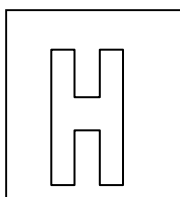


Candidate Name: _____

Class Adm No

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2017 Promotional Examination II

Pre-university 2

Biology Higher 1

8875/01

18 September 2017

1 hour

Additional Materials: Optical answer sheet

READ THESE INSTRUCTIONS FIRST

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

Write your name, Adm No. and class on all the papers you hand in.

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

Paper 1

There are **thirty** 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.

Calculators may be used.

This question paper consists of 19 printed pages.

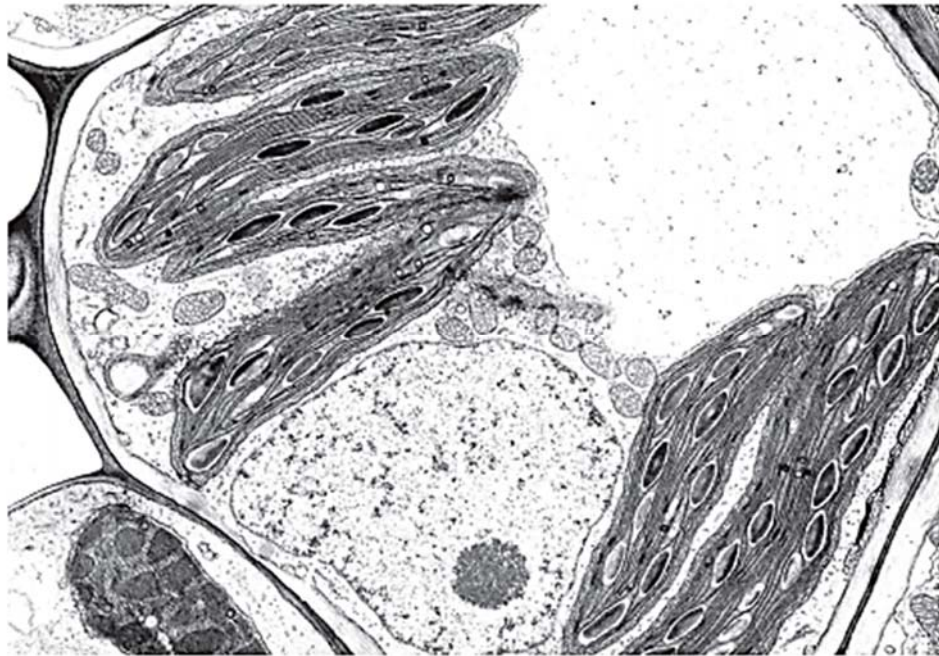
[Turn over

1. A student was tasked to observe a root hair cell using an electron microscope. He was asked to confirm the presence or absence of the cellular structures within the root hair cell.

Which option best describes his observations?

	Structure with a double membrane, inside which are stacks of flattened membranes	Area near the nucleus containing a pair of structures that are composed of microtubules	Structure with a double membrane with inner membrane infolded	Network of tubular-shaped membranous sacs with no ribosomes visible on outer surface of membranes
A	Present	Present	Present	Absent
B	Present	Absent	Absent	Present
C	Absent	Present	Present	Present
D	Absent	Absent	Present	Present

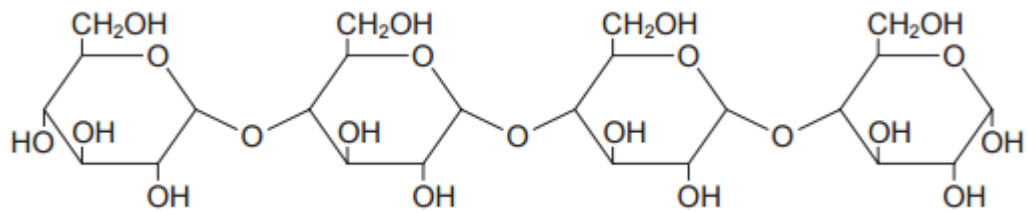
2. The magnification of this electron micrograph is 5000X.



What is the actual size of the nucleolus?

