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| Civics Group | Index Number | Name (use BLOCK LETTERS) |
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H1



**ST. ANDREW'S JUNIOR COLLEGE
2015 JC2 Preliminary Examinations**

H1 BIOLOGY

8871/1

Paper 1: Multiple Choice

Friday

18 September 2015

1 hour 15 minutes

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser (not supplied)
Soft pencil (type B or HB is recommended)

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write your name, civics group and index number on the multiple choice answer sheet in the spaces provided.

There are **30** questions in 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 multiple choice answer sheet.

INFORMATION TO CANDIDATES

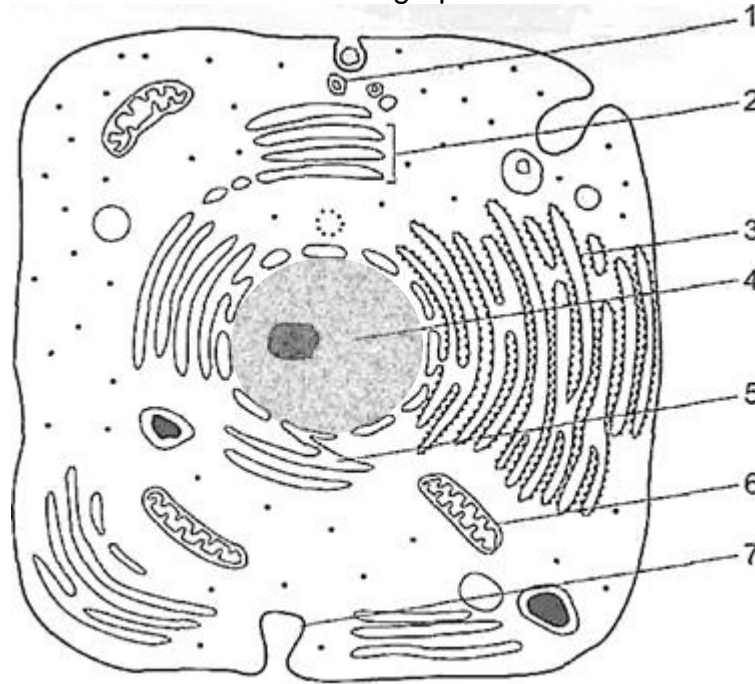
Each correct answer will score one mark. A mark will not be deducted for wrong answer. Any rough working should be done in this booklet.

At the end of the examination, submit the multiple choice answer sheet only.

This document consists of **18** printed pages.

[Turn over

- 1 The figure below shows an electron micrograph of a human cell.



Which of the following does not correctly identify its structure-function adaptation?

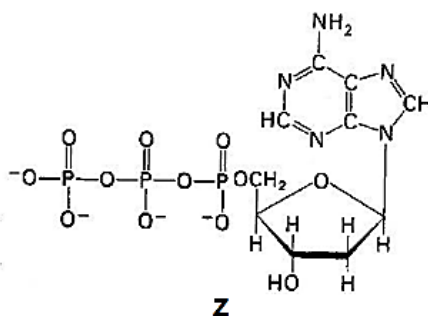
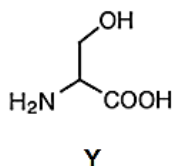
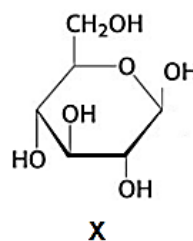
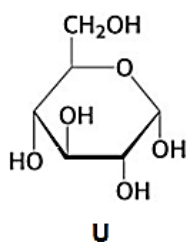
| | Function | Structural adaptation |
|----------|------------------------|---------------------------------------|
| A | Cholesterol production | Extensive 5 |
| B | Enzyme secretion | Extensive 1, 2, 3 and 6 |
| C | Phagocytosis | Extensive 1 and 6 |
| D | Absorption | Extensively-folded 7 |

- 2 Which of the following processes do not involve lysosomes?

- 1 Cell division
- 2 Intracellular digestion
- 3 Protein synthesis
- 4 Removing damaged mitochondria

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

3 Figure below shows the structure of four monomers.



Which of the following combination of polymer, monomer and bond formed between monomers is correct?

