

**H1**ANDERSON JUNIOR COLLEGE  
HIGHER 1

---

**BIOLOGY****8875/01**

Paper 1 Multiple Choice

**Monday 21 September 2015**

Additional Materials: Multiple Choice Answer Paper

**1 hour  
30 marks**

---

**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.

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

Write your name, PDG and identification number on the Answer Sheet.

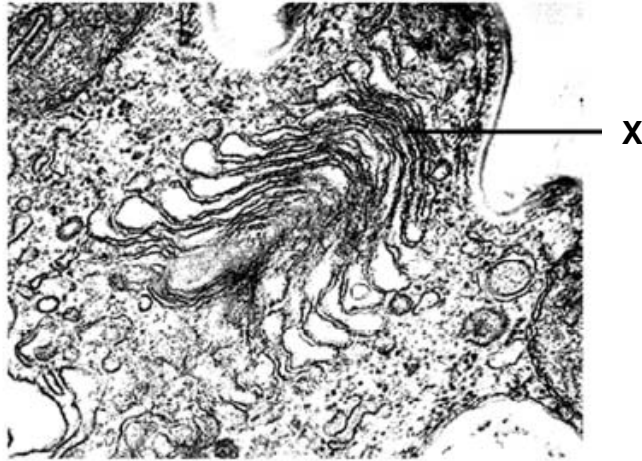
There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

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

Any rough working should be done in this booklet.

Calculators may be used.

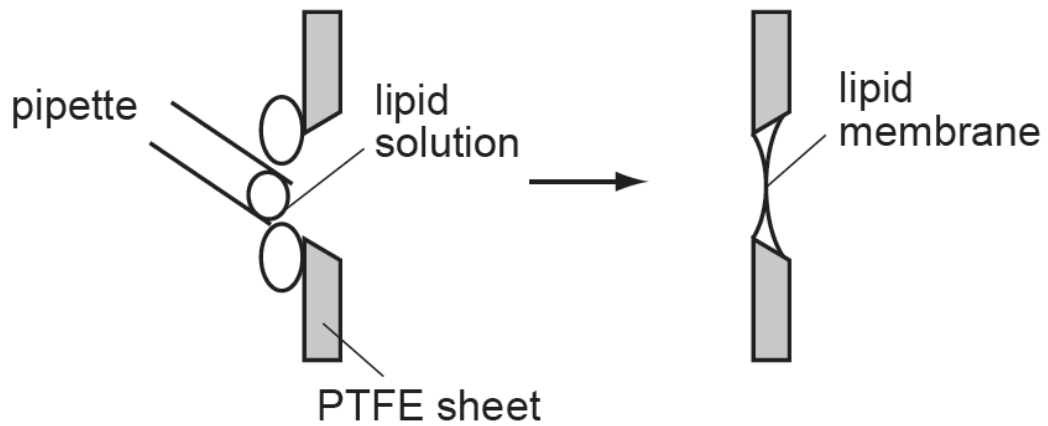
1 Which of the following are the most likely consequences for a cell lacking structure **X**?



1. The cell dies because it is unable to make glycoproteins to detect stimuli from its environment.
2. The cell dies from a lack of enzymes to digest food taken in by endocytosis.
3. The cell dies from the accumulation of worn out organelles within itself.
4. The cell is unable to reproduce itself.
5. The cell is unable to export its enzymes or peptide hormones.

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

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



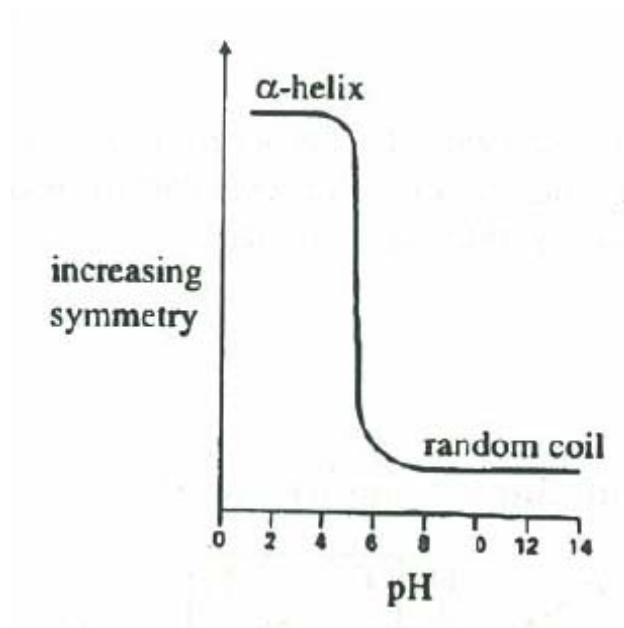
Such a lipid membrane is impermeable to water soluble materials including charged ions such as  $\text{Na}^+$  or  $\text{K}^+$ .

