

Candidate Name: _____

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MERIDIAN JUNIOR COLLEGE
JC2 Preliminary Examinations 2016
Higher 1

H1 BIOLOGY

Paper 1 Multiple Choice Questions

8875/01**22 September 2016**
1 hourAdditional 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.

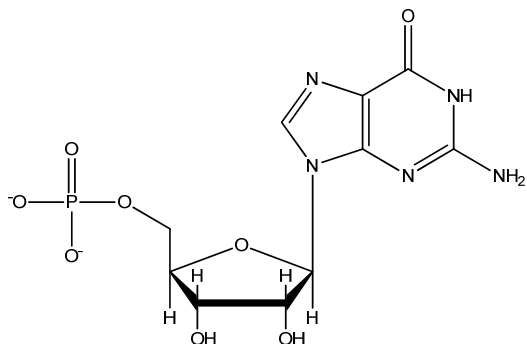
You may keep this booklet after the examination.

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

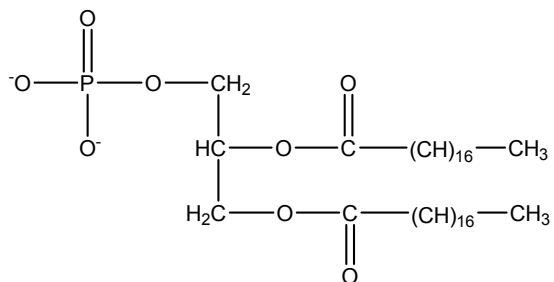
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QUESTION 1

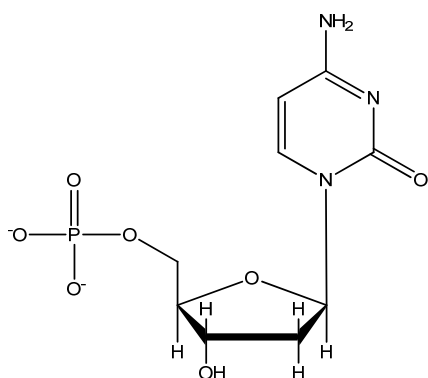
A student used centrifugation to separate the various intracellular structures of human liver cells by size and density. Which of the following molecule(s) would you expect to find in the fraction containing mitochondria?