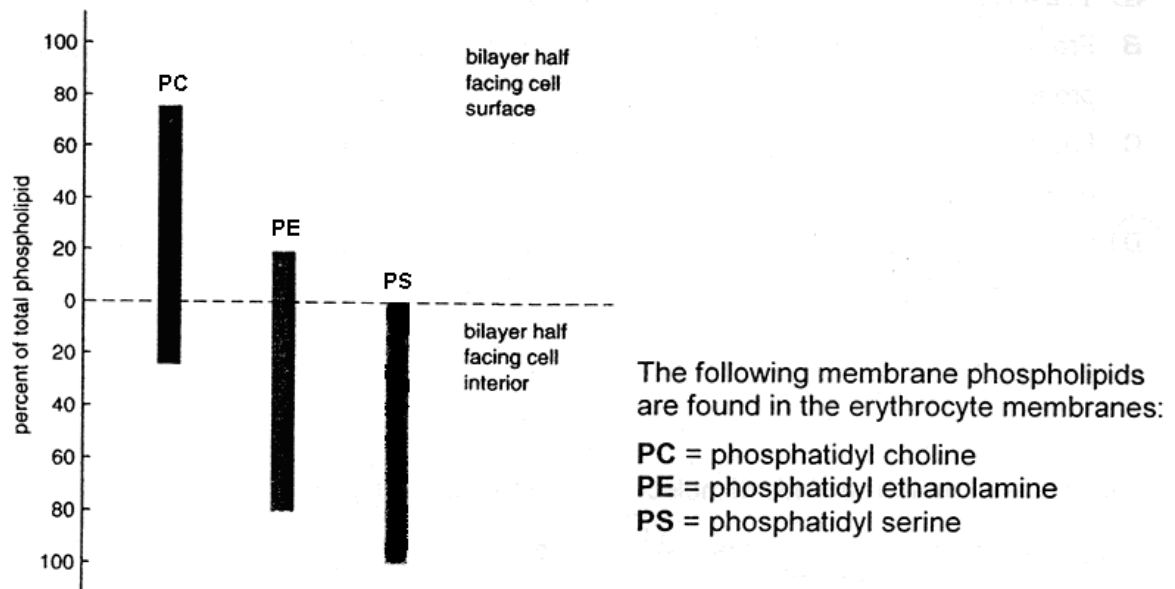
| | <i>starch</i> | <i>cellulose</i> | <i>polypeptide</i> | <i>polynucleotide</i> |
|----------|--|--|--------------------------|--|
| A | X , β -1,4 glycosidic bond | U , α -1,4 glycosidic bond | Z , ester linkage | Y , disulphide linkage |
| B | U , α -1,4 glycosidic bond | X , β -1,4 glycosidic bond | Y , peptide bond | Z , phosphoester linkage |
| C | Z , peptide bond | X , hydrogen bond | Z , ionic bond | U , hydrogen bond |
| D | X , ionic bonds | Y , peptide bond | U , hydrogen bond | Z , α -1,6 glycosidic bond |

4 Which of the following statement(s) describe(s) unsaturated fats?

- 1 They have a higher melting point than saturated fats.
- 2 Each molecule is an ester formed by a fatty acid with an alcohol other than glycerol.
- 3 At room temperature, they are closely packed.
- 4 They contain double bonds that cause kinks in the hydrocarbon chain.

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

- 5 The following diagram illustrates the types of membrane phospholipids found in the intact erythrocytes (red blood cells).

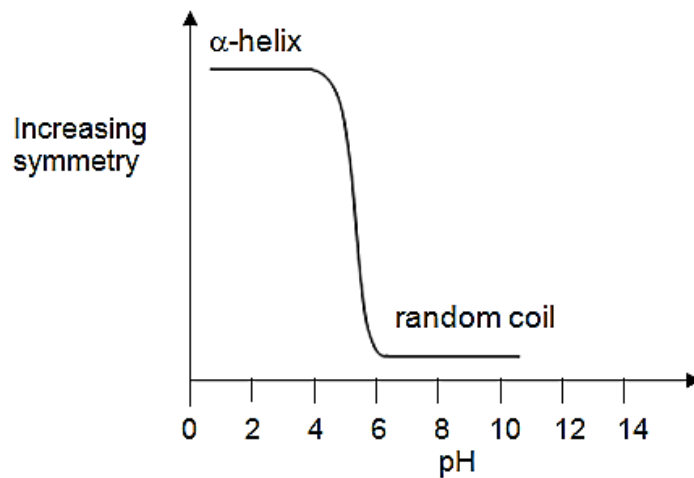


Which of the following statement(s) correctly identifies with the graph?

- 1 76% of the total membrane phospholipids contain choline and 20% contain ethanolamine.
- 2 24% of the inner total membrane phospholipids contain choline and 80% ethanolamine.
- 3 Most **PC** is confined to the outer surface of the erythrocytes while most of the **PE** are confined to the inner surface of the erythrocytes.
- 4 Membranes, in general, can be concluded to be asymmetric.