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

What kind of molecule is gramicidin?

- 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.

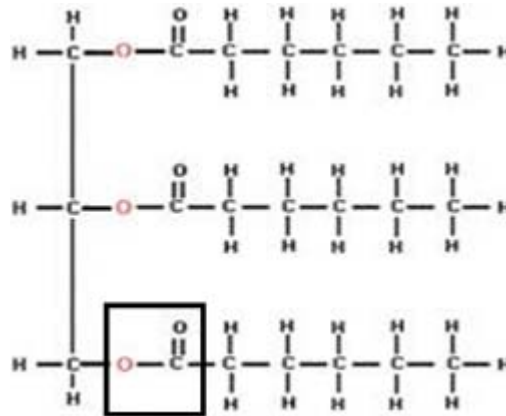
- 3 The graph shows the effect of pH on the structure of a protein which consists entirely of repeating residues of one amino acid.



Which of the following statements is true?

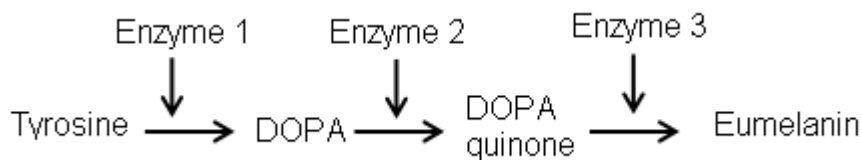
- A At high acidity, the protein loses its primary structure.
- B At high acidity, the protein loses its secondary structure.
- C At low acidity, the protein loses its primary structure.
- D At low acidity, the protein loses its secondary structure

- 4 The diagram below shows a molecular structure.



What bond is enclosed by the box in the diagram above?

- A Glycosidic bond
  - B Peptide bond
  - C Ester bond
  - D Phosphodiester bond
- 5 A part of the metabolic pathway to forming eumelanin in an individual is shown below.



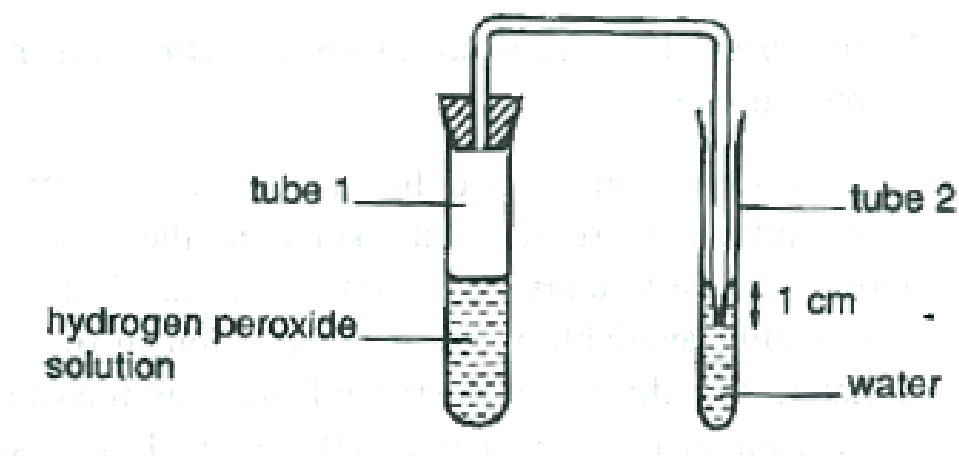
The addition of substance **X** resulted in no change in the concentration of tyrosine, an accumulation of DOPA and a near absence of both DOPA quinone and eumelanin.

Further addition of DOPA quinone results in formation to eumelanin.

What does the information indicate about substance **X**?

- A It is an inhibitor of enzyme 1.
- B It is an inhibitor of enzyme 2.
- C It reacts with DOPA.
- D It reacts with DOPA quinone.

- 6 Potato tubes contain an oxidoreductase enzyme that is able to catalyse the breakdown of hydrogen peroxide. The experiment is set up as shown below.



An investigation was carried to determine how differing concentration of hydrogen peroxide affects the rate of breakdown. 10 discs of 2 mm long potato slices were used each time.

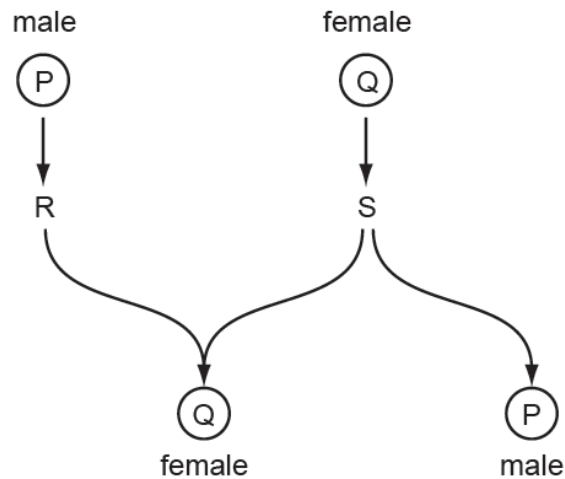
The table below shows the results of the investigation.

