



BIOLOGY

9790/01

Paper 1 Multiple Choice

May/June 2012

1 hour 15 minutes

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)



READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the one you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

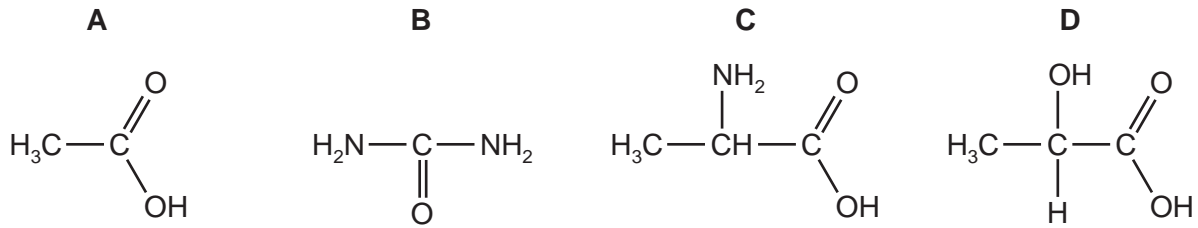
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any working should be done in this booklet

This document consists of **19** printed pages and **1** blank page.

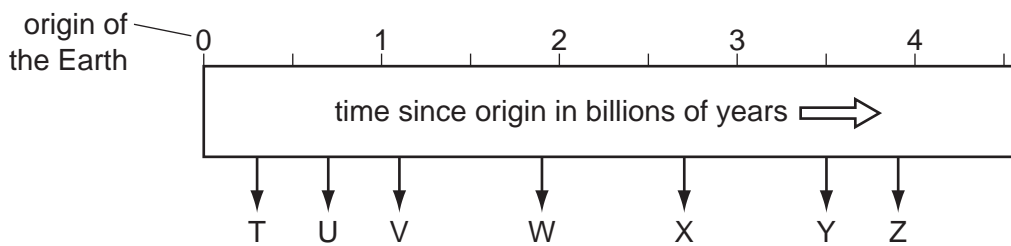


- 1 Which molecule, produced by the Miller-Urey experiments, is an essential component of enzymes that are necessary for life?



- 2 The Earth is thought to be about 4.6 billion years old.

The diagram includes a time-line which shows some of the stages in the evolution of life on Earth.



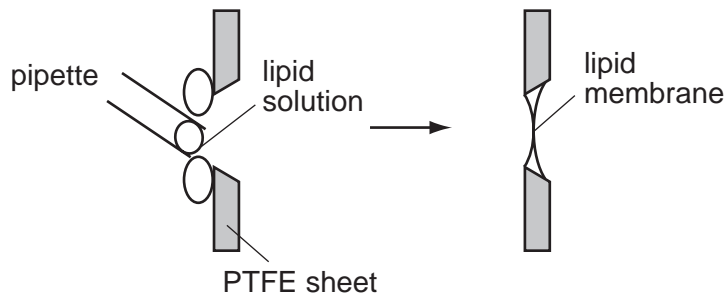
Which row shows the correct time sequence of these events?

	first evidence of life developing on Earth	first evidence of prokaryotes on Earth	first evidence of eukaryotes on Earth
A	T	W	Y
B	U	X	Y
C	U	V	W
D	V	X	Z

- 3 How many condensation reactions have occurred during the formation of a single chain of three nucleotides from phosphate, deoxyribose and bases?

A 2 **B** 5 **C** 6 **D** 8

- 4 Lipid membranes can be formed in the laboratory by painting phospholipids over a PTFE sheet with a hole in it.



Such a lipid membrane is impermeable to water-soluble materials including charged ions such as Na^+ or K^+ .

In one experiment with Na^+ ions, no current flowed across the membrane until a substance called gramicidin was added, at which time current flowed.

Which statement is consistent with this information and your knowledge of membrane structure?

Gramicidin becomes incorporated into the membrane and is

- A a carbohydrate molecule found only on the outside of the membrane.
 - B a non-polar lipid which passes all the way through the membrane.
 - C a protein molecule with both hydrophilic and hydrophobic regions.
 - D a protein molecule which has only hydrophobic regions.
- 5 When a competitive inhibitor is introduced into an enzyme reaction, how will the V_{max} and K_m be affected?