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

- 6 The graph below shows the effect of pH on the structure of a protein which consists of entirely of repeating residues of one amino acid.



Which statement is true?

- A At low acidity the protein loses its primary structure.
 - B At low acidity the protein loses its secondary structure.
 - C At high acidity the protein loses its secondary structure.
 - D At high acidity the protein loses its tertiary structure.
- 7 Which set of terms matches the definitions in the table?

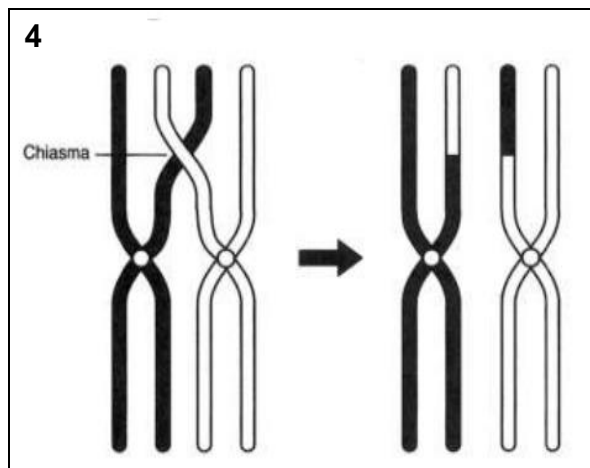
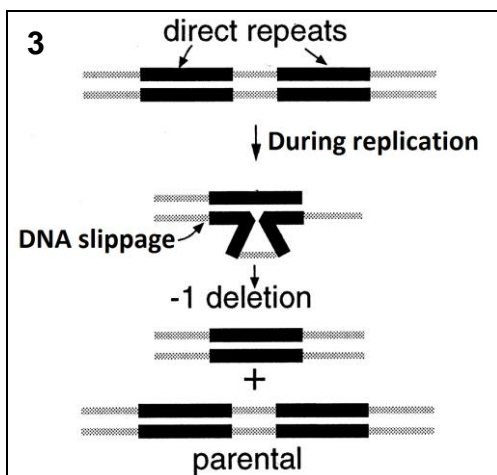
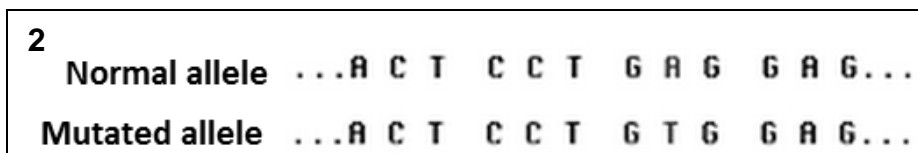
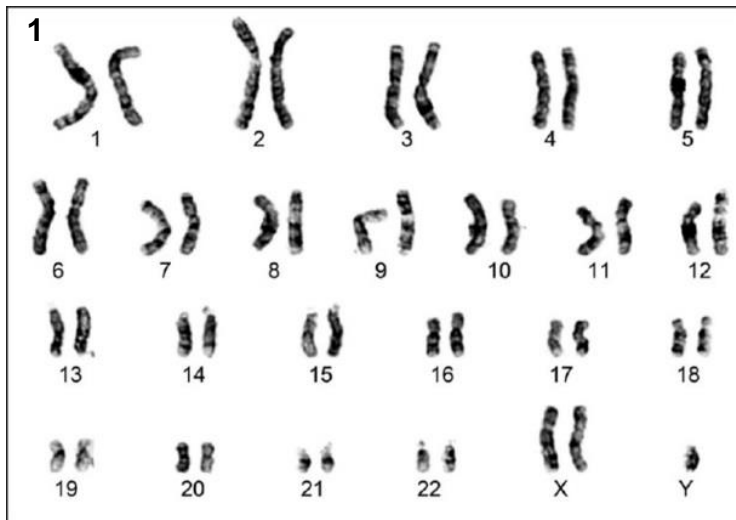
| | Definition | | | |
|---|--|---|---|---|
| | The structure that replicates in S phase | In animal cells, the 'pinching in' process that divides the cytoplasm | The cell structure that dissociates to allow chromosome attachment to the spindle | The phase of the cell cycle immediately prior to entering mitosis |
| A | Centriole | Cytokinesis | Nuclear envelope | S phase |
| B | Centriole | Late telophase | Nucleolus | S phase |
| C | Chromatid | Cytokinesis | Nuclear envelope | G ₂ phase |
| D | Chromatid | Late telophase | Nucleolus | G ₂ phase |

8 Which of the following event(s) occur during mitosis?

- 1** Centrioles replicate and form a spindle.
- 2** Cytokinesis occurs.
- 3** DNA forms sister chromatids.
- 4** Organelles duplicate
- 5** Centromeres divide.