Bubbles per minute	Concentration of hydrogen peroxide / mol dm <sup>-3</sup>			
	0.5	1.0	1.5	2.0
Average number	4	9	16	20

How would the results differ (if any) if a single piece of 2 cm long potato was used instead?

- A The average number of bubbles would remain the same.
- B The average number of bubbles in all concentration would increase.
- C The average number of bubbles in all concentration would decrease.
- D The average number of bubbles would be the same in 0.5 mol dm<sup>-3</sup> and 1.0 mol dm<sup>-3</sup> hydrogen peroxide solutions.

- 7 Sex determination such as bees and wasps is not controlled by sex chromosomes.



Using the diagram, which row in the table shows how sex is determined in these insects?

	P	Q	R	S
A	n	n	Mitosis	Mitosis
B	n	2n	Mitosis	Meiosis
C	2n	n	Meiosis	Meiosis
D	2n	2n	Meiosis	Mitosis

- 8 Induced chromosome mutations produced a fertile hybrid species from cabbage and radish.

The table shows the chromosome numbers in the parental species and the hybrids.

Type of cell	Number of chromosomes per cell
Parental cabbage	18
Parental radish	18
Parental gametes	9
F <sub>1</sub> hybrids	18
F <sub>1</sub> gametes	18
F <sub>2</sub> hybrids	36
F <sub>2</sub> gametes	18
F <sub>3</sub> hybrids	36

At which stage did the chromosomes mutation occur?

- A During fusion of parental gametes.
- B During formation of F<sub>1</sub> gametes.
- C During formation of F<sub>2</sub> gametes.
- D During fusion of F<sub>1</sub> gametes.

9 What is the basis for the difference in the synthesis of the leading and lagging strands of DNA molecules?

- 1 The anti-parallel nature of the DNA strands.
- 2 One strand is synthesized in 5' to 3' direction and another strand is synthesized in 3' to 5' direction.
- 3 DNA nucleotides are added to 3' end only.
- 4 One strand acts as template for leading strand while the other strand acts as template for lagging strand.

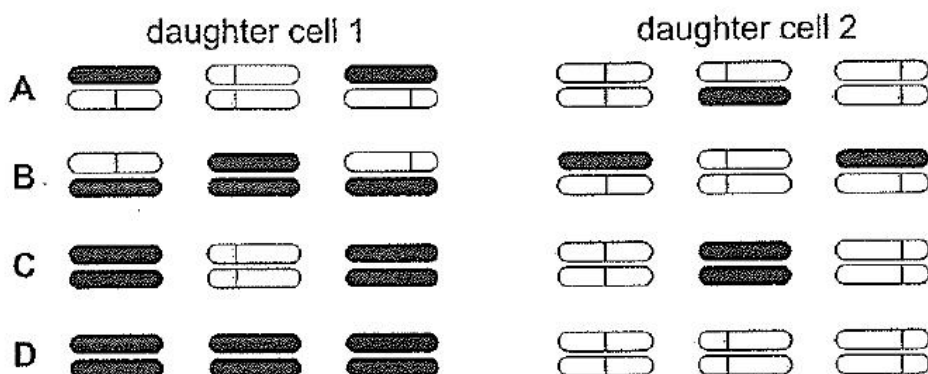
- A 1 and 3  
B 1 and 4  
C 2 and 3  
D 2 and 4

10 The following experiment was carried out.

1. Haploid cells, containing three chromosomes each, were grown in a medium containing radioactive  $^{15}\text{N}$ , so that all the DNA was labelled.
2. Cells in early interphase were then transferred to a medium with normal  $^{14}\text{N}$ .
3. A single cell was immediately isolated and allowed to divide once. When the two daughter cells reached the next metaphase, they were fixed and their three chromosomes were inspected for radioactivity.

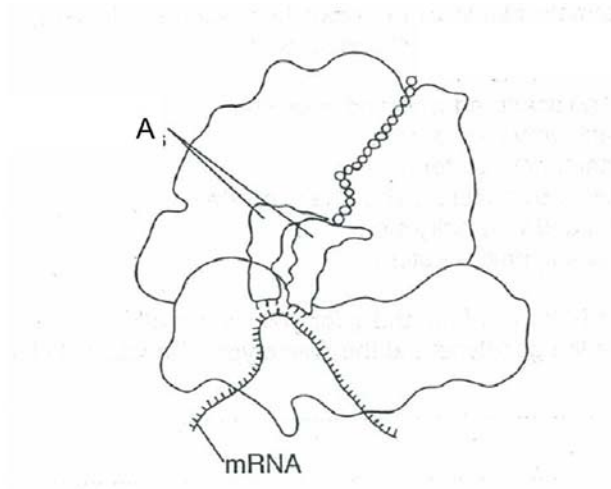
Which diagram represents the distribution of radioactivity at metaphase in the two daughter cells?

key  = normal chromatid  = radioactive chromatid





11 The diagram shows a process occurring at the rough endoplasmic reticulum.



Which of the following is true of molecule A?

