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YEAR 12 *Trial Exam Paper*

2017

BIOLOGY

Written examination

Worked solutions

This book presents:

- high-level sample answers
- explanatory notes
- mark allocations
- tips on how to approach the exam

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SECTION A – Multiple-choice questions

Question 1

Answer: B

Explanatory notes

Option A is incorrect. Peptide bonds are not polar.

Option B is correct. The primary structure is a peptide chain, which consists of amino acids joined by peptide bonds.

Option C is incorrect. Phosphodiester bonds are found in nucleic acids.

Option D is incorrect. Bonding between amino acid monomers are covalent, not ionic.

Question 2

Answer: A

Explanatory notes

Option A is correct. A hydrolysis reaction is required to break peptide bonds; this needs water as a substrate.

Option B is incorrect. ADP would not provide any energy for the reaction.

Option C is incorrect. Light energy is not used for breaking peptide chains.

Option D is incorrect. Adding oxygen to a peptide chain would not cause the peptide bonds to break.

Question 3

Answer: A

Explanatory notes

Option A is correct. DNA codes for the sequence of amino acids, which is the primary structure of a protein molecule.

Option B is incorrect. The secondary structure is caused by folding due to the primary structure.

Option C is incorrect. The tertiary structure is caused by folding due to the primary and secondary structures.

Option D is incorrect. The quaternary structure is caused by attraction between polypeptide chains.

Question 4

Answer: A

Explanatory notes

Option A is correct. Statements 1 and 4 are both correct for enzymes.

Option B is incorrect. Statement 2 is incorrect because protein synthesis occurs at the ribosome; modification occurs at the Golgi apparatus for exocytosis.

Option C is incorrect. Statement 2 is incorrect (as shown above) and statement 3 is incorrect because enzymes can be also found outside of cells and inside of organelles.

Option D is incorrect. Statements 2 and 3 are incorrect, as shown above.

Question 5

Answer: B

Explanatory notes

Option A is incorrect. Cholesterol and phospholipids are not involved in cell signalling.

Option B is correct. All three are found on the surface of cell membranes and have specific shapes for cell recognition.

Option C is incorrect. Cholesterol and phospholipids are not involved in cell signalling.

Option D is incorrect. Phospholipids are not involved in cell signalling.

Question 6

Answer: A

Explanatory notes

Option A is correct. Any substance that is not hydrophobic will be hydrophilic.

Option B is incorrect. Both move substances with the diffusion gradient.

Option C is incorrect. No ATP is required for diffusion.

Option D is incorrect. Only facilitated diffusion requires membrane proteins.

Question 7

Answer: B

Worked solution

If the 200 thymine bases are 20 per cent of the total, then the total number of bases is 1000.

Due to complementary base pairing, there are 200 adenine bases.

This leaves 600 bases. Due to complementary base pairing, there are 300 guanine and 300 cytosine bases.

Question 8

Answer: D

Explanatory notes

Option A is incorrect. DNA contains deoxyribose sugar, not ribose sugar.

Option B is incorrect. DNA contains deoxyribose sugar, not ribose sugar.

Option C is incorrect. DNA contains deoxyribose sugar, not ribose sugar.

Option D is correct. There is no ribose sugar in DNA.

Tip

- *Remember that DNA only contains deoxyribose sugar. Ribose sugar is only found in RNA.*

Question 9

Answer: C

Explanatory notes

Option A is incorrect. There is no thymine in RNA.

Option B is incorrect. There is no thymine in RNA.

Option C is correct. This sequence has the correct complementary RNA base for every DNA base.

Option D is incorrect. The third and fifth bases in the complementary RNA sequence are incorrect.

Tip

- *Remember that RNA will not contain any thymine bases, so options A and B are incorrect. Option C is the only strand with the correct complementary base sequence.*

Question 10

Answer: D

Explanatory notes

Option A is incorrect. Six water molecules are given as reactants of photosynthesis in the equation. To balance the equation, there would not be any water molecules in the products. Glucose is needed to balance the equation.

Option B is incorrect. ATP is made in the first stage of photosynthesis and is used in the second stage. It is not a product of photosynthesis.

Option C is incorrect. Chlorophyll is a green pigment that absorbs light energy. It is not a product of photosynthesis.

Option D is correct. Glucose is the main product of photosynthesis that is missing from the equation.

Question 11

Answer: D

Explanatory notes

Option A is incorrect. Photosynthesis would not affect cellular respiration because the two processes occur in different organelles and use different enzymes.

Option B is incorrect. Cellular respiration occurs continuously.

Option C is incorrect. Cellular respiration occurs continuously.

Option D is correct. Cellular respiration is required at all times to produce ATP.

Question 12

Answer: C

Explanatory notes

Option A is incorrect. Oxygen is not a source of energy.

Option B is incorrect. Chlorophyll is a green pigment and reflects green light.

Option C is correct. Red light can be absorbed by chlorophyll.

Option D is incorrect. Glucose is a product of photosynthesis.

Question 13

Answer: B

Explanatory notes

Option A is incorrect. Photosynthesis occurs in chloroplasts, not respiration.

Option B is correct. Glycolysis (anaerobic respiration) is the first stage of cellular respiration and takes place in the cytosol.

Option C is incorrect. The Krebs cycle and electron transport chain occur in the mitochondria only if oxygen is present. Glycolysis happens first in the cytosol.

Option D is incorrect. Respiration does not take place in the nucleus.

