



TEMASEK JUNIOR COLLEGE
PRELIMINARY EXAMINATION
JC 2/ IP YEAR 6 2017

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H1 BIOLOGY

Paper 1 Multiple Choice

8875/01

Monday 18 September 2017
1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, Centre number and index number on the Answer Sheet in the spaces provided unless this has been done for you.

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 separate Multiple Choice Answer Sheet.

Read the instructions on the Multiple Choice Answer Sheet very carefully.

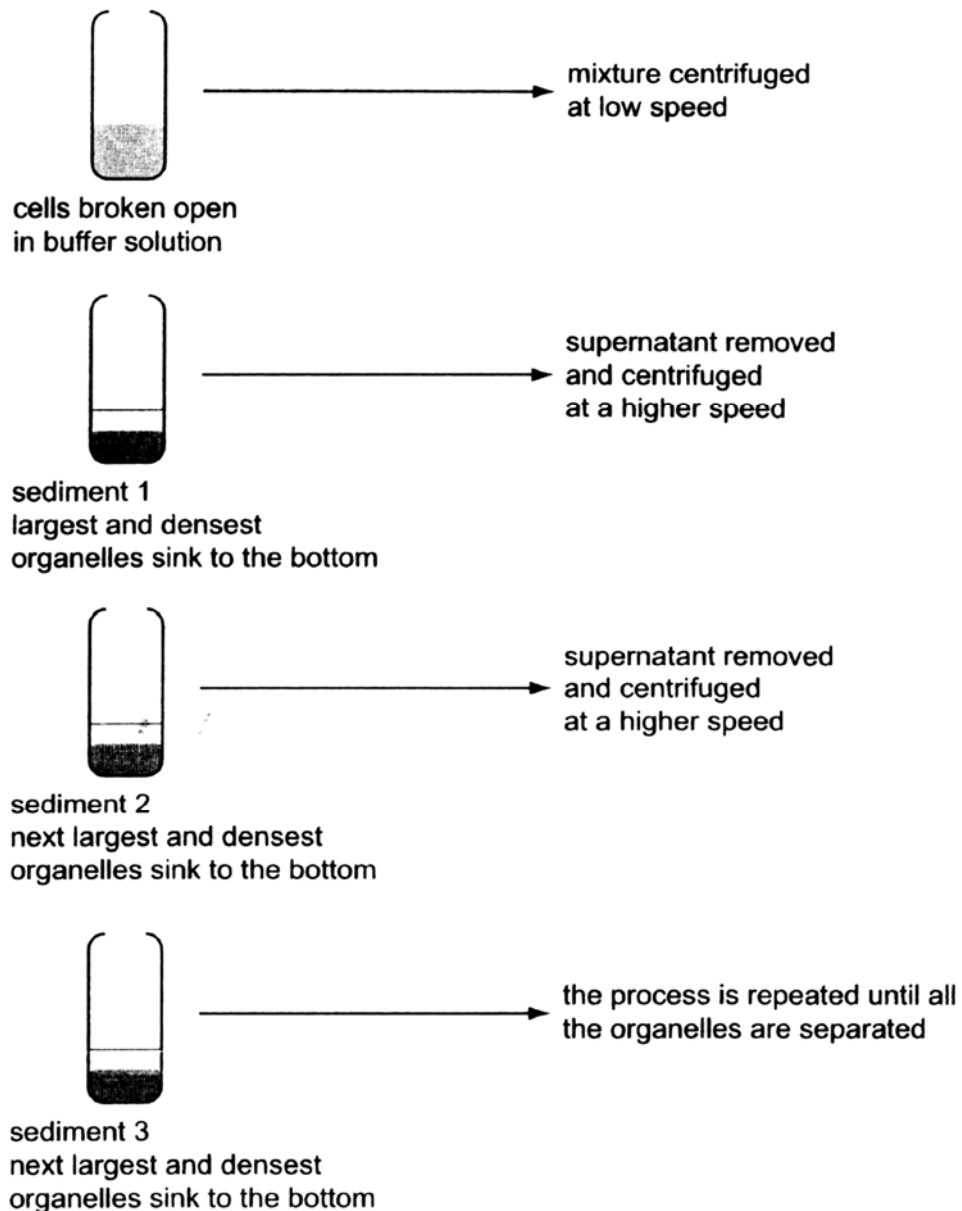
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.

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

- 1 Fractionation is used to separate plant cell components of a leaf extract according to their size and density. The diagram shows the main steps in fractionation.

