



Units 3 and 4 Biology

Practice Exam Solutions

Stop!

Don't look at these solutions until you have attempted the exam.

Any questions?

Check the Engage website for updated solutions, then email practiceexams@ee.org.au.

Section A – Multiple-choice questions

Question 1

The correct answer is C. Gibberelins are a group of plant hormones responsible for growth all over the plant.

Question 2

The correct answer is C.

Question 3

The correct answer is C. Rheumatoid arthritis is an autoimmune disease whereby the body identifies **healthy** joint tissues as being foreign and as a result mounts an immune response against them.

Question 4

The correct answer is A. Due to the large energy demands of muscle cells they often contain multiple mitochondria to generate the energy required.

Question 5

The correct answer is A. Viruses are described as obligate intracellular parasites which means in order to survive they require a host cell to reproduce.

Question 6

The correct answer is D. DNA is found in all 3 organelles. RNA is found both inside the nucleus and in the cytosol.

Question 7

The correct answer is D.

Question 8

The correct answer is B. An attenuated vaccine contains a weakened form of the virus. Importantly, it has the surface antigens that result in the body activating the humoral response. The B memory cells that are produced in this process reside in the circulation long term, allowing them to effectively mount a response against that particular strain of the virus in the future.

Question 9

The correct answer is B. Ribosomes on the rough endoplasmic reticulum synthesise proteins.

Question 10

The correct answer is D.

Question 11

The correct answer is A. Body temperature is maintained to ensure the body maintains a stable internal environment temperature within narrow limits. Negative feedback is utilised to achieve this.

Question 12

The correct answer is B. Any experiment requires only one independent variable (IV) to be tested and all the other variables to be constant. Since the investigation is to determine the effect of pH on enzyme activity, temperature should remain constant. Furthermore, to ensure that it is the enzyme's activity that is being modified there needs to be controls (substrate only test tubes) set up at the differing pH levels in order to act as a baseline for the experiment.

Question 13

The correct answer is C. Inactivating or destroying the enzyme slows down the conversion of sugars to starch, helping to preserve the sweetness of the corn.

Question 14

The correct answer is C. Quaternary structured proteins are composed of more than one polypeptide chain, each coded for by different genes.

Question 15

The correct answer is B. T helper cells activate the specific immune responses. B cells produce antibodies, **not** antigens. Macrophages are not involved in the specific immune response.

Question 16

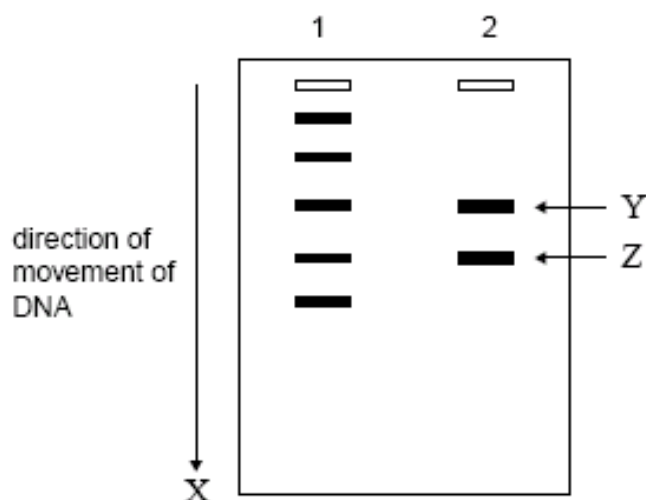
The correct answer is A.

Question 17

The correct answer is B.

Question 18

The correct answer is D.



The restriction enzyme has not cut the plasmid once, it has cut it twice. Fragment Y is not smaller than fragment Z, smaller molecules travel further down the gel than larger ones. X marks the positive, not the negative pole of the gel box. The plasmid is approximately 6 kb. If you order the fragments in the standard sample from largest to smallest, fragment Y corresponds to a 4kb fragment and fragment Z corresponds to a 2kb fragment and together they make up the 6kb plasmid.

Question 19

The correct answer is B. A restriction enzyme (endonuclease) cuts, not joins, pieces of DNA. It has a recognition sequence where it cuts the DNA at specific nucleotide sequences. Recognition enzymes can produce sticky or blunt ends depending on the type of restriction enzyme. A restriction enzyme will not produce two fragments when it cuts a circular vector once, it only produces one fragment.

Question 20

The correct answer is D. The cut plasmid results in 3 fragments: 1.5kb, 2kb and 2.5kb. The smallest fragments travel the greatest distance from the well.