Tip

- *You need to know where each stage of respiration occurs, along with the inputs and outputs of each stage. The first stage of aerobic and anaerobic respiration is glycolysis, which occurs in the cytosol of cells.*

Question 14

Answer: B

Explanatory notes

Option A is incorrect. The electron transport chain occurs on the cristae membrane of mitochondria.

Option B is correct. Oxygen is needed as the final acceptor of electrons to form water with hydrogen ions.

Option C is incorrect. CO_2 is produced in the Krebs cycle and glycolysis.

Option D is incorrect. The electron transport chain produces 32–34 ATP.

Question 15

Answer: C

Explanatory notes

Option A is incorrect. The introns are removed and the exons are retained.

Option B is incorrect. The promotor sequence is retained but it is not transcribed.

Option C is correct. Introns are not translated and are removed by spliceosomes during post-transcription modification.

Option D is incorrect. These codons are retained to stop and start translation.

Question 16

Answer: C

Explanatory notes

Option A is incorrect. RNA polymerase is used to make mRNA in transcription.

Option B is incorrect. DNA polymerase is used in DNA replication.

Option C is correct. tRNA is used at the ribosome to pair with mRNA during translation.

Option D is incorrect. Spliceosomes are used in post-transcriptional modification.

Question 17

Answer: D

Explanatory notes

Option A is incorrect. RNA polymerase disassociates from DNA at the terminator sequence.

Option B is incorrect. Transcription factors are the product of regulatory genes; transcription factors do not bind to regulatory genes

Option C is incorrect. Translation (not transcription) occurs at ribosomes.

Option D is correct. Transcription factors bind to the promotor region of a structural gene to initiate transcription.

Tip

- *Remember that transcription factors bind to the promotor region of structural genes to initiate transcription. This allows RNA polymerase to bind and then move along the coding section of the gene. Transcription factors are coded for by regulatory genes.*

Question 18

Answer: A

Explanatory notes

Option A is correct. In prokaryotic cells, regulatory genes code for repressor molecules.

Option B is incorrect. Lactose binds to the repressor molecule and prevents it from binding to the operator sequence.

Option C is incorrect. RNA polymerase binds to the promotor region.

Option D is incorrect. RNA nucleotides pair with the coding DNA sequence to produce the mRNA molecule.

Tip

- *Remember that, in prokaryotic cells, the expression of an operon is switched off by the production of repressor molecules, which are coded for by regulatory genes.*

Question 19

Answer: D

Explanatory notes

Option A is incorrect. lacZ, lacY and lacA are structural genes that code for enzymes.

Option B is incorrect. lacZ, lacY and lacA are structural genes that code for enzymes.

Option C is incorrect. lacZ, lacY and lacA are sequences of DNA.

Option D is correct. lacZ, lacY and lacA are all structural genes that are found on bacterial chromosomal DNA. These genes code for enzymes to break down lactose.

Question 20

Answer: D

Explanatory notes

Option A is incorrect. The question tells you that glucose is absent. Therefore, glucose cannot affect the expression of the genes.

Option B is incorrect. The repressor molecule binds to the operator region and switches off gene expression.

Option C is incorrect. Allolactose and the repressor molecule do not inhibit each other. The repressor blocks RNA polymerase from transcribing the structural genes.

Option D is correct. Allolactose binds to the repressor molecule and prevents it from binding to the operator sequence. The genes are then switched on and transcribed by RNA polymerase.

Tip

- *The repressor molecule is coded for by a regulatory gene and is therefore a protein. The repressor molecule's shape is specific to its function. When the allolactose molecule binds to it, the shape of the repressor molecule changes and it is prevented from binding to the operator sequence.*

Question 21

Answer: C

Explanatory notes

Option A is incorrect. These terms refer to an immune response, not cell signalling as shown in the diagram.

Option B is incorrect. Translation is part of protein synthesis, which is not shown in the diagram.

Option C is correct. These are the three main stages of cell signalling, in the correct order, as shown in the diagram.

Option D is incorrect. Recognition and induction are not accurate terms for this example. Recognition is a vague term.

Question 22

Answer: A

Explanatory notes

Option A is correct. Autocrine signalling is when a cell produces a chemical signal to act on itself.

Option B is incorrect. Paracrine signalling occurs between neighbouring cells.

Option C is incorrect. Endocrine signalling occurs via the bloodstream.

Option D is incorrect. Communication between adjacent neurons occurs across a synapse and is an example of paracrine signalling.

Question 23

Answer: D

Explanatory notes

Option A is incorrect. Steroid hormones are lipid-based molecules and can move through the lipid membrane to bind to receptors inside the cell.

Option B is incorrect. Steroid hormones are lipid-based molecules and are hydrophobic.

Option C is incorrect. Steroid hormones are released by glands and move through the bloodstream to target cells. This is endocrine signalling.

Option D is correct. Steroid hormones are lipid-based molecules and are therefore hydrophobic. They move through the cell membrane by simple diffusion and bind to an intracellular receptor.

Question 24

Answer: D

Explanatory notes

Enzymes lower the activation energy of reactions. The activation energy is shown as the increase in energy after the reaction begins. Both Ea and Eb are activation energies. Eb is smaller than Ea, which is due to the presence of enzymes, as indicated by the label.

Option A is incorrect. Ea + Eb is the sum of the two activation energies.