- A** 0.2 μm
- B** 0.5 μm
- C** 2 μm
- D** 20 μm

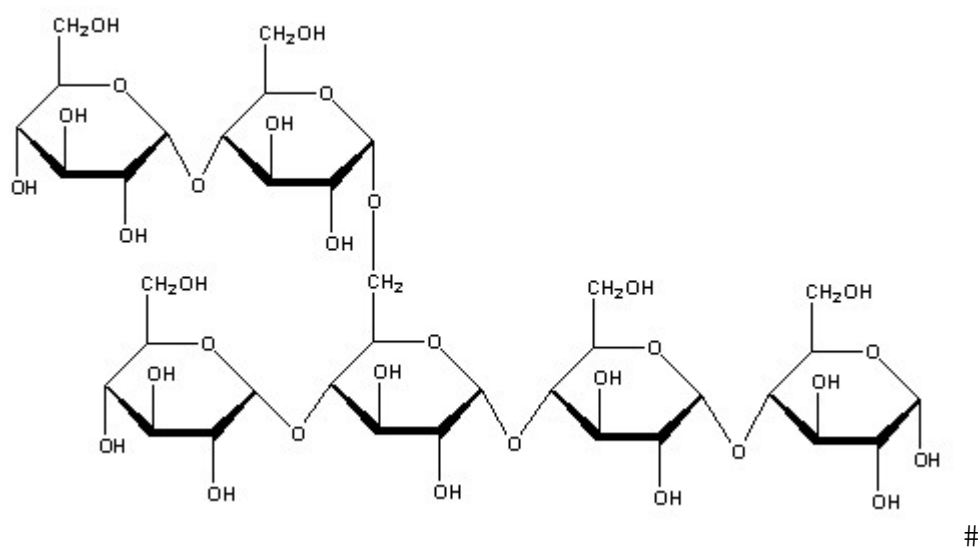
3. The diagram shows a section of the starch molecule.



Which of the following procedures could be performed in order to test for the presence of the reducing sugars in amylose?

- I add amylase and then heat with Benedict's reagent
 - II add maltase and then heat with Benedict's reagent
 - III boil with ethanol and then heat with Benedict's reagent
 - IV boil with hydrochloric acid, neutralise and then heat with Benedict's reagent
- A** I and IV only
B II and IV only
C II and III only
D I, II and IV only

4. The diagram shows part of a polysaccharide.

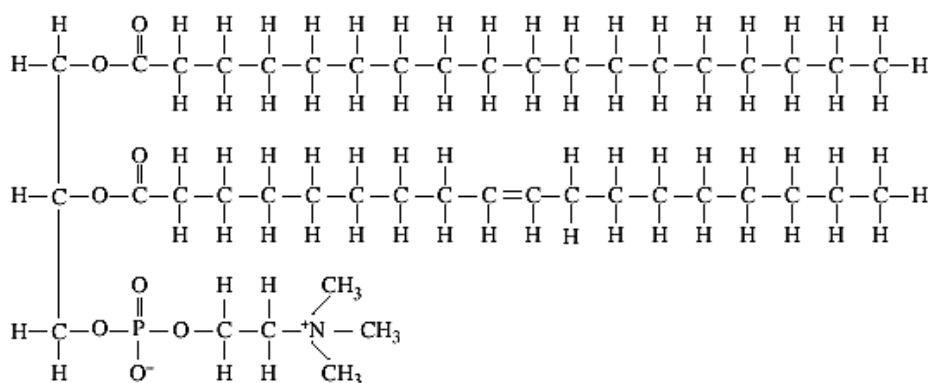


If all the glycosidic bonds in this molecule are hydrolysed, how many water molecules will be used and how many separate glucose molecules will be produced?

#

	Number of water molecules used	Number of glucose molecules produced
A	1	0
B	4	5
C	4	6
D	5	6

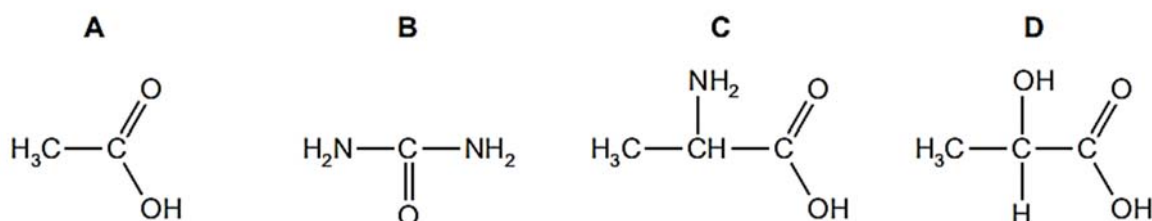
5. The diagram shows a lipid molecule.



Which option best describes the products of hydrolysis?

