

BIOLOGY

Units 3 & 4 – Written examination



2019 Trial Examination

SOLUTIONS

SECTION A: Multiple-choice questions (1 mark each)

Question 1

Answer: B

Explanation: Option A indicates outside the cell. Option C indicates between cells. Option D indicates one celled.

Question 2

Answer: D

Explanation: Large molecules like hormones must be exported by exocytosis. Option A is how large molecules enter a cell, option B is endocytosis of fluid and option C is an engulfing process.

Question 3

Answer: A

Explanation: These large molecules are formed by condensation reactions. They are called macromolecules because they are large and biological.

Question 4

Answer: A

Explanation: Amino acids are connected by peptide bonds and then hydrogen bonds form to create α helices and β pleated sheets. Ionic bonds and disulphide bonds form at the tertiary level of protein structure.

Question 5

Answer: D

Explanation: Thymine and adenine are present but not in equal amounts. It is single stranded and can move out of the nucleus. The sugar is ribose, option D.

Question 6

Answer: B

Explanation: The enzyme is RNA polymerase and introns are removed.

Question 7

Answer: D

Explanation: A non-competitive inhibitor does not compete with the substrate for the active site. It is usually non-reversible. Co-enzymes do not inhibit enzymes.

Question 8

Answer: C

Explanation: All enzymes are proteins, they catalyse a specific reaction and they decrease the activation energy of a reaction.

Question 9

Answer: B

Explanation: Breaking down reactions are termed catabolic and they release energy – exergonic.

Question 10

Answer: D

Explanation: O₂, ATP and NADPH are outputs of photosynthesis.

Question 11

Answer: D

Explanation: Options A and C are similar and may have an effect, but option D is more critical. Option B does not comply with the information in the question.

Question 12

Answer: B

Explanation: Apoptosis is a programmed cell death that involves caspases and fragments called blebs. Phagocytosis is involved later in order to clean up debris.

Question 13

Answer: C

Explanation: As a peptide hormone, receptors are on the outside of the liver cell. Transduction involves a G protein.

Question 14

Answer: D

Explanation: Options A, B and C are all a strategy used by plants. They do not produce chemicals similar to antibodies. Only animals have an adaptive immune system.

Question 15

Answer: C

Explanation: Options A, B and D are all involved in the innate immune response. Antibodies are part of the adaptive immune system.

Question 16

Answer: A

Explanation: Option B is usually an organism or non-cellular agent. Option C is the result of an immune response. Option D is a chemical which inhibits bacterial reproduction.

Question 17

Answer: A

Explanation: Option B is not correct as it is a lack of recognition that is involved rather than recognition. The MHC markers are still active, so option C is also incorrect. Option D is incorrect as not all cells will be recognised as antigens.

Question 18

Answer: B

Explanation: A population is described as not evolving if its allele frequencies remain constant over several generations. It may be more at risk of extinction but it does not indicate it is becoming extinct therefore Option C is incorrect. Option D refers to gene flow and while the numbers of individuals in and out, may be balanced, the alleles the individuals have, coming in and out of the population, may not be the same.

Question 19

Answer: D

Explanation: All options will change allele frequency. Options A, B and C are likely to be more rapid than Option D. Mutations will usually only affect individuals in a population whereas the other options will usually affect groups of individuals.

Question 20

Answer: C

Explanation: A bottleneck will substantially reduce genetic diversity, so option B is incorrect and will therefore lead to an increased risk of extinction. Option A refers to immigration and emigration not bottleneck.

Question 21

Answer: D

Explanation: The only genetic information that is passed to offspring is what is present in gametes, mature germ cells. Option C refers to body cells.

Question 22

Answer: A

Explanation: Options B, C and D are gene mutations which are likely to affect only one protein. Chromosomal mutations however can affect a number of genes and have the ability to be most harmful.