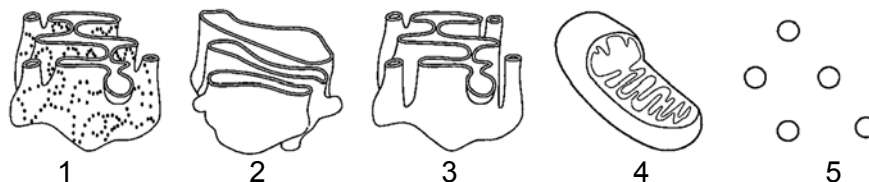


DCPIP and buffer solution were added to each sediment and the mixtures were left in the light for fifteen minutes. When DCPIP is reduced, it will turn from blue to colourless.

Which sediment(s) will cause DCPIP to be colourless?

- A Sediment 2 only
- B Sediment 3 only
- C Sediments 1 and 2
- D Sediments 2 and 3**

- 2 The diagram shows five different structures that can be observed in cells.



Which structures would be present in large quantities in a cell that is actively synthesising the following molecules?

	Extracellular glycolipids	Proteins
A	1, 4, 5	3, 4, 5
B	1, 3, 4, 5	1, 2, 4, 5
C	2, 3, 4, 5	1, 2, 4, 5
D	2, 3, 4, 5	1, 3, 4, 5

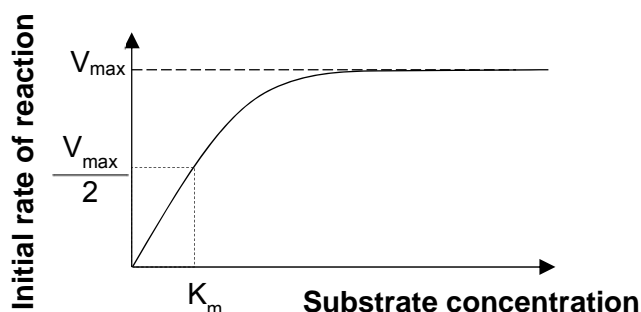
- 3 Keratin is a fibrous protein in skin, hair and nails. The features of one form of keratin are listed.

- 1 The peptide chain has mainly small amino acid residues.
- 2 Each peptide chain forms an α -helix.
- 3 Two helices coil together.
- 4 Covalent bonds link adjacent helices.

Which features are the same in collagen molecule?

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

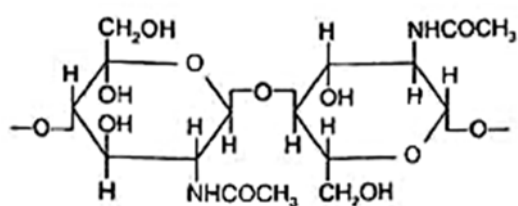
- 4 The value K_m is the substrate concentration at which the rate of an enzyme-catalysed reaction is half its maximum rate, $\frac{V_{max}}{2}$. The K_m was measured in the presence of a competitive inhibitor and a non-competitive inhibitor.



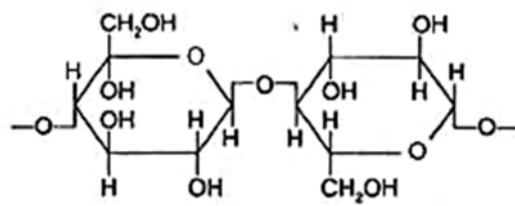
How will the value of K_m be affected in the presence of inhibitors?

	value of K_m in presence of	
	competitive inhibitor	non-competitive inhibitor
A	less	less
B	less	more
C	more	less
D	the same	more

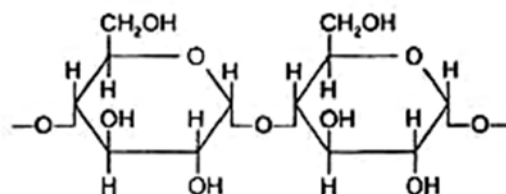
- 5 The diagrams show short sections of some common polysaccharides and modified polysaccharides.



