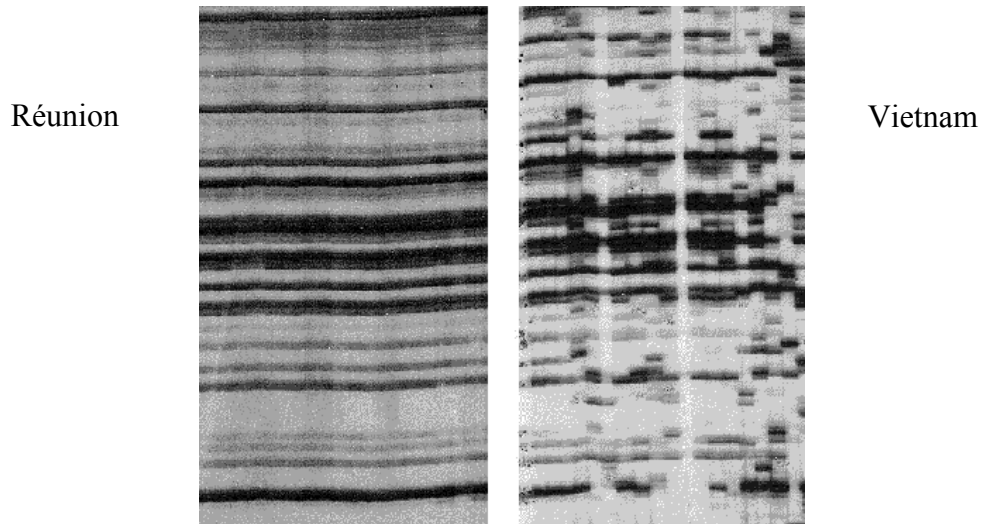
Question 34

In populations, a single characteristic can be controlled by more than one gene. In humans, eye colour is controlled by at least six different genes and is an example of polygenic inheritance. With respect to eye colour, the human population demonstrates

- A. no variation.
- B. discontinuous variation.
- C. continuous variation.
- D. temporal variation.

Question 35

The Asian bramble (*Rubus alceifolius*) is an introduced weed on some Pacific islands. Genetic variation was studied by means of a DNA fingerprint technique called amplified fragment length polymorphisms (AFLP). Each vertical lane on the gel represents DNA from a single individual; each AFLP band is thought to represent an independent DNA fragment, and polymorphisms are revealed by presence or absence of bands. In its native range in Vietnam, this species is highly polymorphic, while in an introduced population on the island of Réunion, no polymorphisms are observed. This suggests that the founder population was very small.



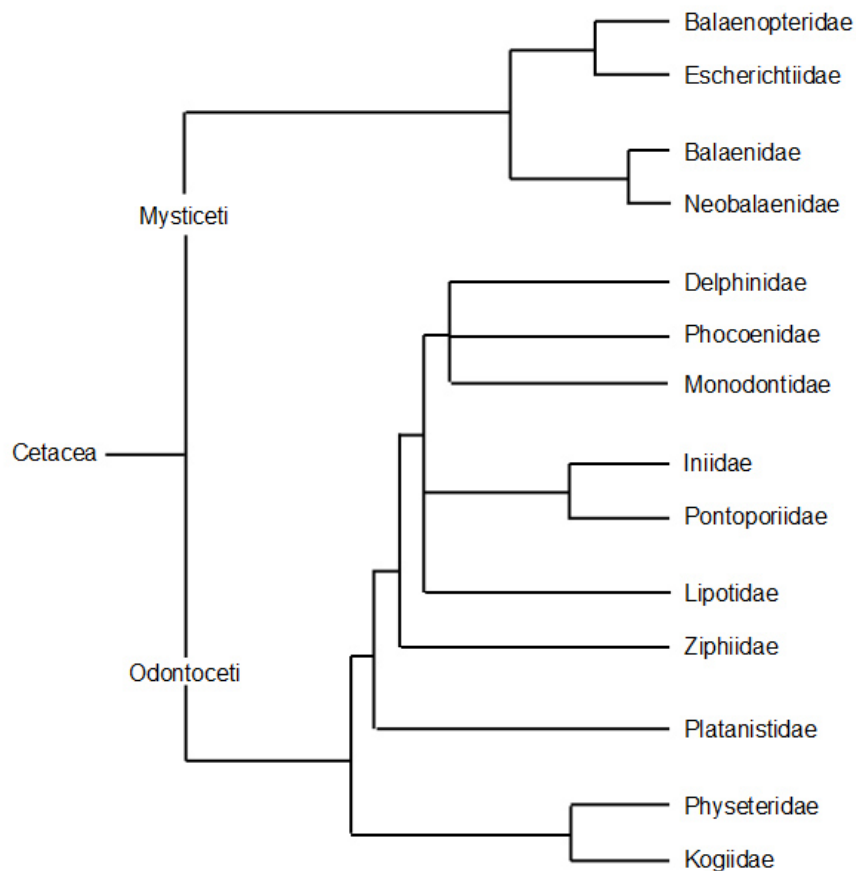
Source: Amsellem L et al. 2000. *Mol. Ecol.* 9: 443-455, reproduced by permission.
<<http://www.ucl.ac.uk/~ucbhdjm/courses/b242/InbrDrift/InbrDrift.html>>

The process most likely to have caused the difference in the AFLP of the introduced population is

- A. founder effect.
- B. genetic drift.
- C. natural selection.
- D. bottleneck effect.