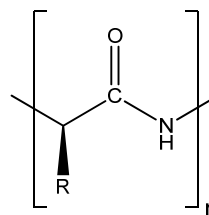
I



II



III

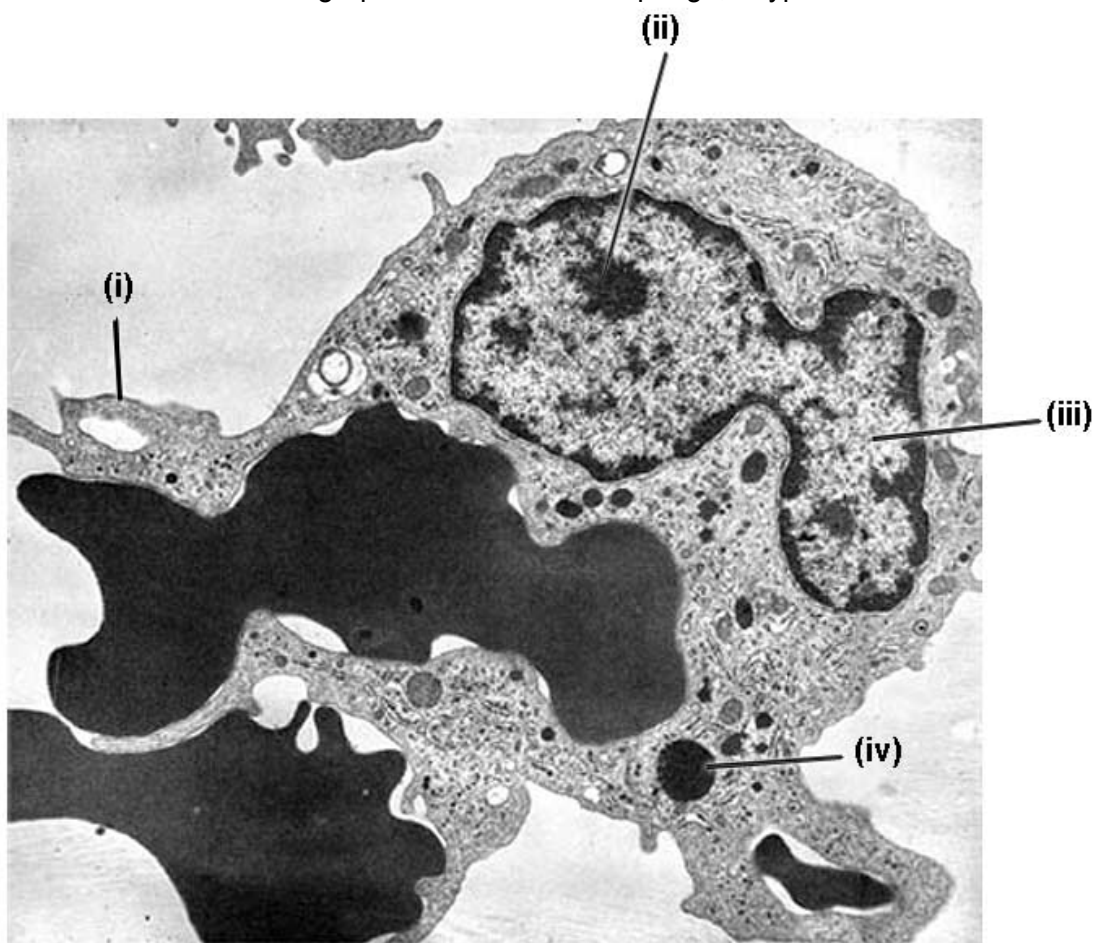


IV

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

QUESTION 2

The figure below is an electron micrograph of a human macrophage, a type of white blood cell.



Which of the options correctly matches structure with function?

	Structure (i)	Structure (ii)	Structure (iii)	Structure (iv)
A	Engulfs foreign bacteria	Contains genes that code for hydrolytic enzymes	Transcription of ribosomal RNA	Contains enzymes for secretion
B	Engulfs worn out red blood cells	Partial assembly of ribosomes	Contains genes that code for specific receptor proteins	Contains hydrolytic enzymes
C	Engulfs foreign bacteria	Transcription of ribosomal RNA	Contains genes that code for specific receptor proteins	Contains enzymes for secretion
D	Engulfs worn out red blood cells	Contains genes that code for hydrolytic enzymes	Transcription of ribosomal RNA	Contains hydrolytic enzymes

QUESTION 3

Polar bears are well adapted for the Arctic environment. The following are some statements about biological molecules found in the cell membrane.

- 1 Channel proteins allow ions to flow through by facilitated diffusion.
- 2 Glycoproteins in the membrane enable communications between cells.
- 3 Phospholipids with unsaturated fatty acid chains will be more spaced out than phospholipids with saturated fatty acid chains.
- 4 The higher the percentage of cholesterol in the membrane, the more fluid the membrane becomes.

How many of these statement(s) account for how the polar bears are adapted for the Arctic environment?

A 1 **B** 2 **C** 3 **D** 4

QUESTION 4

The phospholipid bilayer of a certain type of cell was analysed by separating the two layers and analysing the components of each layer.

Which option shows the composition of each layer?

A	Glycolipids	Phospholipids	Glycoproteins	Cholesterol
Inner layer	0%	80%	0%	20%
Outer layer	15%	50%	15%	20%

B	Glycolipids	Phospholipids	Glycoproteins	Cholesterol
Inner layer	15%	50%	15%	20%
Outer layer	0%	80%	0%	20%

C	Glycolipids	Phospholipids	Glycoproteins	Cholesterol
Inner layer	10%	60%	20%	10%
Outer layer	30%	50%	0%	20%

D	Glycolipids	Phospholipids	Glycoproteins	Cholesterol
Inner layer	30%	50%	0%	20%
Outer layer	15%	50%	15%	20%

QUESTION 5

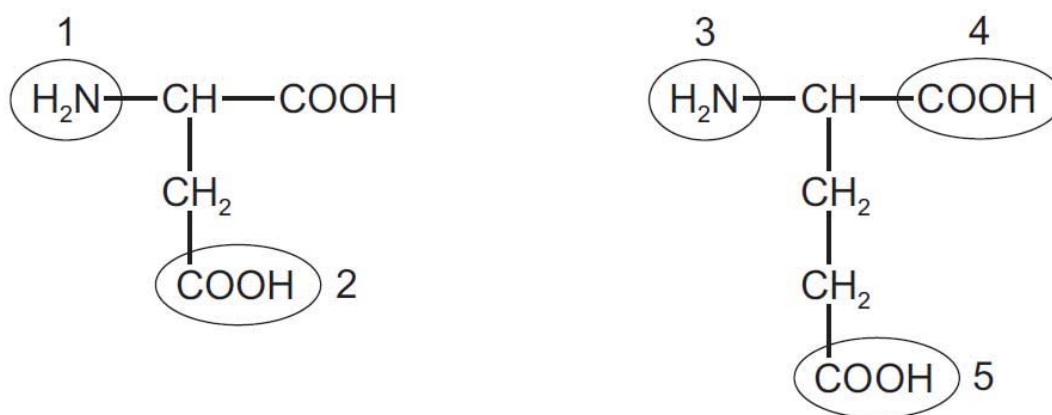
Which feature(s) adapt a cellulose molecule for its function?