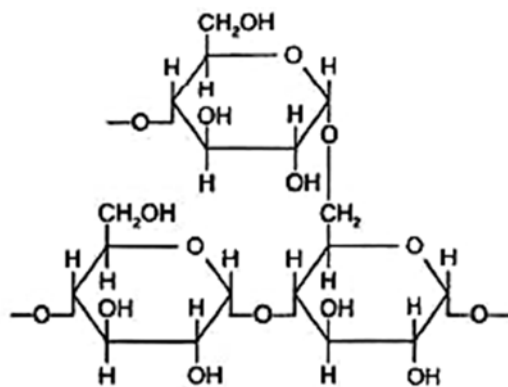
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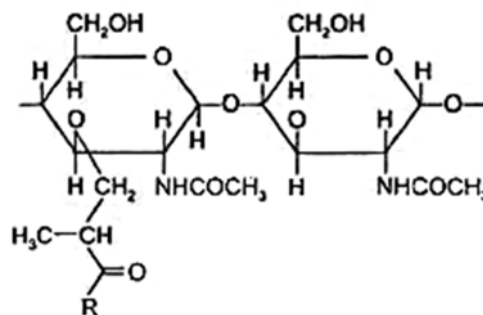
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3



4



5

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	polysaccharide G	polysaccharide H	polysaccharide J	polysaccharide 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

- 6 Which of the following statement about membranes is correct?
- 1 All intracellular membranes in a eukaryotic cell have the same type of lipids and proteins.
 - 2 The outer and inner membranes of mitochondria have the same type of transport proteins.
 - 3 Carbohydrates form part of glycoproteins or glycolipids in the membranes.
 - 4 All plant cell membranes have cholesterol.

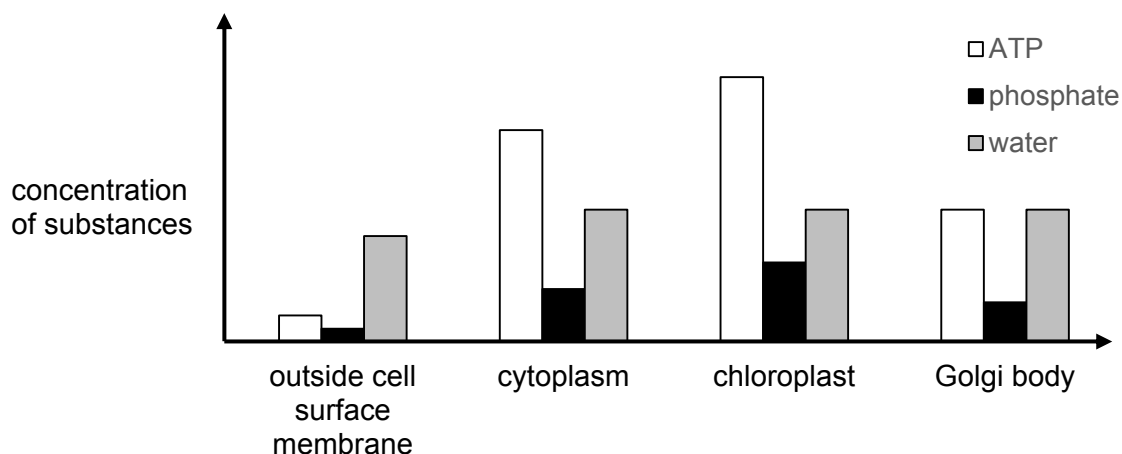
A 3 only

B 1 and 4

C 2 and 3

D 1, 3 and 4

- 7 The chart shows the concentration of some substances outside the cell surface membrane, in the cytoplasm, in the chloroplast and in the Golgi body of a plant cell.



Which statement about the direction of movement of these substances and the process by which they are moving is correct?

A ATP is leaving the chloroplast by facilitated diffusion, water is leaving the plant cell by osmosis.

B Phosphate and ATP are entering the chloroplast and Golgi body by active transport.

C Phosphate and ATP are leaving the Golgi body by facilitated diffusion, water is leaving the plant cell by osmosis.

D Phosphate is entering the chloroplast by facilitated diffusion, water is entering the chloroplast by osmosis.

- 8 No crossing over occurs during meiosis in male fruit flies of the species *Drosophila melanogaster*.

The diagram shows the four pairs of homologous chromosomes present in a testis cell of a male fly.



Which set of chromosomes in a gamete nucleus shows the genetic variation resulting from independent assortment?