	V_{max}	K_m
A	decrease	increase
B	decrease	no change
C	increase	decrease
D	no change	increase

- 6 Which cell organelle shows prokaryotic cell structure and has been proposed as providing evidence of endosymbiosis?
- A Golgi apparatus
 - B mitochondrion
 - C nucleolus
 - D ribosome

- 7 Which statement correctly describes a role of histone proteins?
- A** All eukaryotic genes are transcribed continuously because they are not packaged by histones.
- B** DNA must be selectively released from its histone packaging before transcription can occur in bacteria.
- C** Histones package prokaryote chromatin into the nucleosomes that form the bulk of the chromosome.
- D** The organisation of DNA by histones in eukaryotes allows some gene control sequences to be thousands of base pairs away from the gene concerned.
- 8 At which stage in the cell cycle will a lack of availability of extracellular growth factors result in cells entering the G_0 phase?
- A** M **B** G_1 **C** G_2 **D** S
- 9 A key feature of most multicellular organisms is the ability to differentiate and produce specialised cells.

Which row best describes the ability of **zygotic cells** to differentiate?

	totipotent	pluripotent	multipotent
A	✓	✓	✓
B	✓	x	✓
C	✓	x	x
D	x	✓	✓

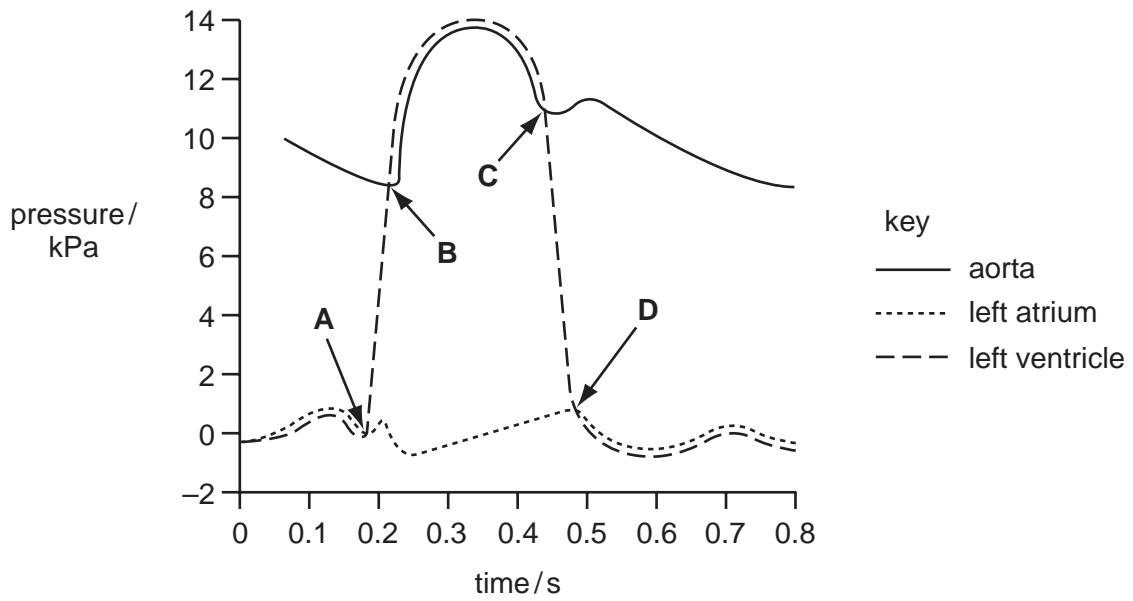
key

✓ = ability

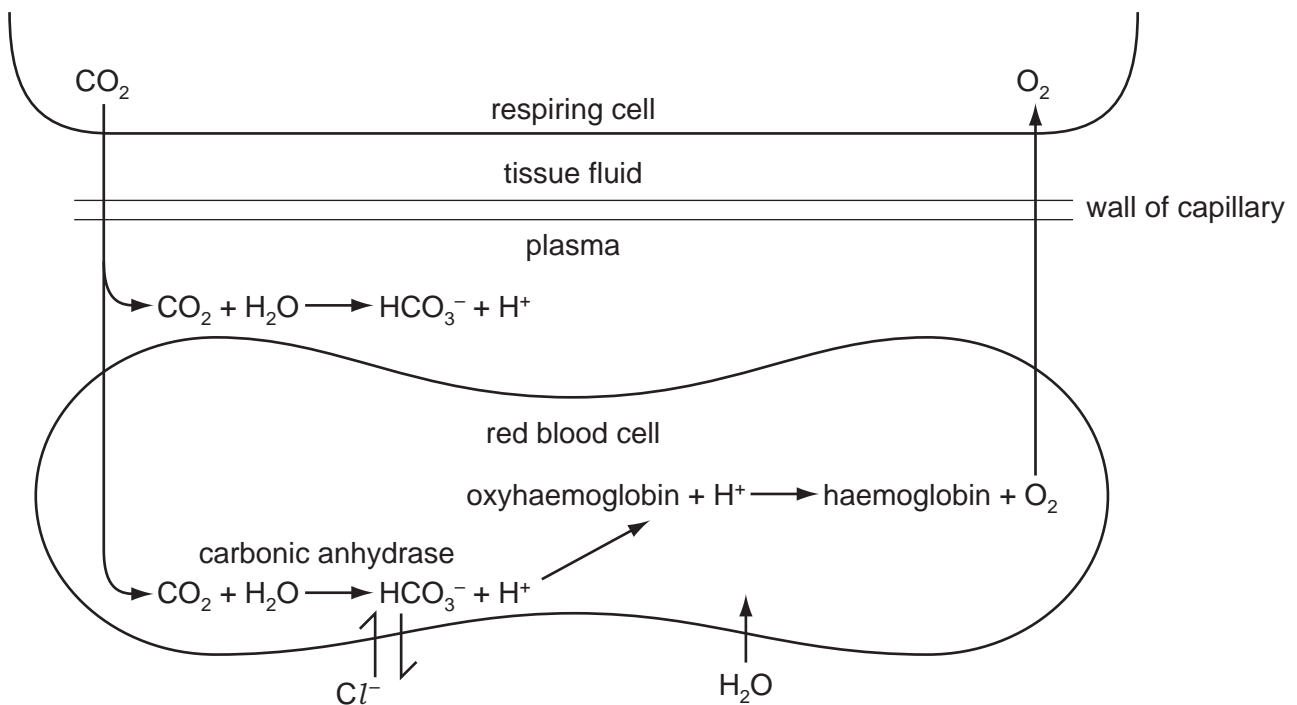
x = no ability

- 10 The graph shows pressure changes in the aorta, left atrium and left ventricle during one beat of the human heart.

