



MERIDIAN JUNIOR COLLEGE
JC2 Preliminary Examinations 2017
Higher 1

CANDIDATE
NAME

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CIVICS
GROUP

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INDEX
NUMBER

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H1 BIOLOGY

8875/01

Paper 1 Multiple Choice

21 September 2017

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

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

Write in soft pencils.

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

Write your name, civics group and index number on the Multiple Choice Answer Sheet provided.

There are thirty 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 Multiple Choice 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.

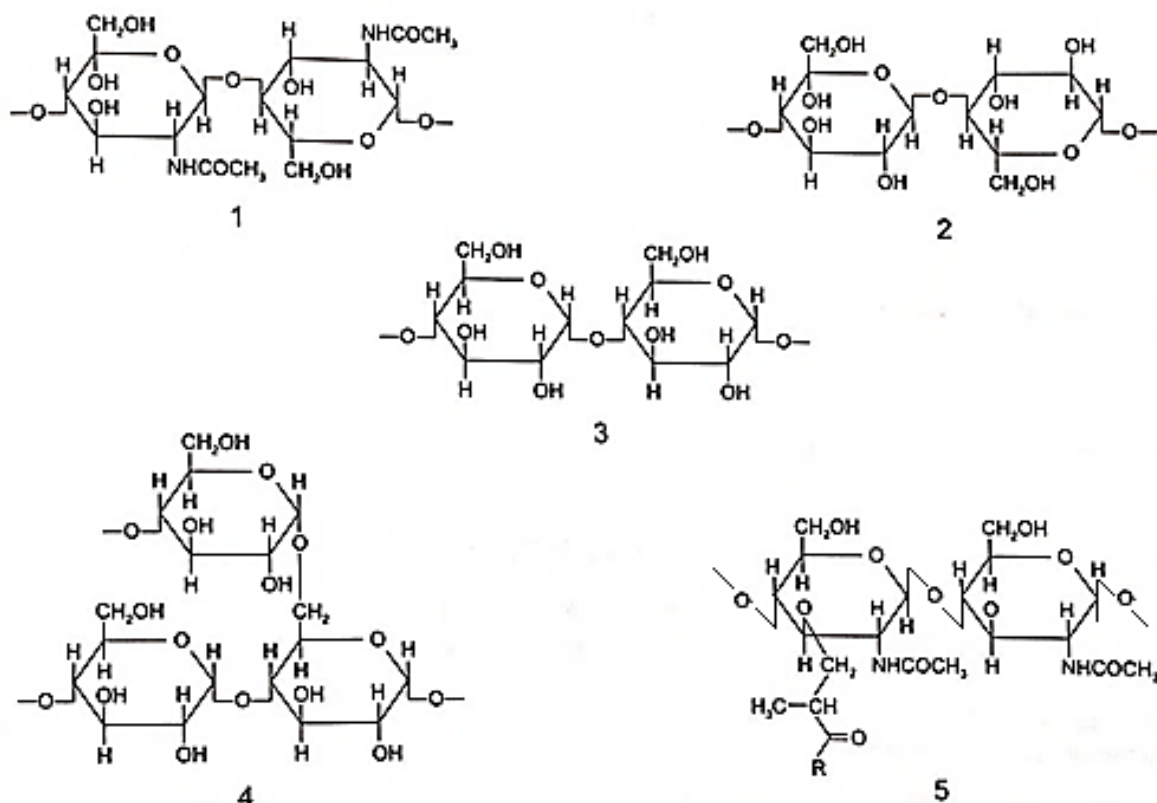
You may keep this booklet after the examination.

This paper consists of **16** printed pages.

[Turn over]

QUESTION 1

The diagrams show short sections of some common polysaccharides and modified polysaccharides.



The polysaccharides can be described as below.

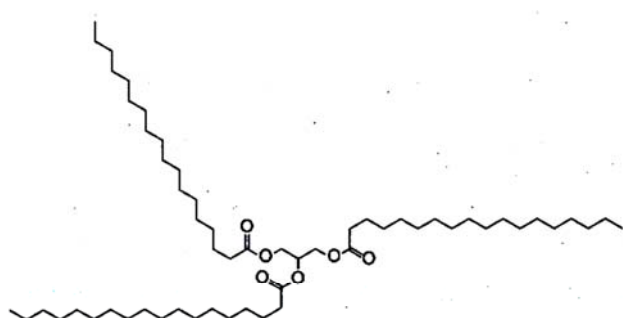
- Polysaccharide **F** is composed of β -glucose monomers with 1,4 glycosidic bonds
- Polysaccharide **G** is composed of α -glucose monomers with 1,4 and 1,6 glycosidic bonds
- Polysaccharide **H** is composed of N-acetylglucosamine and N-acetylmuramic acid monomers with β -1,4 glycosidic bonds.
- Polysaccharide **J** is composed of α -glucose monomers with 1,4 glycosidic bonds
- Polysaccharide **K** is composed of N-acetylglucosamine monomers with β -1,4 glycosidic bonds

Which shows the correct pairings of polysaccharide descriptions and diagrams?

