

BIOLOGY

Unit 3 & 4 – Written examination



2023 Trial Examination

SOLUTIONS

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

Question 1

Answer: C

Explanation:

A protein is functional when at a tertiary structure, as this is the 3-dimensional shape.

Question 2

Answer: C

Explanation:

The repressor protein is not part of the operon, as an operon is a group of structural genes under the control of the one promoter region. The leader region includes the attenuator; however, this is not a regulatory protein. The repressor protein binds to the operator region not the promoter.

Question 3

Answer: C

Explanation:

As a plasmid is circular, the first cut creates a linear strand. Following that, the next four cuts create 5 fragments, as shown below.

	cut 1		cut 2		cut 3		cut 4	
Fragment 1		Fragment 2		Fragment 3		Fragment 4		Fragment 5

Question 4

Answer: D

Explanation:

Plants produce ethanol, not lactic acids. FADH and NADPH are not part of glycolysis, with FADH being produced in the Krebs cycle and NADPH being produced in the light dependent stage of photosynthesis.

Question 5

Answer: A

Explanation

The first exposure to an allergen causes the IgE antibodies produced by plasma cells to bind to mast cells. Allergens do not stimulate the third line of defence, therefore no memory cells or T_H cells are produced.

Question 6

Answer: C

Explanation

MHC markers are used to differentiate between self and non-self. Whilst all somatic cells contain the same genetic material, this is not used to identify self.

Question 7

Answer: B

Explanation

Most proteins interact with other proteins to undertake their specific functions, and as such, as studied collectively. Proteins do vary within the body, but this is due to the multicellular nature of individuals.

Question 8

Answer: D

Explanation

The PAM sequence is 3 nucleotides long and provides the binding site for Cas9, as well as identifying the target sequence that needs to be unzipped.

Question 9

Answer: A

Explanation

CAM plants open their stomata at night to reduce the chance of photorespiration occurring. They are less energy efficient, and as such, are generally smaller than C3 plants.

Question 10

Answer: A

Explanation

The amino acid code is degenerate as more than one codon can code for the same amino acid.

Question 11

Answer: D

Explanation

DNA is universal as every living thing is composed of the same 5 nucleotides, with each triplet coding for the same amino acid. There are 3 stop codons but there is only 1 start codon.

Question 12

Answer: B

Explanation

Due to a population bottleneck, where the numbers declined due to a natural disaster, and the remaining population is not representative of the original population, it would be expected that genetic diversity would decrease.

Question 13

Answer: D

Explanation

PEP carboxylase converts carbon dioxide into a 4 carbon product, malate, in C4 and CAM plants. In C3 plants, Rubisco is used for the initial carbon fixation.

Question 14

Answer: B

Explanation

As the substrate concentration increases, the availability of enzyme active sites will limit the rate of reaction, and saturation will occur.

Question 15

Answer: D

Explanation

The net ATP in glycolysis is 2, the net ATP in Krebs is 2 and 26 ATP are produced in the electron transport chain. A total of 30 ATP is produced in aerobic respiration.

Question 16

Answer: C

Explanation

As DNA ligase is an enzyme, this makes it a protein. The monomers of proteins are amino acids.

Question 17

Answer: D

Explanation

The attenuator regulates transcription by how fast translation of the trp codons occurs, and whether a terminator or an anti-terminator hairpin loop is formed.

Question 18

Answer: C

Explanation

The image is of a ribosome (evident by the small and large sub-unit). Ribosomes are composed of ribosomal RNA and proteins.

Question 19

Answer: B

Explanation

The primary lymphoid organs are the site of lymphocyte maturation (bone marrow and thymus), whereas the secondary lymphoid organs are the site of antigen presentation.

Question 20

Answer: C

Explanation

Education campaigns are examples of social strategies, as they aim to inform people of risks and rely on goodwill to do the right thing. Removing/cleaning shoes of incoming passengers would be a manner in which they could contain the spread.

Question 21

Answer: C

Explanation

Fungal cell walls are composed of chitin. Chitinase ends in 'ase' therefore is an enzyme. Chitinases are an enzyme that break down chitin.

Question 22

Answer: D

Explanation

The first response occurred at point 1, and the second response occurred at point 2. The graph shows a steep incline at point 2, and does not cross the x axis, memory cells are the reason for the stronger response.

Question 23

Answer: A

Explanation

The only viable option is active natural, as they have developed memory as evident by the stronger second response.

Question 24

Answer: B

Explanation

Hominins are hominoids both have binocular colour vision, and hominins are solely bipedal.

Question 25

Answer: B

Explanation

The data is reproducible as it was obtained by different observers. Repeatable data is obtained by the same person. The true value is not known, so although the values are similar, the data may not be accurate.

Question 26

Answer: D

Explanation

Poorly calibrated equipment, using a different probe or a different plant could all produce different results.