Question 21

The correct answer is C. Crossing over occurs in homologous pairs of chromosomes in prophase I of meiosis. This process involves movement of DNA molecules.

Question 22

The correct answer is D. Ribosomes are composed of rRNA (ribosomal RNA) and proteins.

Question 23

The correct answer is B. Transcription precedes translation in eukaryotes. Options C and D are related to DNA replication.

Question 24

The correct answer is B. Natural selection and artificial selection are not random. Parallel evolution is the separate evolution of two species from a common ancestor resulting in similar traits/allele frequencies, therefore does not result in random changes.

Question 25

The correct answer is A.

Question 26

The correct answer is D. If you remove only individuals who are homozygous for the disorder from the population those who are heterozygous for the condition will still be able to reproduce and pass the allele on. Ensuring there is interbreeding with individuals from other populations could increase the frequency of the allele if the other populations have it. Interbreeding may also reduce the frequency of the allele, but this would probably take more than one generation. Increasing the size of the population would not completely eliminate the allele.

Allowing only homozygous dominant individuals to breed is the most effective method, because it means that no alleles for the recessive disorder will be passed on to the next generation.

Question 27

The correct answer is D.

Question 28

The correct answer is B. Selection results in the survival and reproduction of "fit" individuals over less "fit" individuals, not in extinction. Genetic drift occurs due to chance, not natural selection. Mutations are random and do not result from natural selection.

Question 29

The correct answer is A. Homologous structures may not have the same function but possess a common evolutionary origin. They usually have a similar basic structure, like the skeletal structure in bats' wings compared to the forelimbs of humans. Homologous structures do not always contain bones, and not all related animals (e.g. mammals) have homologous features.

Question 30

The correct answer is B.

Question 31

The correct answer is A. Follow the guinea pigs' and the Old World porcupines' branches back until they meet, at about 60 million years ago. Guinea pigs are more closely related to chinchillas than they are to beavers. Guinea pigs and hamsters have a common ancestor, and New World porcupines are not the most closely related group to the guinea pigs.

Question 32

The correct answer is A. Similar selection pressures result in similar traits being selected for, e.g. the ant eating trait. Convergent evolution involves the independent evolution of groups who do not have a recent common ancestor, who when put under similar selection pressures acquire similar traits. Convergent evolution results in analogous (not homologous) structures.

Question 33

The correct answer is D. Soft-bodied organisms are more likely to decay and less likely to fossilize. Acid disintegrates organic material. D is the best answer because if the organism is covered by a flow of lava this will prevent scavengers from eating it, or the weather from damaging it, or bacteria from decaying it (as the organism will be sealed in without oxygen).

Question 34

The correct answer is A. They have a recent common ancestor, and they have developed different traits due to different selection pressures. If they evolved via parallel evolution they would have similar characteristics. Gene flow is the transfer of genes or alleles between populations. If this had occurred, the populations would stay similar to one another, as they would effectively share the same gene pool. It is not an example of convergent evolution because the populations have a recent common ancestor and evolve to become different instead of more similar.

Question 35

The correct answer is C. Ammonoids are not the most ancient species; they evolved after Nautiloids and Trilobites. The number of Ammonoid species decreased four times in the fossil history before they died out. 500 million years ago, the Trilobites had the greatest number of different species as they had the greatest width (as indicated by the diagram) at this time. Trilobites became extinct after, not before the bony fish entered the fossil record.

Question 36

The correct answer is D. The gorillas diverged first then the chimps and humans diverged together later from a common ancestor.

Question 37

The correct answer is C. Australia, New Guinea and South America were all part of Gondwana. Marsupials evolved in Gondwana and spread out into different parts of Gondwana, which became South America, Australia and New Guinea when the supercontinent split up.

Question 38

The correct answer is D.

Question 39

The correct answer is B.

Question 40

The correct answer is C.

Section B – Short-answer questions

Marks allocated are indicated by a number in square brackets, for example, [1] indicates that the line is worth one mark.

Question 1a i

Eukaryotic cell [1].

Question 1a ii

The cell depicted in the diagram possesses a membrane bound nucleus and organelles [1].

Question 1b i

Mitochondrion [1].

Question 1b ii

The mitochondrion is the site of ATP production during aerobic respiration, providing the cell with a source of energy to fuel cellular metabolism [1].

Question 2a

Phospholipid [1].

Question 2b

Structure Y is referring to the fatty acid tails of the phospholipid, which are hydrophobic in nature [1].