Question 23

Answer: D

Explanation: Homologous features have a genetic ancestry (siblings) whereas analogous features may appear similar but have no recent common ancestor (“Goths”).

Question 24

Answer: C

Explanation: Most fossils have been mineralised and so option A, carbon dating would not be applicable. Options B and D can be used to gain an idea of the age of fossils but the most accurate would be radiometric dating.

Question 25

Answer: A

Explanation: Option A is a statement about the fossil record, not a reason why life forms have changed over time. Options B, C and D all contribute to the change in life forms over geological time.

Question 26

Answer: C

Explanation: Option A is a ridiculous overstatement. Option B is incorrect as evolution may well speed up after a mass extinction. All life forms can be affected, and so option D is incorrect.

Question 27

Answer: D

Explanation: The donkey and horse have the most recent common ancestor, approx. 2 mya.

Question 28

Answer: B

Explanation: Gibbons and Chimps diverge at approximately 7.5 mya according to the diagram. Read down vertically.

Question 29

Answer: D

Explanation: A cladogram is a rooted phylogenetic tree (shows direction) that has a scale.

Question 30

Answer: B

Explanation: Option A is incorrect as it does not refer to the fact that a master gene controls a series of other genes.

Question 31

Answer: B

Explanation: There has been a lot of movement in the definition of these terms but there is current agreement that hominin refers to all ancient and modern humans.

Question 32

Answer: A

Explanation: The evolution of bipedalism, walking on two legs, is a biologically structural evolution.

Question 33

Answer: C

Explanation: Y is gorilla, Z is *Australopithecine*, W is *Homo erectus*, and X is modern human.

Question 34

Answer: C

Explanation: Options A, B and D are characteristics of primates. The precision grip has evolved during modern human evolution.

Question 35

Answer: B

Explanation: Restriction enzymes or endonucleases are referred to as biological scissors as they are able to cleave DNA. Option C makes copies of DNA and option D separates fragments of DNA according to size.

Question 36

Answer: B

Explanation: Plasmids are double stranded DNA so option A is incorrect. They do not necessarily carry favourable genes and can be inserted into bacterial cells but not viral vectors.

Question 37

Answer: C

Explanation: The plasmids can be placed in an antibiotic environment after modification but only those that have taken up the modification will be able to grow and reproduce. Hence, they are identified.

Question 38

Answer: B

Explanation: Option A refers to intentional modification at the genetic technology level. Option C is the insertion of a gene from an organism in another species. Option D is natural selection rather than artificial selection or selective breeding.

Question 39

Answer: B

Explanation: The global nature of the spread of the disease warrants it being described as a pandemic rather than an epidemic. Option D refers to something that is local to an environment. Option C is a historical reference that is not necessarily worldwide.

Question 40

Answer: B

Explanation: Enzymes and enzyme pathways are not designed but the discovery and knowledge of them enables the design and production of molecules that will inhibit the disease pathways.

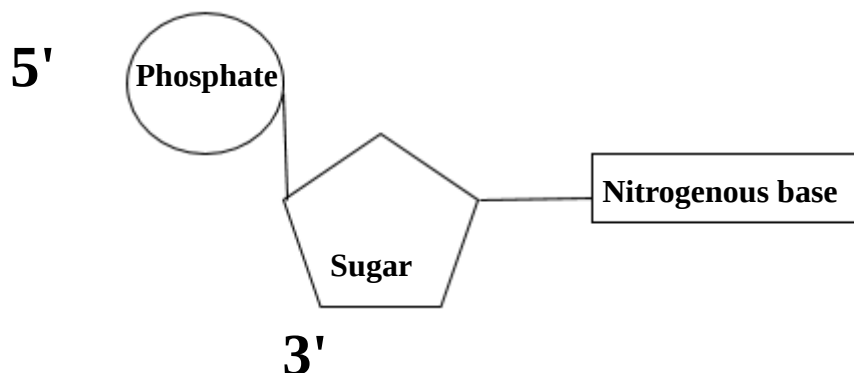
SECTION B: Short-answer questions

Question 1 (4 marks)

- a. The dialysis bag would be likely to increase in size (1) due to the movement of water along the concentration gradient, into the bag (1).
2 marks
- b. The lack of any visual sign of substances in the water/lack of any substances tested for such as protein/glucose/starch in the water.
1 mark
- c. Would need to represent a cell wall. Could place the dialysis bag inside a test tube or some other rigid structure.
1 mark

Question 2 (3 marks)

- a. On diagram. All need to be correct for 1 mark.