Question 27

Answer: A

Explanation

As the snake does not have legs, the presence of a pelvis and hind legs in the skeleton is a vestigial structure. It is not a transitional fossil as the structures are not functional in the snake.

Question 28

Answer: D

Explanation

Allopatric speciation requires a geographical barrier between two populations whereas sympatric speciation occurs in the same location. Homologous structures show evolutionary relationships whereas convergence is where similar selection pressures cause organisms to look similar despite not sharing ancestry.

Question 29

Answer: C

Explanation

Allergic reaction and inflammatory responses would see an increase in neutrophils, whereas virally infected cells would promote clonal expansion of Tc cells.

Question 30

Answer: A

Explanation

Plasma cells target cellular pathogens whereas cytotoxic T cells target intracellular pathogens. Memory cells are suited to longer term infections, and mast cells are part of the inflammatory response.

Question 31

Answer: C

Explanation

Antigen presenting cells have MHC II markers, whereas all nucleated cells have MHC I markers. Interferons are a chemical signal released from viral infected cells.

Question 32

Answer: B

Explanation

The image shows a small group separating from the parental population. As such, this is the founder effect. The bottleneck is typified by a random decrease in allele frequencies in a population in the same region.

Question 33

Answer: B

Explanation

An accurate value is one that is close to the true value. Precise values are ones that have a small range.

Question 34

Answer: A

Explanation

Integrity is the accurate reporting of information, which the company failed to do. Non-maleficence is to do no harm, and beneficence is to maximise benefit.

Question 35

Answer: C

Explanation

Humans produce lactic acid whereas plants produce ethanol and carbon dioxide. Anaerobic respiration produces 2 ATP whereas the electron transport chain, that is part of aerobic respiration, produces 26 ATP.

Question 36

Answer: D

Explanation

A limitation with using amino acid sequencing is silent mutations in DNA are not evident, and the degeneracy of the amino acid code allows for various DNA triplets to code for an amino acid.

Question 37

Answer: C

Explanation

Lucy being a more ancient hominin would have longer arms than legs. Over time, the pelvis has become more bowl shaped and the arch in the foot has become more pronounced.

Question 38

Answer: D

Explanation

Gene flow (which increases genetic variation) reduces the chance of extinction as different populations are more likely to have different selection pressures, and therefore bring new alleles to a population.

Question 39

Answer: B

Explanation

Index fossils are abundant, exist across a wide range of geographical regions during a small time frame.

Question 40

Answer: C

Explanation

H. neanderthalensis is more closely related to *H. heidelbergensis* than *H. sapiens* as they diverged 0.5 mya compared to *H. sapiens* who diverged 0.94 mya. *G. gorilla* has diverged the earliest.

SECTION B Short-answer questions

Question 1 (8 marks)

a.

Organelle	Role in the protein secretory pathway
Ribosome	Site of protein synthesis
Rough Endoplasmic Reticulum (ER)	Modification and folding of protein
Vesicle (one only)	Secretory – moves protein to the plasma membrane for export. Transport – moves protein within the cell from the rough ER to the Golgi body
Golgi Body	Further modification and packaging
Mitochondria	Provides the energy for active transport.

1 row = 1 mark, Total - 3 marks

b. Amino acids

1 mark

c. AUG UUU AGA CCU CGC AAU UCG (1)

Start/Met – Phe – Arg – Pro – Arg – Asn – Ser (1)

2 marks

d. Frameshift (1)

which alters the reading frame after the mutation (1) OR Amino acid Pro is replaced with Ala (1)

2 marks

Question 2 (9 marks)

a. Clustered Regularly Interspaced Short Palindromic Repeats

1 mark

b. Cas 9 and EcoRI both cut double stranded DNA (1). EcoRI has a specific recognition site, whereas Cas9 recognises a PAM site (1)

2 marks

c. Isolate genes for two different insulin polypeptides (1) and ligate/use DNA ligase to insert into two different plasmids into the β -galactosidase gene (1) and transform into two separate bacteria (1). Plate on agar containing X gal and ampicillin – those transformed bacteria turn blue (1). Once the genes are expressed and the fusion proteins are produced by each bacteria, these fusion proteins are then purified (1), and the insulin polypeptides are removed and then combined together to produce functional insulin (1).

6 marks

Question 3 (17 marks)

a. Water is split in the light dependent stage of photosynthesis (1) with the H^+ ions loaded on to NADP⁺ (1) to be used to form glucose in the light independent/Calvin stage of photosynthesis (1)

3 marks

b. C₄ plants undergo carbon fixation in the mesophyll (1) during the day (1) whereas CAM plants undergo carbon fixation occurs in the mesophyll (1) at night (1).

4 marks

c. NADP(H) (1) moves H^+ ions from the grana to the stroma (1). ATP (1) provides the energy for formation of glucose (1).

4 marks

d. CAM plant (1). Carbon fixation is occurring using PEP carboxylase, therefore malic acid is higher at night than during the day (1) Carbon dioxide intake is higher at night than day when stomata are open(1).