- 9 What is the role of stem cells with regards to the function of adult tissues and organs?
- A Stem cells are fully differentiated cells that reside under the surface of epithelial tissue, in position to take over the function of the tissue when the overlying cells become damaged or worn out.
 - B Stem cells are totipotent cells that divide asymmetrically, giving rise to one daughter cell that remains a stem cell and one daughter cell that will differentiate to replace damaged and worn out cells in the adult tissue or organ.
 - C Stem cells are embryonic cells that persist in the adult, and can give rise to all of the cell types in the body.
 - D Stem cells are cells that have yet to express the genes and produce proteins characteristic of their differentiated state, but do so when needed for repair of tissues and organs.
- 10 A gene coding for an ion channel consists of 249 999 base pairs, which have 26 introns and 27 exons. During mRNA processing, a final transcript of 3570 bases is left.

How many additional amino acids would have been needed had the gene not contained introns?

- A 82 143
- B 83 324
- C 83 333
- D 83 342

- 11 Antibiotics are used to kill pathogens that infect people, without causing damage to human cells.

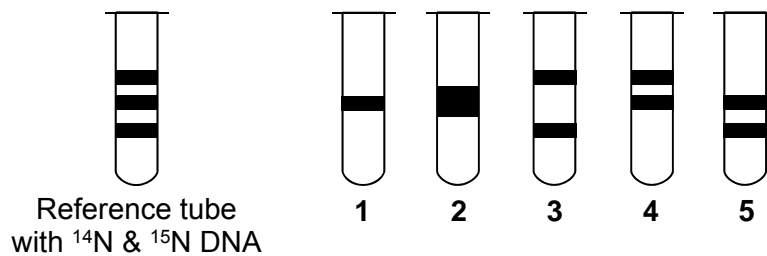
Different antibiotics work in different ways.

- Erythromycin binds to bacterial ribosomes.
- Nystatin binds to ergosterol which replaces cholesterol in pathogenic fungi.
- Rifampicin binds to bacterial RNA polymerase.
- Ciprofloxacin binds to DNA topoisomerase (enzyme that removes supercoiling of DNA).

Which antibiotic directly inhibits the following process in pathogens?

	Membrane formation	DNA replication	Transcription	Translation
A	rifampicin	ciprofloxacin	erythromycin	nystatin
B	rifampicin	nystatin	erythromycin	ciprofloxacin
C	nystatin	ciprofloxacin	rifampicin	erythromycin
D	nystatin	rifampicin	ciprofloxacin	erythromycin

- 12 Cells of the bacterium *E. coli* were grown for many generations on a medium containing only the heavy isotope of nitrogen ^{15}N . The cells were then transferred to a medium containing only ^{14}N and grown for two generations. Samples of the bacteria were then removed from the culture. The DNA from each sample was extracted and centrifuged at very high speeds in a solution of caesium chloride. The diagram below illustrates the distribution of DNA in various centrifuge tubes, 1, 2, 3, 4 and 5.



Which of the centrifuge tube above would support the hypothesis of conservative and semi-conservative DNA replication?

	conservative replication	semi-conservative replication
A	4	2
B	2	3
C	3	4
D	5	1

- 13 Which of the following statement is correct?

- 1 Each nucleosome consists of DNA wound twice around a histone octamer, a protein core made up of 4 different types of histone proteins.
- 2 Negatively charged histones bind tightly to positively charged DNA via ionic attractions.
- 3 The 10nm fibre coils to form a 30nm chromatin fibre or solenoid.
- 4 The 8 nucleosomes assemble to form looped domains, which are attached to chromosome scaffolds.
- 5 The looped domains coil further to form highly condensed chromosomes during prophase.

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

- 14 In most organisms, six different triplets of the DNA strand that is complementary to mRNA code for the amino acid serine: AGA, AGG, AGT, AGC, TCA and TCG.

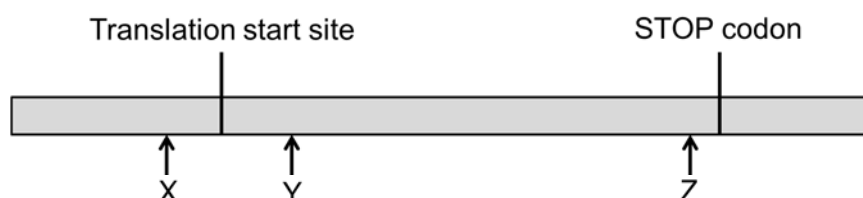
In the yeast *Candida albicans*, a seventh DNA triplet, GAC, also codes for serine. In most organisms, this triplet codes for leucine.

The diagram shows part of an mRNA molecule from *C. albicans*.