- b. Deoxyribose
1 mark
- c. On diagram above. Both must be correct for 1 mark
1 mark

Question 3 (4 marks)

Each row of the table must be correct to obtain 1 mark. Total of 4 marks

Double stranded DNA	5' G A T T T A C C G A T C G A A C G C 3' C T A A A T G G C T A G C T T G C G					
mRNA sequence	G A U U U A C C G A U C G A A C G C					
mRNA codons	GAU	UUA	CCG	AUC	GAA	CGC
tRNA anticodons	CUA	AAU	GGC	UAG	CUU	GCG
Amino acid sequence	Asp	Leu	Pro	Ile	Glu	Arg

Question 4 (4 marks)

- a. Stable enough so that successive generations of species can maintain their individual characteristics but not so stable that evolutionary changes cannot take place. 1 mark
- b. A cell stores a huge amount of genetic information for the synthesis of many thousands of proteins. 1 mark
- c. Must be able to be copied exactly before cell division so that daughter cells contain an accurate copy of the genetic information of the parent cells. 1 mark
- d. It must be expressed precisely in terms of protein synthesis as each cell grows, so that newly synthesised proteins are accurately produced. 1 mark

Question 5 (7 marks)

- a. An operon is a functioning unit of DNA containing a cluster of genes under the control of a single promoter (1). Most found in prokaryotic organisms (1). 2 marks
- b. Regulator or regulatory gene. 1 mark
- c. Operator 1 mark

- d. The repressor protein can bind to the chemical (inducer) (1). This means that RNA polymerase can attach at the promoter (1) and transcribe the enzymes needed for the chemical's (inducer's) breakdown (1).

3 marks

Question 6 (5 marks)

Term	Description
B-lymphocyte or Plasma B cell	A white blood cell that makes antibodies
Pathogen	An infectious agent that causes disease
Antibody	A blood protein produced in response to and counteracting a specific antigen
Vaccination	treatment with a vaccine to produce immunity against a disease
Active immunity	Immunity provided when first infected by a pathogen

5 marks

Question 7 (12 marks)

- a. *Chlorella vulgaris* – unicellular or single celled.
Both needed for the mark.

1 mark

- b. The population went into decline as much of it was consumed by the predatory flagellate that was added by inoculation.

1 mark

- c. Some would survive because they had formed into loose clumps that were too large to be consumed.

1 mark

- d. The ability to form these loose clumps would be an ability determined genetically. Only some would have the genetic capability.

1 mark

- e. Unicellular (single celled) organism that has flagella (flagellate) and will eat other organisms (predatory).

1 mark

- f. The selection pressure was avoiding being consumed.

1 mark

- g. The fact that some algal cells could clump together and avoid being consumed gave these algal cells a selection advantage.

1 mark

- h. The 8 cell colonies were large enough to avoid predation (1) but small enough to maximize nutrient uptake by diffusion alone (1).

2 marks

- i. A large multi celled colony will have less surface area exposed to the nutritive medium and diffusion alone will not reach internal areas adequately (1). Multicellular organisms deal with this by evolving systems for transport within the organism (1).

2 marks

- j. When the selection pressure was removed, the algae became predominantly unicellular again.

1 mark

Question 8 (12 marks)

- a. i. This enzyme can withstand high temperatures.