- 1 Long chains of β -glucose molecules have multiple branches.
- 2 Many hydrogen bonds are formed between adjacent chains.
- 3 Cellulose is insoluble in water.

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

QUESTION 6

The diagrams show the structures of two amino acids, each of which has two carboxylic acid groups ($-\text{COOH}$).



Which groups form the bonds that maintain the configuration of α -helices?

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

QUESTION 7

Which of the following statement(s) is/are true of all enzymes?

- 1 soluble in water
- 2 catalyse the breakdown of large molecules into smaller molecules
- 3 only have one active site
- 4 have a quaternary structure

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

QUESTION 8

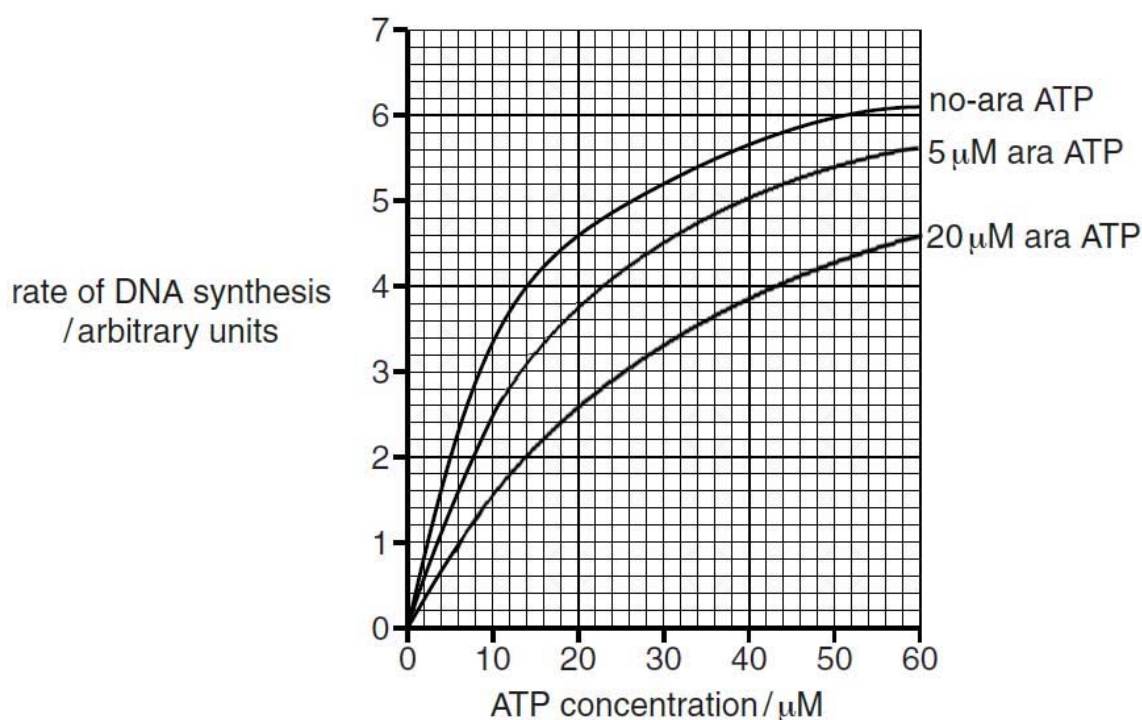
DNA polymerase is an enzyme involved in the replication of DNA. One of the substrates required by DNA polymerase is ATP.

ara-ATP is a chemical that affects DNA polymerase activity.

In an investigation, the effect of different concentrations of ATP on the rate of DNA synthesis was determined:

- with no ara-ATP
- with a low concentration of ara-ATP
- with a high concentration of ara-ATP

The results of the investigation are shown in the graph below:



Which of the following statements about the effects of ara-ATP are **false**?