- A** Its bases are complementary to those of the mRNA strand.
- B** It is synthesized by transcription of the genes in the nucleolus.
- C** It fits into another enzyme which has an active site for another molecule.
- D** There are less than 20 different types of them in the cytosol.

**12** Ribonuclease is an enzyme that digests RNA.

The mRNA of the gene coding for a functional ribonuclease, for the first 15 nucleotides, has the following sequence.

AUGAAUGAAACUGCU

A **non-functional** molecule of ribonuclease has been isolated. The first three amino acids of this non-functional molecule of ribonuclease are:

met – lys – leu –

The genetic code table is shown below.

first position	second position				third position
	U	C	A	G	
U	phe phe leu leu	ser ser ser ser	tyr tyr STOP STOP	cys cys STOP trp	U C A G
C	leu leu leu leu	pro pro pro pro	his his gln gln	arg arg arg arg	U C A G
A	ile ile ile met	thr thr thr thr	asn asn lys lys	ser ser arg arg	U C A G
G	val val val val	ala ala ala ala	asp asp glu glu	gly gly gly gly	U C A G

Which event occurs to explain the information given above?

- A** A single base deletion mutation results in a frameshift mutation.
- B** A silent mutation occurs, but due to the degeneracy of genetic code, it results in different amino acids coded despite using the same mRNA codons.
- C** Translation started with ribosome binding to the second START codon.
- D** Two tRNAs have carried a different amino acid.

- 13** A strain of mice has been genetically modified so that they display symptoms of a recessive sex-linked trait that causes death before the mice are able to breed.

In these mice, 33% of the alleles of this gene were recessive.

In multiple crossings of carrier females and normal males, it was found that 50% of the males died, but no females.

What percentage of the alleles of this gene in the surviving offspring would be recessive?

- A** 0%
- B** 17%
- C** 20%
- D** 33%

- 14** In mice, the gene loci for mice coat pattern and whisker curvature are located on different chromosomes. For the gene locus controlling coat pattern, the allele for 'dappled' coat (**D**) is dominant to the allele for 'plain' coat (**d**). For the gene locus controlling whisker curvature, the allele for 'straight' whiskers (**W**) is dominant to the allele for 'bent' whiskers (**w**).

A male mouse with plain coat and bent whiskers was mated to a female dappled mouse with straight whiskers. The phenotypes and number of offspring mice having each phenotype was counted and recorded in the table below.

Phenotype	Number of offspring
dappled, straight whiskers female	52
dappled, straight whiskers male	39
plain, straight whiskers female	44
plain, straight whiskers male	48

In a separate cross, a female mouse with plain coat and bent whiskers was mated to a male dappled mouse with straight whiskers. The phenotypes and number of offspring mice having each phenotype was counted and recorded in the table below.

Phenotype	Number of offspring
dappled, straight whiskers female	24
plain, straight whiskers male	31

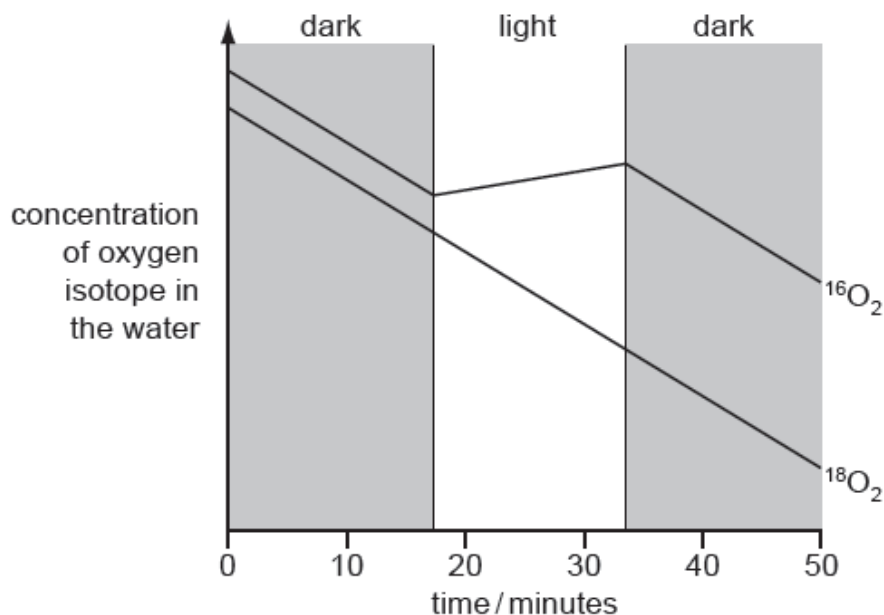
If the female parental mice from the first cross was mated to the male parental mice from the second cross and 96 offspring was produced, how many offspring mice would be expected to have dappled coat and straight whiskers?