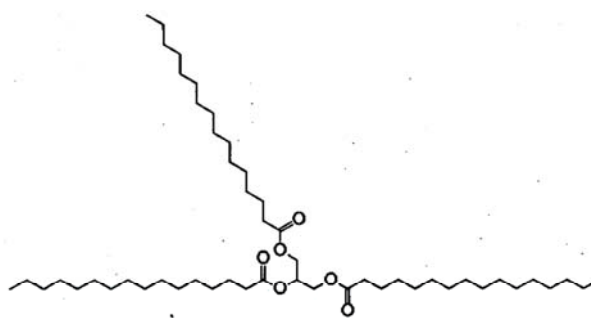
Polysaccharide					
	F	G	H	J	K
A.	2	4	5	3	1
B.	2	5	4	1	3
C.	3	4	1	2	5
D.	3	5	4	1	2

QUESTION 2

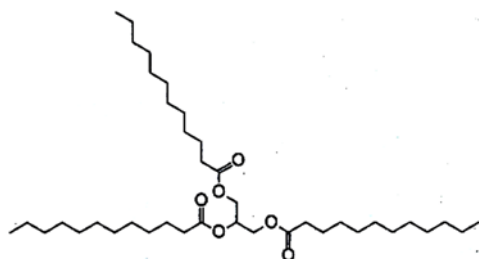
The formulae and melting points of five triglycerides are shown in the diagram. Each triglyceride contains three identical fatty acids.



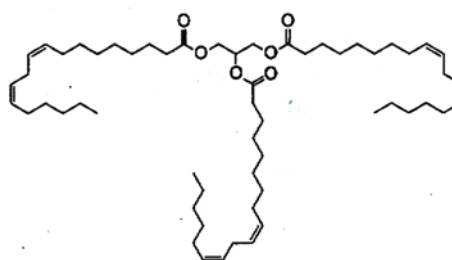
tristearin 72°C



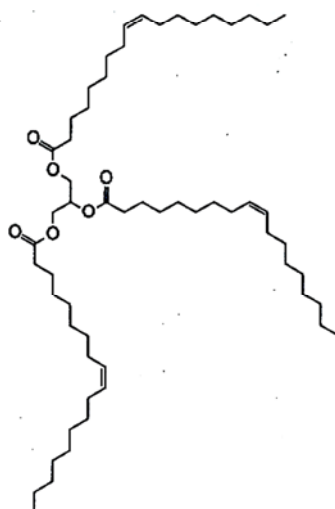
tripalmitin 65.5°C



trilaurin 46°C



trilinolein -13°C



triolein -4°C

Which two structural features of the molecules make the melting point higher?

	number of double bonds	length of fatty acid chains
A.	fewer	longer
B.	fewer	shorter
C.	more	longer
D.	more	shorter

QUESTION 3

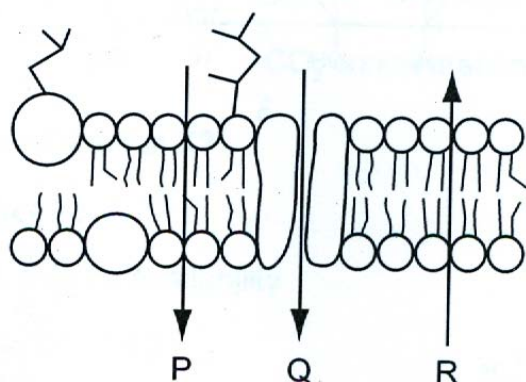
Four students, **A**, **B**, **C** and **D**, were given the same sequence of amino acids removed from a collagen molecule. Each student was asked to analyse the sequence and to explain how their analysis could be linked to a feature of collagen

Which student's statement shows a correct feature of collagen linked to a correct analysis of the amino acid sequence?