	AGU	UCG	CGG	UCA	AGC	ACC	UGG
codon number	11	12	13	14	15	16	17

Which mutation of the DNA that is complementary to this mRNA could result in *C. albicans* producing a polypeptide with a continuous sequence of five serines in it?

- A substituting a purine with a pyrimidine in the DNA coding for codon 13
 B substituting a purine with a pyrimidine in the DNA coding for codon 16
 C substituting a pyrimidine with a purine in the DNA coding for codon 13
 D substituting a pyrimidine with a purine in the DNA coding for codon 16
- 15 During the process of transcription, errors sometimes occur such that certain nucleotides are repeated. The diagram shows a strand of mRNA produced from a particular gene.



Which of the following event will most likely lead to the synthesis of a non-functional protein?

- A One base pair is inserted at X.
 B Three base pairs are inserted at X.
 C One base pair is inserted at Y.
 D Three base pairs are inserted at Z.
- 16 The speech defect known as stuttering may involve two genes, **G** and **N**. Most people are homozygous for the alleles **g** and **n** and are not stutterers.

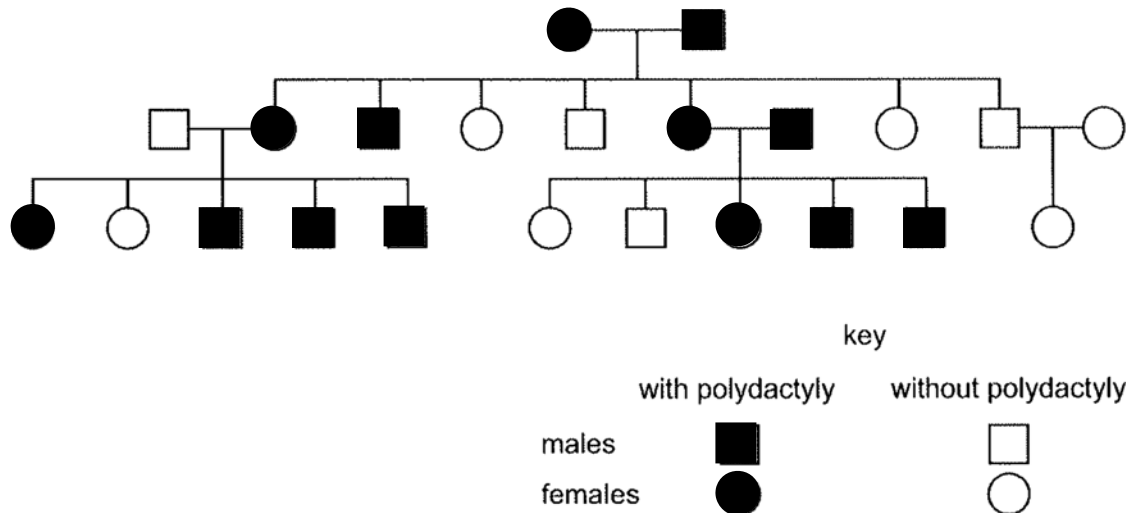
However, recent research has shown that the presence of either of the mutant alleles **G** or **N** can cause stuttering in heterozygotes.

Using this information, which proportion of the children of a couple, the father with genotype **Ggnn** and the mother **ggNn**, are likely to be stutterers?

- A 3/16
 B 8/16
 C 9/16
 D 12/16

- 17 Polydactyly is a genetic condition, controlled by a single gene, in which people are born with extra fingers and toes.

The diagram shows the pedigree of a family.



What is true about the inheritance of polydactyly?

	The allele coding for polydactyly is dominant	The allele coding for polydactyly is autosomal	Offspring of parents with polydactyly will all inherit the allele	More males than females will inherit the polydactyly allele
A	True	True	False	False
B	True	False	False	True
C	False	False	False	True
D	False	False	True	True

- 18 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 parent plants.
- 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 length, of a height varying between 55.0–71.0 cm.

- 19 The pigment haemoglobin found in red blood cells of mammals and birds combines readily with oxygen.

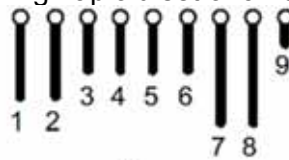
DNA analysis has revealed that a form of haemoglobin is found in a wide range of unrelated phylogenetic groups including bacteria, annelids, arthropods and leguminous plants.

