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YEAR 12 *Trial Exam Paper*

2015

BIOLOGY

Written examination

Sample answers

This book presents:

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

SECTION A – Multiple-choice questions

Question 1

Answer is A

Explanatory notes

A is correct – molecule A is DNA, it is found in the nucleus (nucleolus).
B is incorrect – DNA is not found in the plasma membrane.
C is incorrect – DNA is not found in the endoplasmic reticulum.
D is incorrect – DNA is not found in the Golgi apparatus.

Question 2

Answer is D

Explanatory notes

A is incorrect – hydrolysis is the cleavage of bonds between monomers in a polymer due to the addition of water.
B is incorrect – lysis is the breakdown of a cell, not the joining of monomers to form a biomolecule.
C is incorrect – hybridisation is the process of joining two complementary strands of DNA, not the joining of monomers to form a biomolecule.
D is correct – condensation is the joining of two molecules to produce a larger molecule, with the release of water.

Question 3

Answer is B

Explanatory notes

A is incorrect – diagram shows molecule as double stranded molecule, it cannot be ssDNA.
B is correct – diagram shows molecule as double stranded molecule, it is dsDNA.
C is incorrect – diagram shows molecule as double stranded molecule, it cannot be tDNA.
D is incorrect – diagram shows molecule as double stranded molecule, it cannot be rRNA.

Question 4

Answer is C

Explanatory notes

A is incorrect – Structure A shows two peripheral proteins (not an integral protein), B is a glycolipid (not a carbohydrate), C is a phospholipid (not a glycolipid), D is a channel protein (not just a protein).
B is incorrect – Structure A shows two peripheral proteins (not a single), C is a single phospholipid (not multiples).
C is correct – Structure A shows two peripheral proteins, B is a glycolipid, C is a phospholipid, D is a channel protein.
D is incorrect – Structure A shows two peripheral proteins (not a glycoprotein), B is a glycolipid (not a carbohydrate), C is a phospholipid (not a glycolipid), D is a channel protein (not a protein channel).

Question 5

Answer is B

Explanatory notes

A is incorrect because the fact that cells cannot create new mitochondria and chloroplasts if they are removed supports symbiogenesis.
B is correct because nuclear DNA occurs in the form of multiple linear chromosomes, not a single circular chromosome.
C is incorrect because the fact that mitochondria, chloroplasts and bacteria all have transport porins supports symbiogenesis.
D is incorrect because the fact that the formation of new organelles occurs through a process that is similar to binary fission supports symbiogenesis.

Question 6

Answer is B

Explanatory notes

A is incorrect – necrosis is premature not programmed, apoptosis is programmed and not caused by trauma.
B is correct – necrosis is premature, caused by toxins, apoptosis is programmed, prevents tumours.
C is incorrect – necrosis is premature not programmed and does not involve membrane blebbing, apoptosis is programmed and beneficial, not premature and detrimental.
D is incorrect – necrosis is not beneficial, apoptosis is programmed, but not caused by toxins.

Question 7

Answer is D

Explanatory notes

A is incorrect – the Calvin cycle occurs in the stroma, not on the thylakoid membrane.
B is incorrect – the Krebs cycle occurs in aerobic cellular respiration, not photosynthesis.
C is incorrect – the stage of photosynthesis that is independent of light is Calvin cycle, which occurs in the stroma, not on the thylakoid membrane.
D is correct – the light dependent reaction occurs on the thylakoid membranes.

Question 8

Answer is A

Explanatory notes

A is correct – Figure 1 shows an anabolic reaction; photosynthesis is an anabolic process.
B is incorrect – cellular respiration is a catabolic process, not anabolic.
C is incorrect – whilst cellular respiration is a catabolic process, Figure 1 shows an anabolic process.
D is incorrect – photosynthesis is an anabolic process, not a catabolic process.

Question 9

Answer is D

Explanatory notes

A is incorrect – a hormone is a signalling molecule produced within an organism that travels through the bloodstream to act on target tissue within the organism.
B is incorrect – a paracrine hormone is a signalling molecule produced within an organism that passes through extracellular fluid to act on nearby cells within the organism.
C is incorrect – pheromones are signalling molecules which are released externally but they cannot be detected by organisms from different species.
D is correct – pheromones are signalling molecules released externally that can only be detected by members of the same species.

Question 10

Answer is C

Explanatory notes

A is incorrect – pheromones act to attract opposite sexes within a species, the males will not be attracted to other males.
B is incorrect – males will not be attracted to females due to distraction from high volume of pheromone from dispenser.
C is correct – high volume of pheromone from dispenser is likely to overpower the pheromone from the female and insects will be attracted to dispensers.
D is incorrect – pheromone plumes will attract the male insects not repel them.

