Engage Education Foundation

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	69
		Total	109

- 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 32 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

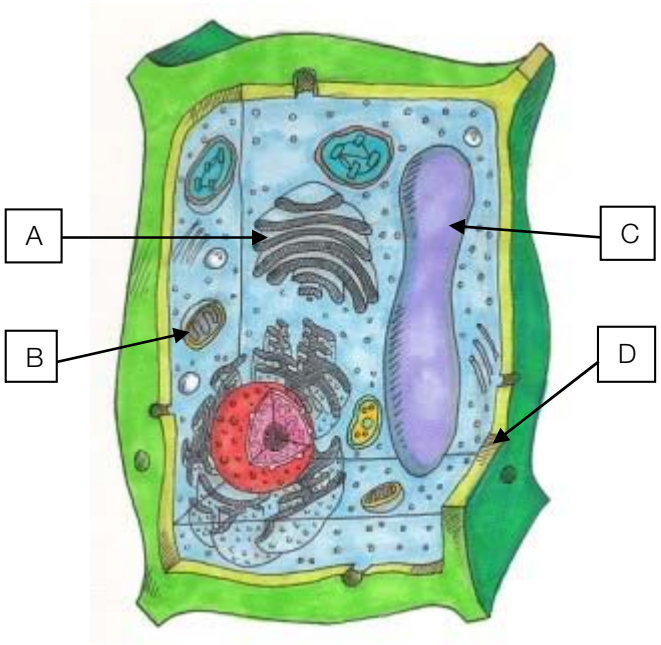
Instructions

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 following diagram depicts a plant cell.



It would be reasonable to conclude that the vacuole is:

A. Structure A
B. Structure B
C. Structure C
D. Structure D

Question 2

The final acceptor molecule in the electron transport chain is:

A. Carbon dioxide
B. NADH+
C. $FADH_2$
D. Oxygen

Question 3
Which of the following reaction models most accurately represents the action of an enzyme?

Key: E: Enzyme, S_1: Substrate 1, S_2: Substrate 2, P_1: Product 1, P_2: Product 2

A. $E + S_1 \rightarrow P_1+P_2$
B. $E+P_1+P_2 \rightarrow S_1+E$
C. $S_1+E \rightarrow E+P_1+P_2$
D. $S_1+S_2 \rightarrow E+P_1$

Question 4
The section of a chloroplast in which the light independent phase of photosynthesis occurs is called the:

A. Granum
B. Thylakoid membrane
C. Stroma
D. Chlorophyll

Question 5
An onion skin cell was left in distilled water for 24 hours. The cell would:

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

Question 6
Fibrin is a:

A. Secondary protein involved in the formation of muscle
B. Tertiary protein involved in the synthesis of skin cells
C. Secondary protein involved in the clotting of blood
D. Steroid hormone involved in male reproduction

Question 7
What is an embolism in plants?

A. A blockage of the phloem due to a build-up of sucrose, or low amounts of sucrose
B. A rupture in the xylem
C. A blockage in the xylem due to air bubbles, frozen water or low water
D. A rupture in the phloem

Question 8
Plants adapted to live in hot dry conditions are:

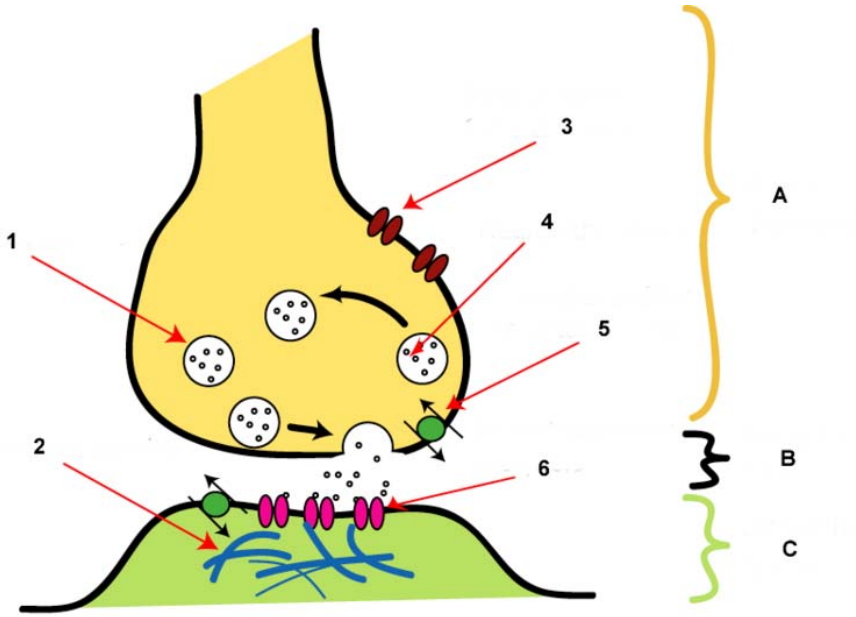
A. Xerophytes
B. Halophytes
C. Aridophytes
D. Hydrophytes

Question 9

Chemical analysis of a section of DNA determined that its thymine quantity was 30%. What would be the percentage of adenine in the mRNA coded for by this gene (assuming no splicing of introns or addition of bases following transcription)?