- A.** Collagen has polypeptides arranged parallel to each other and the sequence contains a large variety of amino acids with different sized R-groups.
- B.** Collagen has polypeptides that are arranged very closely together and the sequence has every third amino acid as glycine.
- C.** Collagen has three polypeptides that can fold into a globular structure and the sequence contains cysteine and amino acids with hydrophobic R groups.
- D.** Collagen is an insoluble molecule and the sequence contains a large proportion of amino acids with hydrophilic R-groups.

QUESTION 4

The diagram shows the cell surface membrane of an actively respiring cell in a tissue that has been placed in a solution of glucose with a lower water potential than that of the tissue cells.



What correctly describe the movements of molecules across the cell surface membrane shown by arrows **P**, **Q** and **R**?

	P	Q	R
A.	diffusion of glucose	diffusion of oxygen	diffusion of water
B.	diffusion of oxygen	diffusion of water	diffusion of glucose
C.	diffusion of water	active transport of glucose	diffusion of oxygen
D.	diffusion of oxygen	Facilitated diffusion of glucose	diffusion of water

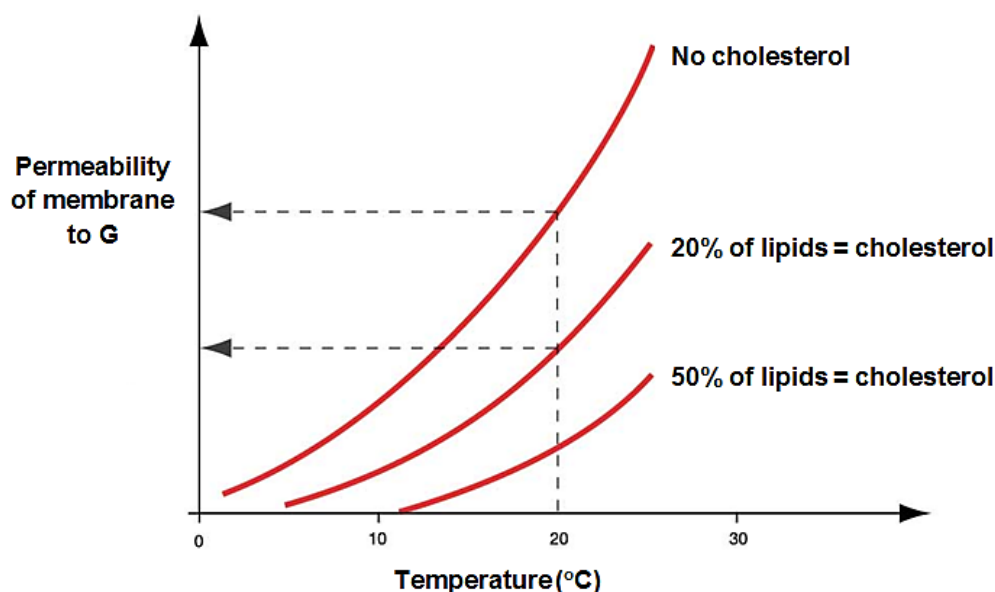
QUESTION 5

What could be a possible explanation for the ability of lysosomes to withstand self-digestion?

- A. Lysosomes contain inactive hydrolytic enzymes.
- B. Lysosome membrane has numerous modified proteins with carbohydrate side-chains.
- C. Lysosomes do not contain lipases which are the enzymes capable of digesting the lipid membrane.
- D. Hydrolases in the lysosomes are inhibited by the acidic internal environment of the lysosomes.

QUESTION 6

The graph below shows the permeability of three different membranes to chemical **G** at different temperatures. These three membranes differ in the amount of cholesterol present in the phospholipid bilayers.

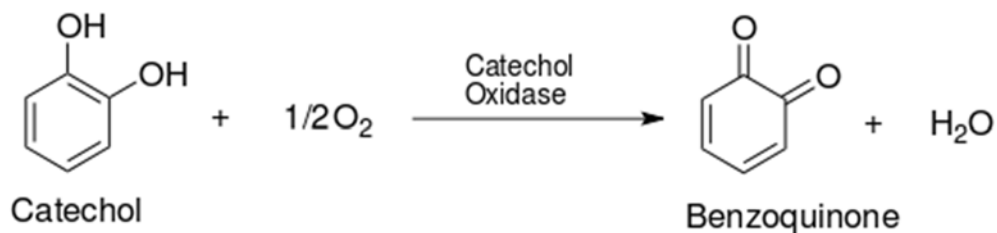


Which of the following is a possible explanation for the observed data?