At which point do the semi-lunar valves first begin to close?



11 The diagram shows some of the events occurring in a capillary in a respiring tissue.



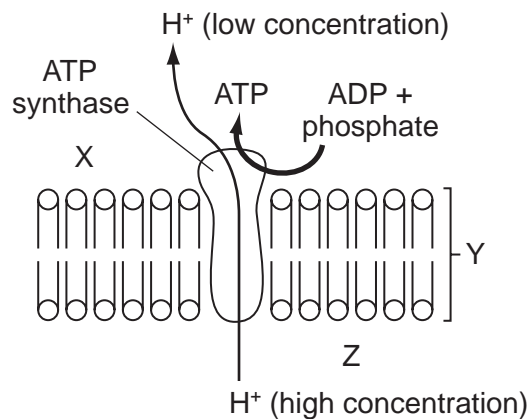
Which statement correctly describes one of these events?

- A** Hydrogen carbonate (HCO_3^-) ions and chloride (Cl^-) ions are exchanged through a protein cation channel in the red blood cell membrane.
- B** Hydrogen carbonate ions (HCO_3^-) are formed at a slower rate in the red blood cell than in the plasma.
- C** Red blood cells at the venous end of a capillary have a slightly greater volume than those at the arterial end.
- D** The increase of chloride ions (Cl^-) causes the water potential of the red blood cell to become less negative.
- 12 When a person eats a meal, which statement about its digestion is **not** correct?
- A** Fat hydrolysis mainly occurs in the small intestine.
- B** Protein digestion begins in the stomach.
- C** The fats in the meal are digested by lipase, secreted by the pancreas.
- D** The meal will be fully digested before it gets to the ileum.
- 13 In mammals, why is glucose present in blood plasma but **not** normally in urine?
- A** ATP is used in reabsorption from the proximal convoluted tubule.
- B** It is oxidised to supply energy for ultrafiltration.
- C** It is stored in the medulla of the kidney.
- D** It is too large to enter the Bowman's capsule.