- 1 ara-ATP binds to an allosteric site on DNA polymerase.
- 2 ara-ATP binds to the active site on DNA polymerase.
- 3 ara-ATP is similar in structure to ATP.
- 4 When ara-ATP binds to DNA polymerase, the shape of its active site changes.
- 5 When ara-ATP binds to DNA polymerase, the rate of DNA synthesis can be increased by increasing the concentration of ATP.

A 1 and 4

B 1 and 5

C 2 and 3

D 2 and 5

QUESTION 9

Which is the correct statement concerning cell and nuclear division?

- A** At prophase, the mass of DNA is doubled. Following anaphase, this mass is reduced by half and following cytokinesis this mass halves again.
- B** Mutagens can cause mutations whereas carcinogens can cause cancer. This means that all mutagens are carcinogenic.
- C** Some of the roles of mitosis are growth, asexual reproduction, cell repair following tissue damage and cell replacement.
- D** Haploid eukaryotes can reproduce by mitosis whereas diploid eukaryotes can reproduce by mitosis or meiosis.

QUESTION 10

Some plants, such as wheat or banana plants, can produce diploid or haploid gametes. These gametes can fertilise other diploid or haploid gametes.

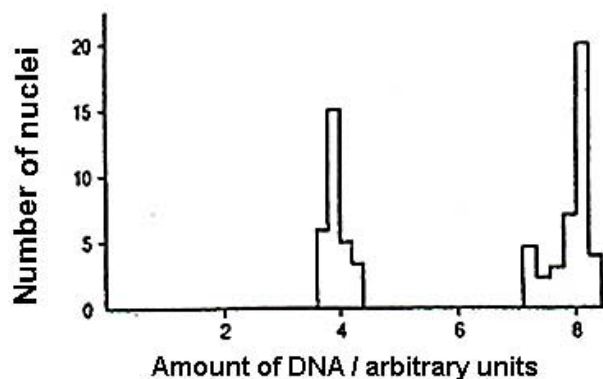
Which statements are correct for plants like these?

- 1 Diploid gametes may be produced by non-disjunction during meiosis.
- 2 The offspring will always show an increased chromosome number.
- 3 The offspring could be $2n$, $3n$ or $4n$.
- 4 The chromosome number could increase with each generation.

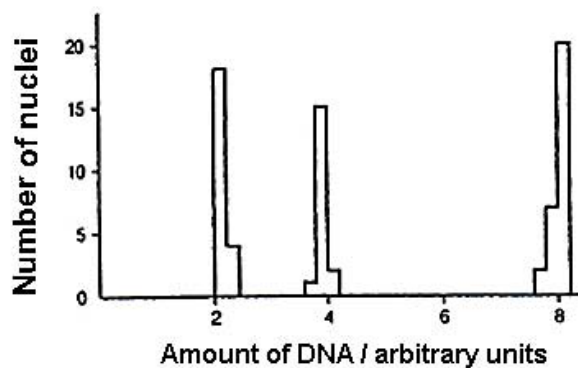
- A** 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

QUESTION 11

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?

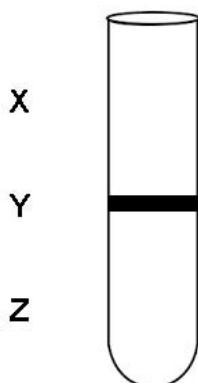
	Graph 1	Graph 2
A	Duplication of DNA	Separation of homologous chromosomes
B	Separation of identical sister chromatids	Separation of non-identical sister chromatids
C	Separation of non-identical sister chromatids	Formation of gametes
D	Breaking and rejoining of homologous regions of chromosomes	Separation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

QUESTION 12

A culture of bacteria was allowed to reproduce using nucleotides containing ^{14}N for many generations. The culture was then allowed to reproduce using nucleotides with the heavy isotope of nitrogen, ^{15}N , for one generation. The DNA of the bacterial cells was then examined using a centrifuge before it was returned to a culture medium with nucleotides containing ^{14}N .

The DNA of the bacterial cells was then examined again after two subsequent generations in the culture medium with nucleotides containing ^{14}N .

The diagram below shows the position of the DNA band at Y in the centrifuge tube when the DNA was first labelled.