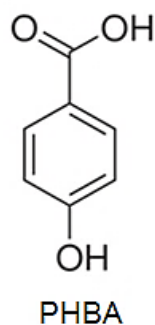
- A. Increase in temperature increases the permeability of the membrane to **G** as cholesterol increases the fluidity of the phospholipids.
- B. At 20°C, an increase in the proportion of cholesterol in the membrane increases the permeability of membrane to **G** as both cholesterol and **G** are non-polar.
- C. Increase in the proportion of cholesterol decreases the permeability of the membrane to **G** as cholesterol decreases the fluidity of the phospholipids.
- D. With an increase in the proportion of cholesterol in the membrane, a lower temperature is required to achieve the same level of permeability for **G** as **G** will gain a higher kinetic energy to penetrate the membrane.

QUESTION 7

Catechol is oxidised to benzoquinone, as shown in the equation, resulting in darkening of peeled fruits.



Catechol oxidase is an enzyme which is inhibited by parahydroxybenzoic acid (PHBA). When PHBA binds to catechol oxidase, it does not change the shape of the enzyme. The structure of PHBA is shown below.



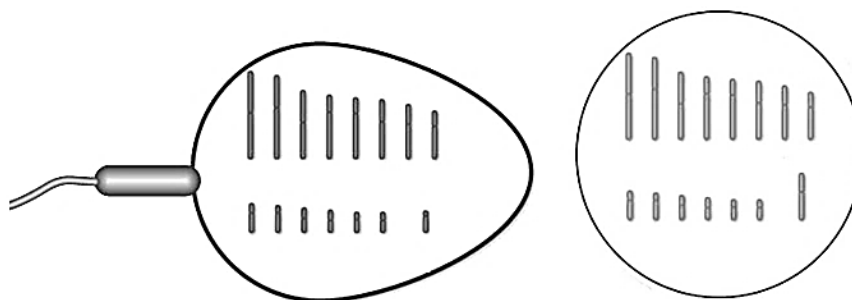
Which of the following statements are **not** correct?

1. PHBA acts as a competitive inhibitor because its structure is similar to the active site of catechol oxidase.
2. PHBA acts as a non-competitive inhibitor because it does not change the shape of the active site of catechol oxidase.
3. In the presence of PHBA, the same V_{max} can be attained at higher catechol concentration.
4. PHBA prevents the formation of enzyme-substrate complex between catechol oxidase, catechol and O_2 .

- A. 1 and 2 only
B. 3 and 4 only
C. 1, 2 and 3 only
D. All of the above

QUESTION 8

The diagram below shows the egg cell and sperm cell formed by one mammal species, as well as the number of chromosomes they contain.

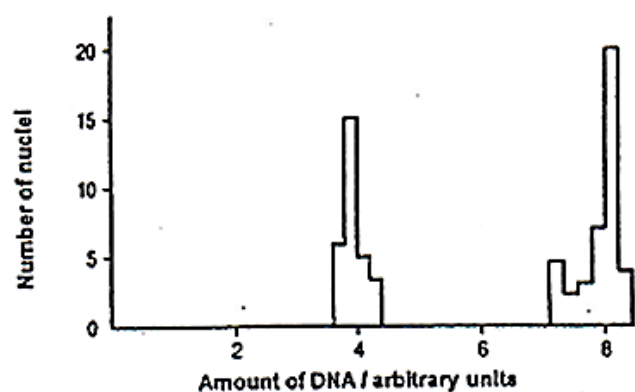


How many DNA molecules would be found in a germ cell (cell that gives rise to gametes) from this organism at prophase II of meiosis II?

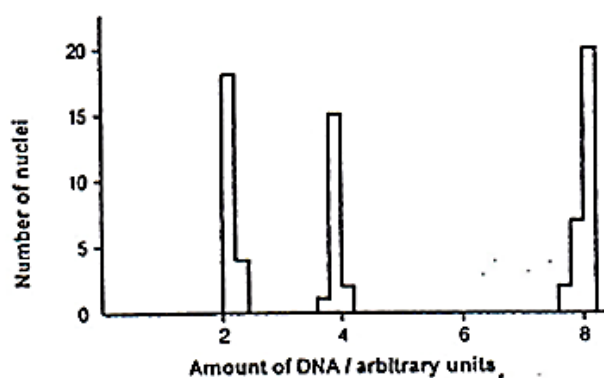
- A. 15 B. 30 C. 60 D. 120

QUESTION 9

The graphs below show the amount of DNA in the nuclei of cells taken from two different parts of a mammalian testis undergoing different nuclear division processes.