A. 20%
B. 30%
C. 40%
D. 60%

Questions 10, 11 and 12 refer to the following diagram:



Source: Wikimedia Commons

Question 10

The region across which neurotransmitters diffuse is marked:

A. 6
B. B
C. 1
D. C

Question 11

Structures 1 and 4, respectively, are produced in the:

A. Golgi Apparatus, ribosomes
B. Ribosomes, Golgi apparatus
C. Endoplasmic reticulum, ribosomes
D. Endoplasmic reticulum, Golgi apparatus

Question 12

Fill in the gaps: Enough of (A) must bind to (B) in order for (C) to be activated and for the message to continue electrically along the neuron.

A. A: 2, B: 6, C: 4
B. A: 4, B: 2, C: 4
C. A: 4, B: 6, C: 5
D. A: 4, B: 6, C: 2

Question 13

Following an infection that stimulates the body's third line of defence, the specific immune system, a memory is kept of the event for future defence. Where is this information kept?

A. In the plasma B lymphocytes in the bone marrow
B. In the memory B lymphocytes in the plasma membrane
C. In the memory B lymphocytes in the bone marrow
D. In the plasma B lymphocytes in the plasma membrane

Question 14

The molecule responsible for allergic reactions is:

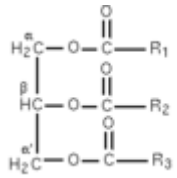
A. Histidine
B. Histones
C. Histamine
D. Helicase

Question 15

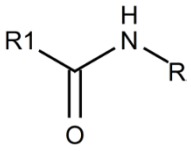
An example of active, natural immunity is:

A. A mother passing antibodies in the colostrum of her breast milk to her newly born child
B. A human receiving a tetanus vaccine
C. A human being bitten by a snake and administered snake anti-venom taken from the serum of a horse
D. A human being exposed to chicken pox as a child and never becoming re-infected

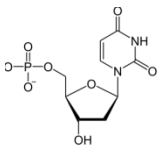
Questions 16, 17 and 18 refer to the following diagrams:



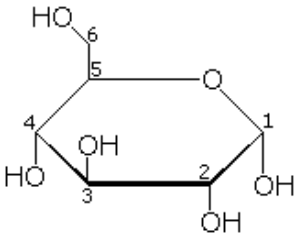
A



B



C



D

Question 16
Which of the images depicts a peptide bond?

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

Question 17
Which of the images depicts a triglyceride?

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

Question 18
Which of the images depicts a monosaccharide?

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

Question 19
Histones are:

A. Small negatively charged proteins that help keep enzymes together
B. Small positively charged proteins that help keep DNA molecules wound up tightly
C. Small negatively charged proteins that help unwind DNA for transcription
D. Small positively charged proteins that keep chromosomes separate from one another

Question 20
Hormones that diffuse externally to an organism and bind to specific external receptors, initiating a response are:

A. A. Pheromones
B. B. Auxins
C. C. Ethylene
D. D. Steroids

Question 21

Males have a greater chance of being affected by X-linked disorders because:

A. They possess two copies of the chromosome containing the gene
B. They possess one copy of the chromosome containing the gene
C. A gene on the Y chromosome makes males more susceptible to disease
D. Males possess less chromosomes than females

Question 22

There are approximately 10,000 pug dogs in Britain; however their gene pool only equates to that of about 50 individuals. This lack of genetic variation is due to:

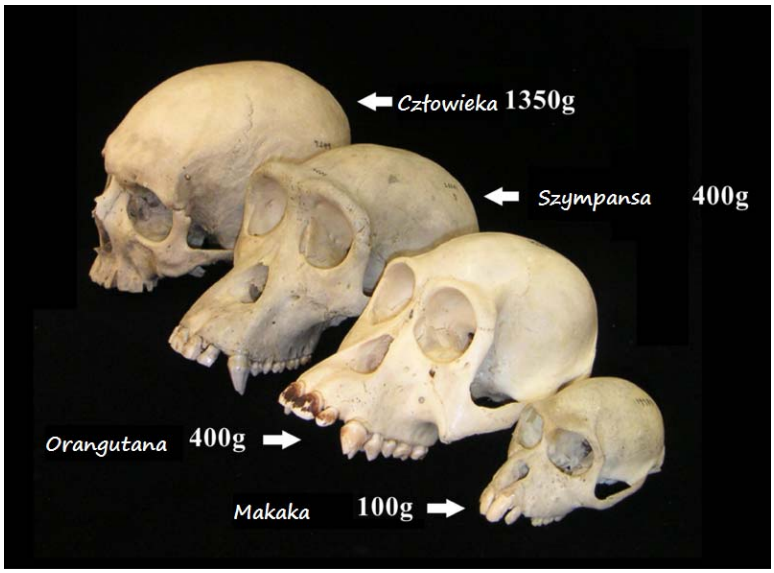
A. Natural selection
B. Mutation
C. The bottleneck effect
D. Artificial selection

Question 23

Natural selection acts upon an individual's:

A. Genotype
B. Phenotype
C. Environment
D. Chromosomes

Question 24



Source: Wikimedia Commons

Based on the image above, which of the following is not evidence of structural change that occurred during Hominid evolution?

A. Shorter and broader pelvis
B. Flattening of the face
C. Enlargement of the frontal lobe proportional to the rest of the brain and an increase in the size of the cranial cavity
D. Decreased prominence of brow ridges

Question 25

The following table depicts the number of amino acid differences in a polypeptide found in a large number of primate species, and can be used to determine an estimate of evolutionary distances.

Species compared	Number of amino acid differences
Man vs Chimpanzee	0
Man vs Gorilla	4
Man vs Monkey	11
Monkey vs Chimpanzee	11
Monkey vs Gorilla	15

It is thus reasonable to conclude that:

A. Humans and gorillas may differ in more than four bases in the DNA sequence which codes for this protein
B. Gorillas are more closely related to chimpanzees than humans are to chimpanzees.
C. Monkeys and gorillas share a more recent common ancestor than do humans and gorillas
D. Humans and chimpanzees have identical DNA sequences in the gene which codes for this protein.

Question 26
Recombination occurs during:

A. Prophase 1 of mitosis
B. Prophase 1 of meiosis
C. Prophase 2 of mitosis
D. Prophase 2 of meiosis

Question 27
The recessive allele for Tay Sach's disease is lethal when homozygous, meaning sufferers do not survive past the age of approximately 5 years. Two parents who are both heterozygous at this gene locus had a child. The chance that their adult child is heterozygous is:

A. 3/4
B. 2/3
C. 1/4
D. 1/2

Question 28
Examples of sexual reproduction include:

A. Budding
B. Vegetative reproduction
C. Meiosis
D. Fragmentation

Questions 29 to 32 refer to the following information:

Horse coat colour is determined by the dominant allele B, which produces a brown colour, and the recessive b allele, which produces a tan colour. There is another gene coding for the presence of pigment in the horse's coat. The presence of the dominant allele for this gene, C, simply means that the horse will have coat colour. If the horse is homozygous recessive at this locus (cc) there is no pigmentation and the horse will be white regardless of alleles coding for brown or tan colour. The B locus and the C locus are independently assorting.

Two horses, heterozygous at both loci are crossed.

Question 29
What are the genotypes of the crossed horses?

A. BBcc x bbCC
B. bbCC x BbCc
C. BbCc x BbCc
D. bbcc x BBCC

Question 30
What possible gametes could occur in each horse as a result of meiosis?

A. BC, Bc, bC, bc
B. BC, bc
C. bC, bc, cb, Cb
D. cB, CB, cb, Cb

Question 31
What are the phenotypic ratios of the offspring?
The punnet square template provided may be useful when determining your answer.