- 14 Which row shows the features of each heavy and each light chain of a monomeric antibody, e.g. IgG?

	single heavy chain	single light chain
A	2 variable regions present	2 variable regions present
B	1 variable region present	variable region absent
C	variable region absent	1 variable region present
D	1 variable region present	1 variable region present

- 15 The diagram shows a membrane in a cell.

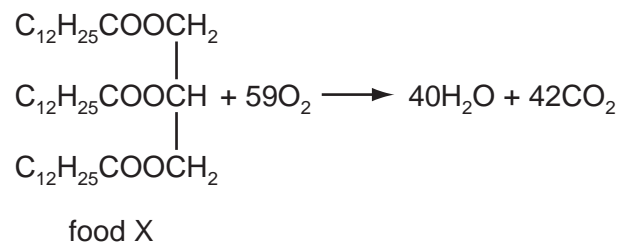


Which would be true of the diagram?

- A** X is the thylakoid space, Y is the thylakoid membrane and the diagram shows ATP synthesis in a chloroplast.
- B** X is the stroma, Y is the thylakoid membrane and the diagram shows ATP synthesis in a mitochondrion.
- C** Y is the thylakoid membrane, Z is the cytosol (cytoplasm) and the diagram shows ATP synthesis in a chloroplast.
- D** Z is the intermembranous space, X is the matrix and the diagram shows ATP synthesis in a mitochondrion.

- 16 The type of food being respired by an organism can be determined by calculating the RQ (respiratory quotient).

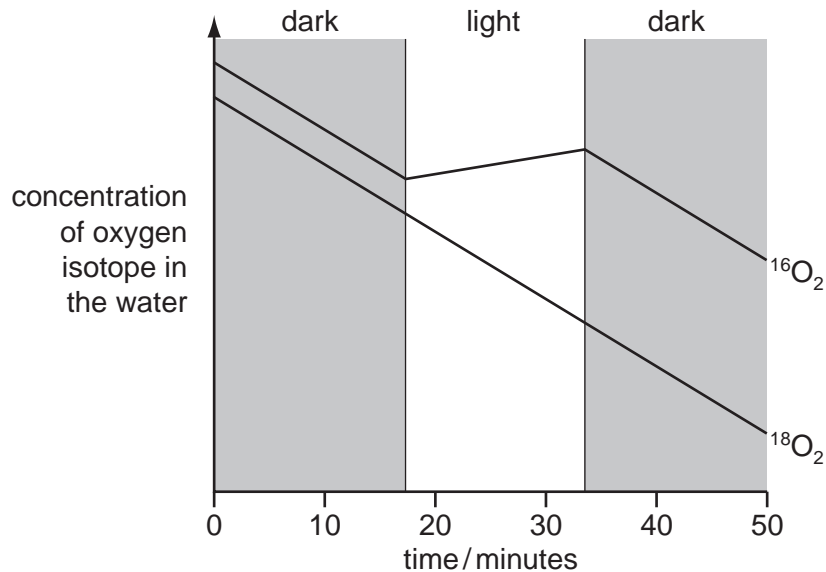
The equation shows the respiration of a food, X.



What is the RQ for food X, and which type of food is being respired?

	RQ	type of food being respired
A	0.68	protein
B	0.71	triglyceride
C	1.40	triglyceride
D	7.10	carbohydrate

- 17 The common isotope of oxygen is ^{16}O . Air containing $^{16}\text{O}_2$ and $^{18}\text{O}_2$ was bubbled through a suspension of algae for a limited period. After this, the concentration of these two isotopes of oxygen in the water was monitored for the next 50 minutes whilst the algae were subjected to periods of dark and light. The results are shown in the diagram.



What is the best explanation for these results?

