TEMASEK JUNIOR COLLEGE
PROMOTIONAL EXAMINATION
JC1 2023

H2 BIOLOGY

9744

Section A Multiple Choice

Friday, 22 September 2023

2 hours and 40 minutes

Additional Materials: Multiple Choice Answer Sheet

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 (MCAS).
Write in soft pencil.
Do **NOT** use staples, paper clips, glue or correction fluid.

There are **twenty** 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.

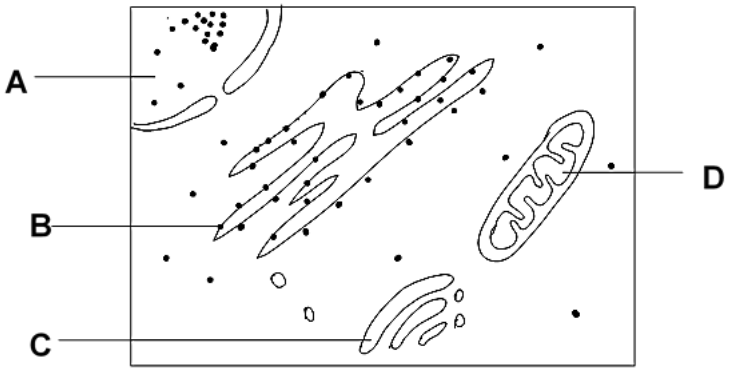
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

Note: The OMS will be collected after 40 minutes during the examination.

Section A

Answer **all** the questions in this section.

1 In the diagram below (not drawn to scale), which of the labeled parts, **A**, **B**, **C** or **D** does not contain nucleic acids?



2 The table provides the description of four membranous structures in a cell. Which structure is correctly matched with its function?

	Structure	Function
A	An extensive network of tubes and sacs; each tube and sac bounded by a single membrane	Lipid synthesis
B	A spherical sac bounded by a single membrane	Protein synthesis
C	A sac bounded by two membranes, the inner membrane is highly folded	Packaging of proteins
D	A stack of elongated, curved sacs; each sac bounded by a single membrane	Photosynthesis

3 Some organisms change the composition of their membranes to maintain membrane fluidity when the temperature changes.

Which changes occur in the composition of the membranes following a change to low temperature?

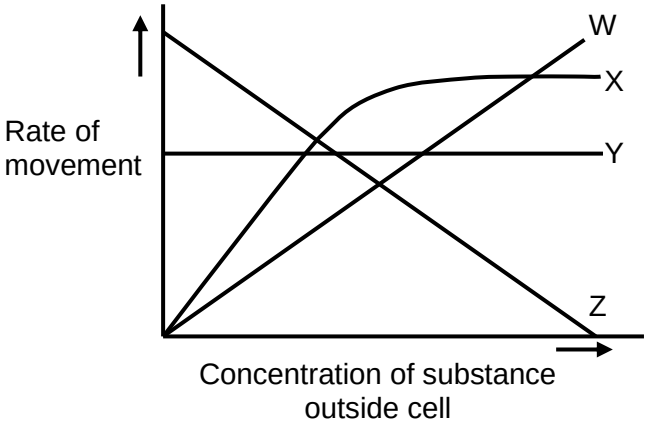
A Increase phospholipids, decrease cholesterol.

B Increase saturated fatty acids, increase cholesterol.

C Increase saturated fatty acids, decrease cholesterol.

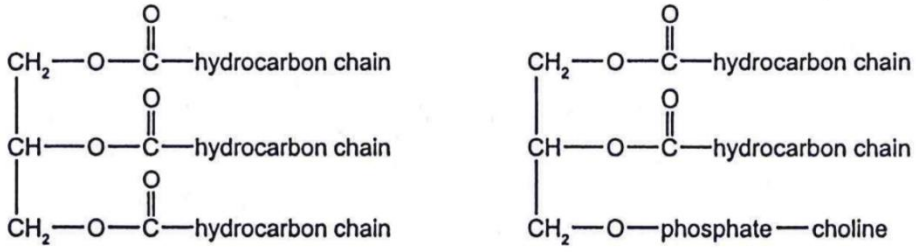
D Increase unsaturated fatty acids, increase cholesterol.

4 Which of the following curves best represent the movement of substances into a cell by simple diffusion and facilitated diffusion?