Graph 1



Graph 2


Which correctly describes one **unique** event taking place in the cells from graph 1 and graph 2 respectively?

	Graph 1	Graph 2
A.	Duplication of DNA	Separation of homologous chromosomes
B.	Separation of identical sister chromatids	Separation of non-identical sister chromatids
C.	Separation of non-identical sister chromatids	Formation of gametes
D.	Breaking and rejoining of homologous regions of chromosomes	Separation of homologous chromosomes


QUESTION 10

Meselson and Stahl found that in dividing cells, DNA is copied by semi-conservative replication. At the time of their discovery it was thought that DNA might be copied in one of three ways.

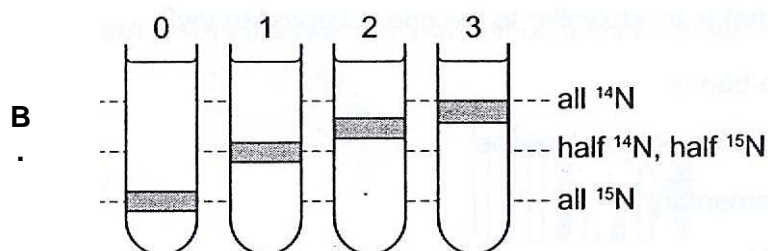
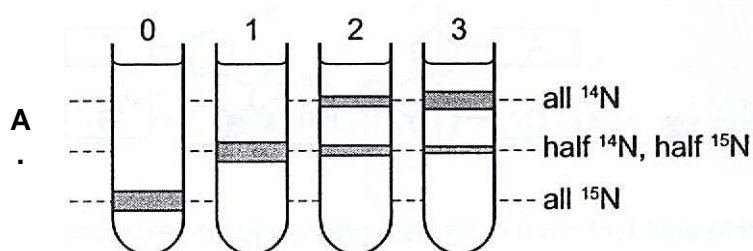
In the diagram, the original DNA strands are shown by solid lines and the copy strands by dotted lines.

semi-conservative 

conservative 

dispersive 

Which set of results would have proved that the DNA replication was **conservative**?



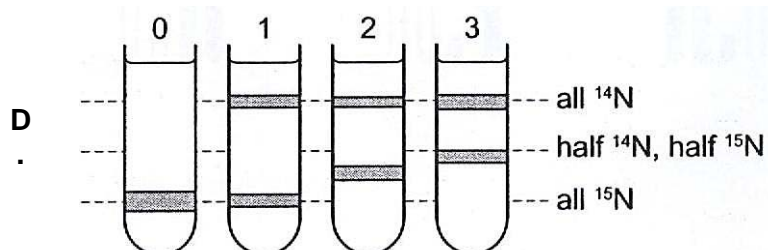
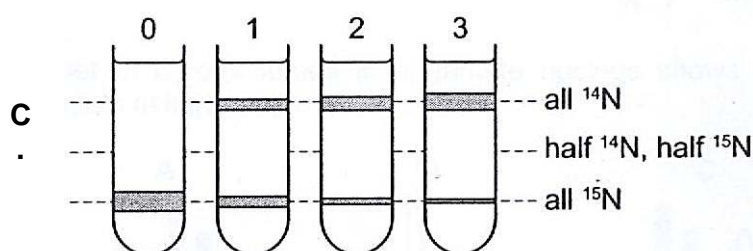
key

0 = original culture in ^{15}N

1 = first generation in ^{14}N

2 = second generation in ^{14}N

3 = third generation in ^{14}N



QUESTION 11

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. Stop codons are UAA, UGG and UGA.
6. mRNA codons have the same nucleotide sequence as DNA triplets on template strand.

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

QUESTION 12

In three different possible genetic dictionaries, the genetic code for the amino acid cysteine is given as:

- I **ACA** or **ACG**
- II **TGT** or **TGC**
- III **UGU** or **UGC**

The explanation for this may be:

1. Some genetic dictionaries show mRNA codons, others show DNA triplets.
2. The genetic code can be read in either the 3' or 5' direction along the DNA.
3. Some genetic dictionaries show the triplet code on the DNA strand complementary to the mRNA code, others show the triplet code on the other DNA strand.
4. The genetic code is a degenerate triplet code.

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

QUESTION 13

Fabry's Disease is a disease that results from a mutation that occurs in the α -galactosidase A gene.

The sequence of part of the normal and mutated alleles for α -galactosidase A gene is shown below.