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

9 Which of the following diagrams, 1 – 4, does not show chromosomal mutation?

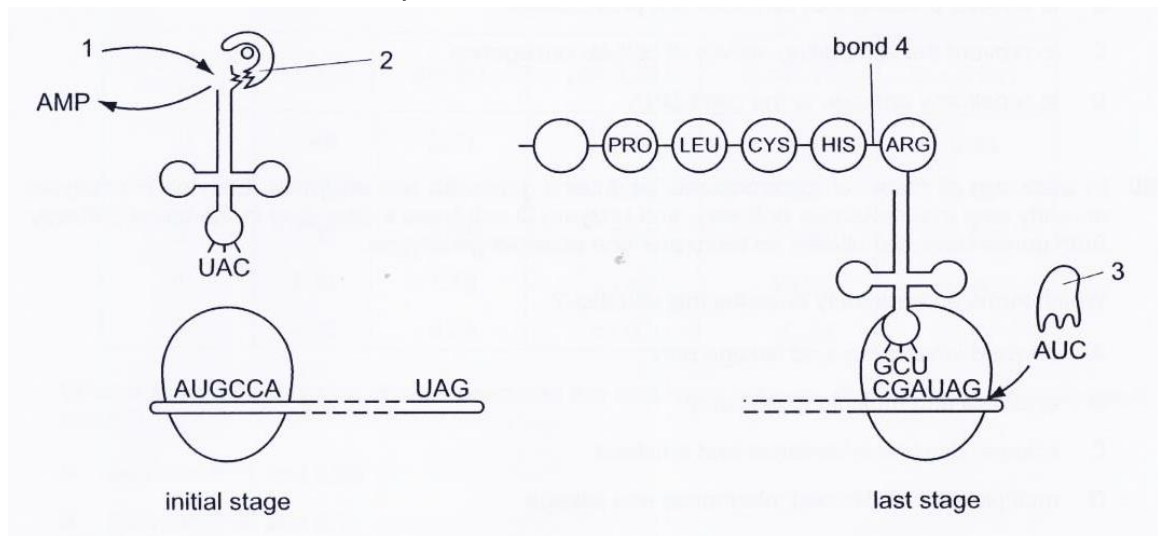


- A** 1 and 2
- B** 1 and 3
- C** 2 and 4
- D** 2, 3 and 4

10 Which correctly describes the structure of DNA during transcription?

- A** Double-stranded region with two loops of unpaired bases.
- B** Double strand held together by covalent bonds between nucleotide pairs.
- C** Double-stranded with single-stranded sections associated with polymerase enzymes.
- D** Single strand formed by base pairing cytosine with guanine and adenine with thymine.

11 A number of molecules other than tRNA and mRNA are involved during translation. The diagram below shows some of these molecules and some of the nucleotides in the codon and anticodon positions.



Which line in the table is correct for labels 1 – 4?

| | 1 | 2 | 3 | 4 |
|----------|-----|---------------------------|------------------------------|---------------|
| A | ADP | Aminoacyl tRNA synthetase | Amino acid | Hydrogen bond |
| B | ADP | Amino acid | Translation releasing factor | Hydrogen bond |
| C | ATP | Amino acid | Aminoacyl tRNA | Peptide bond |
| D | ATP | Aminoacyl tRNA synthetase | Releasing factor | Peptide bond |

- 12 After sequencing of the fragment carrying a mutation in the gene coding for phosphofructokinase, four changes were observed:

| <i>mutation</i> | <i>wild-type sequence</i> | <i>mutant sequence</i> |
|-----------------|---------------------------|------------------------|
| W | AUU | GUU |
| X | GAU | GAA |
| Y | GAC | GAU |
| Z | UUU | UCU |

With reference to Tables 12.1 and 12.2, which of the mutations (**W**, **X**, **U** or **Z**) would you test immediately to confirm that this is the relevant mutation that resulted in a change in the tertiary structure of the phosphofructokinase?