Question 2c

A molecule would require a protein channel if it was either a:

- Charged molecule.
- Large polar molecule.

Maximum [1].

Question 2d

- Steroid hormones are lipid soluble [1]
- Steroid hormones require a carrier molecule in order to be transported in the blood [1]
- Steroid hormones diffuse through the membrane where they may bind with their receptor in the cytosol [1]

Question 2e

- The fresh water is hypotonic and water enters the cell via osmosis [1]
- Without a cell wall, it ruptures [1]

Question 3a

A system where the response to a particular stimulus reverses the direction of that stimulus – the mechanism of homeostasis.

Question 3b

Either of:

- Passage along nerves is electrical/faster than neurohormone transmission.
- The transport of neurohormones is chemical/slower than electrical transmission along a neuron.

Question 3c

Ethanol does the opposite of ADH in that it decreases the permeability of the cells in the collecting duct to water [1]. This creates dilute urine [1].

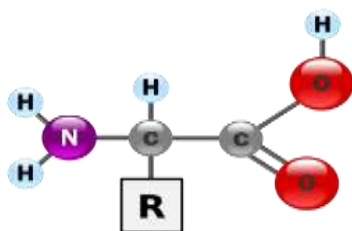
Note: no prior knowledge of the excretory system is required to answer this question. Using all the information provided in the stem of the question would lead to the answer.

Question 3d

- X: sensory neuron [1]
- Y: interneuron [1]

Question 4a

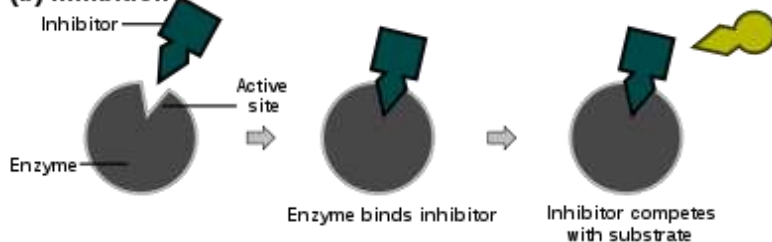
The general structure of an amino acid is:



[1].

Question 4b

(b) Inhibition



- Diagram [1]- The diagram should show the glyphosate binding to the active site of the enzyme as shown in the diagram above and show that the normal substrate is unable to bind.
- Labels [1]- Including substrate, enzyme and glyphosate (competitive inhibitor)
- Explanation [1]- glyphosate binds to the active site of the enzyme preventing the enzyme's normal substrate from binding, and hence preventing amino acid synthesis.

Question 4c i

The light-dependent stage [1].

Question 4c ii

- Water is split to form oxygen gas [1].
- Water is split to form H⁺ or NADPH is formed [1].
- ATP is formed (from ADP and Pi) [1].

Question 4d i

Oxygen concentration [1].

Question 4d ii

Oxygen from the surrounding air is being used by the plant for cellular respiration [1]. OR

Due to being exposed to the dark, photosynthesis has declined, and there is net cellular respiration utilising the oxygen [1].

Maximum [1].

Question 5a

- mRNA travels to the ribosomes where it gets translated [1].
- tRNA carries specific amino acids to the ribosomes and complementary base pairing occurs between the various codons and anticodons [1].
- The amino acids are bonded together in a long chain to form a protein/polypeptide [1].

Question 5b

Anabolic reaction [1].

Question 5c

Any two of:

- DNA has the nucleic base Thymine, while RNA has Uracil [1].
- DNA has a deoxyribose sugar, while RNA has ribose sugar [1].
- DNA is a double stranded molecule, whereas RNA is a single stranded molecule [1].

Maximum [2].

Students need to ensure when identifying differences, they include comparative statements to adequately outline the distinction.

Question 5d i

A viral vaccination would contain a weakened or attenuated version of the virus, or parts of the virus (eg protein coat) [1].

Question 5d ii

- The viral antigens contained in the vaccine circulate the body which will ultimately result in T helper cells stimulating the production of Plasma B cells and Memory B Cells [1].
- Memory B cells reside in the circulation, and upon secondary infection can readily produce antibodies needed to combat the virus [1].

Question 6a

Two [1].

Question 6b

To produce many copies of the DNA sample so that there is enough DNA for analysis [1].

Question 6c

A type of replication that results in replicated DNA that contains one of the original strands of DNA and one new strand [1].

Question 6d

- The claim made by the mother is not supported because a child must receive all of its DNA from its parents [1].
- The child has a band of DNA which is neither in common with its mother or the male TV personality, so the male in question cannot be its father [1].