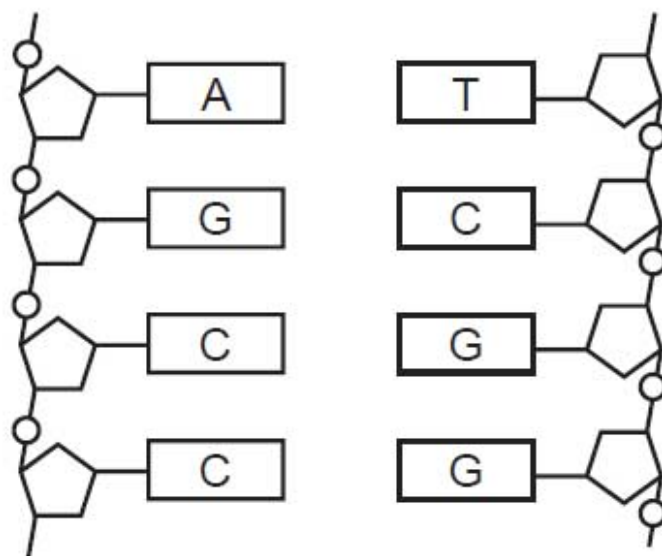


Which option shows the number of bands and their respective band positions?

	After one generation in ^{14}N medium	After another generation in ^{14}N medium
A	Two bands, 50% at Y and 50% at Z	Two bands, 75% at Y and 25% at Z
B	Two bands, 50% at Y and 50% at Z	Two bands, 25% at Y and 75% at Z
C	Two bands, 50% at X and 50% at Y	Two bands, 75% at X and 25% at Y
D	Two bands, 50% at X and 50% at Y	Two bands, 25% at X and 75% at Y

QUESTION 13

The diagram shows part of a DNA molecule.



How many hydrogen bonds are involved in holding these strands of DNA together?

- A** 12 **B** 11 **C** 9 **D** 8

QUESTION 14

The following processes take place during gene expression.

- 1 The phosphorylated amino acid forms a covalent bond with the tRNA molecules.
- 2 The formation of hydrogen bonds between the codons of mRNA and the anticodons of tRNA.
- 3 The addition of water to hydrolyse the covalent bond between an amino acid molecule and a tRNA molecule.
- 4 The reaction between a hydroxyl group of one amino acid and a carboxyl group of another amino acid to form a covalent bond.
- 5 The reaction between an ATP molecule and an amino acid molecule, which is catalysed by acyl-tRNA transferase.

What is the sequence of these processes during gene expression?

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

QUESTION 15

In 1985, it was discovered that a bacterium, *Mycoplasma capricolum*, used a deviant genetic code. The codon UGA resulted in the addition of tryptophan to the growing polypeptide chain.

A short sequence of nucleotides was synthesised with the following base sequence:

3' CTGGCAACTATTTCAACTCATATC 5'

How many peptide bonds would be formed by ribosomes when this sequence undergoes transcription and translation in *Mycoplasma capricolum* and a human liver cell?

	<i>Mycoplasma capricolum</i>	Human liver cell
A	1	0
B	2	1
C	3	2
D	4	3

QUESTION 16

In fruit flies, one gene controls wing form (normal or vestigial) and one gene controls eye colour (red or normal brown).

A fly with normal wings and normal brown eyes is crossed with a fly with vestigial wings and red eyes. All the F_1 are normal for both characteristics.

However, when F_1 are crossed with each other, the resulting F_2 is:

45 normal wing, normal brown eye
17 normal wing, red eye
16 vestigial wing, normal brown eye
5 vestigial wing, red eye
1 normal wing, orange eye

What is the best explanation for the results of this dihybrid cross?

- A** Codominance
- B** Gene mutation
- C** Multiple alleles
- D** Sex linkage

QUESTION 17

A cross between a round-leaved, pink flower plant and an oval-leaved, pink flower plant produced the following offspring:

151 round-leaved, pink flower
53 round-leaved, white flower
52 oval-leaved, white flower
153 oval-leaved, pink flower

Key

R - round leaf

r - oval leaf

T - pink

t - white

What were the genotypes of the parents?

- A** RrTt x rrTt **B** RRTt x rrTT **C** RrTT x rrTt **D** RRTT x rrTT

QUESTION 18

Two parents have a son who has blood group **O** and haemophilia. One parent has blood group **O** and the other has blood group **B**. Neither parent has haemophilia.