- A** 24
- B** 72
- C** 96
- D** None

- 15** Duchenne muscular dystrophy is a condition characterised by progressive muscle wasting. It is caused by a recessive mutation in the DMD gene, located on the X chromosome. The DMD gene codes for a protein known as dystrophin, which, in healthy individuals, prevents damage and weakening of the muscle fibres.

Which statement explains why **not** all affected males inherit the mutation from their mother?

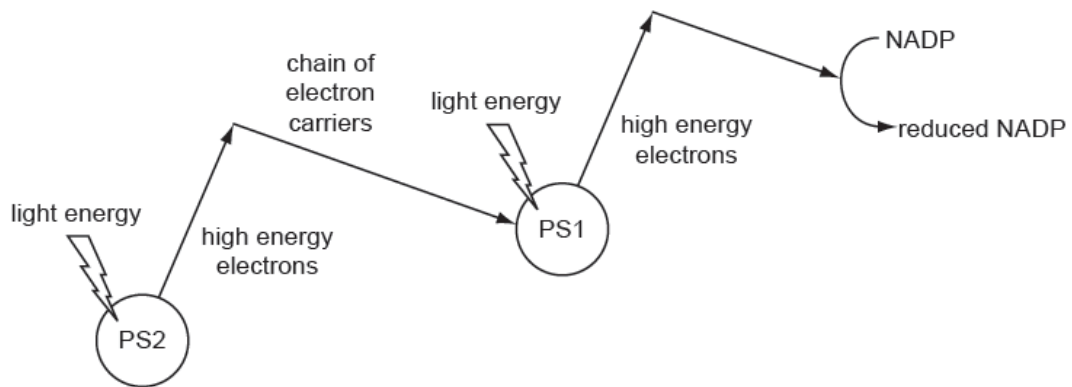
- A** Some affected males inherit the mutation from their father, who has inherited the mutation from a carrier mother.
  - B** Some affected males inherit the normal allele of a carrier mother but synthesize dystrophin molecules that have an altered tertiary structure.
  - C** Some males with mothers who are not carriers of the mutated allele are affected as a result of a new mutation in the DMD gene.
  - D** The father contributes a normal allele which masks the recessive allele from the mother.
- 16** The common isotope of oxygen is  $^{16}\text{O}$ .  $^{16}\text{O}$  and  $^{18}\text{O}$  is bubbled through a suspension of algae for a limited period. After this, the concentration of these two isotopes of oxygen was monitored for the next 50 minutes whilst the algae were subjected to periods of light and dark. The results are shown in the diagram.



What is the best explanation for these results?

- A**  $^{16}\text{O}_2$  was being absorbed at different rates in light and dark.
- B** The algae can distinguish chemically between the two isotopes.
- C**  $^{16}\text{O}_2$  was being produced in photosynthesis but was not being absorbed in respiration.
- D** The algae produce oxygen from the water which is used in photosynthesis, but only in the light.

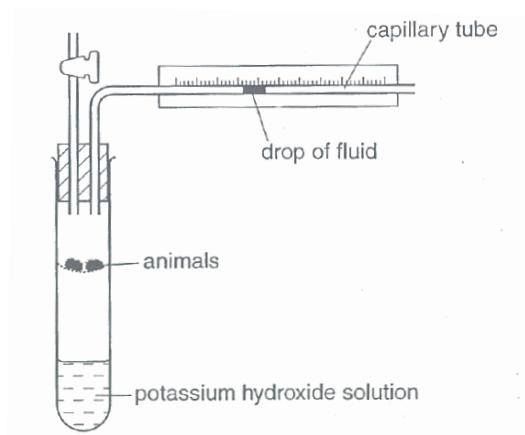
17 The diagram shows some of the processes in the light-dependent stage of photosynthesis.



Which of the following would stop electrons from being transferred down the electron transport chain?

- A Proton pump coupled to electron carriers were inhibited.
- B Reduced NAD unable to transfer electrons to electron transport chain.
- C Thylakoid membrane becomes 'leaky'.
- D Bleaching of chlorophyll.

18 A respirometer was set up to investigate the rate of respiration as shown below.



At the end of the experiment, it was found that the drop of fluid moved to the left significantly more than expected. Mitochondria from the animals were isolated to investigate the cause.