Normal allele

Codon	37	38	39	40	41	42	43	44	45
mRNA	CCU	UGG	ACC	CAG	AGG	UUC	UAA	GGC	GGA

Mutated allele

Codon	37	38	39	40	41	42	43	44	45
mRNA	CCU	UGG	ACC	CCG	CAG	AGG	UUC	UAA	GGC

Using the information of the normal and mutated alleles above, it is reasonable to conclude that

- A. A frame shift mutation has occurred.
- B. A duplication has occurred.
- C. An insertion of an amino acid has occurred in the mRNA.
- D. The polypeptide that is translated from the mutated allele will be longer.

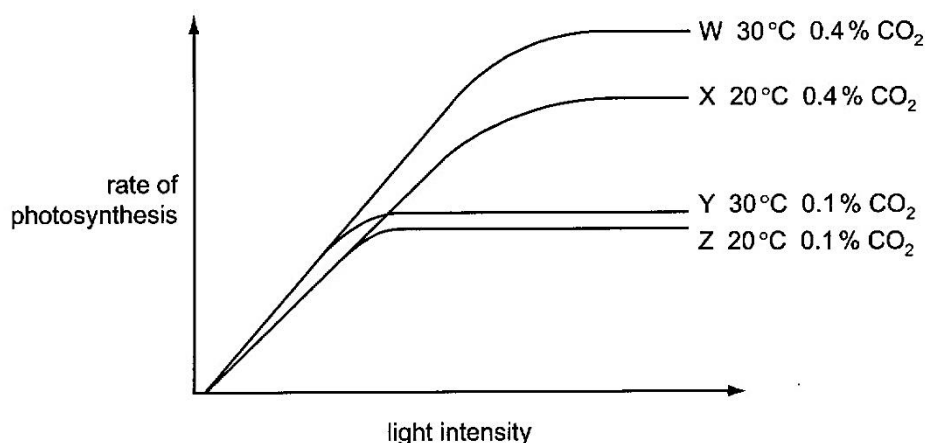
QUESTION 14

Which statement concerning polypeptide synthesis is correct?

- A. A particular cell type will transcribe all the genes present in one set of chromosomes but will only process particular pre-mRNA transcripts to enable polypeptide synthesis.
- B. Different cell types will transcribe different sets of genes to produce different pre-mRNA transcripts and synthesise different polypeptides.
- C. The same pre-mRNA transcripts are synthesised by all cell types but different introns are removed from the transcripts before translation to synthesise polypeptides.
- D. The same set of genes will be transcribed by different cell types but different RNA transcripts in each cell type proceed to translation to synthesise different polypeptides.

QUESTION 15

The diagram shows the results of an investigation into the effect of changing light intensity on the rate of photosynthesis at two different carbon dioxide concentrations and two different temperatures.



Which factor is limiting the rate of photosynthesis shown in curve X at high light intensities and which curve supports this?

- A. carbon dioxide, curve Y as a decrease in carbon dioxide concentration decreases rate
- B. carbon dioxide, curve Z as rate becomes constant at lower light intensities
- C. temperature, curve W as an increase in temperature increases rate
- D. temperature, curve Z as rate becomes constant at lower light intensities

QUESTION 16

Which of the following is correct?

- A. Cellular respiration uses ATP to produce energy for activities and reactions in the cell.
- B. Cellular respiration oxidises ATP for activities and reactions in the cell.
- C. Cellular respiration produces ATP for activities and reactions in the cell.
- D. Cellular respiration hydrolyses ATP for activities and reactions in the cell.

QUESTION 17

Rotene, oligomycin and DNP are metabolic poisons which affect cellular respiration. The effects of rotene, oligomycin and DNP on aerobic respiration are summarised in the following table.

Metabolic Poisons	Effect of metabolic poison on cells		
	ability to use glucose	ability to use oxygen and amount used	ATP yield
rotene	yes	No	decreases
oligomycin	yes	Yes – same amount used	decreases
DNP	yes	Yes – increase amount used	decreases

Which of the following correctly identifies the specific functions of these metabolic poisons?

	rotene	oligomycin	DNP
A.	Increases inner membrane permeability	inhibits ATP synthase	Inhibits electron transport
B.	inhibits ATP synthase	Inhibits electron transport	Increases inner membrane permeability
C.	Inhibits electron transport	inhibits ATP synthase	Increases inner membrane permeability
D.	Inhibits electron transport	Increases inner membrane permeability	Inhibits ATP synthase

QUESTION 18

A child with Down syndrome has the genotype $P^1 P^2 P^3$ for a polymorphism on chromosome 21 that has four different alleles — allele P^1 , allele P^2 , allele P^3 , allele P^4 . The child's mother has the genotype $P^1 P^2$ and the father has the genotype $P^3 P^4$.