The following information relates to Questions 36 and 37.

The phylogenetic tree below depicts the evolutionary relationship for the fourteen families of baleen whales.



Question 36

Using the phylogenetic tree it can be concluded that amongst the Odontocetes the most closely related families are

- A. Kogiidae and Delphinidae.
- B. Ziphiidae and Neobalaenidae.
- C. Physeteridae and Platanistidae.
- D. Lipotidae and Balaenidae.

Question 37

The pattern of biological change shown in the phylogenetic tree is best described as

- A. allopatric speciation.
- B. extinction.
- C. convergent evolution.
- D. divergent evolution.

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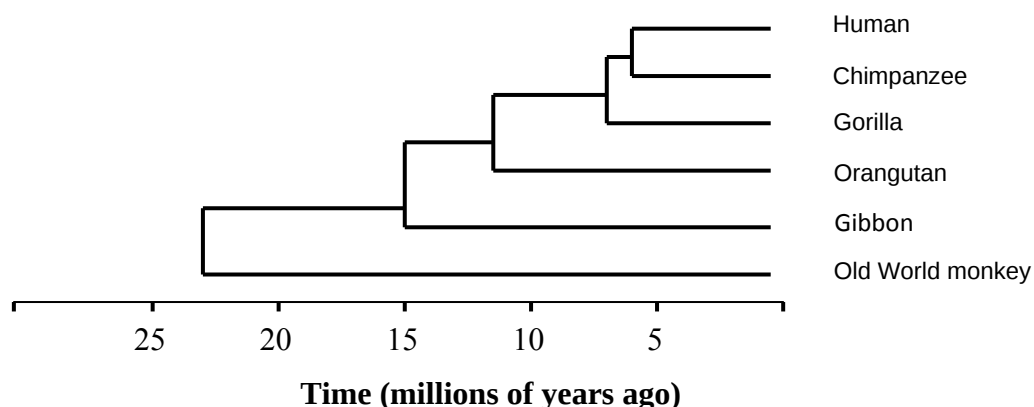
Question 38

The difference between absolute dating and relative dating is that

	Absolute dating	Relative dating
A.	refers to a year or a range of years	indicates a chronological order
B.	comes from an approximation	is derived from radiometric dating techniques
C.	indicates a chronological order	refers to a year or a range of years
D.	is derived from radiometric dating techniques	refers to a year or a range of years

The following information relates to Questions 39 and 40.

Lice are highly specialised blood-sucking parasites that live on a single host species. Each of our ape relatives hosts one louse species, but humans host three types of lice: *Pediculus humanus capitis* (head lice), *Pediculus humanus corporis* (body lice), *Phthirus pubis* (pubic lice). Human head lice and chimp lice are different species but belong to the same genus (*Pediculus*). The co-speciation hypothesis suggests that human head and chimp lice lineages diverged at the same time that hominins and ancestral chimps diverged.



Source: E Barley & J Sharp, *A Tale of Three Lice*, copyright held by the National Centre for Case Study Teaching in Science, University of Buffalo, State University of New York, all rights reserved. Used with permission.

Question 39

The last common ancestor of chimp lice and human head lice lived approximately

- A.** 20 million years ago, on an early ape ancestor.
- B.** 11 million years ago, when ancestral orangutans and hominins diverged.
- C.** 6 million years ago, when ancestral chimps and hominins diverged.
- D.** 100 000 years ago, on an early human.

Question 40

Human pubic lice (*Pthirus pubis*) belong to the same genus as gorilla lice (*Pthirus gorillae*) and are separate species. DNA comparisons show that human pubic lice and gorilla lice most recently shared a common ancestor 3–4 million years ago. Which of the following is LEAST likely to be true?

Hominins could have picked up lice from early gorillas

- A. by sleeping in nests recently used by early gorillas.
- B. by preying on early gorillas.
- C. because they offered a hair niche for colonisation as a result of losing their body hair.
- D. as a result of sharing grooming practices.

END OF MULTIPLE-CHOICE QUESTIONS

**END OF SECTION A
TURN OVER**

SECTION B – Short-answer questions**Instructions for Section B**

Answer **all** questions in the spaces provided. Write using black or blue pen.

Question 1 (5 marks)

In 2010, a research group investigated the effect of licking and grooming behaviour on rat pups by the mother rats. In the study some rat mothers extensively licked and groomed their pups, while others ignored their pups. The results of the study are shown in the table below.

