



TEMASEK JUNIOR COLLEGE
Preliminary Examinations 2016
Higher 1

BIOLOGY

8875/01

Paper 1 Multiple Choice

Tuesday, 20 September 2016

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, index number on the Answer Sheet in the spaces provided unless this has been done for you.

DO NOT WRITE IN ANY BARCODES.

There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C, D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

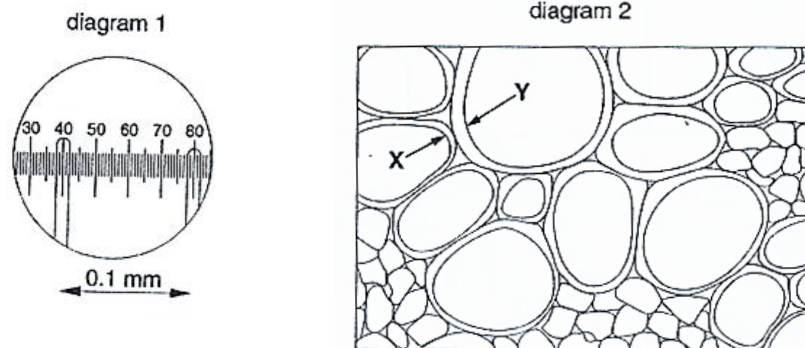
Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough work should be done in this booklet.

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

- 1 Diagram 1 shows a stage micrometer, on which the graduations are 0.1 mm apart, and an eyepiece graticule, as seen through a light microscope.

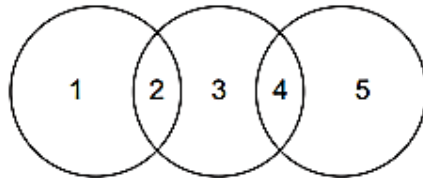
Diagram 2 shows a section of plant tissue viewed at the same magnification.



What is the approximate total thickness of the cell walls between X and Y?

- A $10 \mu\text{m}$ B $20 \mu\text{m}$ C $100 \mu\text{m}$ D $200 \mu\text{m}$

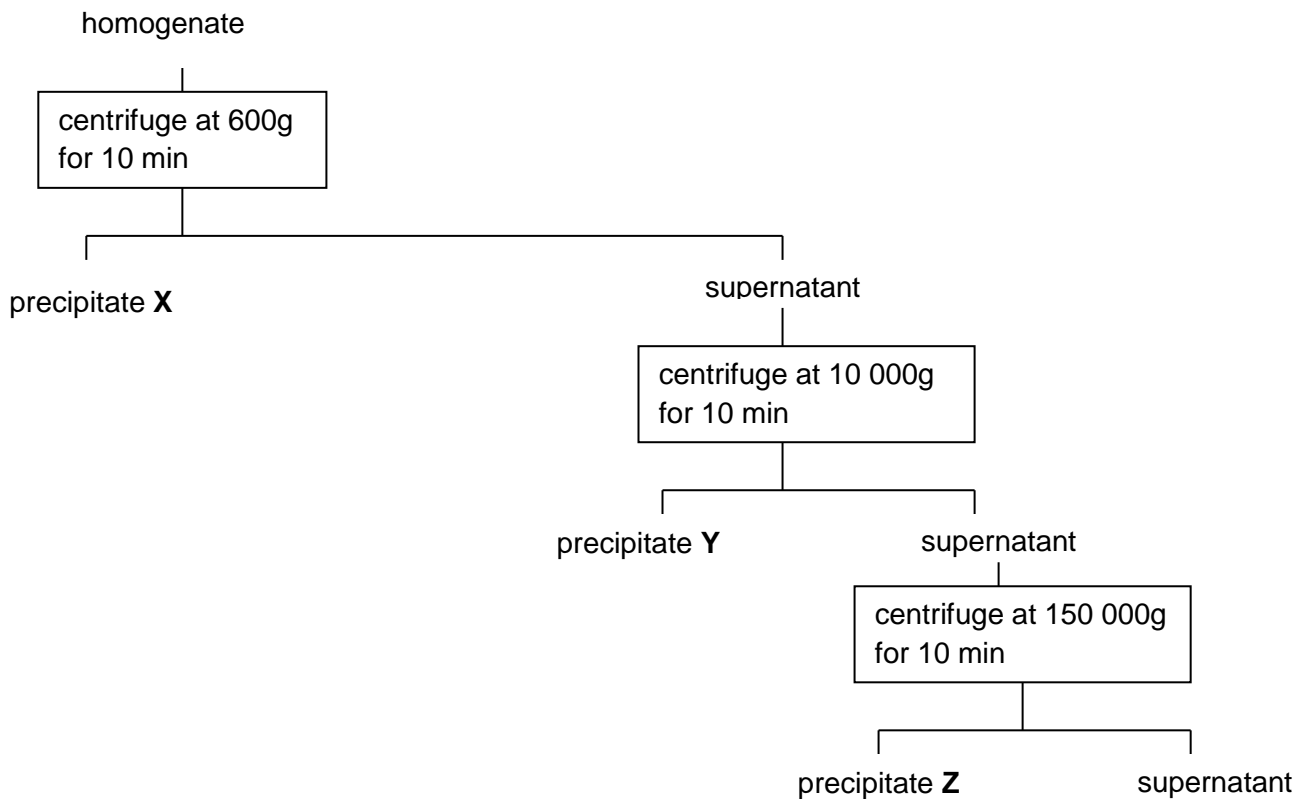
- 2 The diagram shows some similarities between chloroplasts, mitochondria and typical prokaryotes.