Question 11

Answer is D

Explanatory notes

A is incorrect – pinocytosis is the absorption of extracellular fluid into a cell, sodium ions are not fluids.
B is incorrect – active transport is the movement of molecules across a membrane against their concentration gradient. In this case, sodium ions are moving with the concentration gradient.
C is incorrect – endocytosis is the absorption of (large polar) molecules by engulfing them, not ions.
D is correct – sodium ions are passively transported (facilitated diffusion) across the phospholipid bilayer down the concentration gradient.

Question 12

Answer is A

Explanatory notes

A is correct – uptake of potassium ions is against the concentration gradient, therefore gain is through active uptake.
B is incorrect – potassium ions will not diffuse through protein channels into the cells as they are in a higher concentration in the cytosol.
C is incorrect – phagocytosis is the engulfing of solid particles, not ions.
D is incorrect – diffusion is the movement of molecules across a membrane with their concentration gradient. In this case, potassium ions are moving against the concentration gradient.

Question 13

Answer is C

Explanatory notes

A is incorrect – neurotransmitters are the chemicals which allow the transmission of signals from one neuron to the next across a synapse; lignocaine blocks sodium channels and prevents transmission of signals.
B is incorrect – lignocaine is injected from an external source; it is not produced within the body by a gland; it is not an endocrine hormone.
C is correct – by blocking Na^+ channels, lignocaine prevents depolarisation and the transmission of an action potential.
D is incorrect – lignocaine only blocks the transport of Na^+ across the neural membrane, no other ions.

Question 14

Answer is B

Explanatory notes

A is incorrect – structure E is a receptor, not a sensory neuron.
B is correct – structure E is a receptor (organ) and structure G is a motor neuron.
C is incorrect – structure F is a sensory neuron, not a motor neuron and structure G is motor neuron, not an effector.
D is incorrect – structure G is a motor neuron, not a sensory neuron.

Question 15

Answer is B

Explanatory notes

A is incorrect – if anandamide is broken down, pain would not be suppressed and will actually increase, not decrease.
B is correct – if anandamide is broken down, pain would not be suppressed and will therefore increase.
C is incorrect – if anandamide is broken down, it will not increase in amount, pain will not be suppressed and will actually increase.
D is incorrect – if anandamide is broken down, it will not increase in amount.

Question 16

Answer is C

Explanatory notes

A is incorrect – insulin is a hormone that regulates metabolism, not immune response.
B is incorrect – acetylcholine is a neurotransmitter, it is not involved in immune response.
C is correct – lysozyme is a first line defence chemical.
D is incorrect – a lysosome is an organelle involved in breakdown of unwanted substances in a cell.

Question 17

Answer is B

Explanatory notes

A is incorrect – NK are involved in innate (non-specific) immune response and cytotoxic T cells are involved in adaptive (specific) immune response.
B is correct – both NK and cytotoxic T cells protect the host from viral, bacterial and parasitic infections.
C is incorrect – whilst NK and cytotoxic T cells do destroy cancerous cells, they are leucocytes (not erythrocytes).
D is incorrect – whilst NK and cytotoxic T cells are lymphocytes; they do not act against ticks and lice.

Question 18

Answer is D

Explanatory notes

A is incorrect – blood does not enter the lymphatic system.
B is incorrect – histamine is released by mast cells and basophils, which reside in tissue or travel in the blood.
C is incorrect – stem cells are generated in the bone marrow, blood and adipose tissue; not the lymph.
D is correct – following infection, lymphocytes are generated in the lymph nodes.

Question 19

Answer is A

Explanatory notes

A is correct – there will be less energy required when the disaccharide (lactose) is broken into the monosaccharides (galactose and glucose) with an enzyme. Lactose holds more energy in it than galactose and glucose so the graph shows a lower energy level of products than reactants.
B is incorrect – it will require less energy, not more, to break down lactose.
C is incorrect – it will require less energy, not more, to break down lactose with an enzyme and there will be less energy conserved in the molecules after the breakdown.
D is incorrect – there will be less energy conserved in the molecules after the breakdown of lactose in the presence of an enzyme.

Question 20

Answer is A

Explanatory notes

A is correct – around 5% of children vaccinated against rubella do not gain immunity with the first dose, so another dose is given to ensure that immunity is achieved.
B is incorrect – the second dose of the vaccine will boost the production of B memory cells, it will NOT boost the store of mast cells.
C is incorrect – the dosage is spread across the first year and a half of a baby's life as it is the most effective timeframe to allow the immune system to develop immunity.
D is incorrect – vaccination is a form of active immunity, not passive immunity.

Question 21

Answer is B

Explanatory notes

A is incorrect – artificial active immunity occurs when antibodies are produced in response to contact with an actual attenuated (or dead) pathogen.
B is correct – artificial passive immunity occurs when immunoglobulins (antibodies) are provided to the immune system; there is no clonal expansion or production of B memory cells. It is an instant but short-lived response.
C is incorrect – natural active immunity occurs when a person is infected naturally by the pathogen and undergoes the process of clonal expansion and production of B memory cells.
D is incorrect – natural passive immunity occurs when maternal antibodies pass via the placenta or breastmilk to the developing foetus or infant.