In which parent did chromosomes fail to separate, and did this event occur in the first or second meiotic division?

- A.** Mother; Meiosis I
- B.** Mother; Meiosis II
- C.** Father; Meiosis I
- D.** Father; Meiosis II

QUESTION 19

Achondroplastic dwarfism is an autosomal dominant disorder and red-green colour blindness is an X-linked recessive disorder.

An achondroplastic male dwarf with normal vision marries a colour-blind woman of normal height. The man's father is 1.7 meters tall while both the woman's parents are of average height.

What is the probability that their son will be colour-blind and of normal height?

- A.** 0.25
- B.** 0.5
- C.** 0.75
- D.** 1.0

QUESTION 20

A genetic cross performed on the fruit fly, *Drosophila melanogaster*, involved two independently-assorting (unlinked) genes.

gene	alleles
eye shape	bar (narrow)
	round
wing shape	Normal
	vestigial (reduced)

The F₂ generation was observed to show the expected 9:3:3:1 phenotypic ratio, with the majority of the F₂ offspring possessing bar eyes and normal wings.

Two different individuals with bar eyes and normal wings were removed from the F₂ group each subjected to a test cross. The ratios of the resulting phenotypes are shown below.

test cross x individual P = 1 bar eye, normal wing : 1 bar eye, vestigial wing

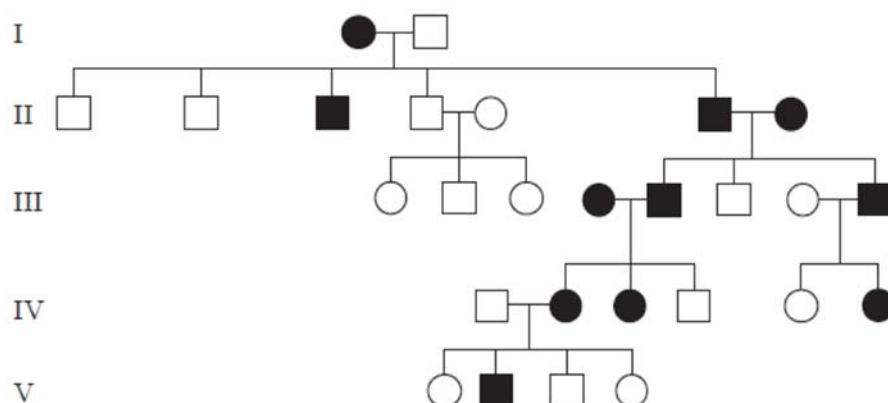
test cross x individual Q = 1 bar eye, normal wing : 1 round eye, normal wing

What is the expected phenotypic ratio for the offspring of a cross between individual P and individual Q?

- A. all bar eye, normal wing
- B. 1 bar eye, normal wing : 1 bar eye, vestigial wing
- C. 3 bar eye, normal wing : 1 bar eye, vestigial wing
- D. 3 bar eye, normal wing : 1 round eye, normal wing

QUESTION 21

The pedigree chart below shows the inheritance of a genetic disease in a family.



What is the nature of the allele that causes this disease?

- A. autosomal dominant
- B. sex-linked dominant
- C. autosomal recessive
- D. sex-linked recessive

QUESTION 22

Which statement concerning chrysanthemum plants, of the genus *Dendranthema*, is a valid example of how the environment may affect the phenotype?

- A. Anthocyanins and anthoxanthins are vacuolar pigments, whereas xanthophylls and carotenes are pigments found in membrane-bound organelles known as plastids. These, together with molecules known as co-pigments, are responsible for the variation observed in petal colour in *Dendranthema*.
- B. Identical genetic crosses performed between varieties of *Dendranthema* result in a greater proportion of offspring plants with plastids exhibiting a yellow colour when grown in a field and a greater proportion of offspring plants with colourless plastids when grown in a glasshouse.
- C. The seeds of a cross between *Dendranthema weyrichii* and *Dendranthema grandiflora* produce plants that are far more frost-tolerant and exhibit an extended flowering season compared with both parents.
- D. The seeds of a cross between *Dendranthema weyrichii* (height varying between 12.5 – 15.0cm) and *Dendranthema grandiflora* (height varying between 8.0 – 25.0 cm) produce plants, when grown in natural day length, of a height varying between 55.0 – 71.0 cm.