- A** Both isotopes of oxygen are used by the algae in the dark in respiration, but in the light oxygen is produced from water in photorespiration.
- B** The algae can distinguish chemically between the two isotopes.
- C** The algae produce oxygen from the water which is used in photosynthesis, but only in the light.
- D** The two isotopes have different rates of diffusion.
- 18 The table shows the results of a series of crosses in a species of small mammal.

coat colour phenotype		
male parent	female parent	offspring
dark grey	light grey	dark grey, light grey, albino
light grey	albino	light grey, white with black patches
dark grey	white with black patches	dark grey, light grey
light grey	dark grey	dark grey, light grey, white with black patches

What explains the inheritance of the range of phenotypes shown by these crosses?

- A** one gene with a pair of co-dominant alleles
- B** one gene with multiple alleles
- C** sex linkage of the allele for grey coat colour
- D** two genes, each with a dominant and recessive allele

- 19 In the fruit fly, *Drosophila melanogaster*, four genes whose recessive alleles code for black body (B/b), curved wings (C/c), purple eyes (P/p) and vestigial wings (V/v) are linked on chromosome 2.

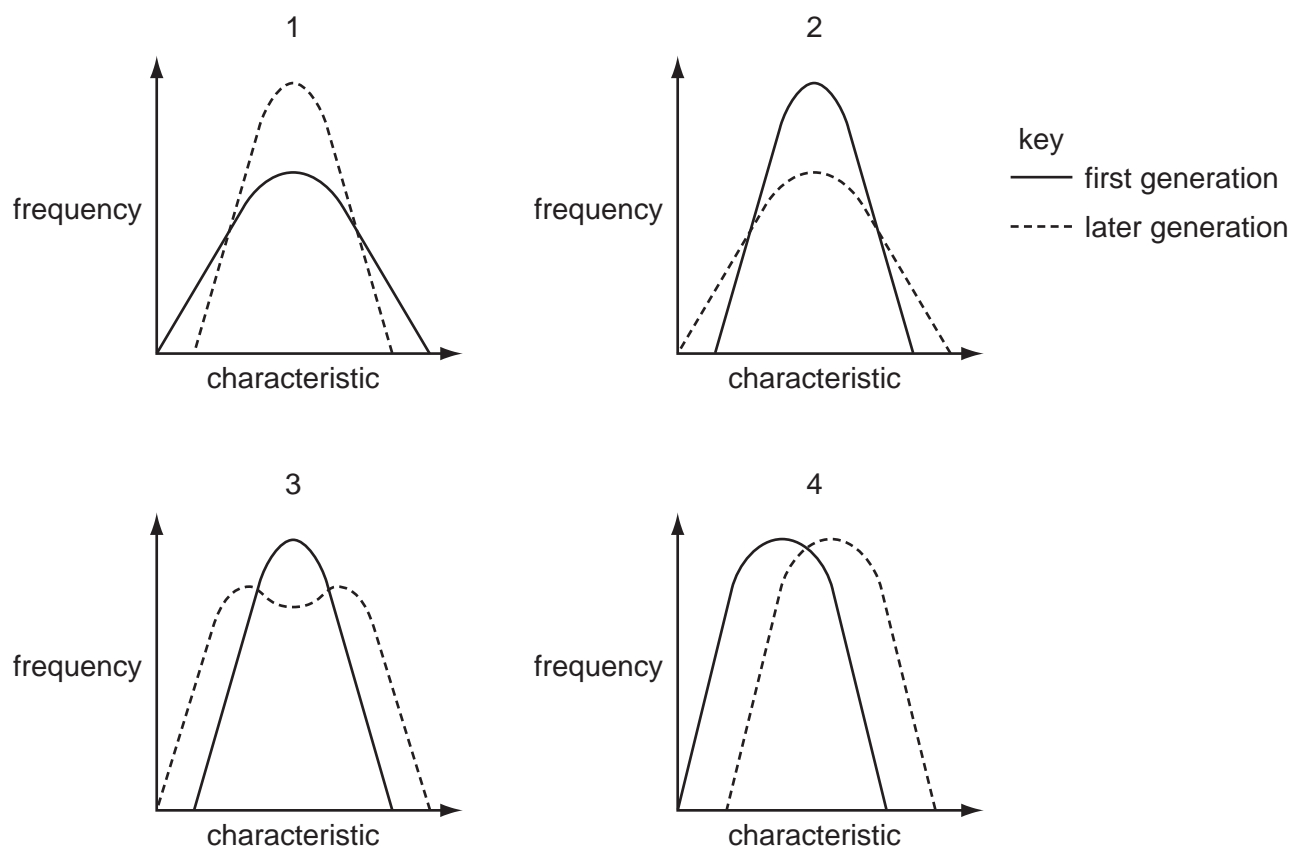
The table shows some distances apart of the gene loci, as determined by breeding experiments.

gene loci	distance between loci/map units
B/b and P/p	6.0
B/b and V/v	18.5
P/p and V/v	12.5
P/p and C/c	21.0
V/v and C/c	8.5

What is the correct sequence of the loci on chromosome 2?