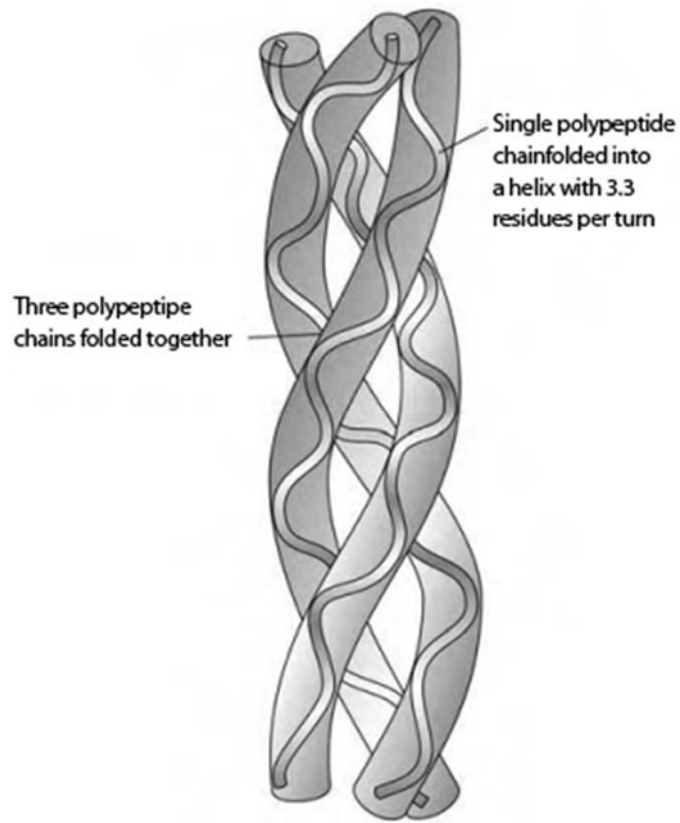
- A** One molecule of glycerol and one molecule of saturated fatty acid
B One molecule of glycerol and two molecules of saturated fatty acid
C One molecule of glycerol, an unsaturated fatty acid molecule and one molecule of saturated fatty acid
D One molecule of glycerol and two unsaturated fatty acid molecules
6. The diagram shows different biomolecules present in a plant cell.

Which molecule is an essential component of Rubisco that are necessary for photosynthesis?



7. How many different types of penta-peptides could be formed using the 20 commonly known amino acids?
- A** 5⁴
B 20⁵
C 5²⁰
D 20⁴

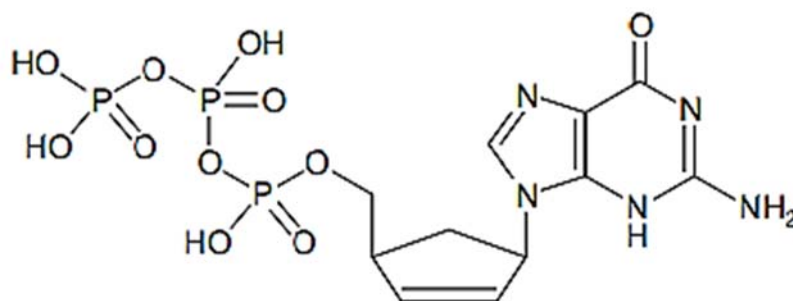
8. The diagram shows a fibrous protein that is commonly found in connective tissues of mammals.



Which statement best describes the fibrous protein?

- A** The small size of the R-groups of amino acid residues in each chain allows the chains to come close together to form hydrogen bonds.
- B** Hydroxyl groups projecting in all directions from each chain allow hydrogen bonds to form and result in bundling of the chains to form microfibrils.
- C** Double bonds present in each chain allow the chains to adopt helical structure.
- D** Complementary base pairing occurs through the formation of hydrogen bonds between chains.

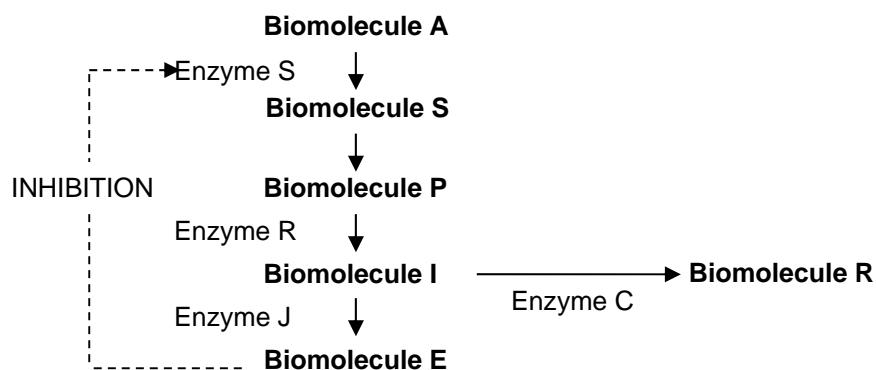
9. Which statement correctly describes the globular protein that is responsible for the oxygen-carrying capacity of the red blood cells?
- A The protein comprises four polypeptide chains and each polypeptide chain contains a prosthetic group of amino acids surrounding an iron ion.
 - B The protein comprises four polypeptide chains with non-polar R groups of the amino acid residues projected towards the centre within each subunit.
 - C The protein can carry a total of four oxygen atoms.
 - D The iron ion in the prosthetic group of each subunit combines irreversibly with oxygen.
10. The diagram shows the molecular structure of compound X that can inhibit RNA polymerase. It is an analogue of a naturally occurring nucleic acid monomer.



Which statement is true about compound X?

- A Compound X is a non-competitive inhibitor.
- B Increasing concentration of the naturally occurring monomer cannot reverse the inhibition by compound X.
- C The naturally occurring monomer contains a purine base.
- D The naturally occurring monomer contains a pyrimidine base.