Which evolutionary processes could account for the distribution of haemoglobin in such a wide variety of organisms?

	adaptive radiation	conservation of genes	natural selection	
A	✓	✓	✓	key ✓ true X false
B	✓	✓	X	
C	✓	X	✓	
D	X	✓	✓	

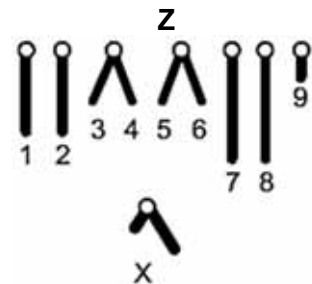
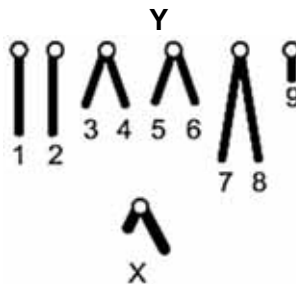
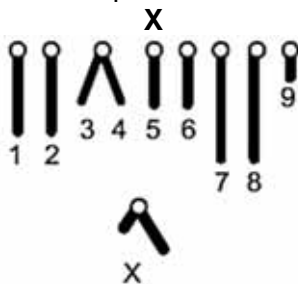
- 20 In some Australian insects, new species have arisen through changes that occurred to chromosomes in an ancestral species. Such changes may involve the joining of chromosomes, the loss of whole or parts of chromosomes, and rearrangement of the genetic material within chromosomes.

One ancestral species has the following haploid set of chromosomes.



X

Three new species have the haploid sets of chromosomes shown below.



What is the most likely order in which these species appear?

- A** ancestral species, species Z, species X, species Y.
B ancestral species, species X, species Y, species Z.
C ancestral species, species Y, species X, species Z.
D ancestral species, species X, species Z, species Y.

- 21 Bacteria in the genus *Wolbachia* infect many butterfly species. They are passed from one generation to the next in eggs, but not in sperm, and they selectively kill developing male embryos.

In Samoa in the 1960s, the proportion of male blue moon butterflies fell to less than 1% of the population. However, by 2006, the proportion of males was almost 50% of the population.

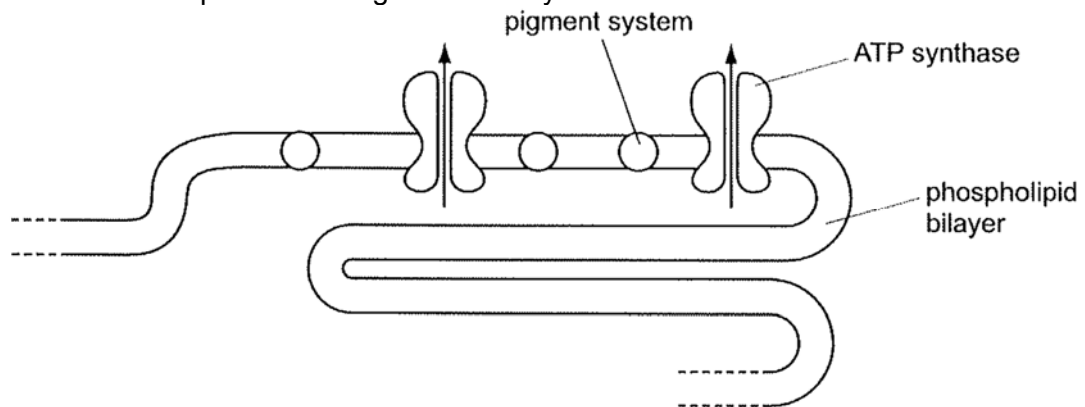
Resistance to *Wolbachia* is the result of the dominant allele of a suppressor gene.

Which statements correctly describe the evolution of resistance to *Wolbachia* in the blue moon butterfly population?

- 1 *Wolbachia* acts as a selective agent.
- 2 The selective killing of male embryos is an example of artificial selection.
- 3 When infected with *Wolbachia*, male embryos that are homozygous for the recessive allele of the suppressor gene die.
- 4 All male embryos that carry the dominant allele of the suppressor gene pass that allele to their offspring.
- 5 The frequency of the dominant allele of the suppressor gene rises in the butterfly population.