Which of the following could be a possible observation made about the mitochondria which best explains the results?

- A Cytochrome b in the electron transport chain was non-functional.
- B Higher than normal amount of cristae observed.
- C Proton pump is decoupled with the electron carriers.
- D ATP synthase is hyperactive.

- 19** The enzyme phosphofructokinase is involved in the phosphorylation of hexose phosphate sugars during glycolysis. It is involved in the control of the rate of glycolysis, and thus respiration, by end-product inhibition.

Deduce which of the following is a description of this enzyme.

	shape of binding site(s)	substrate	products
<b>A</b>	no allosteric site; active site is complementary to ATP and hexose	hexose	hexose phosphate
<b>B</b>	allosteric site is complementary to glucose; active site is complementary to hexose phosphate	hexose phosphate	hexose phosphate
<b>C</b>	allosteric site is complementary to ATP; active site is complementary to ATP and hexose phosphate	hexose phosphate	hexose biphosphate
<b>D</b>	no allosteric site; active site is complementary to hexose biphosphate	hexose biphosphate	Two triose phosphate

- 20** What are vestigial structures?

- A** Their presence cannot be explained by evolution.
- B** They provide evidence of convergent evolution.
- C** They help establish patterns of common ancestry.
- D** They affect survivorship or reproduction.

- 21** The Galapagos Islands are a group of volcanic islands in the eastern Pacific Ocean, about 1000km from South America. Thirteen species of finch are found on the islands. The finches resemble each other closely but differ in their feeding habits and in the shape of their beaks.

Assuming that an ancestral stock of finches came from the mainland, what is the most likely explanation for the existence of similar but distinct species of Galapagos finches?

- A** Individual finches developed different kinds of beak in order to feed on different kinds of food.
- B** Individual finches underwent convergent evolution to produce very similar species.
- C** The finches evolved separately according to the habitat in which they settled.
- D** The finches from the mainland bred with a resident population of a related species and produced new genotypes.

- 22** The table shows equivalent amino acid sequences of part of a protein from four species of animal.

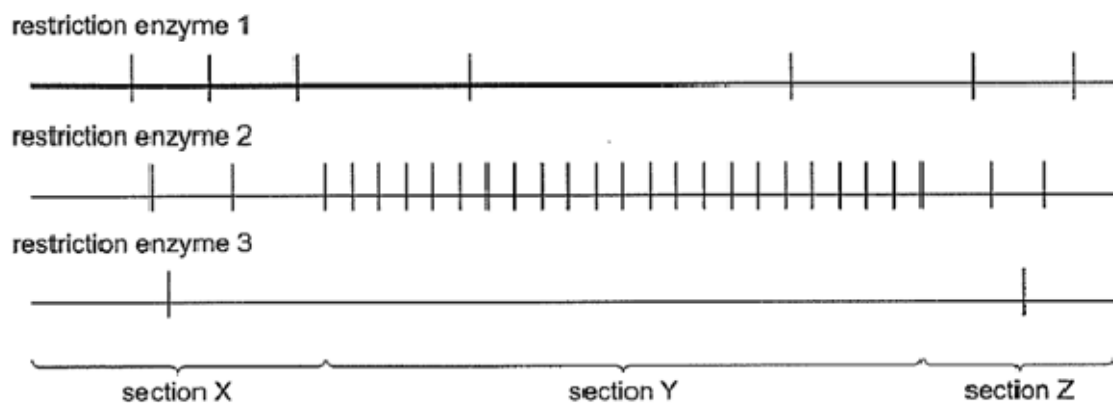
Animal	Amino acid sequence							
<b>1</b>	trp	met	val	glu	cys	asp	arg	leu
<b>2</b>	trp	val	met	glu	cys	asp	asp	ala
<b>3</b>	trp	val	val	glu	cys	asp	arg	leu
<b>4</b>	phe	trp	val	gly	cys	arg	asp	leu

Using the technique of molecular analysis, which pair of animals share the most recent common ancestor and which pair is least closely related?

	Most closely related pair	Least closely related pair
<b>A</b>	1 and 2	1 and 4
<b>B</b>	1 and 3	1 and 4
<b>C</b>	1 and 3	2 and 4
<b>D</b>	2 and 3	3 and 4

- 23** A linear fragment of DNA made up of three sections, X, Y and Z, was cut using three different restriction enzymes.

The vertical lines on the diagrams show the sites at which the different restriction enzymes cut this DNA fragment.