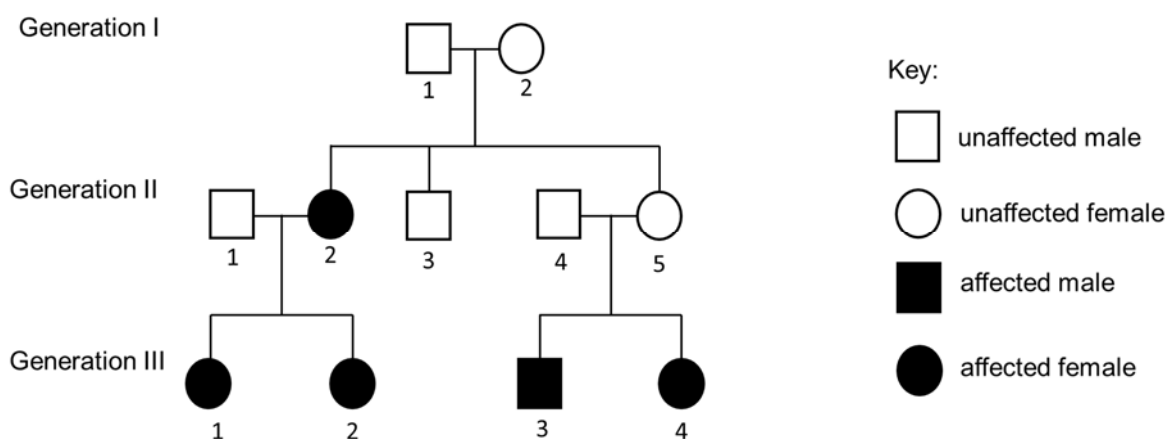
What is the probability that the second child of these parents is a son with blood group **B** who does not have haemophilia?

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

QUESTION 19

Multiple Sclerosis (MS) is a neurodegenerative disease in which the immune system attacks the myelin that protects nerve fibres, upsetting the flow of information between the brain and the body.

The pedigree chart below shows the pattern of MS inheritance in a family.



Which of the following states the inheritance pattern of MS?

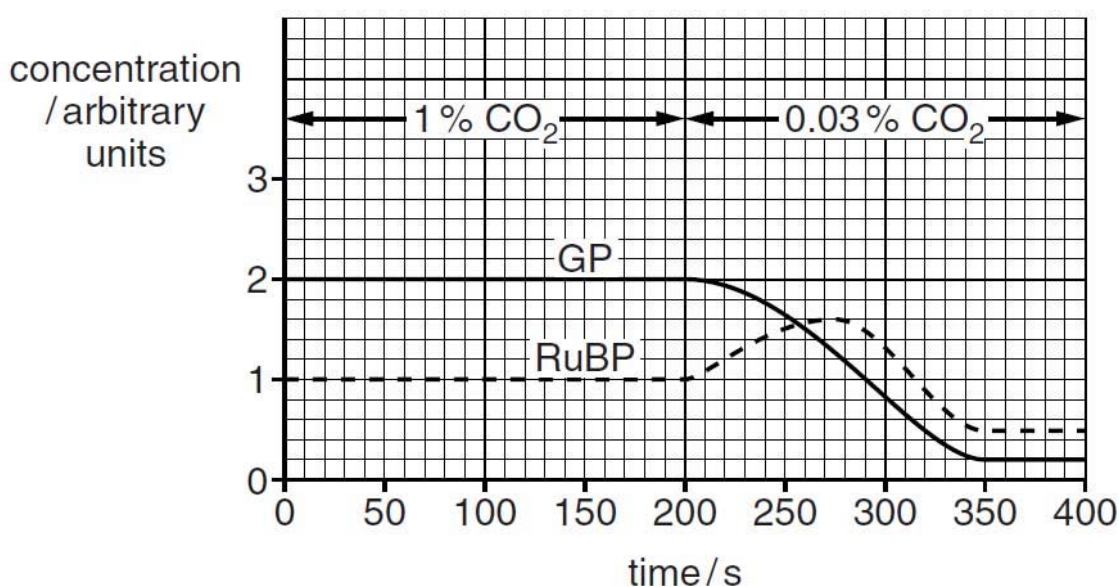
- A** Sex-linked dominant
B Sex-linked recessive
C Autosomal dominant
D Autosomal recessive

QUESTION 20

In an experiment, carbon dioxide concentration was altered to investigate its effects on the light-independent stage of photosynthesis.

- A cell suspension of *Chlorella* was illuminated using a bench lamp.
- The suspension was supplied with carbon dioxide at a concentration at 1% for 200 seconds.
- The concentration of carbon dioxide was then reduced to 0.03% for a further 200 seconds.
- The concentrations of RuBP (ribulose biphosphate) and GP (glycerate-3-phosphate) were measured at regular intervals.
- Throughout the investigation the temperature of the suspension was maintained at 25°C.