Question 22

Answer is C

Explanatory notes

A is incorrect – L represents G_0; the amount of DNA in a cell remains constant.
B is incorrect – the amount of DNA in the cell doubles during N (S-phase).
C is correct – K represents interphase; cell growth occurs during interphase.
D is incorrect – M represents G_1; cytokinesis occurs between J (M-phase) and M (G_1).

Question 23

Answer is D

Explanatory notes

A is incorrect – Individual III9 shows condition when both parents (II3 & II4) do not have it, therefore it cannot be autosomal dominant.
B is incorrect – Individuals II5 & II7 both have condition, their father I2 does not have it, therefore it cannot be Y-linked.
C is incorrect – Individual III9 shows condition when both parents (II3 & II4) do not have it, therefore it cannot be X-linked dominant.
D is correct – Individual III9 shows condition when both parents (II3 & II4) do not have it, therefore it most likely to be X-linked recessive.

Question 24

Answer is B

Explanatory notes

A is incorrect – the chance of having a son (one in two) x chance of having OTC (one in two) = one in four, not one in eight
B is correct – the chance of having a son (one in two) x chance of having the condition (one in two) = one in four
C is incorrect – the chance of having a son (one in two) x chance of having the condition (one in two) = one in four, not one in two
D is incorrect – the chance of having a son (one in two) x chance of having the condition (one in two) = one in four, not zero.

Question 25

Answer is A

Explanatory notes

5' CTTAGCTAACGTAC 3'

3' GAATCGATTGCATG 5' (written in 5' to 3' order: 5' GTACGTTAGCTAAG 3')

A is correct – shows matching answer to that shown in the explanation.
B is incorrect – no consideration given to 5' 3' notation; this shows answer in 3' to 5' order.
C is incorrect – a complementary strand will be a DNA strand (ACGT) not RNA (should not contain U).
D is incorrect – a complementary strand will be a DNA strand (ACGT) not RNA (should not contain U).

Question 26

Answer is C

Explanatory notes

A is incorrect – natural selection is the gradual process by which biological traits become either more or less common in a population as a result of the effect of inherited traits on the differential reproductive success of organisms interacting with their environment. Hunting is not part of the environment.
B is incorrect – gene flow is associated with migration – the Northern elephant seals were not migrating.
C is correct – a population bottleneck is a sharp reduction in the size of a population due to environmental events or human activities.
D is incorrect – genetic variation was reduced in the Northern elephant seal population, not increased.

Question 27

Answer is B

Explanatory notes

A is incorrect – genetic diversity decreases in the Northern elephant seal population.
B is correct – with reduction in gene pool and genetic diversity, the species is more vulnerable to diseases and genetic mutations.
C is incorrect – the genome is the genetic material of an organism; the Northern elephant seal genome does not change in size, just in diversity.
D is incorrect – the rate of genetic mutation in the population is independent of the reduction in genetic diversity.

Question 28

Answer is A

Explanatory notes

A is correct – gene of interest is cut to leave sticky ends not blunt ends.
B is incorrect – antibiotic resistance genes are introduced to distinguish bacteria that have taken up the plasmid from those that have not.
C is incorrect – heat therapy is used to introduce the plasmid to bacterial cells.
D is incorrect – the same restriction enzyme is used to cut bacterial plasmids and the gene of interest.

Question 29

Answer is A

Explanatory notes

A is correct – the vector is the plasmid that carries DNA into a living (host) cell.
B is incorrect – this describes a restriction enzyme, not a vector.
C is incorrect – the sticky end of a DNA fragment is not a vector.
D is incorrect – the blunt end of a DNA fragment is not a vector.

Question 30

Answer is C

Explanatory notes

A is incorrect – gene flow leads to divergent evolution because it maintains genetic variation, genetic drift does not lead to divergent evolution.
B is incorrect – natural selection does occur on islands.
C is correct – when islands are first colonised, many ecological resources are unused, allowing descendants of a colonising species to diversify and descendants have the adaptations that enable them to survive in many different parts of the environment.
D is incorrect – different islands will have different local conditions not identical conditions.

Question 31

Answer is B

Explanatory Notes

A is incorrect – species can experience geographic isolation but still be able to produce viable fertile offspring if the period of geographic separation has been too short for mutations to accumulate.
B is correct – if two species are reproductively isolated from one another they are said to have speciated; hence a new species has arisen.
C is incorrect – A is not correct therefore this cannot be correct.
D is incorrect – B is correct therefore this cannot be correct.