Option B is incorrect. Ea – Eb is the difference in activation energies between the catalysed and uncatalysed reactions.

Option C is incorrect. Ea is the activation energy of the uncatalysed reaction.

Option D is correct. Eb is the lower activation energy and is therefore the enzyme-controlled reaction.

Question 25

Answer: D

Explanatory notes

Option A is incorrect. Only competitive inhibitors bind to active sites.

Option B is incorrect. Active sites bind to substrates.

Option C is incorrect. The amino acid sequence is the primary structure of the entire enzyme.

Option D is correct. Due to their specific shapes, active sites bind to specific substrates.

Question 26

Answer: A

Explanatory notes

Option A is correct. The 60 °C temperature results in the highest productivity.

Option B is incorrect. There is no data in the graph to support this.

Option C is incorrect. While the initial productivity is highest at 65 °C, with time the productivity drops below the productivity of the reaction at 55 °C. This suggests some inhibition or denaturing of the enzyme at 65 °C and this is therefore not the optimum temperature.

Option D is incorrect. The enzymes are working at all three temperatures. There is no evidence in the graph to support the pH level being incorrect.

Question 27

Answer: A

Explanatory notes

Option A is correct. The result is a random error because there was only one anomalous result from a controlled experiment using the conditions and a large sample size.

Option B is incorrect. This is not a systematic error because identical tests were carried out and the error only occurred once.

Option C is incorrect. There is no evidence of selection bias and the error only occurred once.

Option D is incorrect. The test was repeated consistently, as explained in the question.

Tip

- *Use the information provided in the question and look for the most logical answer. It is important that you understand the definition of these terms in the Study Design to be able to answer questions correctly.*

Question 28

Answer: A

Explanatory notes

Option A is correct. A vaccine is an attenuated version of a pathogen that is injected into a patient. It is therefore acquired artificially. That is, the patient does not catch the attenuated pathogen naturally.

Option B is incorrect. Herd immunity is created in a population, not in individuals.

Option C is incorrect. The injection of the vaccine is not a passive response.

Option D is incorrect. Auto immunity is when the body's immune system attacks itself.

Tip

- *You must have a sound understanding of definitions and terms in the Biology course in order to answer this style of question.*

Question 29

Answer: A

Explanatory notes

Option A is correct. Epidemics are outbreaks in local populations.

Option B is incorrect. Pandemics are worldwide outbreaks.

Option C is incorrect. Hypersensitivity is an allergic reaction.

Option D is incorrect. Clonal selection is how specific B cells and T cells replicate.

Question 30

Answer: C

Explanatory notes

Option A is incorrect. Viruses are non-cellular and do not carry out protein synthesis outside a host cell.

Option B is incorrect. Antibiotics are drugs that are used for bacterial infections, not for viral infections.

Option C is correct. Rational drug design uses the concept of competitive inhibition of enzymes, which involves using a complementary shape to block the active sites of enzymes.

Option D is incorrect. Viruses are non-cellular and therefore do not have cell membranes.

Question 31

Answer: C

Explanatory notes

Option A is incorrect. NK cells are non-specific.

Option B is incorrect. The specific immune response will not affect the number of mast cells.

Option C is correct. The vaccine will produce a specific immune response that results in specific antibodies and memory cells in a humoral response.

Option D is incorrect. No body cells will be infected by an attenuated pathogen, so more T cells will not be produced.

Question 32

Answer: C

Explanatory notes

Option A is incorrect. Master genes are found in different species. Variation in the levels of expression of these genes can lead to speciation.

Option B is incorrect. The rate of evolution is controlled by environmental selection pressures.

Option C is correct. Master genes control the expression of a group of structural genes. Option C is the only option that accurately refers to this.

Option D is incorrect. Enzymes are not switched on and off. Master genes control the rate of expression of other genes, not the production of enzymes.

Question 33

Answer: D

Explanatory notes

Option A is incorrect. Master genes control the expression of other genes, not chemical pathways.

Option B is incorrect. Hormones travel through the bloodstream to bind to extracellular receptors and affect signal transduction within target cells.

Option C is incorrect. These proteins bind to the promotor regions of DNA, not to the active sites of enzymes.

Option D is correct. Proteins produced by master genes are transcription factors that switch on the expression of groups of structural genes.

Question 34

Answer: A

Explanatory notes

Option A is correct. Changes in the amino acid sequence occur at a regular rate due to the underlying mutation rate in the DNA. This can be used to determine the time since divergence from a common ancestor of two different species. This is called a molecular clock.

Option B is incorrect. DNA hybridisation forms hybrid stands to compare the similarity in strands of DNA from two species by forming hybrid strands.

Option C is incorrect. Relative dating uses the strata of rock and index fossils to estimate the age of a fossil.

Option D is incorrect. Radiometric dating uses the amount of radioisotopes in fossils to estimate the age of a fossil.

Question 35

Answer: D

Explanatory notes

Option A is incorrect. Other bats diverged earlier from horseshoe bats than dolphins and porpoises.

Option B is incorrect. Old World fruit bats diverged earlier from horseshoe bats and other bat groups, so are less related to horseshoe bats than the groups above them on the tree.

Option C is incorrect. Baleen whales diverged earlier from horseshoe bats than other species and are the least related species to horseshoe bats of the groups shown.

Option D is correct. Horseshoe bats and dolphins and porpoises are on the same branch and are closer connected to each other than other species.