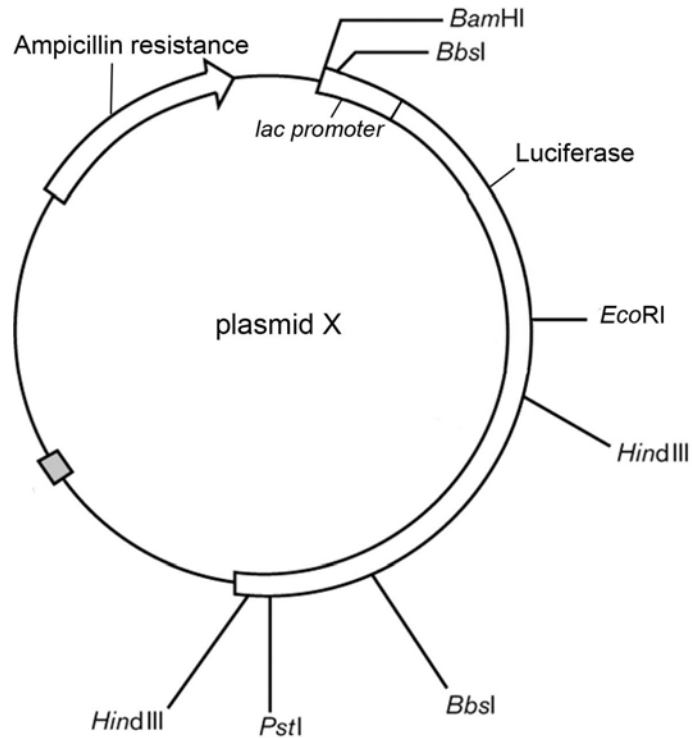


Which conclusion is correct?

- A** Isolation of section Y requires the use of another restriction enzyme.
- B** Sections Y and Z are composed of many repeating sequences of DNA.
- C** Digestion with restriction enzymes 1 and 3 together will produce nine separate DNA fragments.
- D** Restriction enzymes 1, 2 and 3 bind to DNA via complementary base pairing.



- 24** Plasmid **X** can serve as a vector for the insertion of genes to be cloned. Luciferase will allow the bacteria to emit light in presence of luciferin as a substrate.



Which of the following options will allow the selection of the colonies containing the recombinant form of plasmid **X**?

	Selection medium	Phenotype of colonies that contain the inserted gene
<b>A</b>	Containing ampicillin and lactose	White colonies
<b>B</b>	Containing ampicillin and luciferin	Colonies that emit light
<b>C</b>	Containing ampicillin, lactose and luciferin	White colonies
<b>D</b>	Containing ampicillin, lactose and luciferin	Colonies that emit light

- 25** Which of the following sets of primers can be used in the PCR for the amplification of the following DNA sequence?

The dashed lines in the template sequence stand for a long sequence of bases that is to be amplified.

**Template**

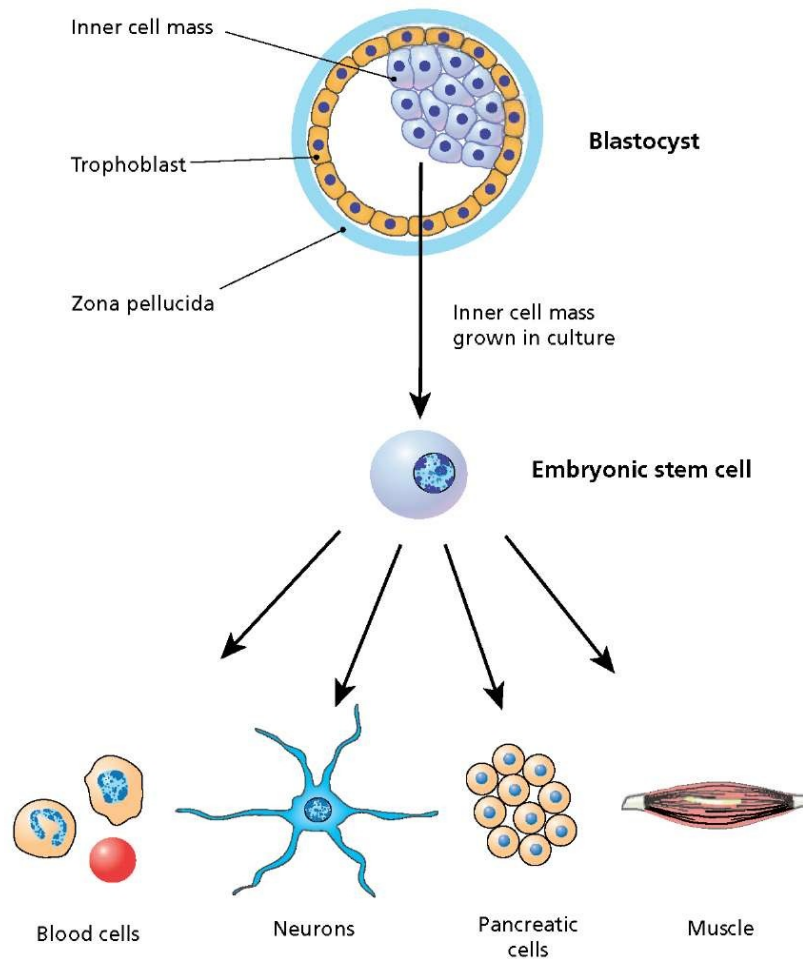
5' ATTCGGACTTG - - - - - GTCCAGCTAGAGG 3'  
3' TAAGCCTGAAC - - - - - CAGGTCGATCTCC 5'