- A** B/b P/p V/v C/c
B C/c V/v B/b P/p
C P/p V/v C/c B/b
D V/v B/b P/p C/c

- 20 The graphs show frequency against a measured characteristic in the first and later generation of an organism.



Which graph represents each type of natural selection?

	directional	disruptive	stabilising
A	1	2	3
B	2	3	4
C	3	1	2
D	4	3	1

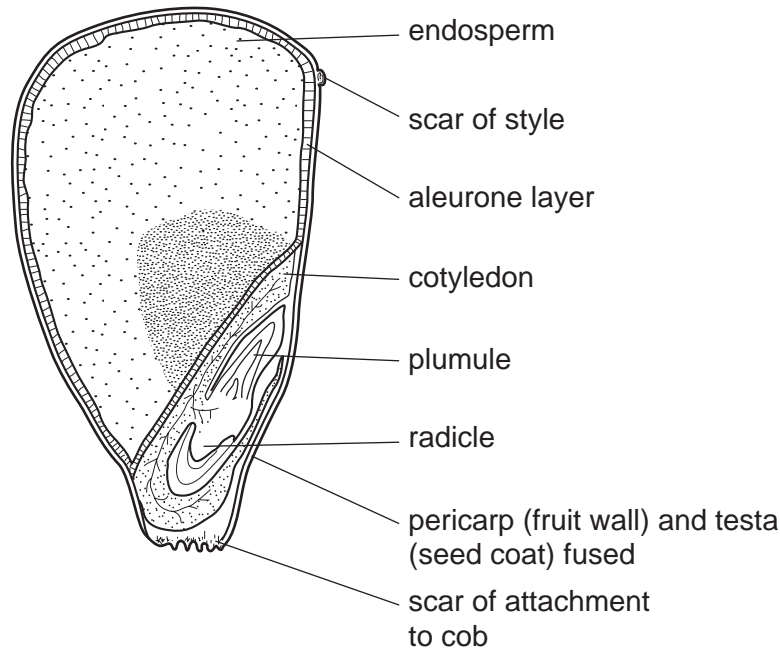
- 21 In humans, the female menopause usually occurs between the ages of 45 and 55. After the menopause, the female no longer menstruates or ovulates.

How do the concentrations of reproductive hormones change at the menopause?

	FSH	LH	oestrogen	progesterone
A	fall	rise	fall	rise
B	fall	rise	rise	fall
C	rise	fall	fall	fall
D	rise	fall	rise	rise

- 22 Maize plants that express the dominant allele, P, have purple cobs.

The diagram shows a single maize kernel (fruit), with a purple pericarp, taken from a plant with the genotype PP which had been pollinated by a plant with the genotype pp.



Which statement correctly describes the kernel?

- A Its pericarp and testa are genetically different because they originate from different individuals.
 - B Its pericarp and testa both have the genotype pp because they originate from the same individual.
 - C Its endosperm is diploid and originates from the PP parent.
 - D Its endosperm is triploid and its genotype may be PPp.
- 23 When an isolated island was settled by humans they introduced cats to the island. These pet cats escaped into the wild.

After about 20 years, the cat population had increased and many native species had disappeared.

What is the reason for this?

- A The introduced cats lacked adaptive behavioural strategies.
- B The introduced cats had been selected as good hunters.
- C The introduced cats occupied a different habitat to native species.
- D The introduced cats occupied a unique niche on the island.

- 24 Conservation of larger areas is considered more worthwhile than smaller ones but sometimes small areas have advantages for some species.

Why do smaller areas sometimes have advantages for some species?

- A fewer predators present
 - B less complex food webs
 - C less intra-specific competition
 - D smaller edge effects
- 25 Marker genes are often inserted into genetically engineered crop plant cells, along with desired genes. Bacterial antibiotic resistance genes are sometimes used as marker genes. These may include short DNA repeats to make them unstable so that they are quite quickly eliminated by the genetically engineered crop plant cells.