Tip

- *When analysing phylogenetic trees, remember that the closer the two species are, the more closely related they are.*

Question 36

Answer: C

Explanatory notes

Option A is incorrect. Human faces are less sloping and flatter than their ancestors.

Option B is incorrect. Brow ridges become smaller the closer the relation to humans.

Option C is correct. Higher foreheads identify how closely related an ancestral species is to modern humans. A higher forehead is a human feature.

Option D is incorrect. Modern humans have a more anterior foramen magnum position than their ancestors. This is believed to support bipedalism.

Tip

- *Only option C is the correct feature for identifying increasing relatedness to modern humans. The other features all show less relatedness. Compared with ancestors, humans have flatter faces, smaller brow ridges and more varied dentition. The key knowledge here is to understand the features of human evolution.*

Question 37

Answer: A

Explanatory notes

Option A is correct. All *Australopithecus* and *Homo* species are examples of primates, hominids and hominins. The divergence comes much later at the genus level.

Option B is incorrect. *Australopithecus* and *Homo* species are also hominin.

Option C is incorrect. *Australopithecus* and *Homo* species are also hominid.

Option D is incorrect. Option A is the correct answer.

Tip

- *It is important that you know the definition of the terms primate, hominin and hominid and know which ancestral species belong to these groups.*

Question 38

Answer: C

Explanatory notes

Option A is incorrect. Haploid describes a single set of chromosomes found in gametes.

Option B is incorrect. Diploid describes the complete set of chromosomes found in the somatic cells of the parents.

Option C is correct. The chromosome number doubled to produce the new species. 'Poly'- means many, and the term used to describe this in plants is polyploid.

Option D is incorrect. Aneuploid refers to a partial set of chromosomes.

Question 39

Answer: C

Explanatory notes

Option A is incorrect. The human gene and the bacterial plasmid need to be cut with the same restriction enzyme to produce complementary ends.

Option B is incorrect. The human gene is isolated by restriction enzymes.

Option C is correct. DNA ligase is used to join the complementary ends of the DNA fragments.

Option D is incorrect. The bacteria take up the transformed plasmids containing the human insulin gene.

Question 40

Answer: A

Explanatory notes

Option A is correct. The use of antibiotic resistance allows the bacteria to be grown in a medium containing the antibiotic. Only bacteria with the antibiotic resistance gene, and therefore the transformed plasmid, will grow. These bacteria can then be collected.

Option B is incorrect. Other safety measures are taken to prevent infection by handling microbes.

Option C is incorrect. Bacteria are not infected by other bacteria. The antibiotics will kill any non-resistant bacteria in the medium.

Option D is incorrect. No new pathogenic strains are being created. The transfected plasmids are only used to produce a human protein.

SECTION B – Short-answer questions

Question 1a.

Worked solution

Exocytosis

Mark allocation: 1 mark

- 1 mark for exocytosis

Question 1b.

Worked solution

A: rough endoplasmic reticulum

B: Golgi apparatus

C: vesicle

Mark allocation: 2 marks

- 2 marks for all three correct terms
- 1 mark for two correct terms
- 0 marks for one or no correct terms

Question 1c.

Worked solution

A protein is synthesised at the rough endoplasmic reticulum by translation. After synthesis at the attached ribosome, the protein enters the membrane of the rough endoplasmic reticulum and folds into its secondary and tertiary structure. Vesicles transport the protein to the Golgi apparatus for further packaging and modification. Another vesicle then transports the protein to the cell membrane and fuses with it to release the protein from the cell.

Mark allocation: 3 marks

- 1 mark for referencing rough endoplasmic reticulum, protein synthesis or translation
- 1 mark for explaining that the protein is packaged and modified at the Golgi apparatus
- 1 mark for explaining that the vesicle transports the protein to the cell membrane

Question 1d.

Worked solution

Proteins are hydrophilic and the lipid membrane is hydrophobic, so the protein cannot pass through by simple diffusion. The protein is also too large to fit between the phospholipids.

Mark allocation: 2 marks

- 1 mark for correct use of chemical composition of proteins and lipids
- 1 mark for correctly identifying the size of the protein molecule

Question 2a.

Worked solution

Any of cell recognition, signalling, transport, structural support or enzyme.

Mark allocation: 1 mark

- 1 mark for any of the functions given above

Question 2b.

Worked solution

X: alpha helix
Y: beta pleated sheet

Mark allocation: 2 marks

- 1 mark for identifying the alpha helix
- 1 mark for identifying the beta pleated sheet

Tip

- *You must use the whole name. Pleated sheet, beta sheet or helix are not acceptable for full marks.*

Question 2c.