	Group A	Group B
Amount of licking and grooming in the first week of pup life	extensive	negligible
Demeanour of pups as adults	happy, calm, healthy	anxious, prone to disease

Group B pups were observed to be anxious and prone to disease.

- a.** What other characteristic did they share in common?

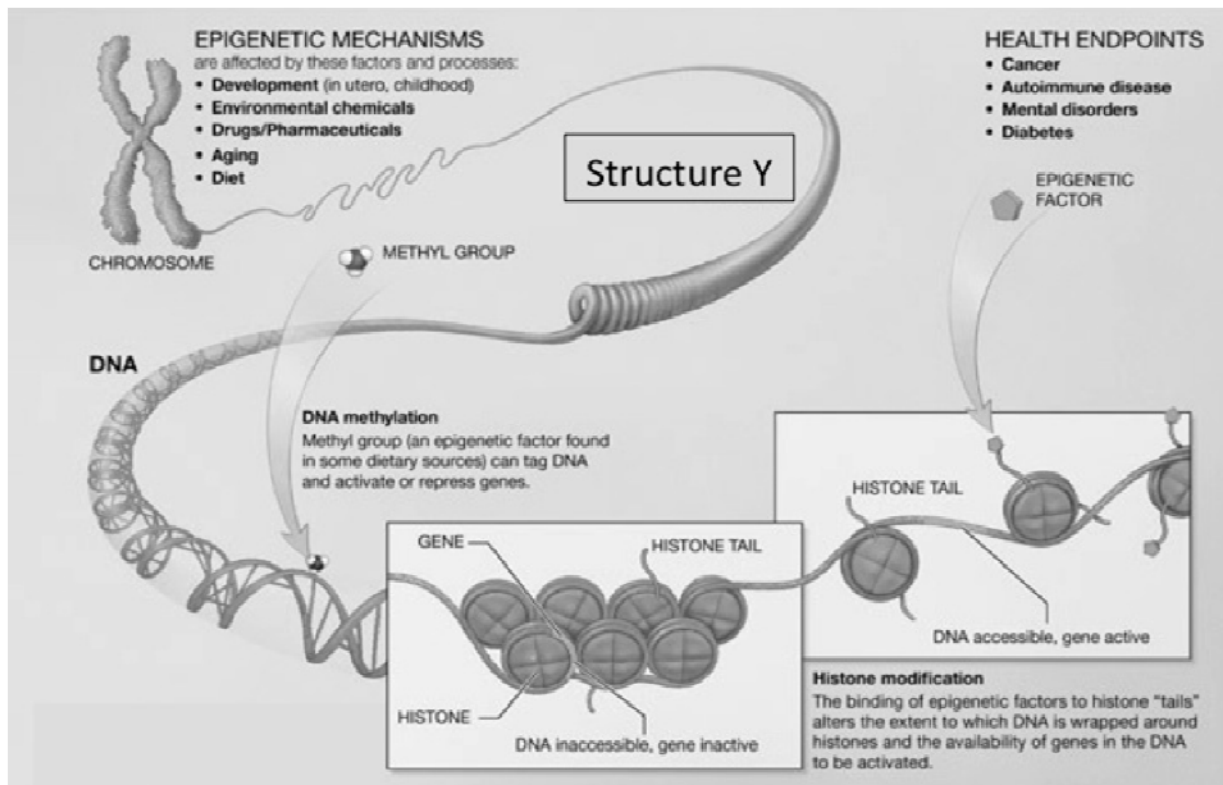
1 mark

Sexual behaviour in female rats is driven by the hormone oestrogen. In another study, it was observed that female rats that had extensive grooming as pups responded less strongly to oestrogen than those that were neglected. Rats that have extensive grooming show attachment of methyl groups around the oestrogen receptor gene, whereas neglected rats show significantly less attachment.

- b.** What conclusion might be drawn from these observations?

1 mark

The following diagram shows the potential outcomes of methylation of DNA.



Source: National Institutes of Health <<http://commonfund.nih.gov/epigenomics/figure.aspx>>

c. i. What is the name given to structure Y?

1 mark

ii. What is a histone?

1 mark

These studies report on a process referred to as epigenetic modification. It is known that gene expression can change during development and maturation. Methylation patterns are copied when DNA is replicated. The changes can make it easier or more difficult for the cell to produce required proteins. Previous research supported the theory that DNA methylation was stable and that no changes occur after birth. The theory of epigenetic modification is highly contested.

d. Identify one evolutionary implication of methylation.

1 mark

SECTION B – continued
TURN OVER

Question 2 (7 marks)

There are several types of amylase (alpha, beta and gamma) that are produced by living organisms.

- a.** To what group of molecules does amylase belong?

1 mark

- b.** What biomolecule does amylase act upon?

1 mark

- c.** How might amylase activity be measured?

1 mark

It has been suggested that temperature may have an effect on the rate of amylase activity.