| | | Second letter | | | | | |
|--------------|---|--|--------------------------------------|--|---|------------------|--------------|
| | | U | C | A | G | | |
| First letter | U | UUU } Phe UUC } UUA } Leu UUG } | UCU } UCC } Ser UCA } UCG } | UAU } Tyr UAC } UAA } Stop UAG } Stop | UGU } Cys UGC } UGA } Stop UGG } Trp | U C A G | Third letter |
| | C | CUU } CUC } Leu CUA } CUG } | CCU } CCC } Pro CCA } CCG } | CAU } His CAC } CAA } Gln CAG } | CGU } CGC } Arg CGA } CGG } | U C A G | |
| | A | AUU } AUC } Ile AUA } AUG } Met | ACU } ACC } Thr ACA } ACG } | AAU } Asn AAC } AAA } Lys AAG } | AGU } Ser AGC } AGA } Arg AGG } | U C A G | |
| | G | GUU } GUC } Val GUA } GUG } | GCU } GCC } Ala GCA } GCG } | GAU } Asp GAC } GAA } Glu GAG } | GGU } GGC } Gly GGA } GGG } | U C A G | |

Table 12.1

Classification of the amino acids based on side chain reactivity and polarity at pH 7.4

| Group I, Hydrophobic | Group II, Polar, Uncharged | Group III, Polar, Charged |
|-------------------------|-------------------------------|------------------------------|
| Gly | Ser | Asp |
| Ala | Thr | Glu |
| Val | Cys | Lys |
| Leu | Tyr | Arg |
| Ile | Asn | |
| Pro | Gln | |
| Met | His | |
| Phe | | |

Table 12.2

- A W
- B X
- C Y
- D Z

13 Which of the following is/are necessary for the development of cancer?

- 1 Arresting cell cycle
- 2 Inducing angiogenesis
- 3 Activation of genes involved in apoptosis
- 4 Regulation of asymmetric division of stem cells
- 5 Loss-of-function mutation in several tumour suppressor genes

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

14 The length of the petiole (leaf stalk) in a type of flowering plant is controlled by two genes, A and B. These genes are found on different loci on non-homologous chromosomes.

Homozygous dominant plants have long petioles (30 cm), homozygous recessive plants have short petioles (10 cm). Each dominant allele contributes 5cm to the petiole length.

F₁ plants with medium length petioles (20 cm) were obtained when a plant with short petiole is crossed with a plant with long petiole. If the F₁ generation plants were allowed to cross, what proportion of their offspring would be expected to have medium length (20 cm) petioles?

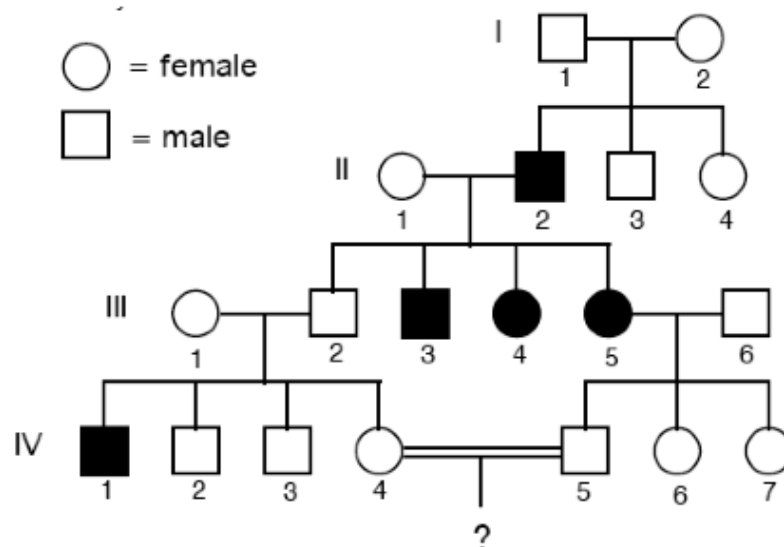
- A 0.0625
- B 0.25
- C 0.375
- D 0.5

- 15 A man with blood type B, whose mother is blood type O, marries a woman with blood type AB. Which of the following are possible phenotypes for their children?

- 1 A
- 2 B
- 3 AB
- 4 O

- A 3 only
- B 2 and 3 only
- C 1, 2 and 3 only
- D All of the above

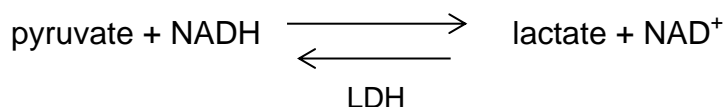
- 16 The pedigree below shows the inheritance of a genetic disorder in a particular family. The disorder is caused by a single mutation. Shaded individuals represent affected family members.



Given that individual III-1 is homozygous for this locus, if individuals IV-4 and IV-5 have a son, what is the probability that he would be affected?