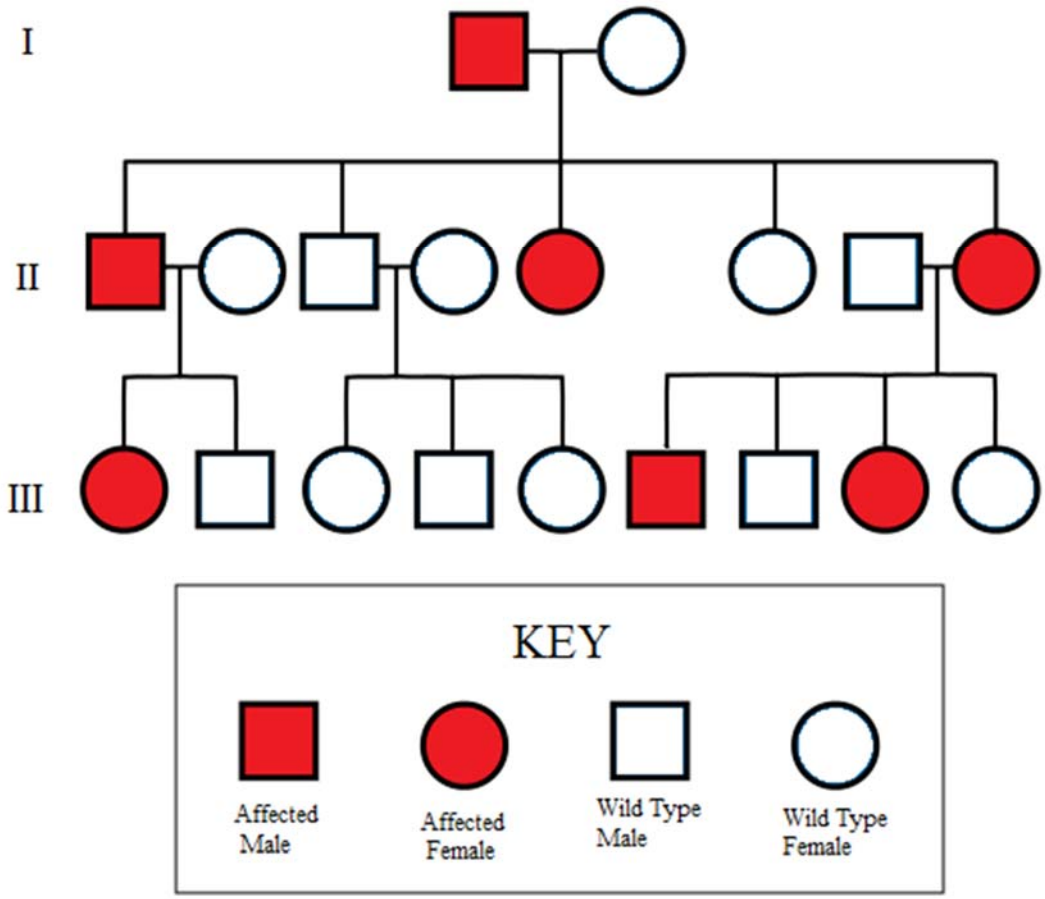
A. 12 brown : 3 white : 1 tan
B. 9 brown : 4 white : 3 tan
C. 9 brown : 3 white : 3 tan
D. 12 brown : 3 tan : 1 white

Question 32

The genetic phenomenon described, where the phenotype of one genotype can mask the phenotype of another genotype, is called:

A. Dominant Epistasis
B. Co-dominance
C. Incomplete dominance
D. Recessive Epistasis

Questions 33 and 34 refer to the following pedigree:



Source: Wikimedia Commons (Author: Jerome Walker)

Question 33

What mode of inheritance is shown for the trait being represented in the pedigree?

A. Autosomal dominant
B. Autosomal recessive
C. X linked dominant
D. X linked recessive

Question 34

If individual III1 were to mate with an individual that did not display the trait, what would be the probability that their offspring WOULD display the trait?

A. 1/3
B. 1/4
C. 1/2
D. 1

Question 35
Which of the following is not an example of analogous features?

A. Similar wing structure on a bird and a bat
B. Human and horse forelimbs having matching bone structure, with differences being simply due to shape.
C. The eye of a mosquito being similar in function to that of a bird
D. The eye of an octopus having similar function and structure to that of a human

Question 36
The half-life of carbon 14 is approximately 5730 years. If a sample of coal was dated to determine its age and was found to have 1/8 its original amount of carbon 14, how old would it be?

A. 5730 x 16 years
B. 5730 x 3 years
C. 5730 x 4 years
D. 5730 x 8 years

Question 37
The amount of DNA present in the nucleus at the end of the G2 phase of the cell cycle is:

A. Half the amount that was present at the beginning of the G2 phase
B. Double the amount that was present at the beginning of the G2 phase
C. Half the amount that was present in the G1 phase
D. Double the amount that was present at the end of the G1 phase