1 mark

- ii. The nucleotides are required to form the new strand on the exposed DNA nucleotides.

1 mark

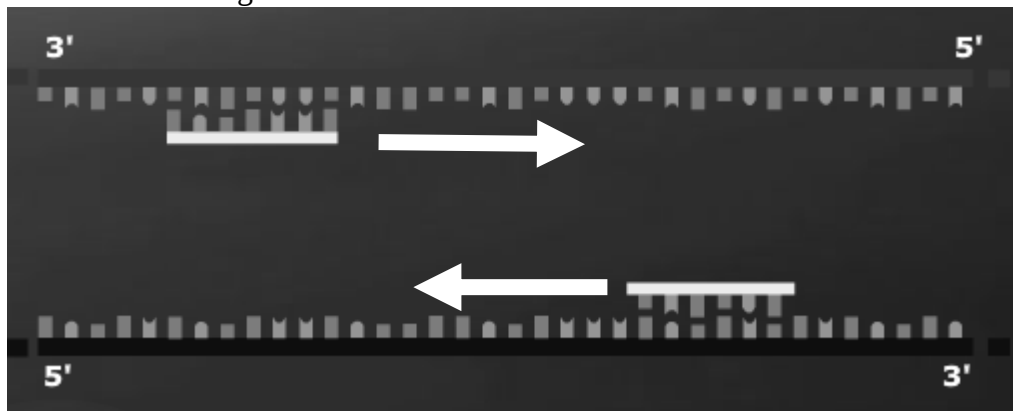
- iii. A primer is a short sequence of DNA nucleotides that is complimentary to an exposed sequence on each end of the DNA(1) and will mark where DNA polymerase will attach to and begin extension(1).

2 marks

- iv. 1 cycle = 2
2 cycles = 4
3 cycles = 8
4 cycles = 16 copies

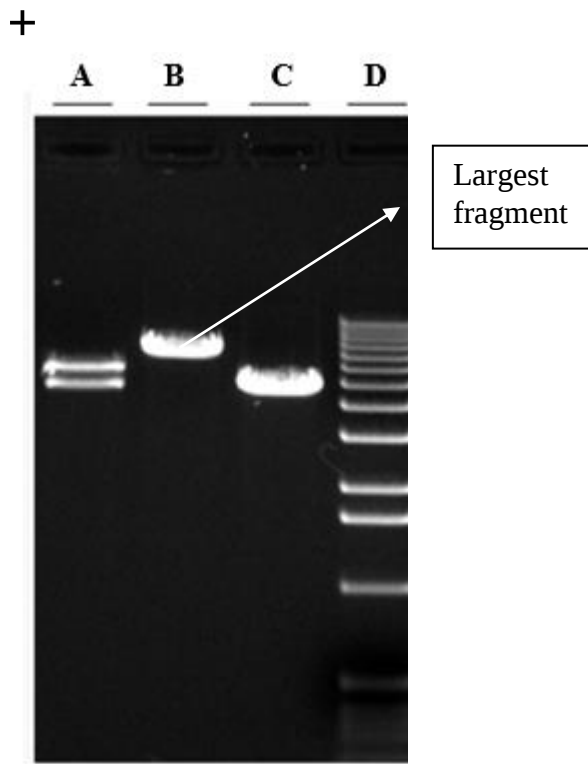
1 mark

- v. On diagram



1 + 1 + 2 + 1 + 1 = 6 marks

b. i. On diagram



ii. On diagram

iii. There are 2 bands shown in sample A because there are 2 fragments of different size in that sample.

iv. the band in sample C appears thicker because there is more of that fragment present than the others.

1 + 1 + 2 + 1 = 5 marks

c. Recombinant DNA is DNA that has been modified by the addition of a foreign piece of DNA.