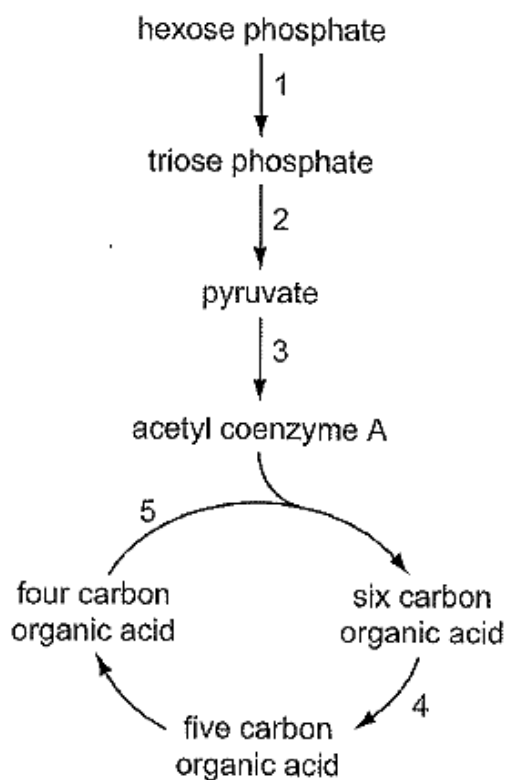
- A $\frac{1}{8}$
- B $\frac{1}{4}$
- C $\frac{1}{2}$
- D 0

- 17 Lactate dehydrogenase (LDH) is an important enzyme in mammalian skeletal muscles where oxygen can be in short supply. The enzyme catalyzes the following reversible reaction:



Which of the following is false?

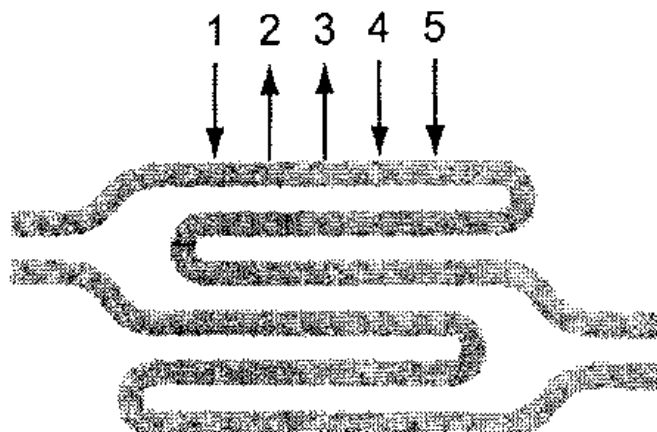
- A NADH can be re-oxidised.
 - B ATP production can continue.
 - C More glucose can be broken down.
 - D Lactate acts as a hydrogen acceptor.
- 18 The flow diagram shows some of the stages in respiration.



During which stages does oxidative decarboxylation occur?

- A 1 and 3
- B 2 and 3
- C 3 and 4
- D 4 and 5

- 19 The diagram shows a section through some membranes of a granum in a chloroplast. The five arrows, 1 - 5, represent substances entering or leaving the granum during photosynthesis.



Which row correctly identifies these substances?

| | 1 | 2 | 3 | 4 | 5 |
|----------|----------------|------------|--------------|------------|--------------|
| A | carbon dioxide | ADP and Pi | reduced NAD | ATP | NAD |
| B | carbon dioxide | ATP | NAD | ADP and Pi | reduced NAD |
| C | water | ADP and Pi | NADP | ATP | reduced NADP |
| D | water | ATP | reduced NADP | ADP and Pi | NADP |

- 20 Which of the following statement(s) is/are true regarding cyclic and non-cyclic photophosphorylation?

- 1 Only cyclic photophosphorylation produces oxygen.
- 2 Only cyclic photophosphorylation can function in the absence of photosystem II.
- 3 Only non-cyclic photophosphorylation will be affected in the absence of NADP reductase.
- 4 The plant switches from cyclic to non-cyclic photophosphorylation when only ATP is required.

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

- 21 The huia, *Heteralocha acutirostris*, was found in New Zealand until 1907, when it became extinct. This bird had a ground-feeding habit and was particularly noted for large, attractive tail feathers. Males and females had very different beak forms, with the males having a short strong beak, whilst the females had a long curved beak to reach into otherwise inaccessible places.

What is the most likely reason for the extinction of the huia?