Question 32

Answer is B

Explanatory notes

A is incorrect – they have evolved similar morphology due to convergent evolution.
B is correct – similar niches and selection pressures have produced similar body shape.
C is incorrect – they have not experienced allopatric speciation.
D is incorrect – this is an example of adaptive convergence not adaptive radiation.

Question 33

Answer is A

Explanatory notes

A is correct – the molecular clock is not exact and only permits inferences about time elapsed since a divergence of a species.
B is incorrect – different species experience changes in amino acids at different times, not at the same time.
C is incorrect – the molecular clock is not exact and only permits determination of the relative (not absolute) time elapsed since a divergence of a species.
D is incorrect – different proteins change at different rates, it is not valid to compare rates of change of different proteins to determine time elapsed.

Question 34

Answer is B

Explanatory notes

A is incorrect – soft body parts will deteriorate quickly, leaving no trace behind.
B is correct – hard body parts persist through time and are not easily degraded.
C is incorrect – slow burial leaves remains exposed to environmental conditions or other scavengers that may interfere with remains.
D is incorrect – strong winds or water currents will lead to deterioration of remains.

Question 35

Answer is C

Explanatory notes

A is incorrect – if the skull contains two-fifths of the carbon-14 of the present day possum, it will be 0.4, not 0.25.
B is incorrect – it will be 0.4, not 0.35.
C is correct – two-fifths of the carbon-14 of the present day possum is 0.4.
D is incorrect – it will be 0.4, not 0.85.

Question 36

Answer is B

Explanatory notes

A is incorrect – carbon dating began in the 1940s and is a well-developed technique.
B is correct – the fossil may be too old and carbon-dating is only good for fossils up to 50 000 years old.
C is incorrect – carbon in the fossil does not leach into the surrounding rock.
D is incorrect – the carbon is in the animal at the time of its death and decreases in quantity; it does not accumulate.

Question 37

Answer is D

Explanatory notes

A is incorrect – ammonites are used for relative dating, not potassium–argon (absolute) dating.
B is incorrect – ammonites are used for relative dating, not uranium (absolute) dating.
C is incorrect – ammonites are used for relative dating, not absolute dating.
D is correct – ammonites are used for relative dating.

Question 38

Answer is A

Explanatory notes

A is correct – clones have identical DNA.
B is incorrect – identical phenotypes do not necessarily mean identical genes.
C is incorrect – dizygotic twins develop from two different zygotes and are not genetically identical.
D is incorrect – clones are produced asexually; DNA comes from one ‘parent’, not two.

Question 39

Answer is D

Explanatory notes

A is incorrect – the egg nucleus is removed, none of its DNA is passed on to the cloned cells.
B is incorrect – the DNA from the somatic body cell nucleus is used, the DNA will be identical.
C is incorrect – the cells from the tissue culture and the foetus will have the same DNA.
D is correct – the DNA will be identical but it will be regulated differently, thus producing different proteins.

Question 40

Answer is C

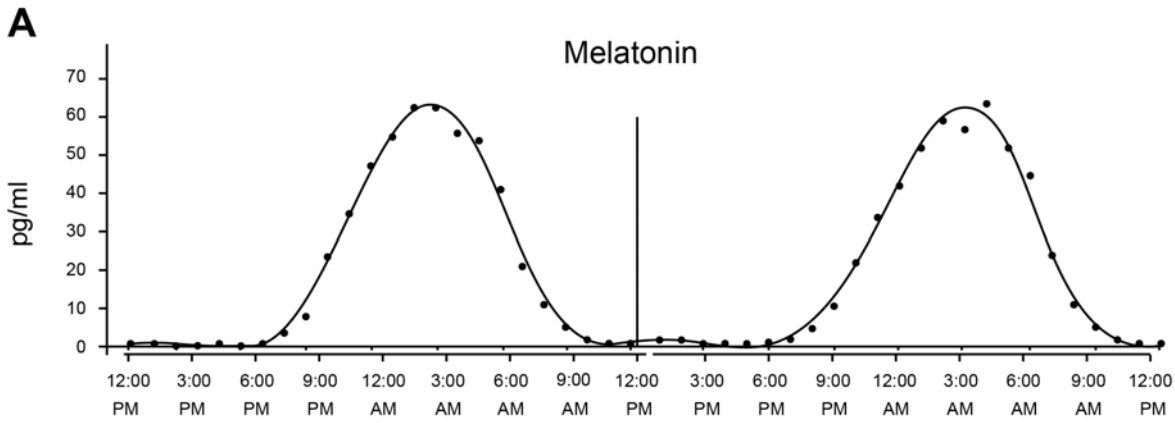
Explanatory notes

A is incorrect – transgenic organisms arise through artificial cross-species exchange of genetic material, not through natural selection.
B is incorrect – recombination through meiosis occurs naturally and will therefore not produce a transgenic organism.
C is correct – a transgenic organism does carry one or more genes that have been artificially introduced from another species.
D is incorrect – a transgenic organism does NOT carry one or more genes that have been artificially introduced from the same species.