Worked solution

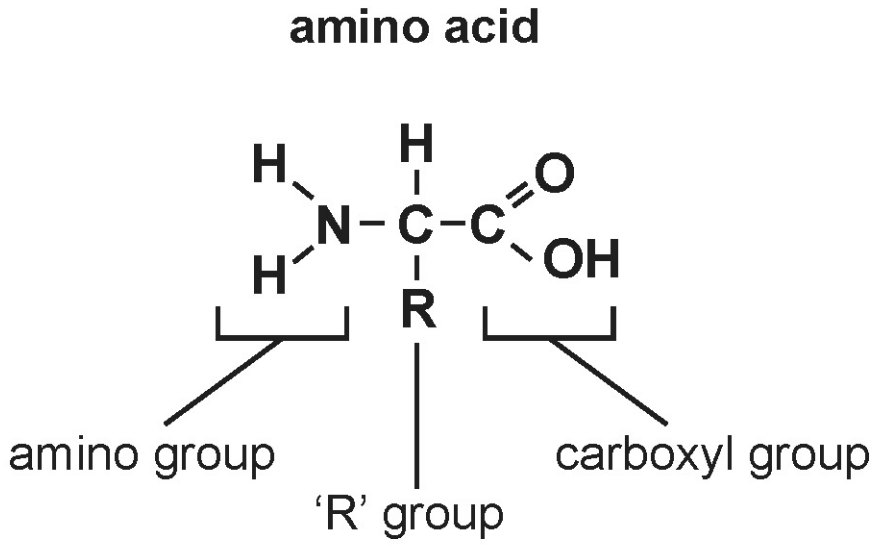
The tertiary level of bonding produces a specific three-dimensional shape. This shape enables the protein to form a structure that is complementary to its target molecule.

Mark allocation: 2 marks

- 1 mark for recognising that the tertiary level of bonding produces a specific three-dimensional shape
- 1 mark for explaining that a specific shape relates to a specific function

Question 2d.

Worked solution



Mark allocation: 3 marks

- 1 mark for each of the three functional groups labelled in the diagram above (up to 3 marks)
  Note: The amine group can be written as NH_2, the carboxyl group can be written as COOH and the R group can be labelled as a variable region.

Question 3a.

Worked solution

Hydrogen peroxide (or $2H_2O_2$)

Mark allocation: 1 mark

- 1 mark for correctly recognising the substrate hydrogen peroxide

Question 3b.

Worked solution

No. Enzymes only catalyse one type of reaction because their specifically shaped active sites can only bond to specific substrates.

Mark allocation: 2 marks

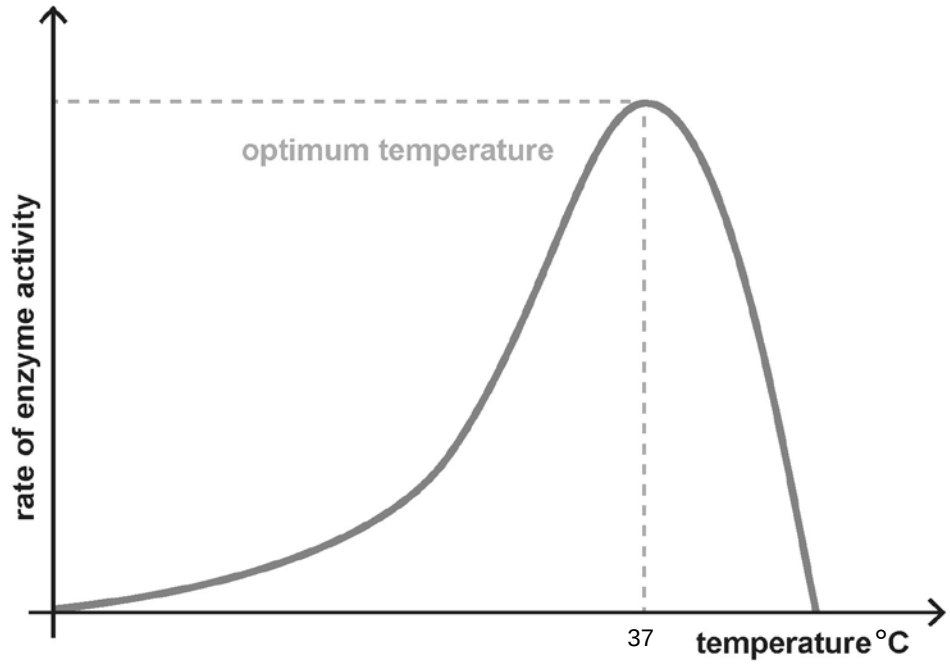
- 1 mark for referencing the specific shape of active site
- 1 mark for explaining that only specific substrates are complementary to active sites

Tip

- *No marks will be awarded for a yes or no response. You must give two points in your explanation to be awarded both marks.*

Question 3c.

Worked solution



Mark allocation: 2 marks

- 1 mark for a gradual slope increasing up to optimum temperature
- 1 mark for steep a decline above 40 °C

Question 3d.

Worked solution

The enzyme becomes denatured because the heat energy causes bonds in the tertiary level of the protein structure to break. This causes the active sites of the enzymes to lose their shape and they then cannot bind to the substrate.

Mark allocation: 2 marks

- 1 mark for recognising that the enzyme denatures due to heat energy
- 1 mark for stating that the active site shape changes and is unable to bind to the substrate

Question 3e.

Worked solution

Put human liver and enzyme catalase into a series of test tubes at a range of pH levels, including pH 7.

Keep all other variables the same: amount of enzyme, amount of liver, time of experiment, ambient temperature, amount of hydrogen peroxide and concentration of hydrogen peroxide.

Measure the amount of oxygen produced in a set time.

The more oxygen produced, the more active the enzyme is.

If the hypothesis is correct, pH 7 should produce the most oxygen.