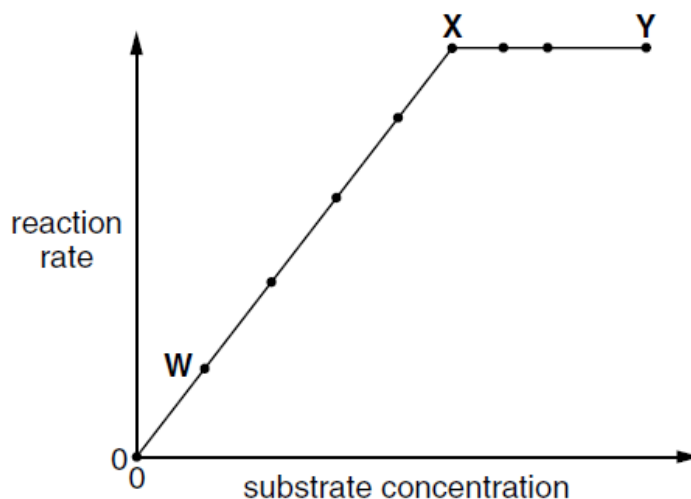
11. A hypothetical metabolic pathway is shown in figure below.



Which changes in enzyme activity will result in the greatest increase in the yield of Biomolecule R?

	Enzyme	Change in activity	Enzyme	Change in activity
A	S	Decrease	J	Decrease
B	C	Decrease	R	Increase
C	J	Increase	C	Increase
D	R	Increase	J	Decrease

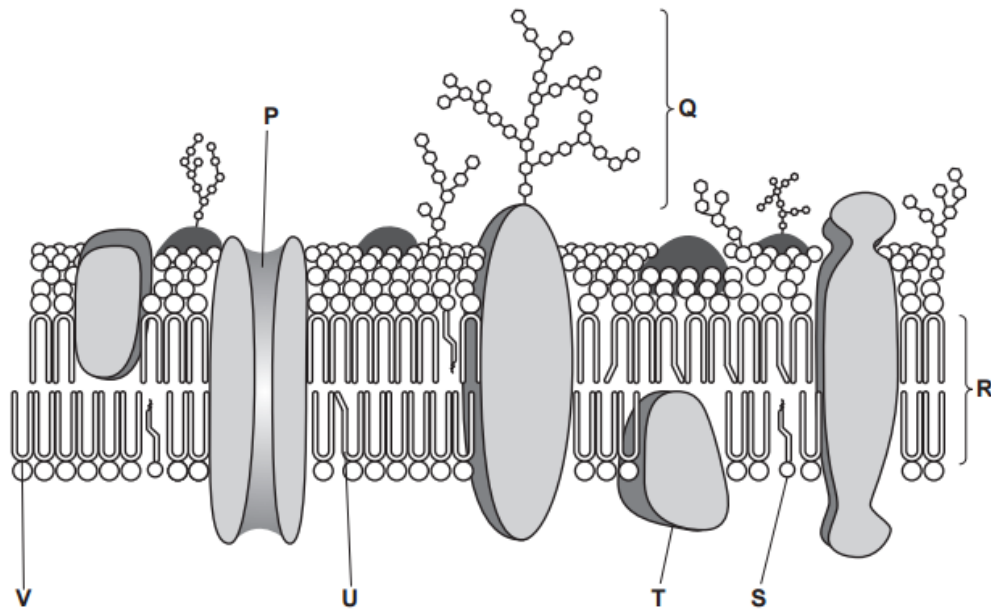
12. The graph shows the effect of substrate concentration on the rate of decomposition of hydrogen peroxide. The catalase concentration is keep constant.



Which statement about the graph is correct?

- A Between X and Y, the number of enzyme molecules is limiting.
- B Between W and X, the number of enzyme molecules is limiting.
- C Between X and Y, the number of substrate molecules is limiting.
- D Between X and Y, the product concentration remains the same.

13. The diagram shows a section through a cell surface membrane from a pancreatic beta cell.



The cell surface membrane of a phagocytic cell has a higher fluidity compared to the pancreatic beta cell.