SECTION B – Short-answer questions

Question 1a.

Sample answer



Mark allocation: 1 mark

- 1 mark for a simplified version of the above diagram

Question 1b.

Sample answer

'Enzyme T' catalyses the rate of reaction that produces melatonin from N-acetyl serotonin. It does this by lowering the activation energy of the reaction OR by providing a specific active site for N-acetyl serotonin.

Mark allocation: 2 marks

- 1 mark for stating 'Enzyme T' catalyses the rate of reaction that produces melatonin
- 1 mark for stating by lowering the activation energy of the reaction OR by providing a specific active site for N-acetyl serotonin

Note: Any two of the three answers would be marked correct.

Question 1c.

Sample answer

It is a steroid hormone, which means that as a signalling molecule it will act by binding with specific intracellular receptors.

Mark allocation: 1 mark

- 1 mark for correct explanation

Question 1d.i.

Sample answer

Melatonin is produced by the pineal gland during darkness. Working nightshift means that in normal dark times they are in light and when they get to sleep – during the day – it is not dark enough, thus they may not make enough melatonin, which stops them from being able to sleep properly.

Mark allocation: 1 mark

- 1 mark for explaining the difference

Question 1d.ii.

Sample answer

He could take melatonin supplements, which will increase his available melatonin levels and thus enable more sleep.

Mark allocation: 1 mark

- 1 mark for the correct answer

SECTION B

Question 2a.

Sample answer

Structure	Name
W	cristae
X	matrix
Y	inner and outer (plasma) membrane

Mark allocation: 2 marks

- 2 marks for all three structures correctly identified, 1 mark for two correct, 0 marks for 1 or 0 correct

Question 2b.

Sample answer

It is the site of the Krebs cycle, which is important to the process of cellular respiration because it generates a large supply of electrons necessary for oxidative phosphorylation (electron transport and chemiosmosis).

Mark allocation: 1 mark

- 1 mark for the correct explanation

Question 2c.

Sample answer

In the absence of oxygen, pyruvate does not cross the membrane around the mitochondrion. It will be converted to ethanol and carbon dioxide (fungi).

Mark allocation: 2 marks

- 1 mark for explaining in the absence of oxygen, pyruvate cannot cross the membrane around the mitochondrion
- 1 mark for explaining that pyruvate is converted to ethanol and carbon dioxide (**OR** lactic acid) in the cytosol

SECTION B

Question 3a.

Sample answer

α-helices of the secondary structure

Mark allocation: 1 mark

- 1 mark for the correct answer

Question 3b.i.

Sample answer

A non-cellular or cellular agent of disease

Mark allocation: 1 mark

- 1 mark for the correct explanation

Question 3b.ii.

Sample answer

Pathogens likely to trigger a response by interferon are viruses or bacteria.

Mark allocation: 1 mark

- 1 mark for identifying either virus or bacterium

SECTION B

Question 3c.

Sample answer

Interferons are proteins (lipid insoluble) and bind specifically to external receptors on the cell membrane. Binding of the interferon activates second messengers in the cytosol which amplifies the initial signal leading to a response from effector proteins which are already present in the cytosol.

Mark allocation: 2 marks

- 1 mark for explaining that interferons are lipid insoluble and bind specifically to external receptors on the cell membrane
- 1 mark for explaining that binding activates the receptor, switching on a signal transduction pathway inside the cell, leading to a change in gene expression

Question 3d.

Sample answer

There may be a mutation that confers resistance **OR** they can block signalling events that occur after the cytokine binds to its receptor.

Mark allocation: 1 mark

- 1 mark for either explaining that there may be a mutation or that they can block signalling

Question 4a.

Sample answer

- zygote – 30 chromosomes
- ovum – 15 chromosomes

Mark allocation: 1 mark

- 1 mark for the correct answer

Question 4b.

Sample answer

ONE of:

- Mitosis ensures transfer of parent cell genome into two identical daughter cells.
- Mitosis enables development and growth or cell replacement or cell regeneration.

ONE of:

- Meiosis enables genetic variation through independent assortment / crossing over / recombination.
- Meiosis increases the likelihood of species survival if it is faced with a selection pressure.
- Meiosis produces cells that contain one of each of the pairs of chromosomes found in diploid cells, producing haploid cells.

Mark allocation: 2 marks

- 1 mark for the correct answer related to significance of mitosis
- 1 mark for the correct answer related to significance of meiosis

Question 4c.

Sample answer

Sex determination in skinks is due to the interaction between genotype and environment OR size of egg yolk determines the sex of the lizard – more yolk produces females OR size of egg yolk determines the sex of the lizard – less yolk produces males.