Mark allocation: 3 marks

Any three of the following points for 1 mark each:

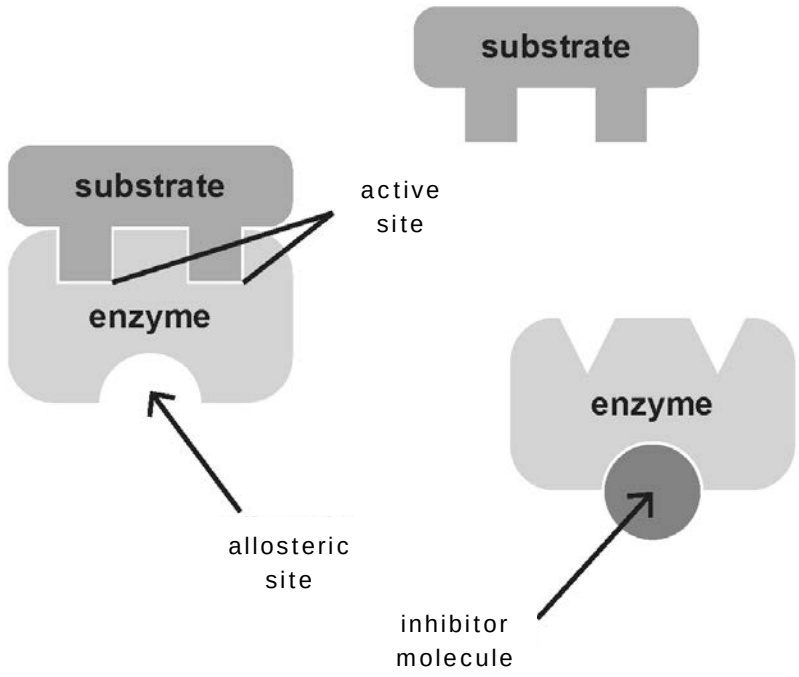
- 1 mark for correct identification of the independent variable: range of pH levels
- 1 mark for correct identification of the dependent variable: amount of oxygen gas produced
- 1 mark for a minimum of two correct control variables
- 1 mark for stating what result will support the hypothesis

Tips

- *Remember that you can answer in dot points. This may help to ensure you state all variables.*
- *Be aware that no marks will be given for repeating any information given in the question.*
- *It is good practice to include the result that will support the hypothesis, which is the final point given above.*

Question 3f.

Worked solution



Mark allocation: 3 marks

- 1 mark for correct labels of enzyme, substrate and inhibitor
- 1 mark for enzyme and substrate binding or showing enzyme and substrate having complementary shapes
- 1 mark for showing the changing shape of the active site and the substrate being unable to bind

Tip

- *Label all parts of your diagrams. When the question asks for diagrams (plural), you must include more than one to achieve full marks.*

Question 4a.

Worked solution

ATP is formed when ADP reacts with inorganic phosphate. When ATP is used by cells, it breaks down into ADP and phosphate.
Using the energy released in cellular respiration, these ADP and phosphate molecules can be reused to form more ATP. This enables cells to regenerate ATP if there is an energy supply.

Mark allocation: 2 marks

- 1 mark for stating that ATP is formed by joining ADP and inorganic phosphate
- 1 mark for explaining that ADP and inorganic phosphate can be recycled to produce more ATP if there is an energy supply

Question 4b.

Worked solution

Stage: Electron transport chain
Electrons from loaded carrier molecules enter cytochromes in the cristae of the mitochondria.
Energy is used to make ATP from ADP and inorganic phosphate.
Oxygen acts as the final acceptor of electrons and combines with hydrogen ions to produce water.

Mark allocation: 3 marks

- 1 mark for identifying the electron transport chain
- 1 mark for correct description of cytochromes and energy from electrons being used to form ATP
- 1 mark for correct description of the formation of water at the end of the chain

Tip

- *Answer in dot points for long answers with lots of information. This will help you plan your way through the response and help you to cover all important steps.*

Question 4c.

Worked solution

The cell is able to produce ATP when the oxygen supply is insufficient for aerobic respiration.

Mark allocation: 1 mark

- 1 mark for identifying that the cell can perform a form of cellular respiration without oxygen

Question 4d.

Worked solution

Light energy is absorbed by chlorophyll and is used to make ATP. The energy in ATP is then used to make glucose molecules in the light-independent phase.

Mark allocation: 2 marks

- 1 mark for explaining that light energy is absorbed by chlorophyll and used to make ATP
- 1 mark for explaining that the energy in ATP is used to make glucose molecules in the light-independent phase

Question 4e.

Worked solution

Water molecules split to produce oxygen gas and hydrogen ions, which are loaded onto NADP carriers.

Mark allocation: 2 marks

- 1 mark for water split to form oxygen
- 1 mark for water split to form hydrogen ions, which are loaded on to NADP carriers

Tip

- *Make sure you know the names of the correct carrier molecules for photosynthesis and respiration. Marks will not be given for incorrect terms.*

Question 4f.

Worked solution

Limiting factors are the lack of carbon dioxide, lack of water, lack of chlorophyll or lack of enzymes.

Mark allocation: 2 marks

- 1 mark for each correct factor (up to 2 marks)

Question 5a.

Worked solution

Testosterone passes through the cell membrane, binds with an intracellular receptor and switches on the expression of a gene. This results in the production of a new protein.

Mark allocation: 2 marks

- 1 mark for referencing initiation of gene expression or protein synthesis; need a direct reference to the hormone testosterone binding to an intracellular receptor
- 1 mark for referencing the production of a new protein by initiating gene expression

Tip

- *When a question asks you to refer to the information given in the diagram, a direct reference must be made to get the marks. Avoid generalisations and be specific – in this example, to testosterone and gene expression.*

Question 5b.