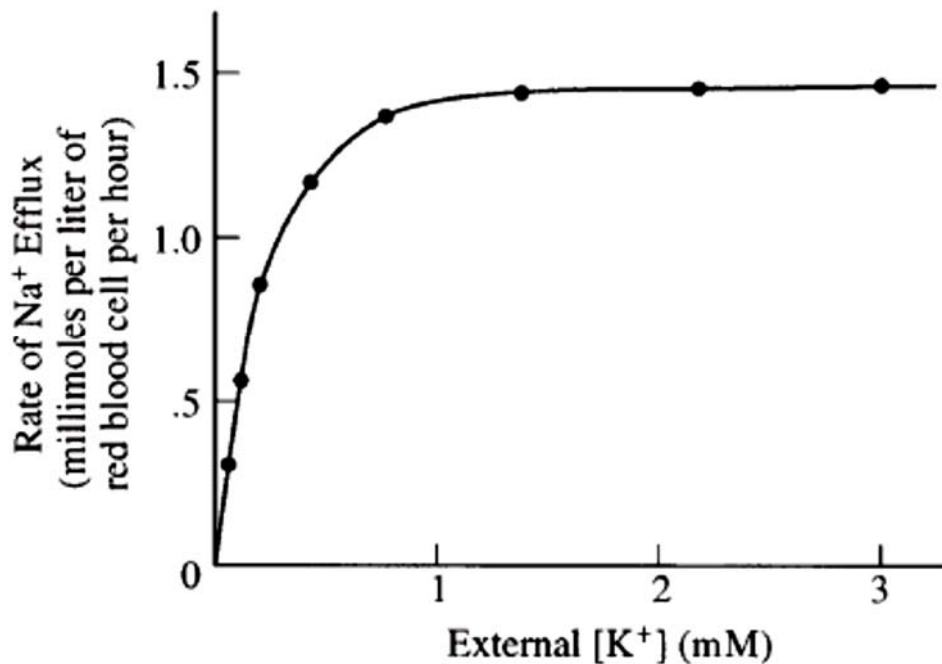
What is the most likely difference that will be observed between a phagocytic cell and pancreatic beta cell?

- A** Higher proportion of component **U** and a lower proportion of component **V**
- B** Higher proportion of component **S** and a higher proportion of component **T**
- C** An increased distance across **R** and a higher proportion of component **V**
- D** Complete absence of component **Q** and a higher proportion of component **P**

14. A student wanted to investigate the rate of efflux of sodium ions in mammalian cells. A freshly isolated population of mammalian cells was rapidly loaded with radioactive sodium and then subdivided into equally sized samples.

The samples were incubated in isotonic solution containing 10mM sodium chloride and varying concentrations of potassium chloride. The other variables were kept constant throughout this experiment.

The graph depicts the relationship between the rates at which sodium ion left the cells and the extracellular potassium ion concentration.



Which statement best accounts for the plateau in the rate of sodium ion efflux at about 1.0 mM external potassium ion concentration?

- A Potassium ions occupy all the potassium-binding sites on the sodium-potassium pumps.
- B Potassium ions compete with sodium ions for transport.
- C Potassium ions make the membrane impermeable to sodium.
- D Potassium ions bind ATP and thereby lowering the substrate concentration.

15. The table below shows the number of chromosomes in each gamete after meiosis and cytokinesis have taken place in two different human germ cells.

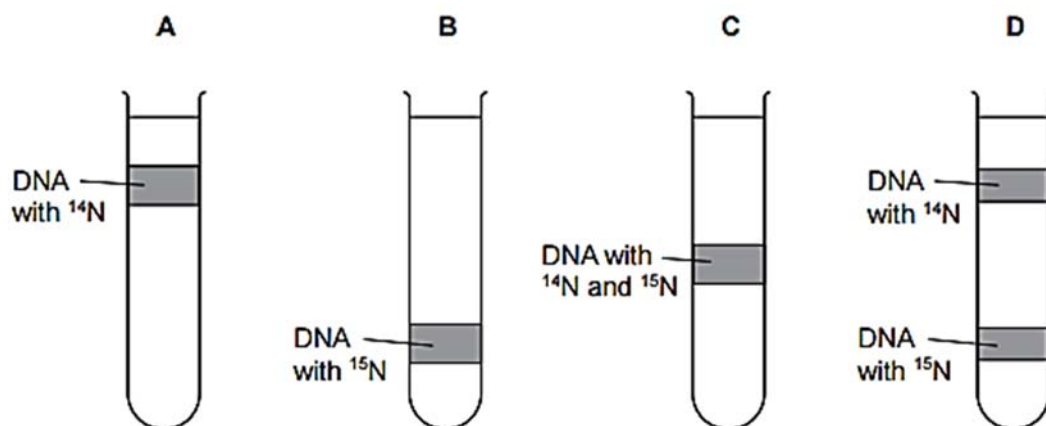
Gametes I-IV were formed from human germ cell **X**, whereas gametes V - VIII were formed from human germ cell **Y**.

Human germ cell X		Human germ cell Y	
Gametes	Number of chromosomes	Gametes	Number of chromosomes
I	22	V	23
II	24	VI	23
III	24	VII	22
IV	22	VIII	24

Which description is consistent with the data shown in the table above?

- A** Non-disjunction occurs for all 23 pairs of homologous chromosomes in germ cell **X**.
B Non-disjunction occurs for a pair of chromatids during anaphase II in germ cell **X**.
C Centromere of a pair of chromatids failed to divide during anaphase II in germ cell **Y**.
D A pair of homologous chromosomes fail to separate during anaphase I in germ cell **Y**.
16. *Escherichia coli* were originally grown for many generations in a medium containing a heavy isotope of nitrogen, ^{15}N . They were then transferred to a medium containing the light isotope of nitrogen, ^{14}N .