QUESTION 23

The diagram shows part of the aligned DNA sequences for the same gene in six species of aquatic animals.

Fin whale	TAAACCCCAATAGTCACAAAACAAGACTATTGCGCCAGAGTACTACTAGCAAC
Humpback whale	TAAACCCCTAATAGTCACAAAACAAGACTATTGCGCCAGAGTACTACTAGCAAC
Sperm whale	TAAACCCAGGTAGTCATAAAAACAAGACTATTGCGCCAGAGTACTACTAGCAAC
Beaked whale	TAAACCTAAATAGTCTCAAAAACAAGACTATTGCGCCAGAGTACTACTAGCAAT
Dolphin	TAAACTTAAATAATCCCAAAAACAAGATTATTGCGCCAGAGTACTATCGGGCAAC
Porpoise	TAAACCTAAATAGTCCTAAAACAAGACTATTGCGCCAGAGTACTATCGGGCAAC

Which is a correct assumption when using this information as evidence for evolutionary relationships?

- A. Differences and similarities in DNA sequences reflect evolutionary relationships.
- B. DNA sequences in different genes from the same six species will suggest different evolutionary relationships.
- C. Point mutations in DNA sequences are not acted on by natural selection.
- D. Mutations that do not change amino acid sequences in proteins are important for natural selection.

QUESTION 24

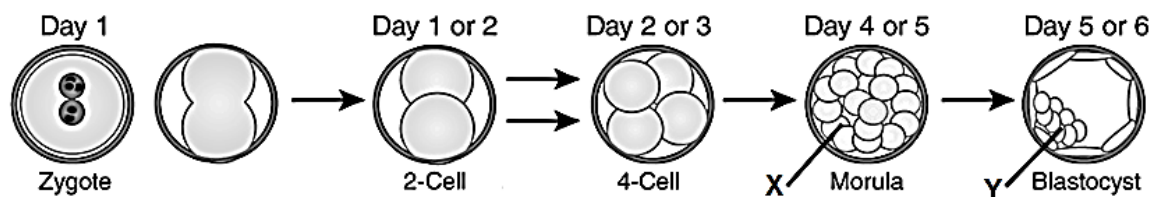
Which of the following is **not** an evidence for evolution?

- A. A beetroot and a carrot are modified parts of plants
- B. Presence of wing bones in the wingless bird, kiwi.
- C. Presence of gills slits in human embryos.
- D. Codon coding for a particular amino acid

QUESTION 25

The figure below shows several stages in the development of an embryo.

Which of the following statements are true about the cells labelled X and Y?



- A. X is a pluripotent cell while Y is a multipotent cell.
- B. X is a pluripotent cell while Y can give rise to multipotent cells.
- C. Y will develop into the entire foetus including its placenta.
- D. X can only give rise to totipotent cells but Y will give rise to pluripotent cells.

QUESTION 26

Induced pluripotent stem cells are stem cells that can be generated directly from differentiated somatic cells under the influence of molecular signals.

Which of the following statements 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 type, including the extraembryonic membranes.
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

QUESTION 27

Which of the following is the restriction sequence for *Bam*HI?

- A 5' GGATCC 3'
- B 5' GACGAC 3'
- C 5' AATGCC 3'
- D 5' ACTACT 3'

QUESTION 28

What are the possible arguments against the use of genetically modified organisms (GMOs)?

1. Insufficient testing of genetically modified crop for their side effects
2. Unforeseen long-term effects of genetic manipulation
3. Accidental genetic recombination in humans as a result of consuming food derived from GMOs
4. Control of food supply by a small number of companies that have access to genetic engineering technology

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

QUESTION 29

Which of the following technique does **not** involve any nucleic acid hybridization?

- A.** Gel electrophoresis
- B.** Gene probing
- C.** Polymerase Chain Reaction
- D.** DNA fingerprinting

QUESTION 30

A student performed the following steps in a Southern blot experiment to determine if a particular gene has been inserted in a genetically modified organism.

1. Transfer of DNA to nitrocellulose membrane.
2. Restriction digestion of genomic DNA.
3. Cleaved DNA separated using gel electrophoresis.
4. Synthesize radioactive probe.
5. Incubate probe and membrane.

Which is the correct sequence to the above steps?

- A.** 2 → 3 → 1 → 4 → 5
- B.** 2 → 3 → 1 → 5 → 4
- C.** 4 → 5 → 1 → 2 → 3
- D.** 5 → 4 → 3 → 2 → 1

😊 **End of Paper** 😊