Which of the following is correct?

	1	2	3	4	5
A	chloroplasts	circular DNA	mitochondria	80s ribosomes	prokaryotes
B	chloroplasts	80s ribosomes	mitochondria	circular DNA	prokaryotes
C	prokaryotes	circular DNA	mitochondria	circular DNA	chloroplasts
D	prokaryotes	70s ribosomes	chloroplasts	80s ribosomes	mitochondria

- 3 The diagram below shows an outline of the procedure for separation of cell components from a liver homogenate in 0.25M sucrose at 0°C.



What do **X**, **Y** and **Z** represent?

	X	Y	Z
A	endoplasmic reticulum and ribosomes	nuclei	mitochondria
B	endoplasmic reticulum and ribosomes	mitochondria	nuclei
C	nuclei	endoplasmic reticulum and ribosomes	mitochondria
D	nuclei	mitochondria	endoplasmic reticulum and ribosomes

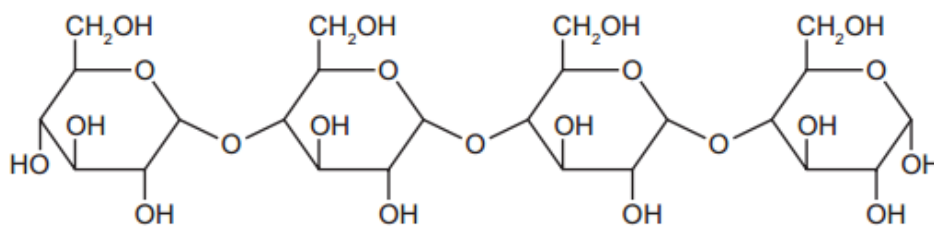
- 4 The table below shows the results of experiments on the rates of absorption of some monosaccharide sugars by pieces of living small intestine, and by similar pieces of intestine poisoned with cyanide which affects the electron transport chain.

<i>sugar</i>	<i>rate of absorption/ arbitrary units</i>	
	<i>by living intestine</i>	<i>by poisoned intestine</i>
glucose	1.00	0.33
xylose	0.30	0.31
fructose	0.40	0.37
galactose	1.10	0.53
arabinose	0.29	0.29

Which sugars are being actively absorbed?

- A glucose and fructose
- B glucose and galactose**
- C glucose and xylose
- D xylose and arabinose
- 5 A marine mammal, such as a seal or porpoise, stores large amounts of subcutaneous fat as 'blubber'. Which one of the following is an **incorrect** statement about the adaptive value of this fat?
- A It has a low energy content for its mass in comparison to other food reserves such as glycogen.**
- B It has an insulating function, fat having a low heat conductivity.
- C It acts as an energy store, being utilised when the animal is short of food.
- D It is insoluble in water therefore it does not affect the osmotic balance of the cells.