The results are shown below.



Which of the following statements is/are correct?

- 1 At 0.03% of CO₂, concentration of GP decreases due to the decrease in the rate of carbon fixation.
- 2 The concentration of RuBP increases between 210s and 250s due to more CO₂ fixation and more RuBP regenerated from triose phosphate.
- 3 There is an accumulation of triose phosphate between 250s to 290s.
- 4 There is an accumulation of RuBP in the chloroplast between 210s and 250s.

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

QUESTION 21

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 22

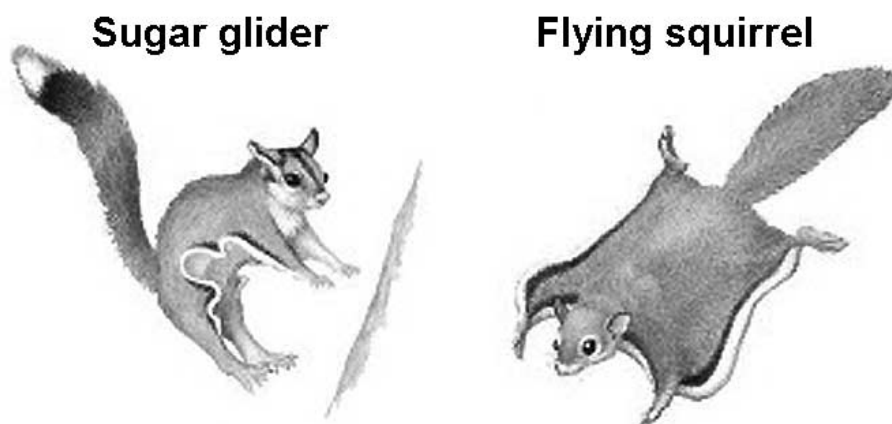
Both glucose and appropriate enzymes are necessary for the process of glycolysis to begin.

Which additional compound must also be present?

- A** acetyl coenzyme A
- B** ATP
- C** pyruvate
- D** reduced NAD

QUESTION 23

The sugar glider, *Petaurus breviceps*, is a marsupial mammal that is found on mainland Australia, New Guinea and parts of Indonesia. The Southern flying squirrel, *Glaucomys volans*, is a mammalian species endemic to the eastern half of North America. Both species have a structural feature known as a patagium, a membrane stretched between their limbs that enables them to glide between trees.



Which of the following **does not** explain the similarities between the sugar glider and the Southern flying squirrel?

- A Divergent evolution resulting in the patagium that serves a similar function in both species.
- B Adaptive radiation from a common mammalian ancestor that was geographically isolated into at least two populations in the past.
- C Natural selection acting on a common mammalian ancestor that was subjected to similar selection pressures on different continents.
- D Convergent evolution resulting in the patagium that serves a similar function in both species.

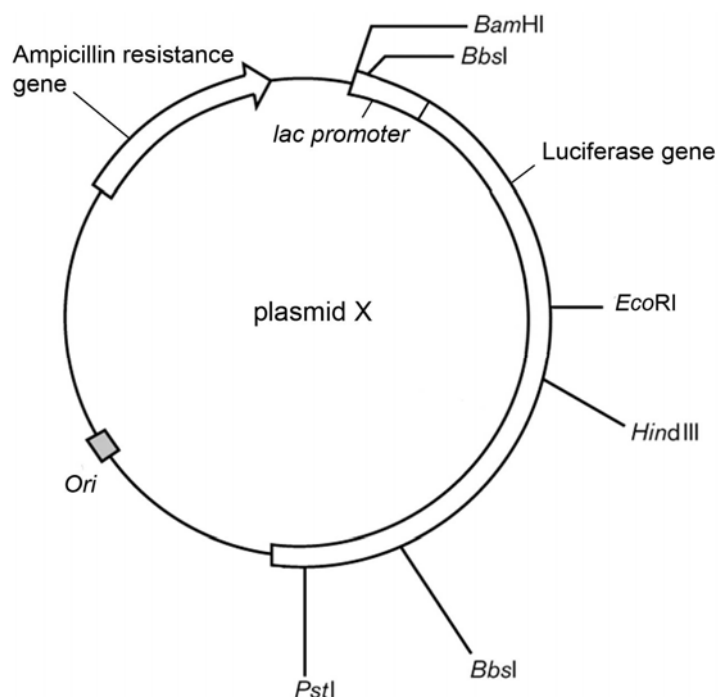
QUESTION 24

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 – 15.0 cm) and *Dendranthema grandiflora* (height varying between 8.0 – 25.0 cm) produce plants, when grown in natural day light, of a height varying between 55.0 – 71.0 cm.