Which is **not** a reason why elimination of such marker genes is favoured?

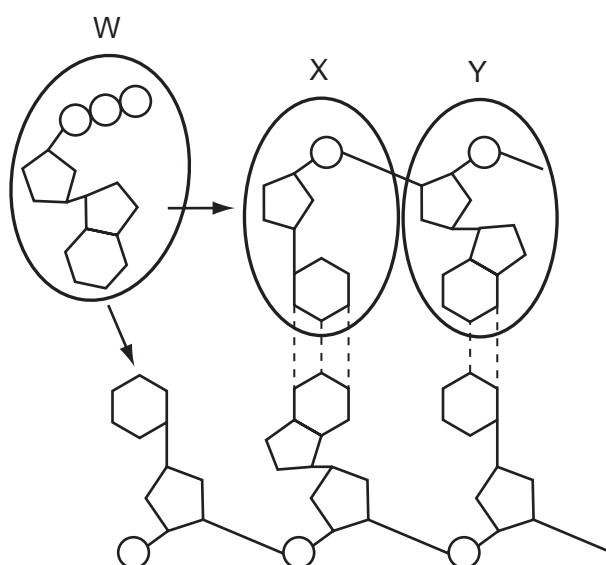
- A It is theoretically possible for the antibiotic resistance marker gene in human food to pass to bacteria in the human gut.
 - B It is difficult to carry out repeated transformations using the same antibiotic.
 - C The antibiotics may affect the growth and differentiation of the fields of crop plants.
 - D There are a few such antibiotic resistance marker genes available.
- 26 The statements below are about bonds found in biological molecules.

- 1 They are formed by condensation.
- 2 Oxygen is part of the bond.
- 3 ATP is hydrolysed to form the bonds.
- 4 The bonds contain potential energy.

Which statements are correct for the bonds in the primary structure of proteins?

- A 1, 3 and 4 only B 3 and 4 only C 1 and 2 only D 1, 2, 3 and 4

27 The diagram shows the synthesis of a polynucleotide. Molecule W is a nucleotide triphosphate.



Which statements are correct?

- 1 The base in W could be the purine, adenine
- 2 The base in Y is the purine, guanine
- 3 The base in X is the pyrimidine, cytosine
- 4 The base in X could be the pyrimidine, uracil

A 1 and 3 only **B** 2 and 3 only **C** 2 and 4 only **D** 1, 2, 3 and 4

28 A new fossil unicellular organism was discovered in rocks 150 million years old. Scientists studied the cell structure of several samples under the electron microscope.

Which features suggest it was a eukaryote and not a prokaryote?

- 1 The nucleus was enclosed by a nuclear envelope with nuclear pores and contained two nucleoli.
- 2 The cisternae of rough endoplasmic reticulum were covered with ribosomes.
- 3 Oval organelles 1-2 μm long, in which the inner membrane was folded.
- 4 The cell wall was an extracellular structure, oval in shape.

A 1 and 2 only **B** 1 and 4 only **C** 1, 2 and 3 only **D** 2 and 3 only

29 Which statements about the genetic code are correct?

- 1 The genetic code has redundancy and is degenerate.
- 2 There is only one codon for the amino acid methionine.
- 3 Codons act as 'stop' and 'start' signals during transcription and translation.
- 4 Prokaryotes generally use the same genetic code as eukaryotes.
- 5 mRNA codons have the same nucleotide sequence as DNA triplet codes.

A 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 5 **D** 2, 4 and 5

30 What would be shown by a microscopic examination of a root tip squash?

- 1 cells with large nuclei at interphase
- 2 cells not dividing and nuclei undergoing mitosis
- 3 nuclei with paired homologous chromosomes visible
- 4 cell walls forming

A 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

31 The effects of some features possessed by various organisms are listed below.

- 1 advantageous mutations may not be passed on
- 2 allows division of labour between cells
- 3 allows greater control of the internal environment
- 4 enables cells to become specialised
- 5 reduces need for coordination within the organism

Which are advantages shared by multicellular organisms?