	Simple diffusion	Facilitated diffusion
A	W	Y
B	W	X
C	X	Z
D	X	W

5 The diagram shows the structure of two lipid molecules.



Which statements correctly describe the two lipid molecules?

1. Both molecules are esters of glycerol.
2. Both molecules are made by condensation reactions.
3. The hydrocarbon chains of molecule X are always from saturated fatty acids.
4. The hydrocarbon chains of molecule Y may be from saturated or unsaturated fatty acids.
5. The hydrocarbon chains of molecule Y are always the same length.

A 1 and 2

B 1 and 3

C 1, 2 and 4

D 2, 3 and 5

6 How many different polypeptides, each consisting of x amino acids, can be made if the number of different amino acids available is y?

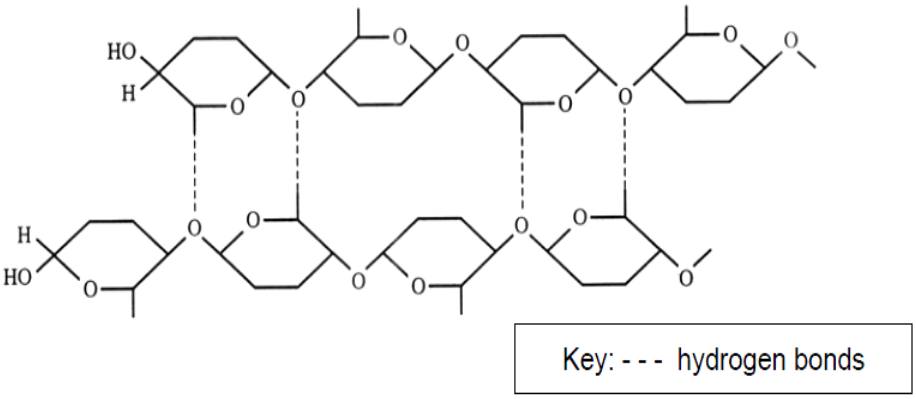
A y^x

B x^y

C yx

D y

7 The figure below shows part of the molecular structure of cellulose.



Which of the following statements are true?

1. The chains are unbranched.
2. Each chain is made up of alternating α-glucose molecules that are rotated 180^o to each other.
3. The hydrogen bonds are possible due to the straight chains of the molecule.
4. Water is needed in the formation of bonds between the chains of the molecule.

A 1 and 3

B 2 and 4

C 1, 2 and 3

D 1, 2, 3 and 4

8 A sugar that is composed of three condensed monosaccharides is hydrolysed by two different enzymes. The products are shown in the table below.

Enzyme used	Products
Galactosidase Sucrase	Galactose and sucrose Melibiose and fructose

What information about the structure of melibiose can be deduced from these results?

A It is a hexose sugar.

B It is composed of fructose and galactose.

C It is composed of glucose and galactose.

D It is composed of sucrose and a monosaccharide.

9 Six tubes were set up as shown in the table:

Tube	Contents
1	Glucose and homogenized red blood cells
2	Glucose and mitochondria
3	Glucose and cytoplasm lacking organelles
4	Pyruvate and homogenized red blood cells
5	Pyruvate and mitochondria
6	Pyruvate and cytoplasm lacking organelles

After incubation, each sample was analysed to determine the presence of carbon dioxide and lactate. In which tubes is lactate most likely to be present?

A 1 and 3 only

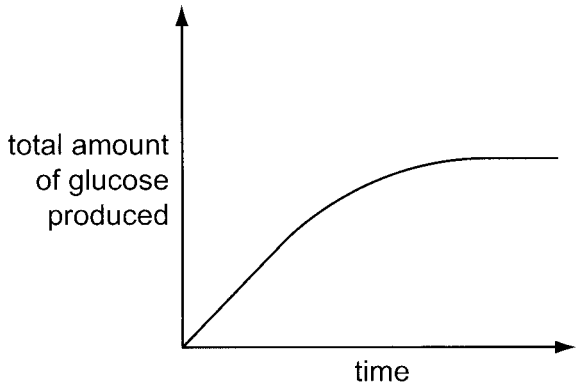
B 3 and 6 only

C 4, 5 and 6 only

D 2, 3, 5 and 6 only

10 Lactose is a disaccharide present in milk. The enzyme β galactosidase catalyses the conversion of lactose to glucose and galactose.