Mark allocation: 1 mark

- 1 mark for one of the correct conclusions

SECTION B

Question 4d.

Sample answer

During the TSP, incubate half the eggs at around 24°C and the other half at 31°C, whilst keeping all other conditions (e.g. moisture, lighting) identical.
Following hatching, record the number of phenotypic males and females in each experimental group **AND** determine the sex chromosomes of all of the hatchlings.
Repeat the experiment several times.

Mark allocation: 3 marks

- 1 mark for explaining that during TSP, incubate half the eggs at around 24°C and the other half at 31°C, whilst keeping all other conditions identical
- 1 mark for explaining that following hatching, record the number of phenotypic males and females in each of the two experimental groups AND determine the sex chromosomes of all of the hatchlings
- 1 mark for stating that the experiment needs to be repeated several (three or more) times

Tip

- *When answering a question on experimental design, students should be careful that they do not repeat information about the experimental design that has already been provided to them in the stem of the question. Marks will only be awarded for new and correct ideas related to experimental design.*

Question 5a.

Sample answer

Histamine is released by cells in the immediate area, causing dilation and increased permeability of blood vessels, leading to an increase in blood flow (increased redness) and plasma (swelling) to immediate area.

Mark allocation: 2 marks

- 1 mark for explaining that histamine is released, causing dilation and increased permeability
- 1 mark for explaining the increase in blood flow and plasma to the area causing redness and swelling

Question 5b.i.

Sample answer

First sting: Bee venom enters bloodstream binding to B-cells with complementary receptors, B-cell proliferation, clonal selection and secretion of complementary antibodies occurs, antibodies bind to mast cells (sensitisation).

Mark allocation: 1 mark

- 1 mark for the correct explanation

Question 5b.ii.

Sample answer

Some people develop hypersensitivity after being stung by bees, creating a more severe reaction (anaphylaxis) when stung again later.

Mark allocation: 1 mark

- 1 mark for the correct answer.

Question 5c.

Sample answer

When mast cells with antibodies attached come into contact with bee venom, it triggers the sudden release of histamines resulting in abrupt dilation of blood vessels, hence drop in blood pressure.

Mark allocation: 1 mark

- 1 mark for the correct answer

SECTION B

Question 6a.

Sample answer

- it results in a frameshift mutation

Mark allocation: 1 mark

- 1 mark for correct answer

Question 6b.

Sample answer

The increase in frequency is due to random genetic drift. In the initial population a single mutation would have acted as a founder mutation. Due to genetic isolation experienced by the population it would have increased in frequency to the level at which it is found today.

Mark allocation: 2 marks

- 1 mark for explaining that it is due to random genetic drift AND single mutation in initial population acts as a founder mutation
- 1 mark for explaining that genetic isolation leads to increased frequency to present day

Question 6c.

Sample answer

There is a heterozygote advantage. The heterozygous genotype Tt has a higher relative fitness than either the TT or tt genotype. There is an advantage to having a higher level of intelligence than normal. Individuals with higher intelligence have higher relative rates of survival and pass their recessive traits on to their children.

Mark allocation: 2 marks

- 1 mark for explaining heterozygote advantage
- 1 mark for explaining that people in the population with higher intelligence have higher rates of survival and pass their recessive traits onto their children

Question 6d.

Sample answer

Both mother and father do not have Tay–Sachs but must have genotype Tt (they are carriers) and will contribute one allele each to the foetus. The foetus has the genotype tt (one allele from each parent).

Mark allocation: 2 marks

- 1 mark for explaining both mother and father do not have Tay–Sachs disease but must have genotype Tt (carriers)
- 1 mark for explaining that the foetus has the genotype tt (one allele from each parent)

SECTION B

Question 7a.i.

Sample answer

- DNA replication

Mark allocation: 1 mark

- 1 mark for the correct answer

Question 7a.ii.

Sample answer

In S-phase of interphase (in the cell cycle)

Mark allocation: 1 mark

- 1 mark for the correct answer

Question 7b.

Sample answer

1. DNA helicase assists in the separation of the two DNA strands (Structure R – parent strand; Structure S – template strand) of the double helix at replication origins, which results in the formation of replication forks (Feature Q).
2. DNA polymerase moves along Structure R (parent strand) starting at the 3' end and moving toward the 5' end / Feature Q; Structure U (the leading strand of daughter DNA) is formed. Simultaneously, Structure T (Okazaki fragments) forms, moving away from Feature Q.
3. Fragments of Structure T (Okazaki fragments) are joined by DNA ligase to form a continuous strand, hydrogen bonds form between parent–daughter strands producing two semi-conservative strands of DNA.