- A** 1, 2 and 3 only
B 2, 3 and 4 only
C 3, 4 and 5 only
D 1, 2, 3, 4 and 5

32 Animals and plants use different types of transport systems and these are driven by energy from various sources.

Four sources are shown below.

- 1 chemical energy from ATP released at globular proteins
- 2 chemical energy from ATP released at fibrous proteins
- 3 kinetic energy
- 4 heat of vaporisation

Which sources are required for circulation, translocation and transpiration?

	circulation	translocation	transpiration
A	1	2	3
B	2	1	4
C	3	4	1
D	4	3	2

33 Which processes are promoted by the hormones insulin and glucagon?

- 1 conversion of glycogen to glucose in hepatocytes
- 2 respiration of glucose in hepatocytes
- 3 uptake of glucose by muscle cells
- 4 release of glucose in urine

	insulin	glucagon
A	1	2
B	2	4
C	3	1
D	4	3

34 Apart from the ABO blood groups, humans can also be Rhesus positive or Rhesus negative.

People with the Rhesus antigen are Rhesus positive. When a Rhesus negative person is given Rhesus positive blood in a transfusion there is no problem. However, a second transfusion of Rhesus positive blood to this Rhesus negative person will result in a reaction between the two types of blood.

Which statements explain this?

- 1 A Rhesus negative person naturally has anti-Rhesus antibodies.
- 2 Exposure to Rhesus antigen causes anti-Rhesus antibody production.
- 3 B-cells make anti-Rhesus antibodies.
- 4 Anti-Rhesus antibody production begins after the second exposure.

A 1, 2, 3 and 4 **B** 1 and 2 only **C** 2 and 3 only **D** 3 and 4 only

35 What are the products of glycolysis?

- 1 pyruvate
- 2 reduced FAD
- 3 reduced NAD
- 4 reduced NADP

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 2 and 4

36 Before the settlement of California in the 1800s, the elk population was very large. By about 1900 there were only a few dozen elk left.

Owing to protection, there are now about 3000 elk living in a small number of isolated herds.

Unfortunately, some of the elk in all the herds have difficulty grazing due to a shortened lower jaw.

Which statements best explain this?

- 1 The early settlers only hunted elk that could graze.
- 2 There was a mutation affecting jaw size in one of the herds.
- 3 There is random mating within each herd.
- 4 The current elk population demonstrates a founder effect.
- 5 There was directional selection favouring short jaws.

A 1, 2 and 4 only **B** 2, 3 and 5 only **C** 2 and 5 only **D** 3 and 4 only

37 Dioecious plant species are adapted to transfer pollen effectively to the stigma of another individual.

Which adaptations are used in wind pollination?

- 1 anther enclosed in petal
- 2 anther pendulous
- 3 feathery stigma
- 4 stigma sticky knob
- 5 pollen rough
- 6 pollen small

- A** 1, 2, 3 and 6 only
B 1, 4 and 5 only
C 2, 3 and 6 only
D 2, 4 and 5 only

38 A comparison of the plants in 65 woods in Dorset with the plants in the same woods 70 years ago gave the following results.

- 1 On average, individual woods contain the same number of species as they did 70 years ago.
- 2 The woods with the most species 70 years ago now contain fewer species.
- 3 The woods with the fewest species 70 years ago now contain more species.
- 4 Overall, 117 species have disappeared and 47 new species have appeared.

Which results suggest that the Dorset woods have lost biodiversity?

- A** 1 and 2 **B** 2 and 3 **C** 2 and 4 **D** 3 and 4

39 What are the similarities between traditional plant breeding and genetic engineering?

- 1 increases chance of mutation
- 2 involves selection of genetic traits
- 3 must involve closely related species
- 4 transfers genes

- A** 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

40 The following statements relate to molecular phylogenetics.

- 1 Lines of descent from a common ancestor to present-day organisms have undergone similar, fixed rates of DNA mutation.
- 2 Organisms with similar base sequences in their DNA are closely related to each other.
- 3 The number of differences in the base sequences of DNA of different organisms can be used to construct evolutionary trees.
- 4 The proportional rate of fixation of mutations in one gene relative to the rate of fixation of mutations in other genes stays the same in any given line of descent.

Which statements, when taken together, suggest the existence of a 'molecular clock' that enables scientists to estimate the time at which one species might have diverged from another?

- A** 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

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