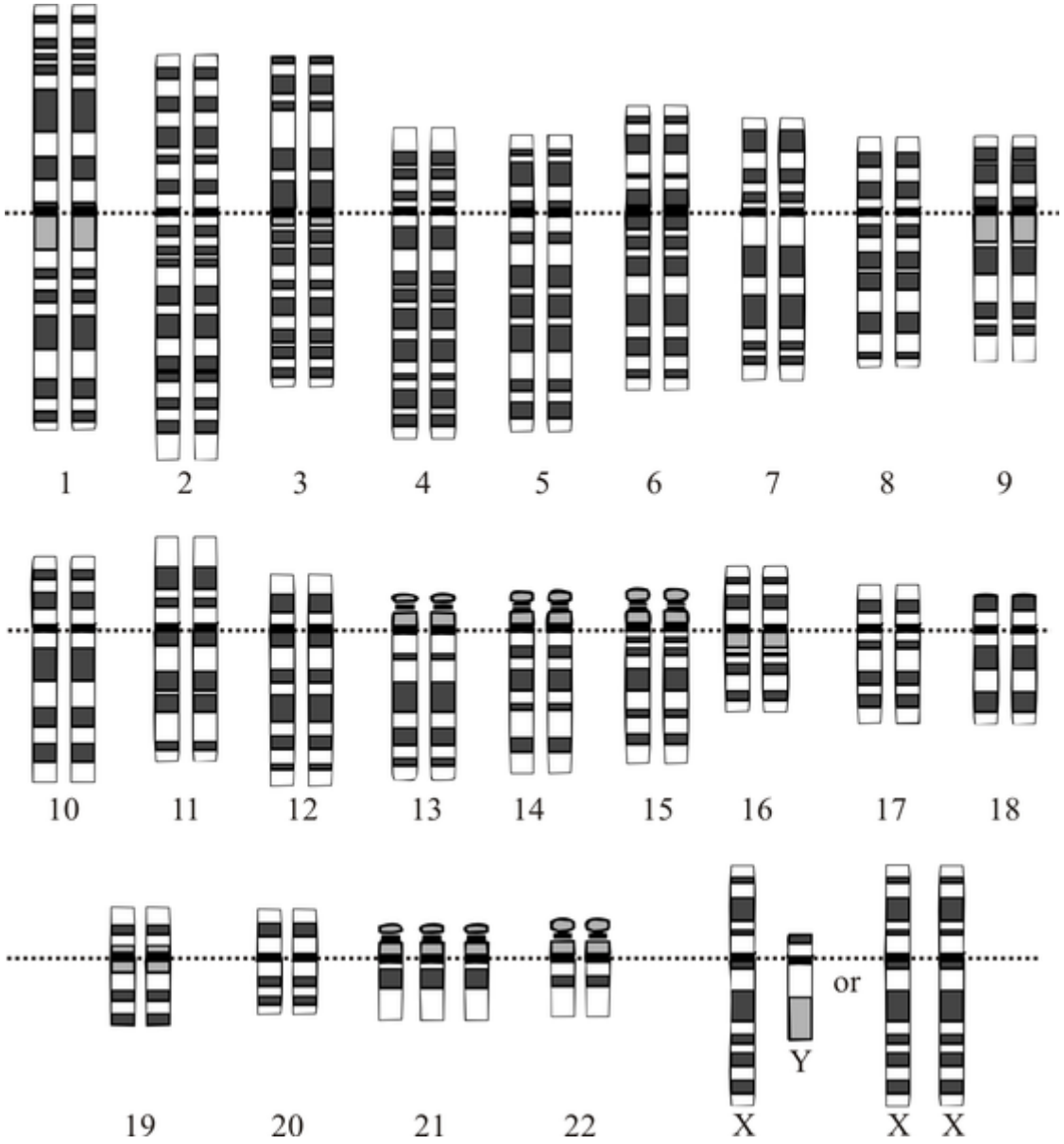
Question 38

Source: Wikimedia Commons (Author: Nick Ares)

The image above is of Atlantic giant pumpkins at a weigh-off in California. The genetic event that has caused the pumpkins to grow so large is:

A. Non-disjunction
B. Polyploidy
C. DNA replication
D. Euploidy

Question 39



Source: Wikimedia Commons

The karyotype shown above is of that of a child suffering from Down's syndrome. The genetic event that has caused this is:

A. Non disjunction
B. Translocation
C. Crossing over
D. Polyploidy

Question 40

The process of inducing a bacterial cell to take up a recombinant plasmid is called:

A. Transduction
B. Transformation
C. Translocation
D. Heat Shock

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

a. Where in the cell does glycolysis occur?