Worked solution

Testosterone binds with an intracellular receptor, so it must be able to diffuse through the lipid layer of the membrane. This would mean that testosterone is hydrophobic and lipid based.

Mark allocation: 2 marks

- 1 mark for stating that the receptor molecule is inside the cell
- 1 mark for explaining that testosterone is lipid based or hydrophobic

Tip

- *Make sure you are specific and refer directly to the information in the diagram.*

Question 6a.

Worked solution

This was a worldwide infection of the same pathogen. It was not limited to local populations.

Mark allocation: 1 mark

- 1 mark for recognising that pandemics are worldwide and not limited to local populations

Question 6b.

Worked solution

A new pathogen emerges to which there is little or no natural immunity in human populations. The pathogen is easily spread between individuals and there is a high volume of transport or movement of the vector or pathogen.

Mark allocation: 3 marks

Any three of the following points for 1 mark each:

- 1 mark for referencing the emergence of a new strain of pathogen with little or no natural immunity in the population
- 1 mark for stating that the pathogen is easily spread or airborne
- 1 mark for the referencing the high volume of movement of carriers transmitting the pathogen
- 1 mark for explaining that outbreak occurs in a high-density population
- 1 mark for referencing the difficulty in detecting, diagnosing or tracking the individuals who are initially infected

Tip

- *The worked solution offers one example of an answer, but there are other correct points that you could use in your answer.*

Question 6c.

Worked solution

An existing strain of influenza mutates to create a new strain. Genetic drift occurs gradually, and this eventually changes the surface proteins or antigen of the virus. Human immune systems do not recognise the new antigen and treat it as a new infection.

Mark allocation: 3 marks

Any three of the following points for 1 mark each:

- 1 mark for stating that an existing strain mutates
- 1 mark for description of genetic drift
- 1 mark for explaining the resulting change in the antigen
- 1 mark for explaining that the new antigen is not recognised by the host's immune system

Question 7a.

Worked solution

Divergent evolution

Mark allocation: 1 mark

- 1 mark for stating divergent evolution or adaptive radiation

Tip

- *Use the information given in the question.*

Question 7b.

Worked solution

Hypothesis B is correct.
It is highly unlikely that the same mutations will occur in the same genes at the same time in isolated populations.
One mutation in the master gene is much more likely to occur in different populations.
The master gene controls the expression of other genes; mutations in the master gene can have different effects on the expression of other genes.
This will produce the range of phenotypes and jaw structures shown in the diagram.

Mark allocation: 3 marks

Any three of the following points for 1 mark each:

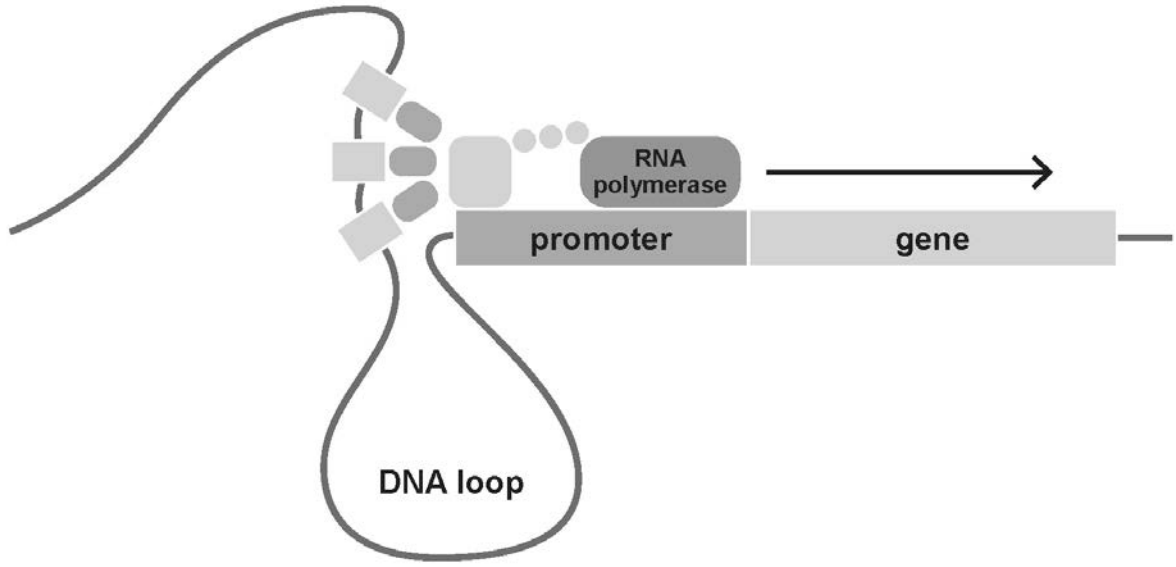
- 1 mark for stating that it is highly unlikely that the same mutations will occur in the same genes at the same time in isolated populations
- 1 mark for explaining that one mutation in the master gene is much more likely to occur in different populations
- 1 mark for identifying that the master gene controls the expression of the other genes
- 1 mark for referring to the production of the range of phenotypes and jaw structures shown in the diagram

Tip

- *Stick to the main steps and points and try not to overcomplicate your answers.*

Question 7c.