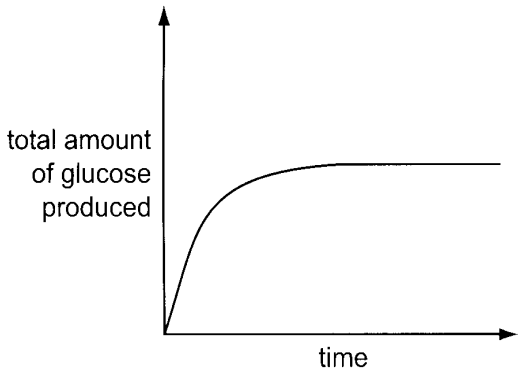
10 cm^3 of a 1% β galactosidase solution was added to 10 cm^3 of milk. The graph shows the total amount of glucose produced over the next ten minutes.



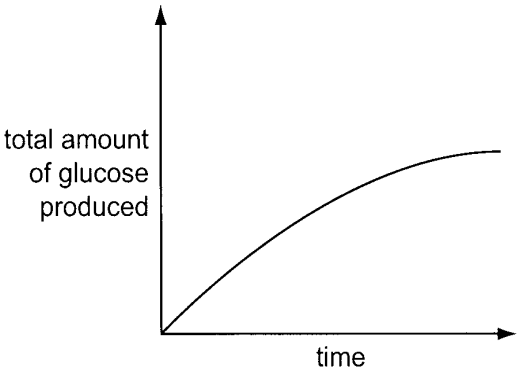
In another experiment, 10 cm^3 of a 2% β galactosidase solution was added to 10 cm^3 milk.

Which graph shows the results that would be obtained?

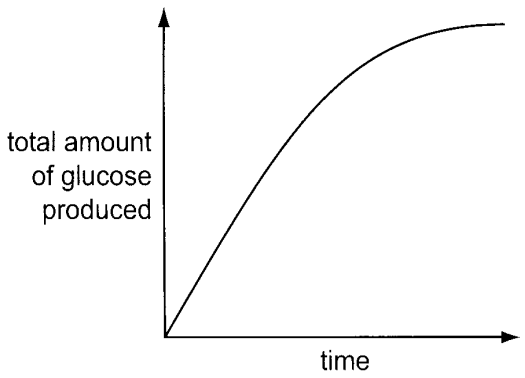
A



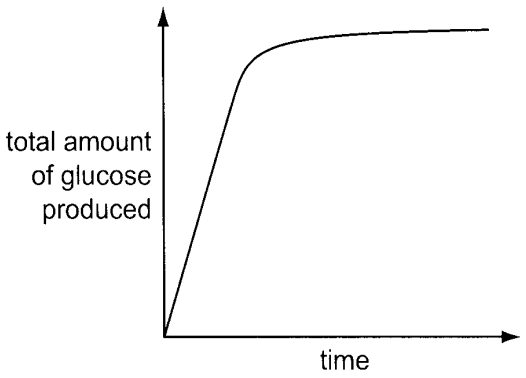
B



C

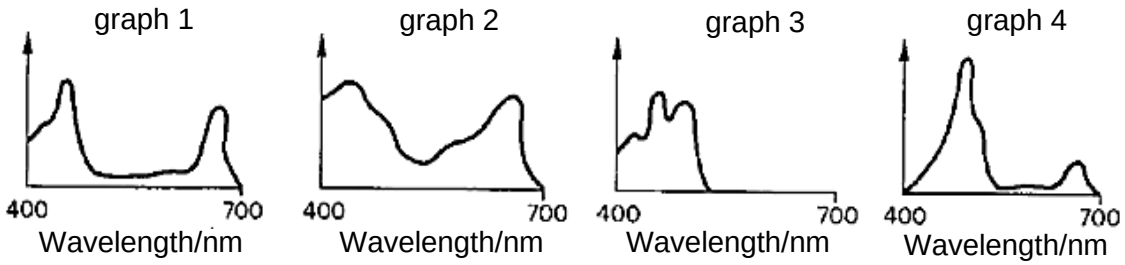


D



11 Three of the graphs below show the absorption spectra of photosynthetic pigments.

One graph shows the action spectrum of photosynthesis for a plant containing the pigments.