- d.** Design an experiment that could be performed to test this idea. Develop a hypothesis and describe the results that would support the hypothesis. You may use a diagram to support your answer.

3 marks

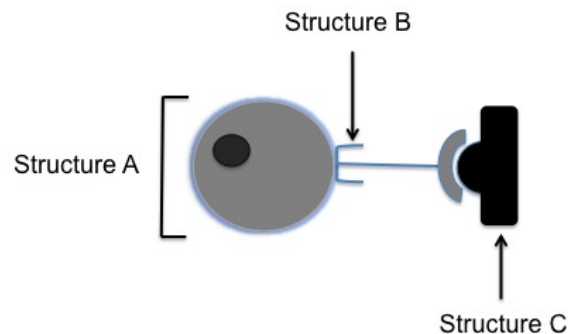
Hypothesis:

Experimental design:

(Blank space below)

Question 3 (7 marks)

Opsonisation is a process in which a pathogen is marked for ingestion and destruction by a protein known as an opsonin. The diagram shows the opsonisation of a bacterium.



- a. i.** Identify structure A.

1 mark

- ii.** What is the function of structure A?

1 mark

- iii.** What event occurs once structure A performs its function?

2 marks

- b. i.** Identify structure B.

1 mark

- ii.** Explain the difference in function between structure B and structure C.

2 marks

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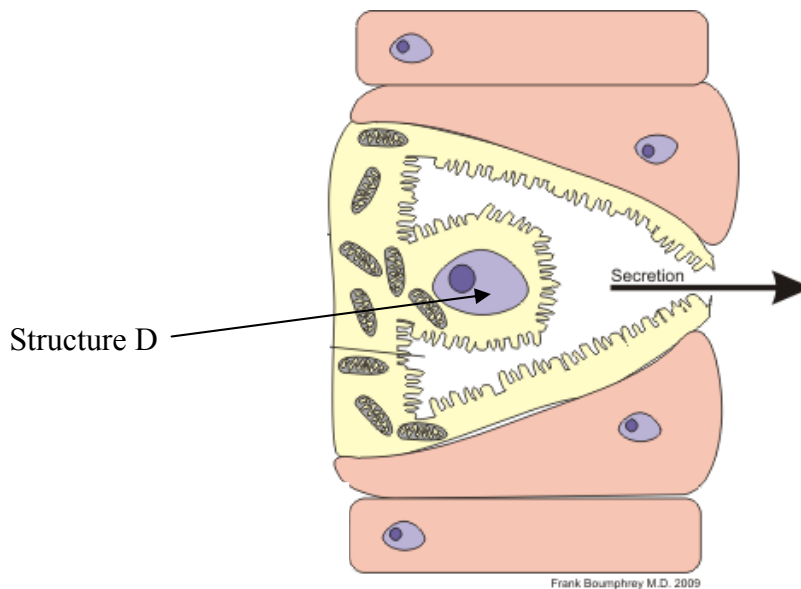
Question 4 (8 marks)

Vitamin B12 is an essential nutrient which is bound to protein and comes from animal products. Vitamin B12 is released from the proteins by the action of a high concentration of hydrochloric acid, produced by parietal cells in the stomach.

- a. Explain why the high concentration of hydrochloric acid in the stomach causes the release of the vitamin B12 molecule from the protein.

2 marks

The diagram below shows a representation of a parietal cell from the stomach.



Source: Boumphreyfr, 2009. Modified from <http://commons.wikimedia.org/wiki/File:Cell_parietal.png>

- b. Identify structure D and state its function.

2 marks

Structure D

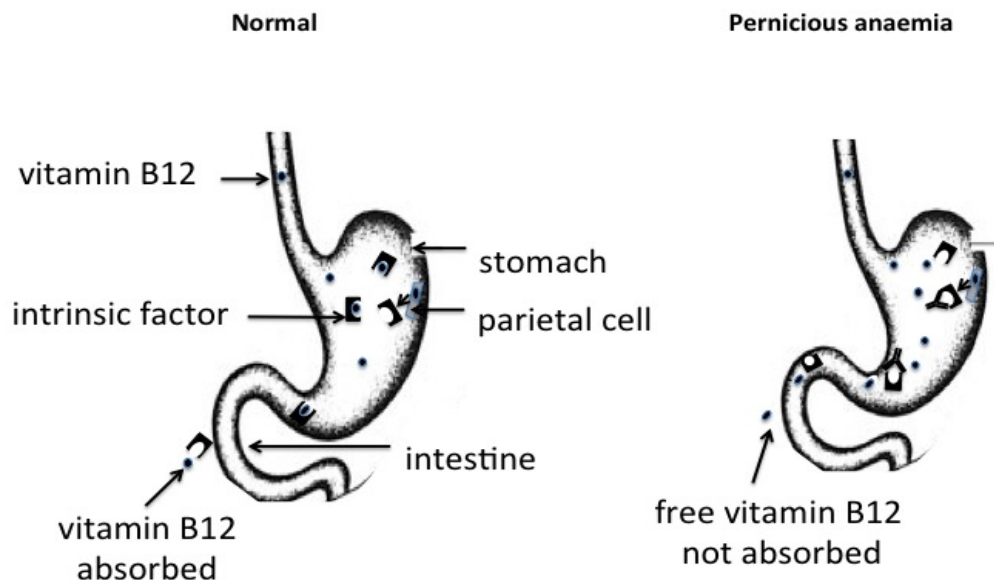
Function

Parietal cells also secrete a glycoprotein called intrinsic factor (IF) which enables the active absorption of vitamin B12 into the body in the ileum, the final section of the small intestine.