- A Humans introduced many species which preyed upon the huia.
 - B New competitors in New Zealand occupied part of the huia's niche.
 - C Male and female huia were unable to breed successfully owing to strong sexual dimorphism.
 - D A few huia became geographically isolated when they arrived at another island, leading to their reduced genetic variation.
- 22 A hurricane swept through a mangrove and uprooted some mangrove seedlings. When these seedlings were deposited onto another mud flat, some were able to take root and grow to maturity.

Which of the following does not describe what would be observed in the next two years?

- A The mud flat does not have some of the species which were originally found in the mangrove.
 - B The populations found on the mud flat have lower genetic variation than those found in the mangrove.
 - C Adaptive radiation occurs on the mud flat as different species arise to occupy the new ecological niches.
 - D Species which are better adapted to conditions on the mud flat will outnumber those which are less adapted.
- 23 Which of the following descriptions refers accurately to homologous structures?

| | Basic structure | Common ancestor | Function performed |
|---|-----------------|-----------------|--------------------|
| A | Same | No | Different |
| B | Different | No | Same |
| C | Same | Yes | Different |
| D | Different | Yes | Same |

- 24** Two areas of molecular biology that have received considerable attention in evolutionary studies are the genetic code and cytochrome C. Cytochrome C is an essential component of all respiratory electron transport chains.

Which statements lend evidence to the ideas that all living organisms are related and that there is a single, rather than a multiple, origin of life?

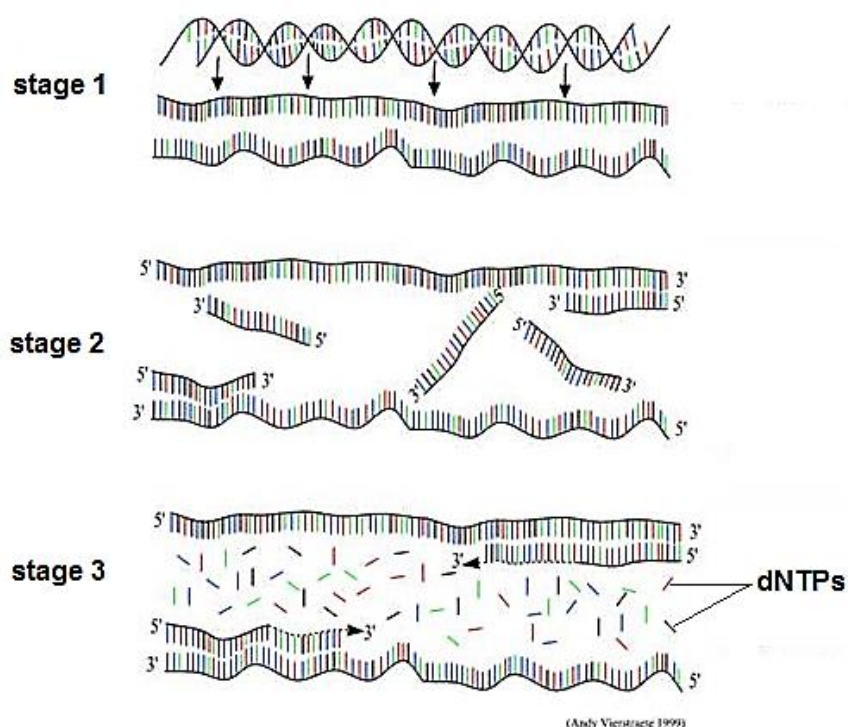
- 1 The almost universal nature of the genetic code is a result of evolutionary convergence from multiple lineages.
- 2 The sequence of amino acids in cytochrome C is similar in organisms that are from similar environments or with similar metabolic demands.
- 3 The majority of organisms have the same, or similar, amino acid sequences for cytochrome C.
- 4 When transferred into a very dissimilar organism, a gene coding for cytochrome C will lead to the expression of a protein that will function in the other organism.

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

- 25** If the first three nucleotides in a six-nucleotide restriction site are ATC, what would the next three nucleotides most likely be?