Which option shows the correct predicted results after the cells are allowed to divide once in the medium with the light isotope?



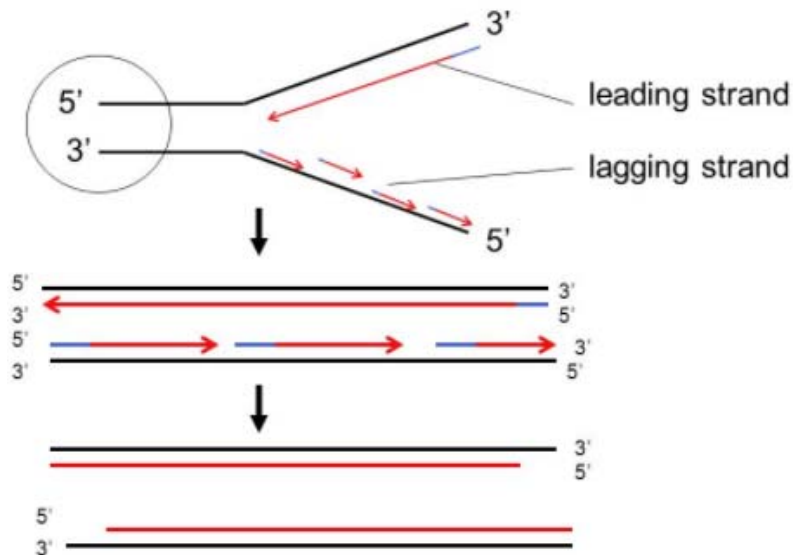
17. The following events occur during transcription.

- I Bonds break between complementary bases.
- II Bonds form between complementary bases.
- III Sugar-phosphate bonds form.
- IV Free ribonucleotides pair with complementary nucleotides.

Which events would have occurred twice before the mRNA leaves the nucleus?

- A I and II only
- B I, III and IV only
- C II, III and IV only
- D All of the above

18. The diagram illustrates the end-replication problem during DNA replication.



Which statements are **false** about end-replication problem of DNA?

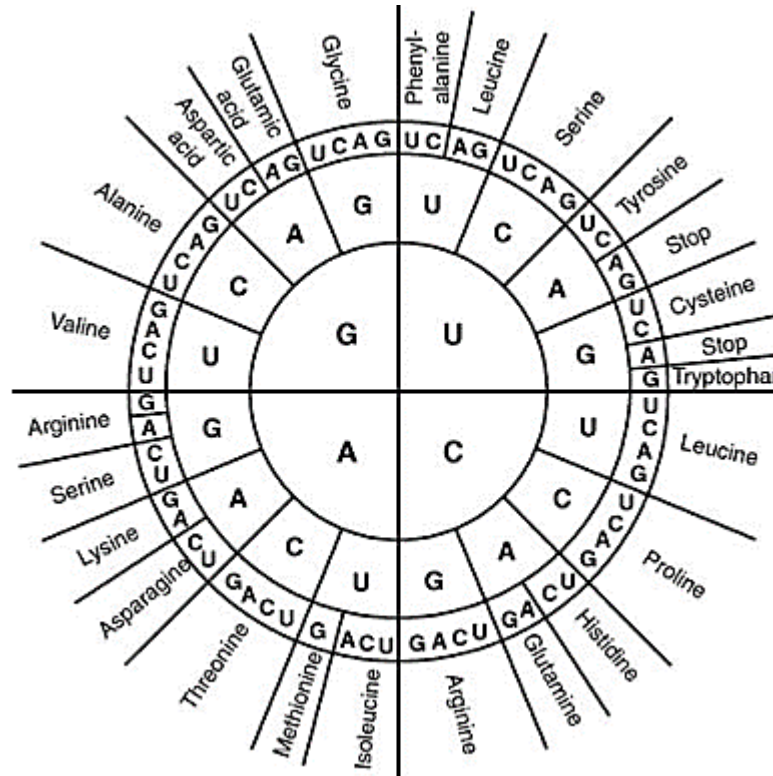
- I When a linear DNA molecule replicates, a gap is left at the 3' end of each new strand because DNA polymerase can only add nucleotides to a 5' end.
- II Repeated rounds of replication produce shorter and shorter DNA molecules.
- III Telomerase prevents the end-replication problem from occurring.
- IV Prokaryotes do not have the end-replication problem.

- A I and II only
- B I and III only
- C II and III only
- D III and IV only

19. Five different amino acids form the following sequence in a section of the polypeptide chain X:

Aspartic acid--Histidine--Glutamine--Cysteine--Histidine--Lysine--Aspartic acid

The diagram below shows the mRNA codon code.



What is the DNA base sequences in the template strand of the gene coding for the given section of X?