Worked solution



Mark allocation: 3 marks

- 1 mark for drawing the transcription factor binding to promotor region or enhancer sequence
- 1 mark for labelling the promotor region upstream of gene sequence or coding sequence
- 1 mark for drawing RNA polymerase joined to transcription factor and promotor region

Tip

- *Read the question carefully. Only one diagram is asked for. Do not draw more, because only the first diagram will be marked. Label all parts of your diagram and name the enzyme.*

Question 8a.

Worked solution

PCR is performed to amplify the DNA segment so that there is enough to be visible in the gel electrophoresis.

Mark allocation: 1 mark

- 1 mark for recognising that PCR is performed to increase the amount of DNA in the sample

Question 8b.

Worked solution

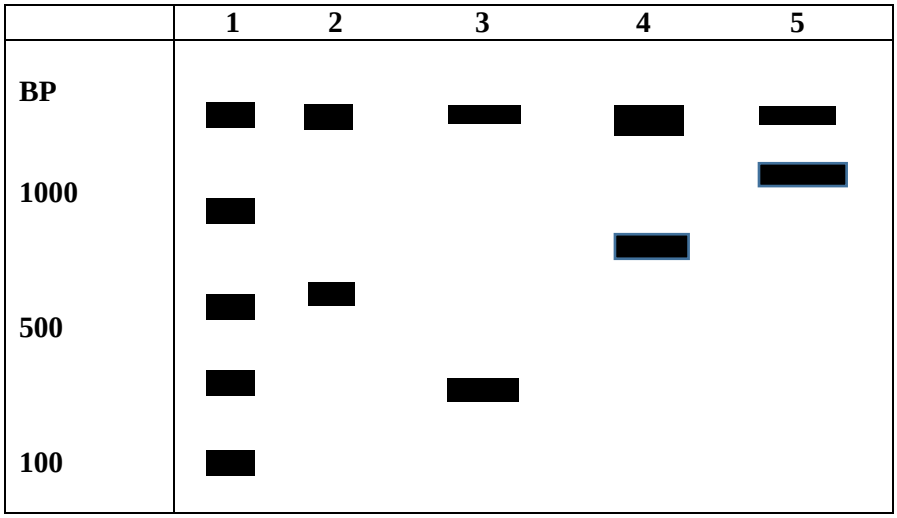
1. Heat the DNA to 90 °C
2. Cool to attach primers
3. Taq polymerase copies DNA strands

Mark allocation: 3 marks

- 1 mark for identifying that the DNA must be heated to 90 °C
- 1 mark for stating ‘cool to attach primers’ or equivalent
- 1 mark for stating ‘Taq polymerase copies DNA strands’ or equivalent

Question 8c.

Worked solution



The larger the segment, the less distance moved. Indicate a line on each well, using the numbers in the left column.

Mark allocation: 2 marks

- 1 mark for every two correct, as shown above
- 0 marks for one correct
- No half marks given

Question 8d.

Worked solution

Standard DNA fragments of known lengths

Mark allocation: 1 mark

- 1 mark for identifying a standard DNA fragments of known lengths

Question 9a.

Worked solution

Adaptive radiation or divergent evolution

Mark allocation: 1 mark

- 1 mark for stating adaptive radiation or divergent evolution; no other terms accepted

Question 9b.

Worked solution

There was variation in the original population.
There were different selection pressures on the different islands.
In each environment, individuals with phenotypes that were successful survived and reproduced.
The allele frequencies of the different phenotypes would change over time in the populations.
The lack of gene flow between populations led to speciation.

Mark allocation: 4 marks

Any four of the following points for 1 mark each:

- 1 mark for identifying that there was a variation in the original species population
- 1 mark for identifying that there were different selection pressures on different islands
- 1 mark for identifying that individuals with phenotypes that were successful in each environment survived and reproduced
- 1 mark for identifying that the allele frequencies of different phenotypes in the populations changed over time
- 1 mark for identifying that geographical isolation or lack of gene flow between populations leads to speciation

Question 9c.

Worked solution

In selective breeding, humans choose which individuals will mate. In natural selection, a selective pressure removes unsuited individuals.

Mark allocation: 2 marks

- 1 mark for correct description of selective breeding: humans choosing individuals, phenotypes and characteristics
- 1 mark for correct comparative statement for natural selection: environment or selective pressure removes unsuited individuals or phenotypes

Question 10a.

Worked solution

Pelvis: wider and more bowl shaped to support upper body weight on two legs.

Femur: more angled and sloping joint with hips. This angles the femur to bring knees and body weight inwards to keep upright.

Foot: big toe forward, becomes weight bearing and not for gripping.

Mark allocation: 3 marks

- 1 mark for correct description of pelvis
- 1 mark for correct description of femur
- 1 mark for correct description of foot

Question 10b.

Worked solution

Anterior position of foramen magnum in skull or s-shaped spine

Mark allocation: 1 mark

- 1 mark for identifying either anterior position of foramen magnum in skull or s-shaped spine

Question 10c.

Worked solution

Heat and denature strands of DNA segments from each species.
Mix DNA from both species to produce a hybrid strand.
Heat the hybrid strand and compare the temperature required to denature the hybrid strand with the temperature required to denature the original strands.
The more similar the temperatures, the greater the similarity of the sequences of DNA.

Mark allocation: 3 marks

- 1 mark for suggesting heat and denature strands of DNA segments from each species
- 1 mark for explanation of this process
- 1 mark for correct explanation of results to compare similarity of strands

END OF WORKED SOLUTIONS