



# Units 3 and 4 Biology

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## Section A – Multiple-choice questions

### Question 1

The correct answer is C.

### Question 2

The correct answer is D. While it is not necessary to know the intricacies of the electron transport chain for this course, it is worthwhile noting this fact. Oxygen is required at the end of electron transport to combine and form water with hydrogen protons that are carrying energy to form ATP.

### Question 3

The correct answer is C.

### Question 4

The correct answer is C. It is necessary for this course to know the specific locations in the chloroplast of the light dependent and light independent phases of photosynthesis.

### Question 5

The correct answer is A. The cell would become turgid because the distilled water would be hypotonic as compared to the cytoplasm of the cell, and thus water would flow into the cell via osmosis in order to decrease the solute concentration gradient.

### Question 6

The correct answer is C. The role of fibrin is covered in studies of the immune response.

### Question 7

The correct answer is C.

### Question 8

The correct answer is A. Xerophytes are adapted to very dry conditions, and are prevalent in the Australian bush.

### Question 9

The correct answer is B. During transcription, thymine bases on the DNA strand would form complementary hydrogen bonds with adenine nucleotides, meaning that if we have 30% thymine in the original DNA then we will have 30% adenine in the messenger RNA.

### Question 10

The correct answer is B.

### Question 11

The correct answer is A.

### Question 12

The correct answer is D. An action potential needs to be large enough to stimulate the neuron to pass it along its axon. In order for that to happen, enough neurotransmitter from the prior neuron must bind to the neuron's receptors.

### Question 13

The correct answer is C.

### Question 14

The correct answer is C.

**Question 15**

The correct answer is D.

**Question 16**

The correct answer is B.

**Question 17**

The correct answer is A.

**Question 18**

The correct answer is D.

**Question 19**

The correct answer is B. Histones wind DNA into tightly supercoiled chromosomes, which can then be separated during mitosis or meiosis

**Question 20**

The correct answer is A.

**Question 21**

The correct answer is B. Males only receive one X chromosome, so are more susceptible to be affected by X linked disorders.

**Question 22**

The correct answer is D. Humans have selected the pug dogs with the best looking 'squashed faces' and have desexed many individuals, greatly reducing the gene pool. This is artificial selection as it has been humans, not nature, that determines the fittest individuals for breeding.

**Question 23**

The correct answer is B.

**Question 24**

The correct answer is A. Although the short, broad pelvis is an example of structural evolution, it is not an example found in the picture. In the exam you must take information from the data if it is presented to you.

**Question 25**

The correct answer is A. Whilst there are four amino acid differences in the DNA sequence, these could be due to more than 4 base differences due to the redundancy in the genetic code.

**Question 26**

The correct answer is A.

**Question 27**

The correct answer is B. Usually in a cross between two heterozygotes, the chance that the progeny are also heterozygous is  $1/2$ . However, as this allele is lethal when homozygous, we can eliminate the chance of that genotype from our punnet square, leaving us with three genotypes possible, two of which are heterozygotes.

**Question 28**

The correct answer is C. Meiosis is an example of sexual reproduction, whereas all other examples given were of asexual reproduction.

**Question 29**

The correct answer is C.

**Question 30**

The correct answer is A.

**Question 31**

The correct answer is B.

	BC	Bc	bC	bc
BC	BBCC	BBCc	BbCC	BbCc
Bc	BBCc	BBcc	BbCc	Bbcc
bC	BbCC	BbCc	bbCC	bbCc
Bc	BbCc	Bbcc	bbCc	bbcc

9 brown : 4 white : 3 tan

**Question 32**

The correct answer is D.

**Question 33**

The correct answer is A. The pedigree is representing an autosomal dominant trait. It does not skip generations, and there are no relationships present indicative of an X linked trait (i.e. no mother to son or father to daughter specific inheritance patterns)

**Question 34**

The correct answer is C. Individual III1 must be heterozygous for the trait, as they have a wild type parent. If they then mated with a homozygous recessive individual, only half of the offspring would receive a dominant allele from individual III1 and display the trait.

**Question 35**

The correct answer is B.

**Question 36**

The correct answer is B.

**Question 37**

The correct answer is D. The G2 phase follows interphase, where DNA is replicated, so there should be double the amount of DNA in the cell at all times in the G2 phase compared to the G1 phase, which occurs prior to interphase.

**Question 38**

The correct answer is B.

**Question 39**

The correct answer is A.

**Question 40**

The correct answer is B

## 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

Cytosol [1] OR cytoplasm [1]

### Question 1b

- Inputs : Glucose, NAD<sup>+</sup>, ADP [1]
- Outputs: 2 x Pyruvate, ATP, NADH [1]

### Question 1c

- Spinorolicus Cinzia* lives in an anoxic environment and is very small, thus it can meet its minimal energy requirements through glycolysis alone [1].
- Humans have much greater energy requirements and face a lactic acid buildup if forced to respire anaerobically for more than a very short period of time [1].