1 mark

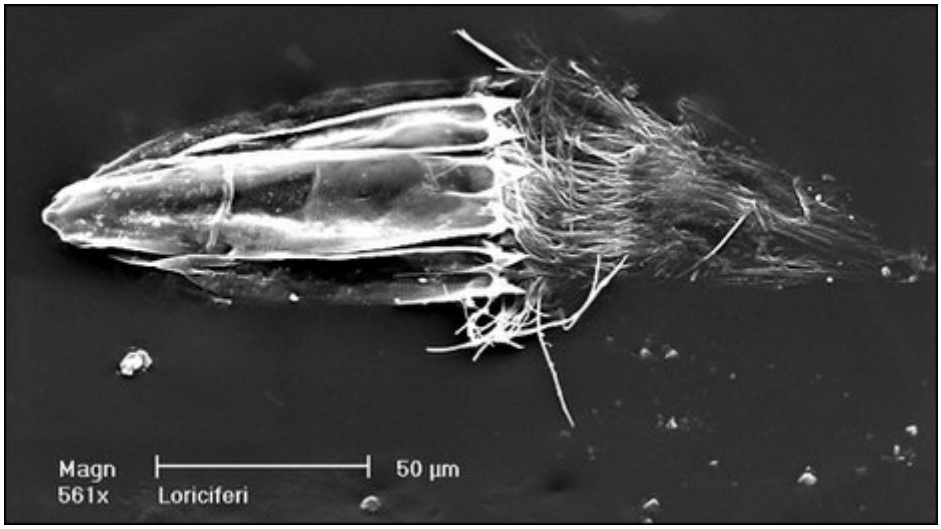
b. Briefly summarise the inputs and outputs of glycolysis.

Inputs:

Outputs:

2 marks

Spinorolicus Cinzia is the first eukaryotic organism to be discovered that does not require oxygen at any stage of its life. This makes it an obligate anaerobe. *Spinorolicus Cinzia* was discovered in the anoxic (depleted of oxygen) L'Atlante Basin of the Mediterranean Sea.



Spinorolicus Cinzia (Source: BBC)

c. Why is it possible for *Spinorolicus Cinzia* to survive anaerobically but it is not possible for humans to?

2 marks

Total: 5 marks

Question 2

a. Explain why a yellow banana, when placed in a paper lunch bag with an overripe orange, will become brown within a day.

2 marks

b. Briefly complete the following table:

Plant tropism or hormone response	Positive / negative / not applicable	Hormone(s) responsible	Brief function of this / these hormones
Phototropism of plant tip towards sunlight			
Geotropism up out of the ground			
Growth of lateral buds			
Flowering			

4 marks

Total: 6 marks

Question 3

The fight-or-flight response is a natural bodily response to potentially dangerous situations where stress hormones (adrenaline, for example) are released from the adrenal glands to prepare an animal for a response to danger. The response is characterised by actions such as shaking, tunnel vision, acceleration of heart/lung activity, increase in blood sugar levels and pupil dilation.

a. Explain whether this is a nervous response, a hormonal response or both.

2 marks

The production of the hormone adrenaline is a biological pathway characterised by a series of enzyme-catalysed biological reactions. The final step in this pathway begins with a hormone called noradrenaline, which not only works in a similar way to adrenaline, but is also converted to adrenaline by an enzyme in the adrenal gland. Suppose a person is producing too much adrenaline, and is suffering adverse effects such as increased blood pressure, constantly raised metabolic rate, and feelings of anxiousness.

b. Outline a potential drug that could be synthesised to overcome this.

3 marks

Total: 5 marks

Question 4

a. Explain why, in cases of fever, human body temperature will be raised to around 40 degrees Celsius, but if it is raised much higher there is a real cause for concern. If possible, include a graph in your answer.

2 marks

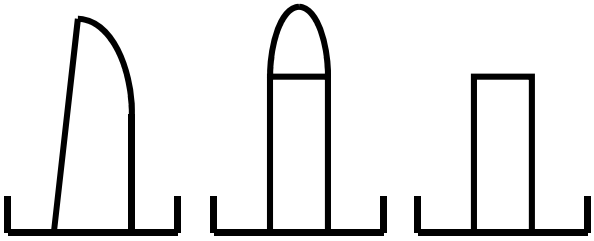
b. A person is bitten by a dog. Initially, blood flow to the wound appears unrestricted, but after a period of minutes it is obvious that the flow of blood is slowing. What process is responsible for this observation? Briefly outline this process.

2 marks

Total: 4 marks

Question 5

An experiment was set up to analyse the effects of the plant hormone auxin. 3 shoots were grown in identical conditions with one plant left intact, one with its coleoptile removed and then replaced and one with its coleoptile tip removed and not replaced. All were subjected to equal light, H_2O, CO_2 and nutrients. The following diagram represents the experimental set up.



a. Name the independent and dependent variables.