Question 7a

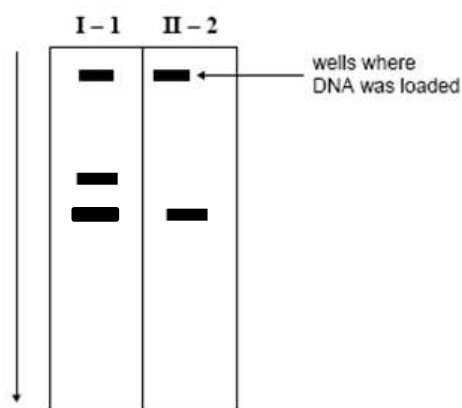
A point mutation [1].

Question 7b

The normal amino acid sequence would have the amino acid glycine at the position indicated by the GGU codon and the abnormal amino acid sequence will have cysteine at this position instead, potentially altering the function of the protein [1].

Question 7c

Restriction enzymes are proteins and can therefore be denatured by heat that surpasses their optimum, compromising their function and their usefulness in DNA manipulation [1].

Question 7d

[1] for each column correctly drawn.

Maximum [2].

Question 8a

- Genetic variation would exist in the population before the myxoma virus was introduced, whereby some rabbits would have been resistant to the virus [1].
- The resistance to the virus is a heritable trait that gives the rabbits with this trait a selective advantage [1].
- While other individuals died after exposure to the virus, these individuals survived and reproduced, passing on the resistance trait to their offspring, increasing the percentage of myxoma resistant rabbits [1].

Answers cannot be generic in nature and must refer to the myxoma virus and the rabbit population in order to gain full marks.

Question 8b

The virus can produce large numbers of virus particles in the blood of the rabbit if it is highly virulent and hence increase its reproduction [1].

With many rabbits and mosquitoes in the environment it has many opportunities to move onto other hosts if it kills its current host [1].

Question 8c

- In an environment with few rabbits, the virus has fewer opportunities to move on to another rabbit host if it kills its first host [1].
- It is a selective advantage to a virus in this situation to keep its host alive [1].

Question 9a

- A small group from a population of lizards would have been separated geographically from the main group [1].
- Over time, the two lizard populations would have been exposed to different environmental pressures and natural selection would have acted upon their phenotypes to produce different traits in each population [1].
- After a long period of time, the two populations would have become so different genetically, that they could no longer reproduce to produce fertile and viable offspring and would then be considered separate species [1].

Question 9b

One of:

- The species could be introduced into another environment similar to Pedra Branca Rock and bred under favourable habitat conditions.
- A management program could also be devised to ensure that no predators of the lizard are allowed onto the island and that the lizard's native environment is protected and conserved.
- Any other reasonable intervention.

Maximum [1].

Question 10a

Using stratigraphy - comparing the depth of the different fossils in the soil. Fossils that are buried more deeply than others are usually older [1].

Question 10b i

- There were many scavengers present in the time of *Archaeopteryx* so few individuals were left to fossilize.
- *Archaeopteryx* lived and died in oxygen rich environments where their bodies decomposed quickly.

[1] for any of the above answers given or any other reasonable answer.

Maximum [1].

Question 10b ii

- *Archaeopteryx* were sometimes half eaten by predators or scavengers before they were buried for fossilization.
- Rocks and the ground can shift, moving and sometimes destroying the fossils they contain.
- *Archaeopteryx* might have been partially decomposed by aerobic bacteria before they were in an environment suitable for fossilization.

[1] for any of the above answers given or any other reasonable answer.

Maximum [1].

Question 10c

- Diagram B [1].
- Diagram A suggests that modern birds are equally related to *Rahona* and *Archaeopteryx*. Diagram B shows that modern birds share a more recent common ancestor with *Rahona* than *Archaeopteryx* [1].

Question 11a

Human 1 [1].

(Due to less nucleotide differences).

Question 11b i

Skeletal structure/morphology may be used to assist in determining the evolutionary relationship of Neanderthals with humans and chimpanzees [1].

Question 11b ii

Carbon dating can be used because the fossil is approximately 25, 000 years old [1].

Question 12a

Skull 1 [1].

Question 12b

More prominent brow ridge than skull 2 [1], larger jaw than skull 2 [1], larger teeth than skull 2 [1], sloping face compared to skull 2 [1].

[1] for each feature listed.

Maximum of [2].

Question 12c

The genera either became extinct before it was possible or a requirement to migrate out of Africa [1].