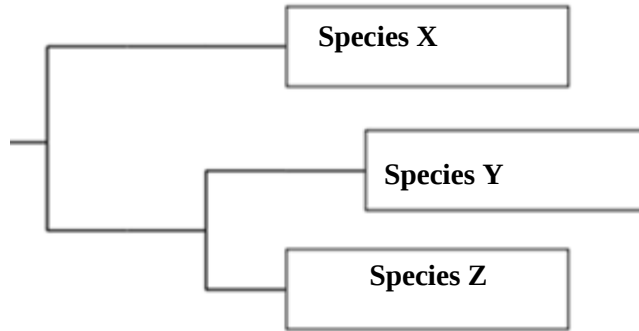
1 mark

Question 9 (6 marks)

- a. i. 7 differences
ii. 6 differences
iii. 3 differences

1 + 1 + 1 = 3 marks

b.



1 mark

- c. Species Y and Z are the most closely related because they have the least nucleotide differences in the sequence shown (1). This indicates that they had a common ancestor more recently and are the most closely related (1).

2 marks

Question 10 (6 marks)

- a. The lack of any significant genetic difference between the Rampasasans and other groups of contemporary humans (1), fails to signify recent descent from another archaic hominin such as the 'hobbit' (1).

2 marks

- b. Discovery of 'hobbit' genetic material. Accept anything reasonable. It could show that hobbits are not closely related to modern humans and left Africa very early on and would therefore be unlikely to be able to interbreed. It could show that they are closely related to modern humans if Neanderthal and Denisovan genetic sequences are found. It may also show whether they had some genetic defect that led to their small size.

2 marks

- c. Two of:

- isolation from other populations
- a selection pressure that selected for smaller size eg. over-crowding, lack of resources, habitat loss
- significantly long time period

2 marks

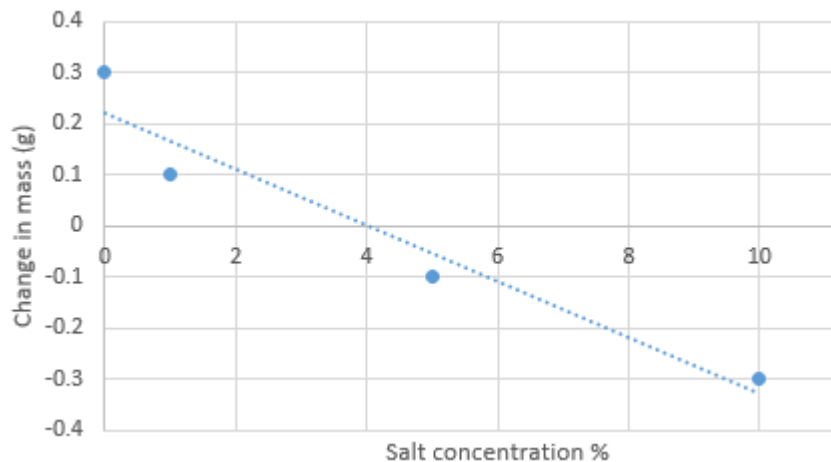
Question 11 (7 marks)

- a. In table: all must be correct for 1 mark

Salt Solution	Mass before experiment (g)	Mass after experiment (g)	Change in mass (g)
Distilled water	1.0	1.3	+0.3
1%	1.0	1.1	+0.1
5%	1.0	0.9	-0.1
10%	1.0	0.7	-0.3

- b. Similar to below:

Graph drawn with appropriate scale on axes(1) and reasonable trend-line(1).



2 marks

- c. When the pieces were placed in hypotonic solutions (0% and 1%) they increased in mass due to water moving in by osmosis (1).

When the pieces were placed in hypertonic solutions (5% and 10%) they decreased in mass due to water moving in by osmosis (1).

2 marks

- d. Internal concentration equivalent to 4% salt solution but allow 3-5 depending on trend-line (1). Must agree with trend-line for mark.

Estimated at where the trend-line crosses axis which is the point where the potato pieces are isotonic with the salt solution (1).

2 marks