- c. Explain whether there would be a greater proportion of free or bound ribosomes in parietal cells.

2 marks

Pernicious anaemia is a condition in which the body is unable to make enough healthy red blood cells because it is unable to absorb enough vitamin B12. The body produces autoantibodies which block the function of IF. The diagram compares the gut of a person who has normal absorption of vitamin B12 with the gut of a person who has pernicious anaemia.



- d. What is the name given to a condition in which the body produces autoantibodies?

1 mark

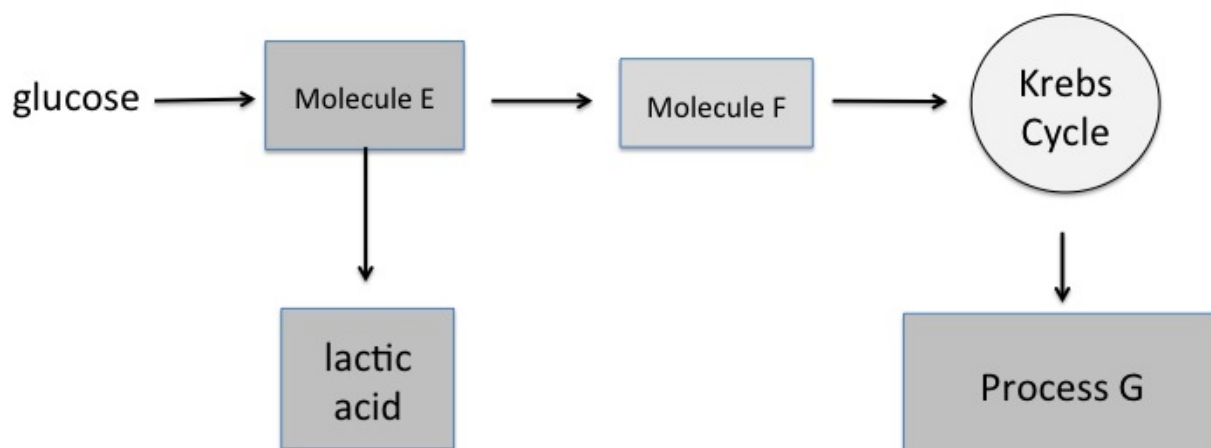
- e. How do autoantibodies prevent the absorption of vitamin B12?

1 mark

SECTION B – continued
TURN OVER

Question 5 (11 marks)

The following diagram is a representation of the process of cellular respiration.



- a. Where in the cell does the Krebs cycle occur?

1 mark

- b. i. Identify molecule E.

1 mark

- ii. What is the name given to process G?

1 mark

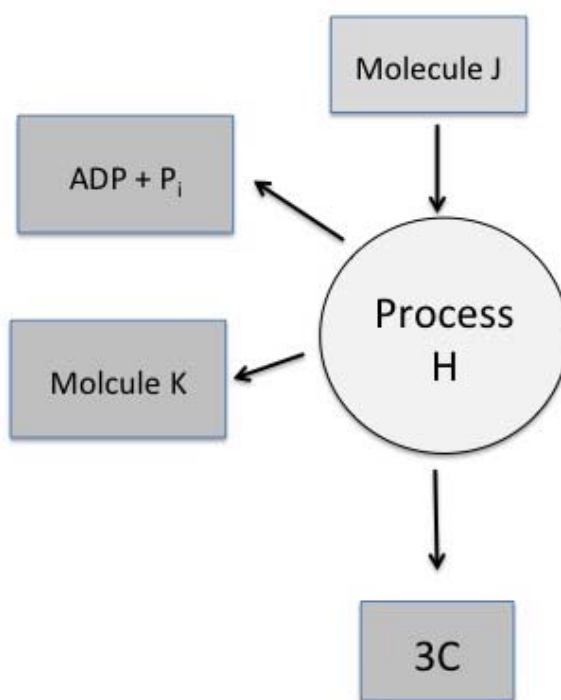
- iii. What is produced in process G?

1 mark

- c. i. What is the name of the process that results in the production of lactic acid?
1 mark

- ii. Under what conditions will this process proceed?
1 mark

In plants, the production of glucose is dependent on the process shown below.



- d. What is the name given to process H?
1 mark

- e. Identify molecule J.
1 mark

- f.** Identify molecule K and explain what will happen to it once it leaves this cycle?