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

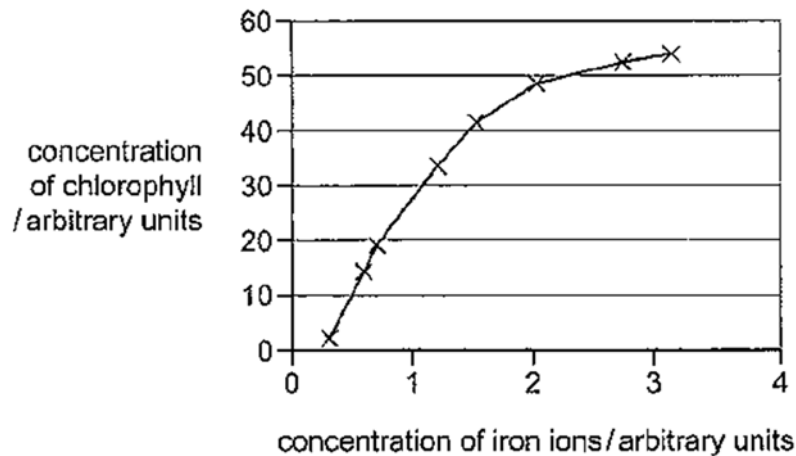
- 22 The diagram shows a small part of a thylakoid membrane. The arrows represent the movement of a particular reaction product through the ATP synthase.



From which chemical was this product derived from?

- A NADH B NADPH C Oxygen **D Water**

- 23 The concentration of chlorophyll in the leaves of beetroot plants grown in increasing concentrations of iron ions was measured. The concentration of the breakdown products of chlorophyll was not determined. The graph shows the results.



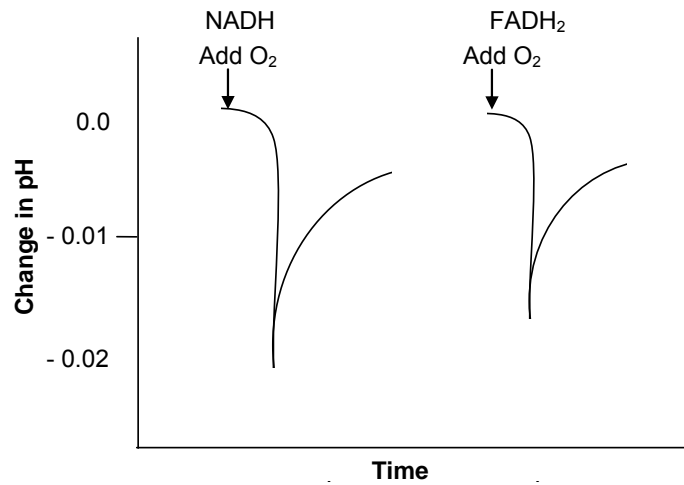
What conclusions can be drawn from the results?

- 1 Concentration of chlorophyll was directly proportional to the concentration of iron ions.
- 2 Concentration of iron ions was a limiting factor for the production of chlorophyll.
- 3 Plants given a higher concentration of iron ions synthesised more chlorophyll.
- 4 Plants given a higher concentration of iron ions increased their rate of photosynthesis.

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

- 24 Which set of reactions releases the smallest number of ATP molecules by substrate level phosphorylation?
- A** conversion of glucose to ethanol and carbon dioxide
B conversion of glucose to lactic acid
C glycolysis of glucose
D one turn of the Krebs cycle

- 25 Isolated mitochondria were incubated with NADH in one experiment and an equal amount of FADH_2 in another set up. The mitochondria were initially deprived of oxygen. A known quantity of oxygen was then added and the pH of the intermembrane space was monitored. The result is shown in the graph.

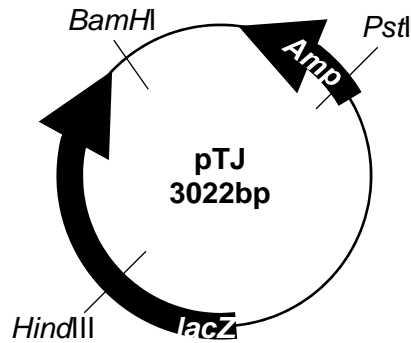


Which of the following can be concluded based on the results?

- 1 Upon the addition of oxygen, glycolysis and subsequently link reaction, Krebs cycle and oxidative phosphorylation occurred.
- 2 Electron transfer was initiated by the addition of oxygen.
- 3 The pH drop was greater with NADH than with FADH_2 , which is consistent with the greater ATP yield that accompanies the oxidation of NADH.
- 4 The rapid decline in pH indicates that protons were pumped into the intermembrane space when oxygen was available.