- A** 3' CTAGTGGTTACAGTGTTCCTA 5'
B 3' CTAGTGGTTACAGTGTTCCTA 5'
C 3' CTAGTGGTTTCTGTGTTCCTA 5'
D 3' CTAGTGGTTACAGTGTTCCTT 5'

20. The sequence below shows an mRNA segment produced from a gene section bearing one point mutation.

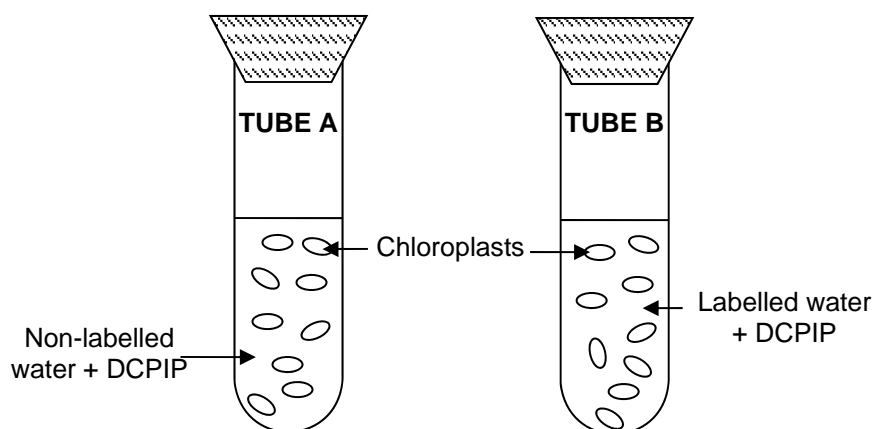
5'-ACCGUAGCAGCU-3'

What is the sequence of the corresponding DNA coding strand prior to the mutation?

- A 5'-AGCTGCTACGGT-3'
 B 5'-ACCGTAGCAGCT-3'
 C 5'-ACCGGAGCAGCT-3'
 D 5'-AGCTGCTCCGGT-3'
21. The experimental setup below is used to investigate the light-dependent reaction of photosynthesis. Chloroplasts are placed in test tubes containing ^{18}O -labeled water (H_2^{18}O) and non-labeled water (H_2^{16}O) respectively.

A few drops of DCPIP, a proton acceptor, are added to each test-tube. DCPIP will decolourise when it is reduced. This colourless DCPIP can be reoxidised to blue.

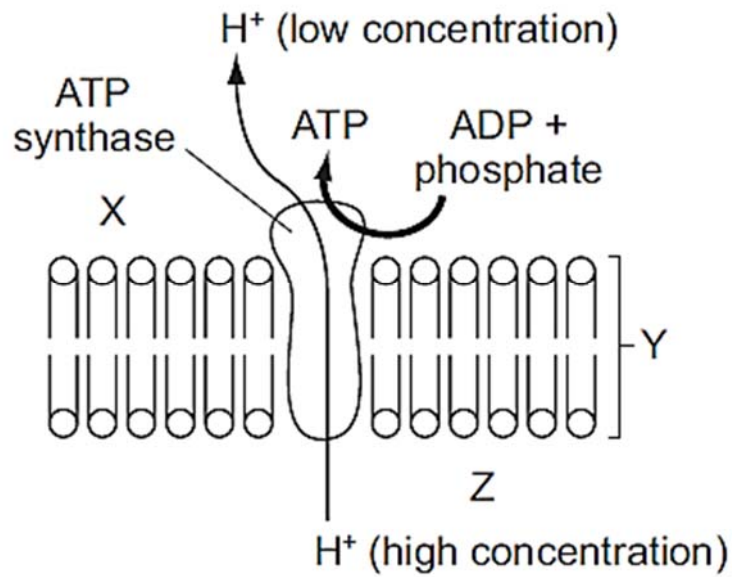
Both test tubes are exposed to light for 20 minutes.



Which row correctly identifies the results of the two test tubes at the end of the experiment?

	TUBE A		TUBE B	
	Gas evolved	DCPIP colour	Gas evolved	DCPIP colour
A	$^{16}\text{O}_2$	Colourless	$^{18}\text{O}_2$	Colourless
B	$^{16}\text{O}_2$	Blue	$^{16}\text{O}_2$	Colourless
C	$^{16}\text{O}_2$	Colourless	$^{16}\text{O}_2$	Colourless
D	$^{16}\text{O}_2$	Blue	$^{18}\text{O}_2$	Blue

22. The diagram shows a membrane in a eukaryotic cell.



Which statement would be true of the diagram?

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

23. A student set up six different test tubes containing animal tissue preparation to investigate different aspects of respiration. The test tubes are then incubated at optimal conditions.

The set-ups are shown below.

Tube	Contents
1	Glucose + homogenised cells
2	Glucose + mitochondria
3	Glucose + cytoplasm lacking organelles
4	Pyruvate + homogenised cells
5	Pyruvate + mitochondria
6	Pyruvate + cytoplasm lacking organelles

Which test tubes would produce carbon dioxide?