2 marks

Molecule K

Explanation

- g.** What is the 3-carbon molecule produced in this process?

1 mark

CONTINUES OVER PAGE

Question 6 (5 marks)

Neurons communicate with each other and with muscles and glands.

- a. What is the name given to the point of neuron communication?

1 mark

The communication between nerves can be electrical or chemical. The following diagrams show an example of the two forms of communication between neurons.

Diagram L

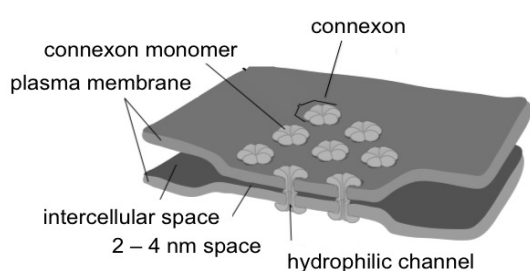
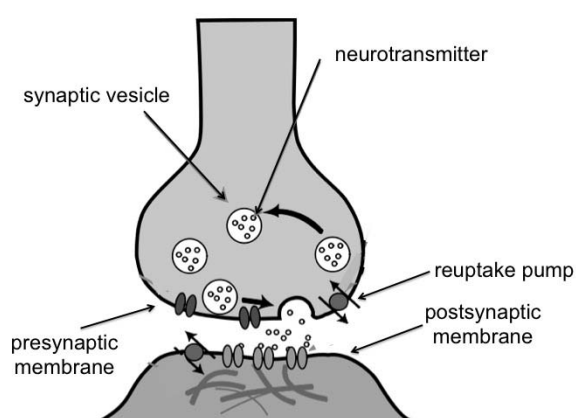


Diagram M



Source for Diagram L: Mariana Ruiz, 2006. Modified from
<http://en.wikipedia.org/wiki/File:Gap_cell_junction-en.svg>

Source for Diagram M: Looie496, 2009. Modified from
<https://en.wikipedia.org/wiki/File:Synapse_Illustration_unlabeled.svg>

- b. State which diagram (L or M) shows chemical communication between two nerves. Explain your choice.

2 marks

The functioning of the human body is dependent on the nervous system and harm can occur when there is a disruption to the transmission of nerve impulses. Acetylcholine (ACh) is an essential neurotransmitter which is hydrolysed by acetylcholinesterase once a nerve impulse has been transmitted. If ACh is not broken down, further nerve impulses will not be transmitted. There are many chemical substances capable of interfering with the action of ACh to prevent transmission of nerve impulses.

- c. Describe one way that transmission of a nerve impulse could be halted.

2 marks

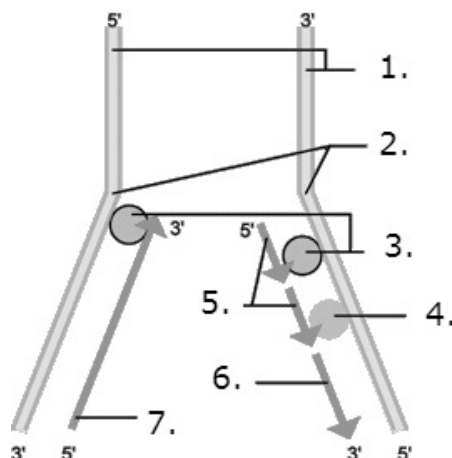
Question 7 (5 marks)

DNA replication occurs as a sequence of enzyme controlled events.

- a. Where does the process of DNA replication take place?

1 mark

The diagram summarises the process of DNA replication.



Source: Daedalus. Modified from <<http://commons.wikimedia.org/wiki/File:Dnareplication-no-text.png>>

- b. Using the information presented in the diagram, complete the following table.

2 marks

Feature	Name
2.	
3.	
4.	
7.	

- c. What is the name given to feature 5 and what causes its formation?

2 marks

Question 8 (8 marks)

A sequence of DNA is shown in the diagram below.

3' AATTATACACGATGAAGCTTGTGACAGGGTTTCCAATCATTAA 5'
 5' TTAATATGTGCTACTTCGAACACTGTCCCAAAGGTTAGTAATT 3'

1. What are the two RNA molecules that could be produced from this sequence?

1 mark

Molecule 1

Molecule 2

Only one of these molecules will be involved in the production of a polypeptide.

- b. i.** Which of the two molecules will become the mRNA molecule?
 Explain your choice.