All the X axes show wavelength. Three of the Y axes show light absorption. One Y axis shows the rate of photosynthesis.

Which of the following identifies the four graphs?

	Absorption Spectra			Action spectrum
	Chlorophyll a	Chlorophyll b	Carotenoids	
A	1	4	3	2
B	2	1	3	4
C	3	2	4	1
D	4	2	1	3

12 A chromatid consists of DNA coiled around protein molecules.

What is the form of DNA in a duplicated chromosome?

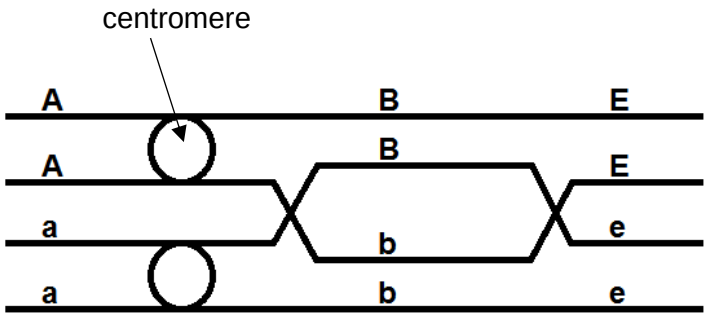
A One molecule of single-stranded DNA

B Two molecules of single-stranded DNA

C One molecule of double-stranded DNA

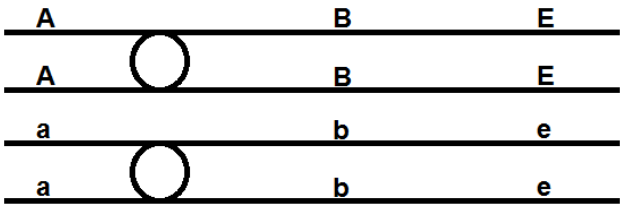
D Two molecules of double-stranded DNA

13 The diagram below shows a pair of homologous chromosomes forming a bivalent.

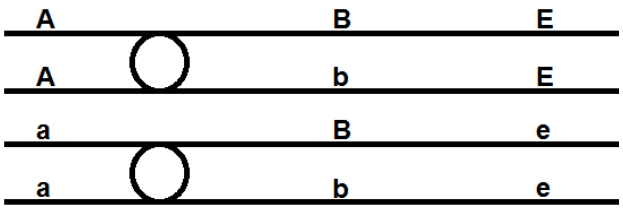


Which of the following correctly represents the final products after meiosis II?

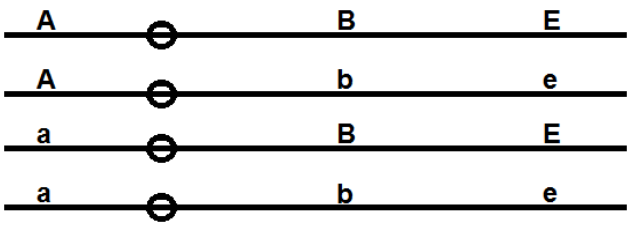
A



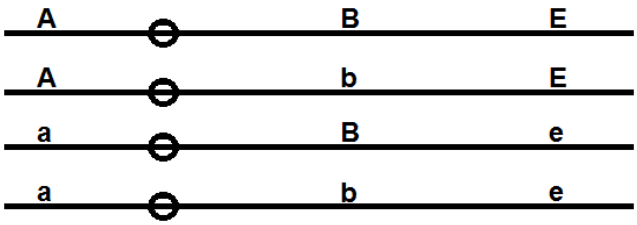
B



C



D



14 Which of the following are true regarding zygotic stem cells and blood stem cells?

1. Both undergo continuous self-renewal throughout the lifetime of the organism.
2. Both are multipotent.
3. Blood stem cells are derived from zygotic stem cells.
4. Zygotic stem cells can differentiate into any cell type, but blood stem cells can only differentiate to form blood cells.

A 1 and 3

B 3 and 4

C 1, 2 and 3

D 2, 3 and 4

15 Research has shown that the liver is one of the very few organs that can regenerate itself completely after surgery. For example, in liver transplant, two-thirds of the liver can be removed, and the remaining one-third will grow in size to replace the lost portion.

Which of the following best explains the information given above?