- A** 5' GTCCAGC 3' & 5' CCTGAAC 3'  
**B** 5' ATTCGGA 3' & 3' GATCTCC 5'  
**C** 5' GGAAGTTG 3' & 5' GCTGGAC 3'  
**D** 5' AUUCGGA 3' & 3' GAUCUCC 5'
- 26** Identification of individuals predisposed to a disease is done by performing DNA analysis techniques such as Polymerase Chain Reaction and gene probing after Southern Blotting. PCR requires the presence of primers for amplification of target gene while a gene probe is used to identify gene of interest.

Which of following comparison of gene probe and primers are false?

- 1** Both are short and single stranded nucleic acids.
  - 2** Both have sequences that are complementary to 3' end of the target gene.
  - 3** Both can only be made up of deoxyribonucleotides.
  - 4** Both must be radioactively-labelled to be identified by autoradiography.
- A** 1 and 2  
**B** 2 and 4  
**C** 3 and 4  
**D** 2, 3 and 4

- 27 Which of the following features of the embryonic stem cells and specialized cells shown in the diagram are true?



	Embryonic stem cells	Specialized cells
<b>A</b>	Embryonic stem cells display greater plasticity when grown in culture than when in blastocyst.	The blood cells are genetically different from the embryonic stem cells because different genes are expressed.
<b>B</b>	Embryonic stem cells are pluripotent and are capable of transdifferentiating (conversion of one differentiated cell type into another) into many different cell types.	The pancreatic cells are genetically identical to the embryonic stem cells but with a different set of genes expressed.
<b>C</b>	Embryonic stem cells are multipotent and are capable of differentiating into limited range of cell types.	The blood cells are genetically different from the embryonic stem cells because different genes are expressed.
<b>D</b>	Embryonic stem cells are pluripotent and are capable of differentiating into many different cells types.	The pancreatic cells are genetically identical to the embryonic stem cells but with a different set of genes expressed.

- 28** Induced pluripotent stem cells are stem cells that can be generated directly from adult stem cells under the influence of molecular signals.

Which of the following statements is/are true?

- 1** An induced pluripotent stem cell can become any cell of the developed organism, but cannot produce trophoblast and placenta to support organismal development, whereas a totipotent stem cell can produce a whole organism including extraembryonic tissue.
  - 2** A totipotent stem cell and induced pluripotent stem cell can give rise to any cell.
  - 3** An induced pluripotent stem cell can give rise to a single cell lineage whereas a totipotent stem cell can give rise to multiple, but limited number of cell lineages.
  - 4** A totipotent stem cell can become any cell of a developed organism, but cannot produce trophoblast and placenta to support organismal development, whereas an induced pluripotent stem cell can produce a whole organism including extraembryonic tissue.
  - 5** Induced pluripotent stem cells have the same developmental potential as embryonic stem cells.
- A** 1 only
- B** 1 and 5 only
- C** 2, 3 and 4 only
- D** 3, 4 and 5 only

**29** One type of genetically modified corn has

- a gene for the production of Bt toxin which protects the plant against a specific insect;
- a 'pat'-gene for tolerance to the herbicide 'Basta'. This gene is used to select plants with the Bt toxin gene;
- an 'amp'- gene which was introduced in the plant together with the Bt toxin gene. This gene gives resistance to the antibiotic ampicillin.

There is concern that the 'amp' gene may transfer to enterobacteria in the human intestine during nucleic acid digestion making treatment with ampicillin ineffective for diseases caused by enterobacteria.

Which statement explains why the transfer of this gene from the plant to bacteria in the human intestine is unlikely?

- A** An origin of replication and appropriate prokaryotic promoters are required for the 'amp' gene to be expressed.
- B** Bacteria cannot take up any DNA released during digestion of the plants by human nuclease enzymes, without the presence of a vector.
- C** 50% of the enterobacteria isolated from humans are 'amp' resistant.
- D** All plant DNA is digested and destroyed in the human intestine during digestion of plant cells by enzymes including human nuclease enzymes.

**30** Which of the following is not a valid concern about the use of Bt corn?

- A** Affecting non-target insects
- B** The decreased usage of herbicide
- C** Pollens of the Bt corns are wind borne
- D** Possible allergic reaction when consumed by human