### Question 2a

- The yellow banana will become brown so quickly because the overripe orange produces the hormone ethylene. [1]
- This is a gaseous hormone [1] and thus can travel to the banana and initiate the ripening response.

### Question 2b

In order to gain each of the 4 marks, the entire row for each plant tropism or hormone response needs to be filled out correctly.

Plant tropism or hormone response	Positive/Negative/Not applicable	Hormone(s) responsible	Brief function of this/these hormones
Phototropism of plant tip towards sunlight	Positive	Auxin, Cytokinins	Apical dominance (required for the 1 mark), lateral growth, root growth
Geotropism up out of the ground	Negative	Auxin, Cytokinins	Shoot growth (required for the 1 mark) Levels of auxins to cytokinins in a plant determine whether it will undergo positive or negative geotropism.
Growth of lateral buds	Not applicable	Cytokinins	Lateral bud growth, (required for the 1 mark) senescence, root and shoot growth.
Flowering	Not applicable	Gibberellins	General plant growth, flowering, (required for the one mark) reproduction, germination, elongation

**Question 3a**

- This response is both a nervous and a hormonal response. Initially it is a hormonal response, as the adrenal gland secretes the hormone adrenalin into the bloodstream and it binds to target cells to initiate the fight or flight response [1].
- However, the effects that occur as a result are nervous responses, such as shaking, which are controlled by a nervous pathway involving the involuntary twitching of muscle cells. [1]

**Question 3b**

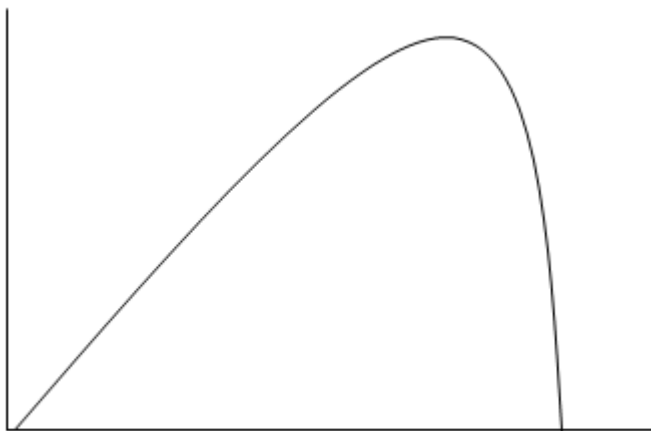
Various answers accepted, but all have to deal with the idea of synthesising a compound that has the same specific shape as a molecule in the pathway of the production of adrenaline, to work as an inhibitor molecule. An example could be:

- A drug could be synthesised that fits the active site [1] of the enzyme that converts noradrenaline to adrenaline, and would thus bind to it and inhibit it from synthesising adrenaline [1].
- The result of this would be a reduced production of adrenaline, which would decrease the symptoms that the person is experiencing [1].

**Question 4a**

- At 40 degrees Celsius, human enzymes can continue to work, and the excess temperature may kill pathogens [1].
- However, if the temperature increases too much, or stays elevated for an extended period of time, bodily enzymes become irreversibly denatured and death may occur [1].

An example of a graph that could be used is below:

**Question 4b**

- The process occurring is blood clotting [1].
- Platelets 'plug' the wound and enzymes in plasma initiate the production of the string-like secondary protein, fibrin, which binds components of the blood together. The result of these processes is a reduction in bleeding from the wound [1].

**Question 5a**

- Independent variable: Alteration to the coleoptile tips
- Dependent variable: Changes observed in coleoptile growth

[1 mark for both correct, 0 otherwise]

**Question 5b**

The shoot left intact is provided as an experimental control. [1] To ensure that changes observed are due to changes imposed (i.e., the dependent variable is due to the independent variable) a control is needed.

**Question 5c**

The first two plants should be drawn having elongated, the third should remain the same. [1]

**Question 5d**

- Plant one should be drawn having elongated whilst plant 2 should be drawn with no change. [1]
- The results for plant one are due to the auxins present in the ground up coleoptiles tips which have diffused through the plant and encouraged upwards growth. [1]

**Question 5e**

Any two of: [1 mark each]

- Repetition of the experiment
- Large sample size
- Complete control and uniformity of all experimental conditions
- Inclusion of a control
- Any other reasonable suggestion

**Question 6a**

- Reasonable diagram [1]
- Use of labels and inclusion of major macromolecules (phospholipid bilayer, including the hydrophilic phosphate heads and hydrophobic lipid tails, cholesterol molecules, glycoproteins, and protein channels) [1]
- Brief description of the function of the phospholipid bilayer (e.g. it is a regulatory barrier between the extracellular and intracellular environments) [1]

**Question 6b**

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
1	Swollen	Hypotonic	Turgid
2	Unchanged	Isotonic	Normal
3	Shrunken	Hypertonic	Plasmolysed

One mark is given for each of the three correct responses.