1 mark

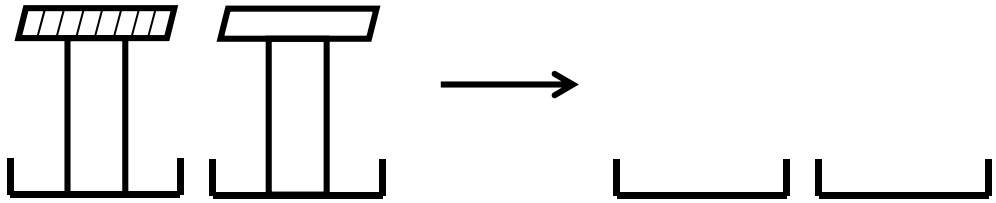
b. What is the purpose of the shoot left intact?

1 mark

c. Draw the expected results of the experiment.

1 mark

d. In the second part of the experiment, two more plant shoots were added with their tips cut off, one with an agar block soaked in juices from ground up coleoptiles tips (plant 1) and one with a plain agar block on it (plant 2). The diagram below represents the experimental set up of these two new plants. Draw the expected results in the spaces on the right, and briefly explain the results for plant 1.



1 2 Results

2 marks

e. What steps must be taken in experimental set ups such as this one to achieve conclusive results?

2 marks

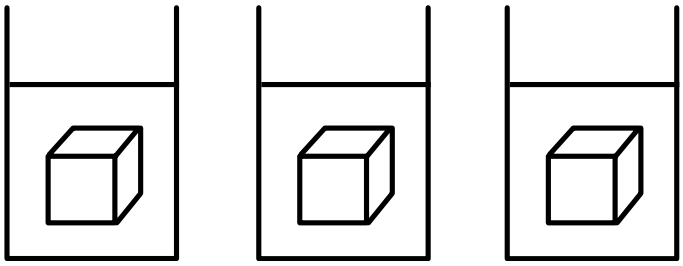
Total 7 marks

Question 6

a. Outline the function of the phospholipid bilayer of a cell membrane through the use of a labelled diagram, showing all major structures and macromolecules.

3 marks

b. An experiment was set up as shown below with 1 cm x 1 cm x 1 cm potato cubes. The concentration of sucrose in each of the potato cubes is 0.1 M. A potato cube was placed in a beaker containing 50 mL distilled water, another potato cube was placed in a beaker containing 50 mL 0.1 M sucrose solution and a third potato cube was placed in a beaker containing 50 mL 1.0 M sucrose solution, as shown below:



distilled water 0.1 M sucrose 1.0 M sucrose

Fill in the following table with expected experimental results:

Beaker	Potato cube appearance	Type of solution (isotonic / hypertonic / hypotonic) that the potato was placed in	Biological term describing the cells of the potato cube after exposure to the solution
1			
2			
3			

3 marks

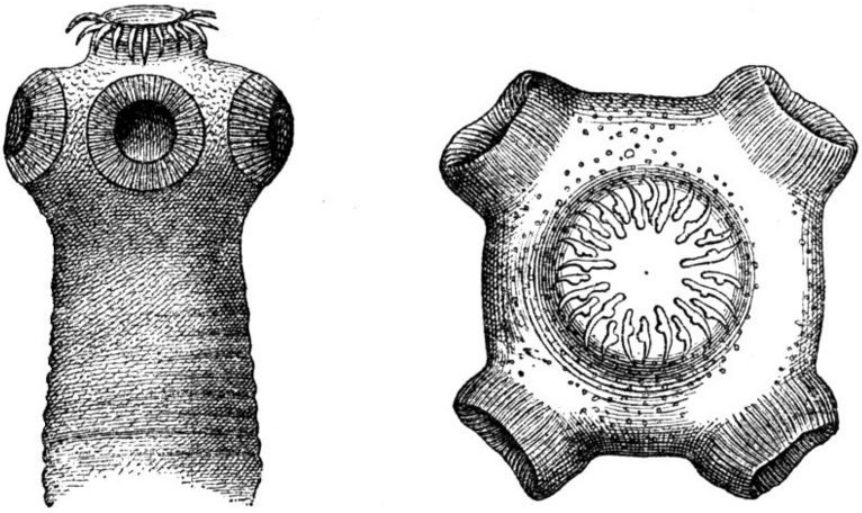
c. Explain how altering the pH of a solution can alter the function of a plasma membrane.

2 marks

Total 8 marks

Question 7

The diagram below is of the pork tapeworm, *Taenia Solium*, which is a eukaryotic parasite that lives in the digestive tract of pigs.