- A** ATC
B CTA
C GTG
D GAT

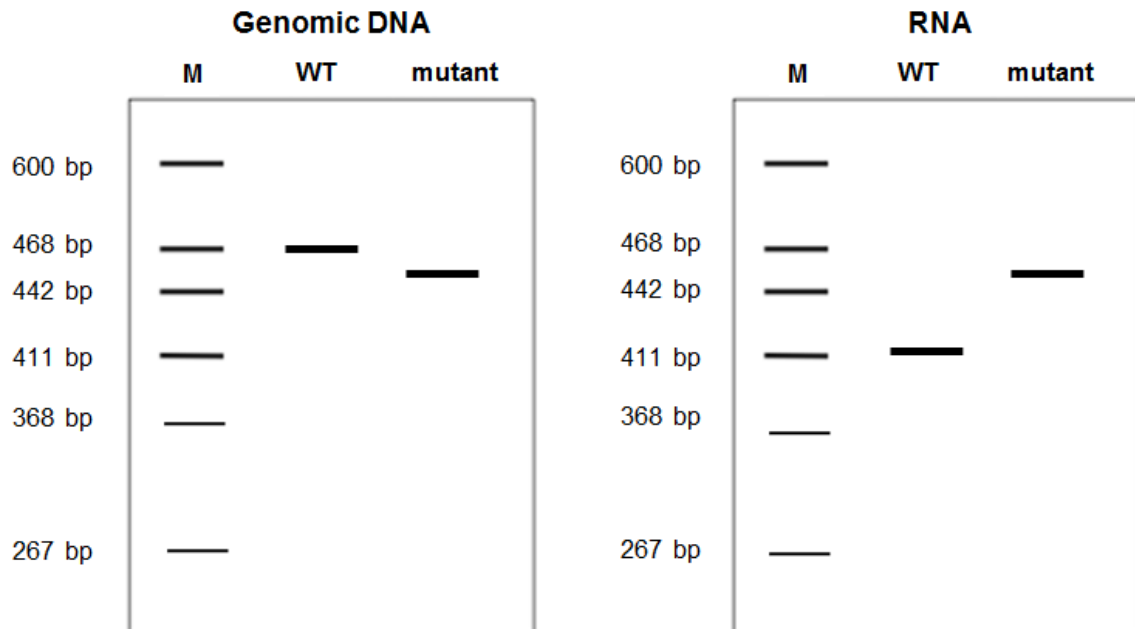
- 26 The diagram below shows the major stages during polymerase chain reaction (PCR).



Which row correctly matches the events to the various stages?

| | stage 1 | stage 2 | stage 3 |
|----------|---------------------------------|---------------------|-------------------------|
| A | Hydrogen bonds are broken | Carried out at 55°C | Requires DNA polymerase |
| B | Phosphodiester bonds are formed | Carried out at 72°C | Requires DNA polymerase |
| C | Phosphodiester bonds are formed | Carried out at 55°C | Requires DNA primers |
| D | Hydrogen bonds are broken | Carried out at 72°C | Requires RNA primers |

- 27** In an investigation of a gene suspected to be involved in a genetic disease, separate PCR procedures were done using genomic DNA and RNA isolated from healthy (wild-type WT) and diseased cells (mutant). The PCR products were analysed on polyacrylamide gels. The sizes of the bands in the molecular weight marker (M) are indicated in base-pairs.



Which of the following best explains the results obtained?

- A** Deletion of an exon in the mutant.
 - B** Deletion of a splice site in the mutant.
 - C** Deletion of several codons in the mutant.
 - D** Deletion of several introns in the mutant.
- 28** Some of the features of different types of stem cells are listed:
- 1 They do not carry out tissue-specific functions.
 - 2 They can develop into a wide range of different types of cells.
 - 3 They can differentiate into cells of a specific lineage to replace worn out ones.
 - 4 They are able to develop into all the cell types in the body to form a whole organism.

Which of these features will be shown by blood stem cells?

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

- 29 The human genome project has identified and mapped the genes on human chromosomes. This is allowing scientists to identify specific, faulty genes which contribute to inherited conditions.

This is useful in many ways, for example

- 1 carriers of faulty genes can be advised about changes in lifestyle to minimise risks.
- 2 carriers of faulty genes can be identified and informed of their risk status.
- 3 diagnostic tests can be developed to identify carriers of faulty genes.
- 4 drugs can be developed to block the action of problem genes.
- 5 embryos can be screened to avoid the birth of affected children.
- 6 employers can take account of the genetic predisposition of employees.

Which two uses arise **directly** from the information provided by the project?

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

- 30 Cows can be genetically modified (GM) by inserting growth hormone genes. Which of the following are valid ethical concerns about GM cows that produce more meat per mass of feed given?

- 1 Introduction of foreign gene may result in production of secondary metabolites which may be toxic to humans who consume them.
- 2 Antibiotic resistance genes in vectors used in GM cows may be passed to the cows, causing them to become resistant to antibiotics.
- 3 GM cows may escape and out-compete the wild populations of bovine species due to their higher rate of growth.
- 4 The meat produced by GM cows is of lower quality than non-GM cows.
- 5 GM cows may pass the foreign gene to their offspring.

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