**Question 6c**

- If a solution becomes too basic the plasma membrane is destroyed because it is composed of lipids, which disintegrate in strong bases [1]
- If a solution becomes too acidic protein channels in the plasma membrane can be denatured meaning selective passage of molecules across the membrane cannot occur. [1]

**Question 7a**

Answers may vary; other responses may be acceptable.

- Warm temperature maintained by homeostasis [1]
- Constant provision of digested or readily digestible food particles [1]

**Question 7b**

Answers may vary; other responses may be acceptable.

Hooks at top of body [1] enable the tapeworm to cling to the sides of the intestine and not be pushed out by peristaltic movements [1]

**Question 7c**

Answers may vary; other responses may be acceptable.

- Tapeworms with hooks survived better in pig intestines than those without (they were hence fitter [1])
- Therefore they had more opportunity for reproduction [1].
- This enabled genes for hooked tops to be passed onto future generations and over time resulted in all *Taenia Solium* tapeworms possessing the hooks due to a gradual increase in allele frequency coding for the hooks [1]

**Question 8a**

Answers may vary; other responses may be acceptable.

- Human : Hunting of wild populations OR removal of habitat [1 for either]
- Natural: Any natural disaster OR rapid climate change [1 for either]

**Question 8b**

- The gene pool of a population following a population bottleneck is reduced [1],
- This is because many individuals and their genes are wiped out and only a few are left to interbreed and contribute their genes to the next generations [1]

**Question 8c**

Smaller gene pool means less genetic resistance to events such as illness or habitat changes [1]

**Question 9a**

A frameshift mutation occurs as a result of an insertion or a deletion, so [1] mark will be gained for either the deletion of the seventh base or the insertion of another base either before or after the seventh base.

**Question 9b**

- Messenger RNA is synthesised in a process called transcription. [1]
- The template DNA strand is unwound and RNA polymerase binds to the promoter area, initiating RNA synthesis. [1]
- When a stop sequence is reached, RNA synthesis ceases and the messenger RNA is modified and sent out of the nucleus via the nuclear pores. [1]

**Question 9c**

- The polypeptide will most likely be inactive [1]
- This is because every codon in the messenger RNA following the frameshift mutation will be altered resulting in a completely different amino acid sequence. [1]

**Question 9d**

There are only 20 amino acids, but there are 64 possible combinations of 3 bases in the codons, thus there is some redundancy in the code. [1]

**Question 10a**

Non-spotted [1]

**Question 10b**

Ss [1]

**Question 10c**

S and s [1]



**Question 10d**

	<b>S</b>	<b>s</b>
<b>S</b>	SS	Ss
<b>s</b>	Ss	ss

[1]

**Question 10e**

1/4 [1]

**Question 10f**

1/2 [1]

**Question 10g**

He will do a test cross between the mouse and a homozygous recessive individual. [1]

**Question 10h**

This hypothesis is more detailed than required for clarification.

- Spot colours show co-dominance, meaning that the black and brown spotted individuals are heterozygous for spot colour. However, no matter what the spot colour genes, individuals who are non-spotted will not show any spot phenotypes [1].

Let the allele BI code for black spots and the allele Br code for brown spots in the following punnet square, which has phenotypes added to clarify the above explanation:

	<b>SBI</b>	<b>SBr</b>	<b>sBI</b>	<b>sBr</b>
<b>SBI</b>	SSBIBI non-spotted	SSBrBI non-spotted	SsBIBI non spotted	SsBIBr non-spotted
<b>SBr</b>	SSBIBr non-spotted	SSBrBr non-spotted	SsBIBr non-spotted	SsBrBr non-spotted
<b>sBI</b>	SsBIBI non-spotted	SsBIBr non-spotted	ssBIBI – black spotted	ssBIBr – Black and brown spotted
<b>sBr</b>	SsBIBr non-spotted	SsBrBr non-spotted	ssBIBr – brown and black spotted	ssBrBr – Brown spotted

[1]

**Question 10i**

<b>Phenotype</b>	<b>Genotype</b>
Non-spotted	SSBrBr, SSBrBI, SSBIBI, SsBrBr, SsBrBI, SsBIBI
Brown-spotted	ssBrBr
Brown and black-spotted	ssBIBr
Black-spotted	ssBIBI

[1/2] for each genotype in first box (you only gain the mark if two are right however, as per VCAA regulations) and [1] for all other genotypes.