Source: Wikimedia Commons

a. What are two benefits of living the in digestive tract of the pig for *Taenia Solium*?

Benefit 1:

Benefit 2:

2 marks

b. What is one physical feature of the pork tapeworm that enables it to live in the intestines of a pig? How does it help the tapeworm survive?

2 marks

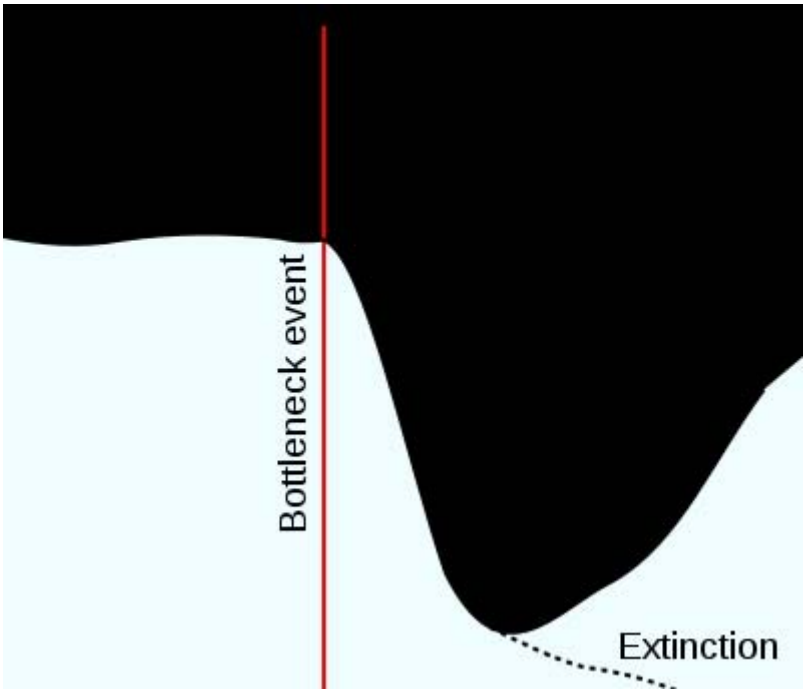
c. Explain, using Darwin's theory of natural selection, how the feature you described in part b. could have evolved in *Taenia Solium.*

3 marks

Total: 7 marks

Question 8

Examine the following graph depicting a population bottleneck.



Source: Wikimedia Commons (Author: TedE)

a. Give one human-caused and one nature-caused example of possible events that may cause a population bottleneck to occur.

Human-caused:

Nature-caused:

2 marks

b. What happens to the gene pool of a population following a bottleneck effect? Why?

2 marks

c. How does a bottleneck effect render a population more susceptible to future decline in numbers and gene pool?

1 mark

Total: 5 marks

Question 9

a. Re-write the following DNA sequence, adding in a frameshift mutation by mutation at, or adjacent to, the seventh base:

3' ATTCGATTGCCCATCTCGAAG 5'

1 mark

b. Explain, briefly, the events that occur during transcription.

3 marks

c. If a frameshift mutation has occurred, what consequence does this have on the polypeptide that the gene was coding for?

2 marks

d. What is meant by the statement 'the genetic code is degenerate'?

1 mark

Total: 7 marks

Question 10

A mouse breeder made the following cross:

Homozygous non-spotted female X homozygous spotted male.

All of the offspring in the F1 were non-spotted.

a. Which phenotype is dominant?

1 mark

b. The genotype of the male parent was ss. What is the genotype of the offspring (the F1 generation)?

1 mark

c. What gametes will the F1 mice produce?

1 mark

d. Two F1 individuals were crossed together and produced progeny. Fill in the appropriate details in the following table:

1 mark

e. What proportion of the offspring will be spotted?

1 mark

f. What proportion of the offspring will be homozygotes?

1 mark

g. The mouse breeder decides to buy a mouse with no spots. How will he determine its genotype?

1 mark

The colour of these spots in the mice is variable. That is, there are black spotted, brown spotted and mice with black and brown spots. The breeder crossed two different strains of non-spotted mice together and obtained large numbers of offspring in the ratio below:

1 black spotted : 2 black and brown spotted : 1 brown spotted : 12 non-spotted

h. Using appropriate genetic terminology, explain these results. A punnet square may be useful.

2 marks

i. Assign every possible genotype to each of the following phenotypes:

Phenotype	Genotype
Non-spotted	
Brown-spotted	
Brown and Black-spotted	
Black-spotted	

6 marks

Total: 15 marks

End of Booklet

Looking for solutions? Visit www.engageeducation.org.au/practice-exams