QUESTION 25

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.



How many possible restriction sites can be used for the expression of human growth hormone gene?

- A** 1 **B** 2 **C** 3 **D** 5

QUESTION 26

Synthesis of human growth hormone (hGH) by genetically-modified bacteria involves the use of the enzyme reverse transcriptase.

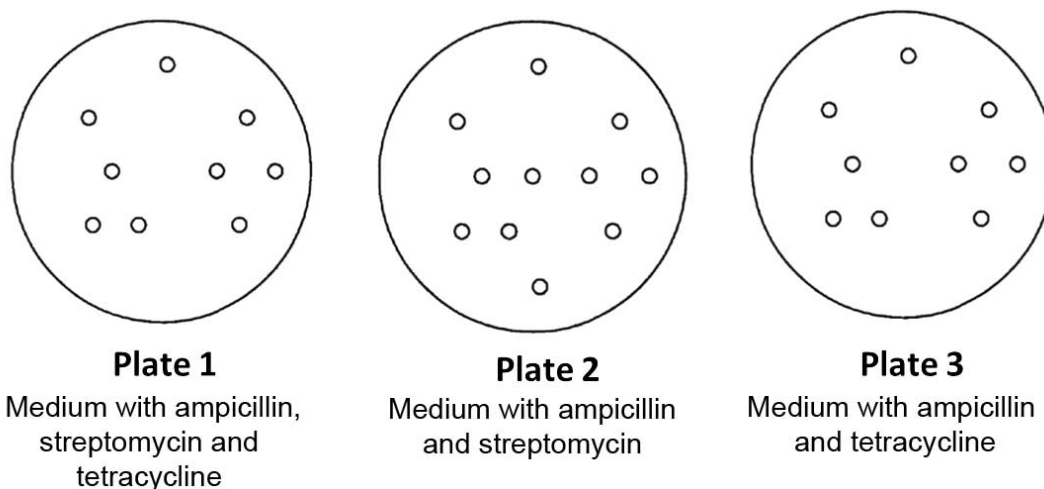
Which of the following statement(s) correctly describe(s) reverse transcriptase used in the above process?

- 1 It causes complementary DNA to be formed from mRNA
- 2 It causes single-stranded DNA to be converted to double-stranded DNA
- 3 It is found in prokaryotic cells
- 4 It is found in eukaryotic cells

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

QUESTION 27

A gene coding for the production of a human gene product was inserted into a plasmid with genes coding for resistance to antibiotics ampicillin, streptomycin and tetracycline. The plasmids were used to transform *E. coli* and the bacteria were grown on a nutrient medium with various antibiotics using replica plating. The resulting plates are shown in the diagram.



Which antibiotic gene(s) contain(s) the restriction site for the insertion of human gene?

- A Ampicillin
- B Streptomycin
- C Tetracycline
- D Ampicillin and tetracycline

QUESTION 28

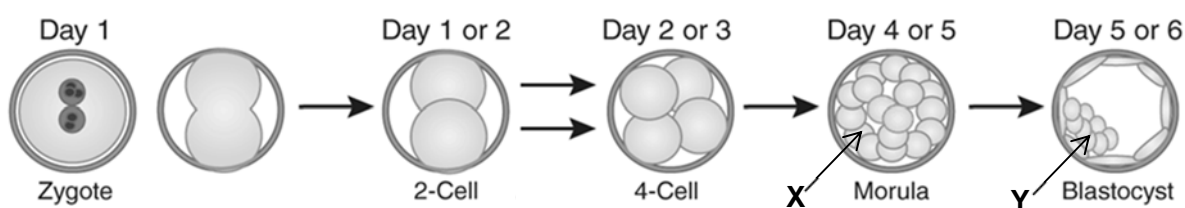
Which one of the following statements about PCR is **false**?

- 1 The PCR cycle involves denaturation of the template, annealing of the RNA primers and polymerization of nucleotides.
- 2 PCR uses thermostable DNA-dependent DNA polymerases.
- 3 Magnesium ion ensures the stability of the thermostable DNA polymerases in PCR as it functions as a cofactor for the thermostable DNA polymerases in PCR.
- 4 Shorter duration of denaturation temperature at 95°C is required if the DNA template has high guanine and cytosine content.

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

QUESTION 29

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 30

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 bacteria present in the lower intestines of 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

END OF PAPER 1