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

26 The restriction sites and selectable markers on the vector pTJ are shown below.



If the gene for C protein were to be inserted into *lacZ* site, what should be added to the agar plate in order to screen for recombinant clones and how would the recombinant clones appear?

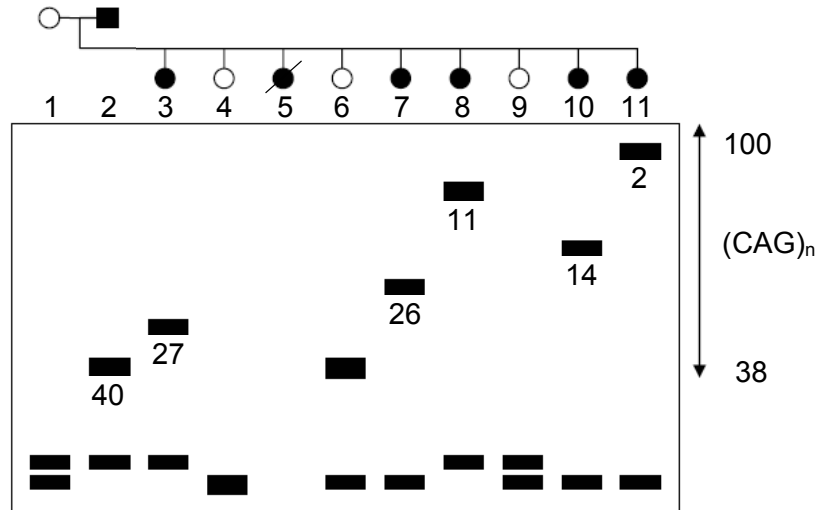
	Chemicals to be added		Colour of colonies
A	ampicillin	X-gal	Blue
B	β -galactosidase	X-gal	Blue
C	ampicillin	X-gal	White
D	β -galactosidase	lactose	White

27 Which of the following is correct?

	Polymerase Chain Reaction	Translation
A	Occurs in the nucleus	Occurs in the cytoplasm
B	Requires ribonucleic acids	Does not require deoxyribonucleic acids
C	Synthesizes selected section of the DNA	Synthesizes selected section of the mature mRNA
D	Uses information on the template between the primers	Uses information on the template between the start and stop codons

- 28 The diagram below shows the results of electrophoresis of PCR fragments. Individuals with Huntington's disease have nucleotide sequence CAG that repeats from 36 to more than 120 times.

The male parent (individual 2) suffers from Huntington's disease when he was 40 years old. Six of his children (individuals 3, 5, 7, 8, 10, 11) suffer from Huntington's disease, and the age at which the symptoms first began is shown by the number below the band containing the PCR fragments.



What conclusion can be drawn from the data above?

- A Individuals 4, 6, and 9 have not inherited the allele that causes Huntington's disease.
 B Individuals 4, 6, and 9 will still develop Huntington's disease at some point in their lives, since the disease is inherited as a dominant trait.
 C Individuals 4 and 9 do not have the trait, and will not get Huntington's disease, but individual 6 is likely to have the disease when she reaches her father's age of 40.
 D Two of the three will develop the disease, since it is inherited as a dominant trait, but the data does not allow us to predict which two.
- 29 What is a concern over the creation of genetically modified farmed animals?
- 1 Some genetically modified food products may cause allergies.
 - 2 Gene transfer between genetically modified farmed animals and those in the wild may alter the gene pool of the species in the wild.
 - 3 Overproduction of certain gene products may cause undue stress to the genetically modified farmed animals.
 - 4 Some genetically modified food products may not be acceptable to certain groups of people.
- A 1 and 4
 B 2 and 3
 C 1, 3 and 4
 D All of the above

- 30** The Human Genome Project (HGP) has brought about great advancements in health and medicine.

Which of the following statements about HGP is correct?

	intended application	ethical concerns
A	developing diagnostic test to identify the gender of a foetus by detecting the presence of the foetal Y chromosome	designing of new antibody-based medicines which target proteins coded for by oncogenes
B	using a suspect's genetic pre-disposition to violent behaviour in criminal trials	screening the genetic make-up of an individual for genetic predisposition to cancer to determine if the individual is suitable to work in a nuclear power plant
C	comparing homologous genes of different human populations to trace lineages and migration patterns	comparing homologous genes to determine evolutionary relationships between organisms
D	prescribing suitable drugs to minimise adverse side effects due to the individual's inability to metabolize the medicine	publishing genetic information of specific individuals in a database readily accessible by the public