A The remaining liver cells grow in size, giving rise to a liver the size of a normal one.

B Compounds secreted by remaining liver cells trigger the conversion of blood cells that pass through the liver, into liver cells.

C Pluripotent embryonic stem cells found in the circulating blood will divide and differentiate to produce liver cells that replace the lost portion.

D Multipotent adult stem cells found in the liver will proliferate and differentiate to produce liver cells that replace the lost portion.

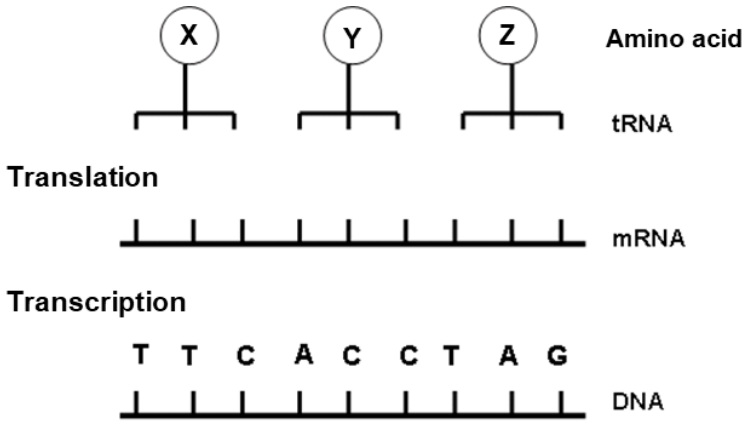
16 Bacteria were cultured in a medium containing heavy nitrogen (^{15}N) until all the DNA was labelled. These bacteria (generation 1) were then grown in a medium containing only normal nitrogen (^{14}N) for two more generations (generations 2 and 3). The percentage of cells containing ^{15}N in each generation was estimated.

What will be the percentage of cells containing ^{15}N in generations 2 and 3?

	percentage of cells containing ^{15}N	
	generation 2	generation 3
A	100	100
B	100	50
C	50	50
D	50	25

17 Given below are the mRNA codons for three amino acids:

Tryptophan	UGG	Lysine	AAG AAA	Isoleucine	AUU AUC AUA



Identify the three amino acids, **X**, **Y** and **Z** in the diagram.

	X	**Y**	**Z**
A	lysine	isoleucine	tryptophan
B	lysine	tryptophan	isoleucine
C	isoleucine	tryptophan	isoleucine
D	tryptophan	lysine	isoleucine

18 About 12,000 genes are expressed in both chick liver and oviduct. However an estimated additional 5,000 genes are expressed only in liver, while an additional 3,000 genes are expressed only in oviduct.

Which of the following could explain these observations?

1 The additional genes may have different methylation patterns in different tissues.
2 The concentrations of transcriptional enhancer elements for the additional genes vary in different tissues.
3 The number of genome copies is different in different somatic cells.
4 A common set of genes are expressed for normal functions in liver and oviduct.

A 1 only

B 2 and 3 only

C 1 and 4 only

D 2 and 4 only

19 Which statements about the *trp* operon are correct?

1 RNA polymerase binds to the *trp* promoter to initiate transcription.
2 The *trp* operon contains three structural genes which codes for enzymes that catalyses the synthesis of tryptophan.
3 The *trp* operon is repressed in the presence of tryptophan.
4 Transcription of the regulatory gene of the *trp* operon depends on the availability of tryptophan.

A 1 and 3 only

B 1 and 4 only

C 2 and 3 only

D 3 and 4 only

20 Which of the following shows the possible effects of a single nucleotide substitution in each of the following locations in a gene on the production of the protein product of that gene?

	Promoter	**Terminator**	**Start Codon**	**Stop Codon**	**Middle of an intron**
A	No protein product is formed	Protein product is shorter than normal	Protein product is longer than normal	Protein product is normal	Too much protein product is produced
B	Too much protein product is produced	Protein product is normal	No protein product is formed	Protein product is longer than normal	Protein product is normal
C	Protein product is normal	Protein product is longer than normal	Protein product is shorter than normal	Too much protein product is produced	Protein product is longer than normal
D	Protein product is longer than normal	Too much protein product is produced	Protein product is normal	Protein product is shorter than normal	No protein product is formed

End of Section A