- A** 1, 2 and 3 only
B 1, 4 and 5 only
C 2, 4 and 6 only
D 4, 5 and 6 only
24. In *Drosophila melanogaster*, the loci for the recessive allele for curly wings and the recessive allele for hairy bristles are located on different chromosomes.

A pure-breeding fly with wild-type wings and wild-type bristles is crossed with a fly with curly wings and hairy bristles. The F₁ generation all had wild-type wings and wild-type bristles. Two of the F₁ were crossed and produced 416 offspring.

Which row correctly identifies the numbers of each phenotype in the F₂ generation?

	Phenotype			
	Wild-type wings Wild-type bristles	Wild-type wings Hairy bristles	Curly wings Wild-type bristles	Curly wings Hairy bristles
A	226	46	44	100
B	312	0	0	104
C	338	0	0	78
D	232	78	82	24

25. Mr and Mrs Li, who are homozygous for blood type A and blood type B respectively, have a son with blood group AB and haemophilia. Neither parent has haemophilia.

What is the probability that the second child of these parents will be a girl with blood group AB and no haemophilia?

- A 1
- B 1 in 2
- C 1 in 4
- D 1 in 8

26. Which statement(s) correctly describe(s) Darwinian evolutionary theory?

- I Advantageous traits acquired during the lifetime of an individual is likely to be inherited.
- II In competition for survival, the more aggressive animals always survive better.
- III Species perfectly adapted to a stable environment will continue to evolve.
- IV Variation between individuals of a species is essential for evolutionary change.

- A IV only
- B II and III only
- C III and IV only
- D I, II and IV only

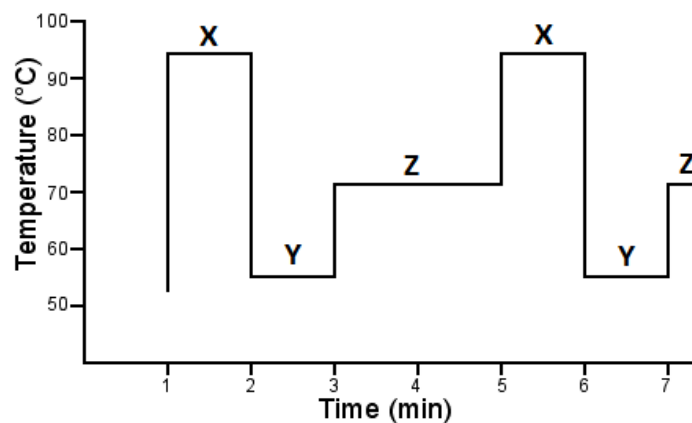
27. Two areas of molecular biology that have received considerable attention in evolutionary studies are the genetic code and cytochrome C. Cytochrome C is an essential component of all respiratory electron transport chains.

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

- I The almost universal nature of the genetic code is a result of evolutionary convergence from multiple lineages.
- II The sequence of amino acids in cytochrome C is similar in organisms that are from similar environments or with similar metabolic demands.
- III Majority of living organisms on earth have the same, or similar, amino acid sequences for cytochrome C.
- IV 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 I and II only
- B II and III only
- C III and IV only
- D I, III and IV only

28. The diagram below shows the changes in temperature in a thermal cycler over time during polymerase chain reaction.



Which statements are true of the graph shown above?

- I Elongation of new strands occurs during Y.
- II Double stranded DNA template denatures into single strands during X.
- III Taq polymerase functions optimally at Z.
- IV DNA primers are annealed to the DNA template during X.

- A I and IV only
- B II and III only
- C II and IV only
- D I, II and III only

29. The human genome project (HGP) was successfully completed on 14 April 2003. HGP was an international scientific research project with the goal of determining the sequence of nucleotide base pairs that make up human DNA, and of identifying and mapping all of the genes of the human genome from both a physical and a functional standpoint.

Several ethical concerns on HGP were raised by the public and scientific community

Which statement is **not** an ethical concern of the HGP?

- A Anxiety may arise in patients when genetic testing is conducted for diseases with no medical treatment currently available.
 - B If genetic sequences are patented, it will increase the cost of genetic research and treatment.
 - C Mankind is tampering with nature when the human genome is modified.
 - D The use of genetic test results may lead to discrimination of individuals by insurance companies and employers.
30. Stem cells are found in many tissues that require frequent tissue replacement such as the skin, the intestine or the blood.

However, within their own environments, a bone marrow cell cannot be induced to produce a skin cell and a skin cell cannot be induced to produce a bone marrow cell.

Which statement explains this?

- A Different stem cells have only the genes required for their particular cell line.
- B Genes not required for a particular cell line are methylated.
- C Genes not required for a particular cell line are removed using restriction enzymes.
- D mRNA that is not required for a particular cell line is destroyed.

End of Paper

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