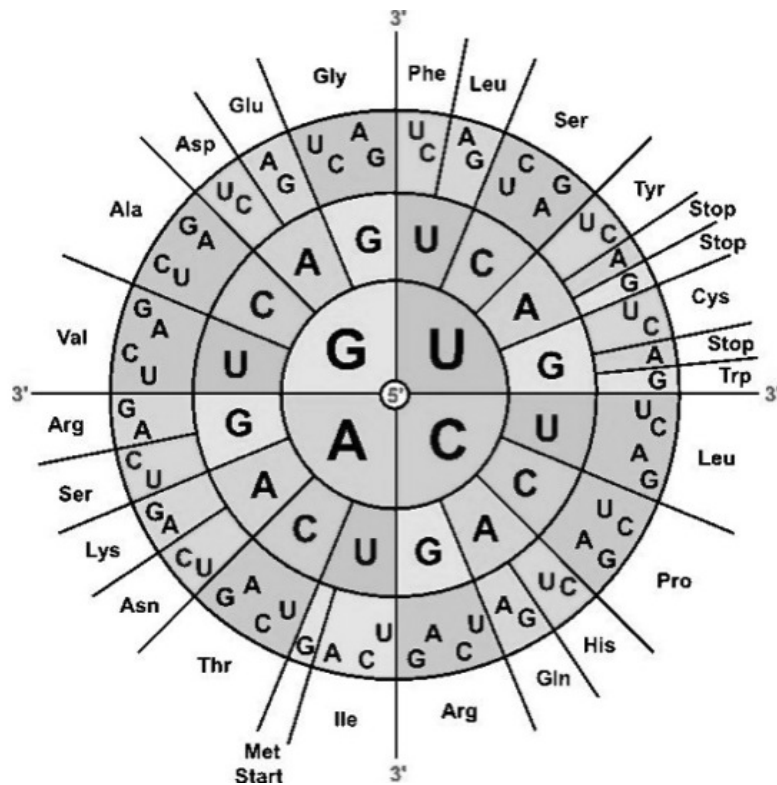
2 marks

- ii.** What is the name of the process that produces a polypeptide from an mRNA molecule?

1 mark

The mRNA codes for the production of the hormone vasopressin.

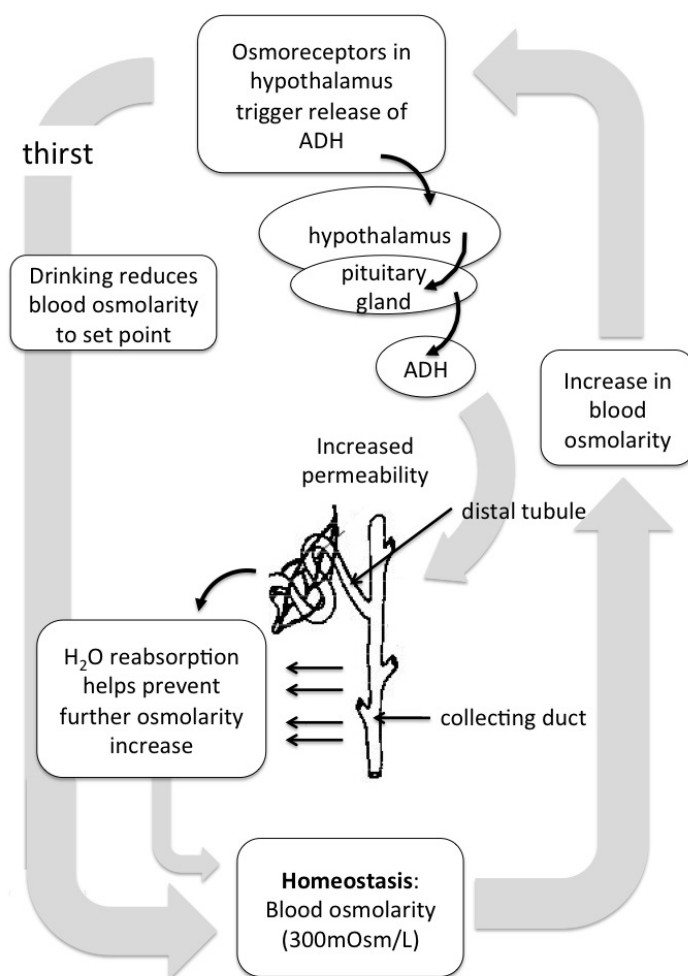
- c. Using the genetic code from the table below, determine the amino acid sequence for vasopressin.



Source: Onie, 2007. Modified from <http://commons.wikimedia.org/wiki/File:Codons_aminoacids_table.png>

1 mark

Vasopressin is a peptide hormone that functions to retain water in the body and to constrict blood vessels. The following diagram shows the regulation of fluid retention in the kidney by vasopressin.



- d. i. What is the stimulus in this control mechanism?