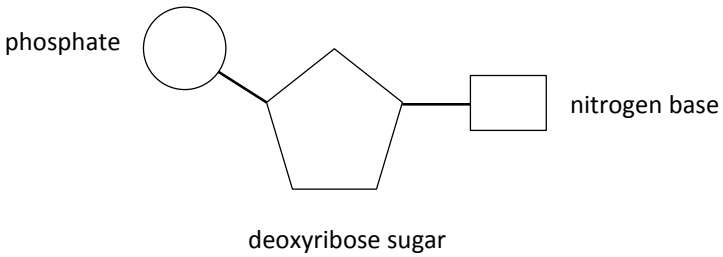
Mark allocation: 3 marks

- 1 mark for DNA helicase
- 1 mark for DNA polymerase
- 1 mark for fragments of Structure T

SECTION B

Question 7c.

Sample answer



Mark allocation: 1 mark

- 1 mark for the monomer

Tips

- *It is expected that students will be able to draw a basic diagram that correctly represents a monomer of any of the biomacromolecules. Whilst many students will be able to present something that looks like the monomer, they are not often correct or clear.*
- *When drawing a nucleotide it is important to remember that the deoxyribose sugar is central and that the phosphate and nitrogen group are attached at opposite points on the pentagonal sugar.*
- *Drawings should not have phosphate and nitrogen groups adjacent to each other, nor should they be bound along a straight edge.*

Question 8a.

Sample answer

Appropriate allele symbols: F – freckles f – no freckles
Parent genotypes: both Ff

	F	f
F	FF	Ff
f	Ff	ff

Offspring genotypes: 1 FF : 2 Ff : 1 ff
Offspring phenotypes: 3 freckled : 1 not freckled

Mark allocation: 3 marks

- 1 mark for the correct allele symbols, parent genotypes, Punnett square showing gametes
- 1 mark for correct offspring genotypes (with correct ratios) – must be out of the Punnett square
- 1 mark for correct offspring phenotypes (with correct ratios)

Question 8b.

Sample answer

In Mendelian inheritance, alleles are either dominant or recessive; an organism with at least one dominant allele will display the effect of the dominant allele. There are no dominant or recessive phenotypes in this specific example, rather they are equally dominant. Therefore hair type is not an example of Mendelian inheritance.

Mark allocation: 2 marks

- 1 mark for the correct description of Mendelian inheritance
- 1 mark for recognition that there is no dominant or recessive phenotype, only equally dominant, correct conclusion drawn that hair type is NOT an example of Mendelian inheritance

Note: students may also recognise an intermediate phenotype, which would be acceptable.

Question 8c.

Sample answer

mother: Ff H^cH^s father: ffH^sH^s

	fH^s
FH^c	FfH^cH^s
FH^s	FfH^sH^s
fH^c	ffH^cH^s
fH^s	ffH^sH^s

Offspring genotypes:
1 FfH^cH^s : 1 FfH^sH^s : 1 ffH^cH^s : 1ffH^sH^s
Offspring phenotypes:
1 wavy hair, freckled : 1 straight hair, freckled : 1 wavy hair, unfreckled : 1 straight hair, unfreckled

Mark allocation: 3 marks

- 1 mark for correct parent genotypes and Punnett square showing gametes
- 1 mark for correct genotypes and ratios
- 1 mark for correct phenotypes and ratios

Tip

- *It is imperative that **ALL** working be shown when determining the outcome of a genetic cross. If genotypes and genotype ratios are required as part of an answer, they must be written out in full and not just left in the Punnett square. Clearly written genotypes and their ratios (whole number) must be presented. The same applies to phenotypes and their ratios.*

Question 9a.

Sample answer

By using twigs as spears to catch insects or grubs **OR** by using twigs to poke into spaces and prise out insects or grubs

Although the pecking behaviour of woodpeckers and woodpecker finches are similar, there are differences in the pecking patterns of these birds.

Mark allocation: 1 mark

- 1 mark for the correct answer

Question 9b.

Sample answer

Convergent evolution as it has evolved birds that are genetically unrelated / have no recent common ancestry between them. They both needed to get food from inside the tree; pecking behaviour evolved in response to the need for food.

Mark allocation: 2 marks

- 1 mark for explaining that pecking behaviour has evolved in birds that are genetically unrelated / have no recent common ancestry
- 1 mark for explaining the need to find food

Question 9c.

Sample answer

Deforestation imposes a geographical barrier in the continuous population of *Dryocopus pileatus*, dividing the population into separate groups. In addition to having genetic variations, each isolated population is exposed to different selection pressures and mutations may accumulate. Gene flow becomes limited and reduced, leading to subspeciation.

Mark allocation: 3 marks

- 1 mark for explaining the geographical barrier in the continuous population
- 1 mark for explaining that genetic variations exist, isolated populations are exposed to different selection pressures and mutations may accumulate
- 1 mark for explaining that gene flow becomes limited/reduced NOT that gene flow stops – it still may occur – this is only about subspeciation

Question 10a.