3 marks

Question 4 (9 marks)

a. Red/white blood cell production (1) OR site of white blood cell maturation (1)

1 mark

b. Antigenic shift has occurred (1) where the surface antigens have changed (1). As such, memory cells are no longer complementary (1), and he has to undergo clonal selection and expansion again (1)

4 marks

c. Presence of galls (1) to isolate the pathogen (1)

OR

vertical hanging leaves (1) to prevent water accumulating and fungal growth occurring (1)

OR

waxy cuticle (1) protective layer (1)

OR

spines/thorns (1) to deter herbivores (1)

OR

any other physical defence

2 marks

Question 5 (15 marks)

a. A disease that reappears after being absent in a population for a significant period of time (1)

b. Scientific:

Use antibiotics (1) to minimize symptoms (1)

Vaccinate (1) to allow memory cells to be produced (1) *although there is no vaccine – this can not be assumed knowledge and hence would be awarded a mark if justified.*

Social

Education campaign (1) to alert people how to dress/wear insect repellent/don't enter tick infested areas/be alert to the symptoms (1)

or any other suitable response

4 marks

c. Disagree (no mark as 50/50). Herd immunity is effective for contagious diseases (1). Lyme disease is spread via ticks, not between human hosts (1)

2 marks

d. If any bacteria remain, they will replicate and make the person sick again (1). The bacteria that are not killed by the antibiotics may mutate (1) and superbugs are created that are resistant to the existing treatment (1)

3 marks

e. Tissue damage stimulates mast cells to release histamine(1) causing vasodilation/leaky capillaries/swelling (1). Immune cells/phagocytes/white blood cells flood the area (1). Blood clot/pus form to seal the area (1). An antihistamine, or an anti-inflammatory drug, is a short term action the individual could take to reduce inflammation (1).

5 marks

Question 6 (9 marks)

a. Food changed from larger items (e.g. seeds/nuts) to smaller items (e.g. insects/grubs) (1) as the blunt beak is used to break open bigger food items such as shells, whereas the pointy beak is used to get into crevices to find smaller food items (1)

2 marks

b. Variation existed in the ancestral population, some finches had blunt beaks, some had pointed beaks (1). The selection pressure of diet meant some finches were better suited to their environment than others (1). Those well suited survived and reproduced (1). Those unsuited, died (1). Over time, the favoured beak became more prevalent in the population (1).

5 marks

c. Two of: They are made of hard parts (1) they do not readily decompose (1) are generally not eaten by scavengers (1)

2 marks

Question 7 (9 marks)

a. The children were told to climb a tree as the Yamuti could not look up (1). This is supported by the fossil evidence of the Diprotodon (1).

2 marks

b. The connection to Country and Place is an important way for Aboriginal people to express their cultural identity (1). The land and waterways in Aboriginal country are not just physical places, but are also spiritual and cultural spaces (1)

2 marks

c. Measure the ratio of $C_{14} - C_{12}$ (1). For every half-life, 5730 years have passed (1). Multiply the number of half-lives by 5730 (1).

3 marks

d. Two of: Hominin would have a less prominent brow ridge, more parabolic jaw, no zygomatic arch, more central foramen magnum, no diastema compared to hominoid.

The statement must be comparative.

2 marks

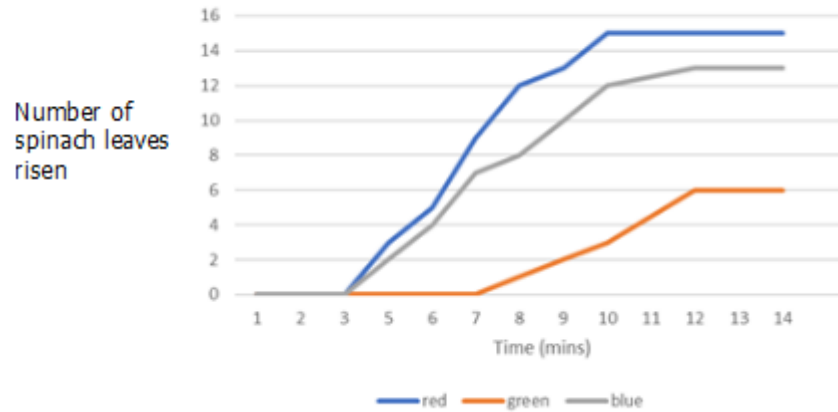
Question 8

a.

1 mark for collect scale/line

1 mark for x axis correct with units

1 mark for y axis correct with units



3 marks

b. Quantitative (1) as it is numerical (1).

2 marks

c. Unknown (1) as there is no repetition of data (1).

2 marks

d. The least amount of photosynthesis is occurring in the presence of the green wavelength of light (1). Green light is not absorbed as well by chlorophyll as red and blue light, therefore, reducing amount of oxygen bubbles produced and reducing the number of spinach leaves which rose to the top of the water (1).

2 marks