1 mark

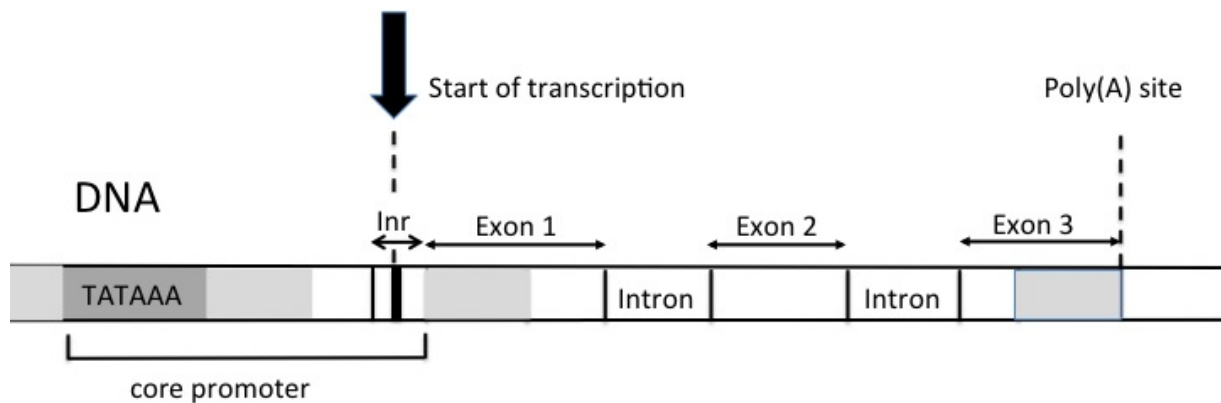
- ii. Is this an example of homeostasis? Explain your answer.

2 marks

SECTION B – continued
TURN OVER

Question 9 (5 marks)

The diagram shows the anatomy of a typical protein-coding eukaryote gene that is transcribed by RNA polymerase II.



The promoter has an initiator sequence (Inr) which surrounds the transcriptional start point and a TATA box 25 base pairs away.

- a. What occurs at the promoter of this gene?

1 mark

- b. Using an arrow, mark on the diagram the upstream region of the gene.

1 mark

- c. What is the difference between an intron and an exon?

2 marks

- d. What effect will an active repressor molecule have on this eukaryote gene?

1 mark

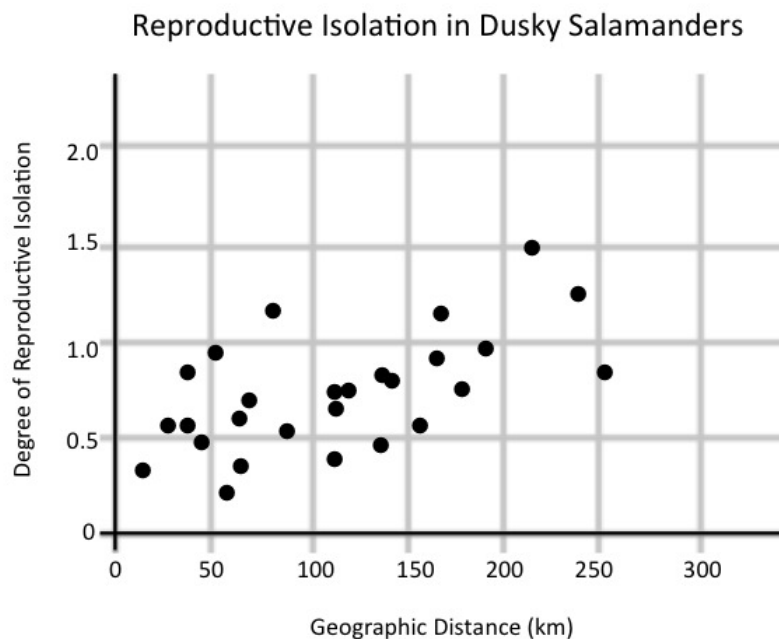
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Question 10 (5 marks)



Source: Ohio Department of Natural Resources, 2005. *Desmognathus ochrophaeus*, <http://en.wikipedia.org/wiki/Allegheny_Mountain_dusky_salamander>

The Allegheny Mountain dusky salamander (*Desmognathus ochrophaeus*) is found living in temperate forests, rivers, intermittent rivers, freshwater springs, and rocky areas of Canada and the United States of America. Under laboratory conditions, biologists tested the ability of salamanders from different populations to produce viable fertile offspring. The results of the experiment are shown in the figure below.



- a.** What is the relationship between reproductive isolation and geographic distance?

1 mark

- b. i.** What is the name of the evolutionary process?

1 mark

- ii.** Outline the steps involved in this evolutionary process.

3 marks

SECTION B – continued
TURN OVER

Question 11 (5 marks)

There are many hypotheses for the emergence of bipedalism in hominins.

- a. i.** Identify one adaptation that is associated with emerging bipedalism.

1 mark

- ii.** Explain how the adaptation encouraged the emergence of bipedalism.

1 mark

A major feature of hominin evolution is increasing brain volume. Intelligence is related to brain organisation and relative size. The capacity for language is one of the most significant specialisations of the brain.

- b.** Name one of the areas of the brain associated with the development of language.

1 mark

- c.** Describe a selection pressure for brain development in early hominins.

1 mark

d. Complete the table.

1 mark

Biological evolution	Cultural evolution
traits from parents, no choice of traits inherited	
Action	Impact on gene pool
biomedical technology	

END OF QUESTION AND ANSWER BOOK