Sample answer

NPC1 is a membrane-bound receptor that binds directly to the viral glycoprotein thereby enabling entry to the host cell. When NPC1 is present, the Ebola virus is able to gain entry to cells and they have low survival; when there is no NPC1 there is a much higher survival rate in mouse cells.

Mark allocation: 2 marks

- 1 mark for explaining that NPC1 is a membrane-bound receptor that binds to the viral GP thereby enabling entry to the host cell
- 1 mark for explaining that when NPC1 present, Ebola virus gains entry to cells and they have low survival. When NPC1 absent there is a much higher survival rate in mouse cells.

Question 10b.

Sample answer

There may be some natural mutations present in the gene for NPC1, which means that the protein is no longer able to bind with the viral GP and the cell cannot be infected by the Ebola virus.

Mark allocation: 1 mark

- 1 mark for the correct suggestion

Question 10c.

Sample answer

An antiviral drug could competitively bind with the NPC1 receptor on a host cell so that the Ebola virus cannot gain entry / infect **OR** the antiviral drug could bind to glycoprotein on the Ebola virus so that it cannot bind to the NPC1 receptor on the host cell.

Mark allocation: 1 mark

- 1 mark for the either stating that it could combine with NPC1 or that it could bind to glycoprotein on the Ebola virus

Tip

- *Students must be able to recall that surface proteins on viruses are used to bind to host cells to assist with infection.*

Question 10d.

Sample answer

They have determined the degree of similarity in RNA nucleotides; the more similar the sequences are, the more closely related they are **OR** they have determined the degree of similarity in RNA nucleotides and been able to establish approximately how much relative time has passed since they diverged from each other.

Mark allocation: 1 mark

- 1 mark for the correct answer

Question 11a.

Sample answer

The group consisting of modern humans and all extinct erect-walking ancestors

Mark allocation: 1 mark

- 1 mark for the correct definition

Question 11b.

Sample answer

There has been an increase in cranial capacity over the course of evolution due to a change in diet and an increased intake of protein **OR** becoming bipedal creates a selection pressure for a more elaborate brain to control motor function and to process incoming sensory information, thus allowing for more successful bipedalism **OR** the development of culture creates a selection pressure for a more elaborate brain for learning and communication, leading to an increase in cranial capacity.

Mark allocation: 1 mark

- 1 mark stating one of the trends outlined in the sample answer

Question 11c.i.

Sample answer

The transition to bipedalism resulted in a decreased size of the bony birth canal, which became significantly narrower over time because of a change in the structure of the pelvis. The trend toward increased intelligence results in a larger cranium, which requires a wider birth canal, not the narrower one which had developed; hence the conflict.

Mark allocation: 2 marks

- 1 mark for explaining that bipedalism resulted in a narrowing of the birth canal due to change in the structure of the pelvis.
- 1 mark for explaining that increasing intelligence leads to larger cranium, which requires a wider birth canal, which no longer exists.

Question 11.c.ii.

Sample answer

Shorter gestation period – hominins have a much shorter gestation than other primates, which means they are born with an underdeveloped brain (smaller cranium) and will be able to pass through the birth canal

OR

Very malleable neonatal head – not fully developed when the infant is born, allowing for the head to develop more after birth and for the cranium to continue growing without affecting the birthing process

OR

Neonatal rotation – allows correct alignment of the shoulders in order to exit the birth canal, important because growth in the size of the cranium as well as the width of the shoulders makes it more difficult for the infant to fit through the pelvic canal

OR

Assisted birth – unlike other primates, hominins have developed a practice of attended births, where assistance is provided by other hominins.

Mark allocation: 1 mark

- 1 mark for stating one of the above explanations

Question 12a.

Sample answer

hybrid

Mark allocation: 1 mark

- 1 mark for the correct term

Question 12b.

Sample answer

The gametes (pollen and ovules) of *Triticum* and *Secale* have undergone meiosis and they are haploid. Following artificial fertilisation they form a cell with 21 unpaired chromosomes. During meiosis, their chromosomes will not be able to form homologous pairs.

Mark allocation: 2 marks

- 1 mark for explaining that pollen and ovules are haploid, produce a zygote that is diploid.
- 1 mark for explaining that during meiosis later on, chromosomes in diploid plant cells will not be able to form homologous pairs.

Question 12c.

Sample answer

It will stop formation of the spindle fibres and double-stranded chromosomes will not separate. This doubles the number of chromosomes, providing the cell with two 'homologous' sets of chromosomes, which makes the plant fertile.

Mark allocation: 1 mark

- 1 mark for the correct suggestion

Tip

- *In this kind of question, students should be able to use their knowledge and understanding of cell division and the purpose of spindle formation, and the information about colchicine provided in the stem to 'solve' the problem of infertility in triticale. Basic concepts must be applied to a more abstract idea.*

END OF SAMPLE ANSWERS

SECTION B