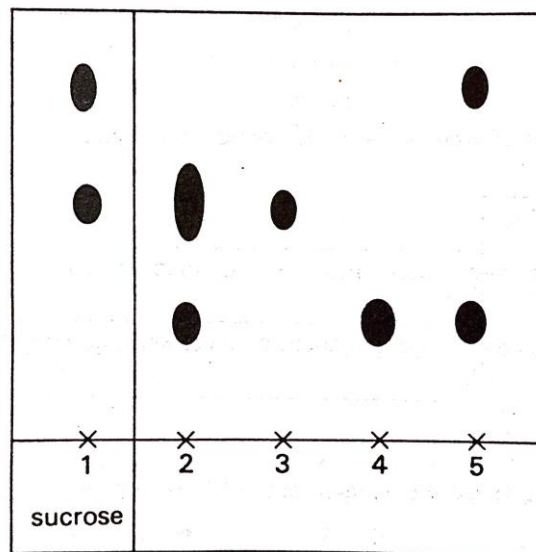
- 6 The molecule shown is a polymer of reducing sugars.



Which procedures could be carried out in order to test for the presence of reducing sugars in this molecule?

- 1 Add hydrolytic enzyme and then heat with Benedict's reagent.
 - 2 Dissolve in water, neutralize and then heat with Benedict's reagent.
 - 3 Boil with hydrochloric acid, neutralize and then heat with Benedict's reagent.
- A** 1, 2 and 3
- B** 1 and 2 only
- C** 1 and 3 only
- D** 2 and 3 only

- 7 Five disaccharides were each hydrolysed with dilute acid, and the purified products were separated by one-dimensional chromatography. The final chromatogram is shown in the diagram below.



If spot 1 represents the products obtained from the hydrolysis of sucrose, which one of the following indicates the results obtained from the hydrolysis of lactose and maltose?

	lactose	maltose
A	2	3
B	2	4
C	5	2
D	5	3

8 An unusual enzyme has been found in a tropical grass.

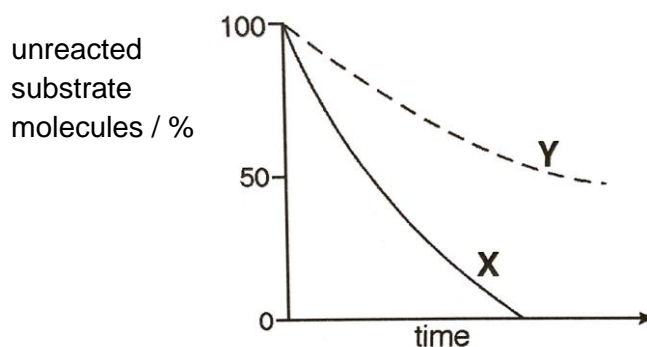
- It catalyses the hydrolysis of the fungal polysaccharide, chitin, into amino sugars.
- It also inhibits the activity of an enzyme in locust guts which catalyses the digestion of amylose.

Which of the following describes the actions of this unusual enzyme?

	reaction catalysed	reaction inhibited
A	hydrolysis of glycosidic bonds	condensation of glycosidic bonds
B	hydrolysis of glycosidic bonds	hydrolysis of glycosidic bonds
C	hydrolysis of peptide bonds	condensation of glycosidic bonds
D	hydrolysis of peptide bonds	hydrolysis of glycosidic bonds

9 Curve **X** represents the course of an enzyme-catalysed reaction under optimum conditions.

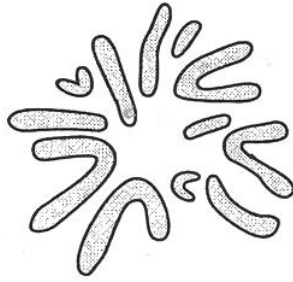
Curve **Y** shows the action of the same enzyme on the same substrate but with one alteration to the reaction conditions.



Which factor, operating to a constant extent throughout the experiment, could give the results shown by curve **Y**?

- A** increased substrate concentration
- B** inhibition by the end product
- C** less concentrated reaction mixture
- D** lower temperature

- 10 The diagram shows some chromosomes at late prophase of mitosis.



How many chromosomes would be present in one nucleus at telophase II of meiosis?

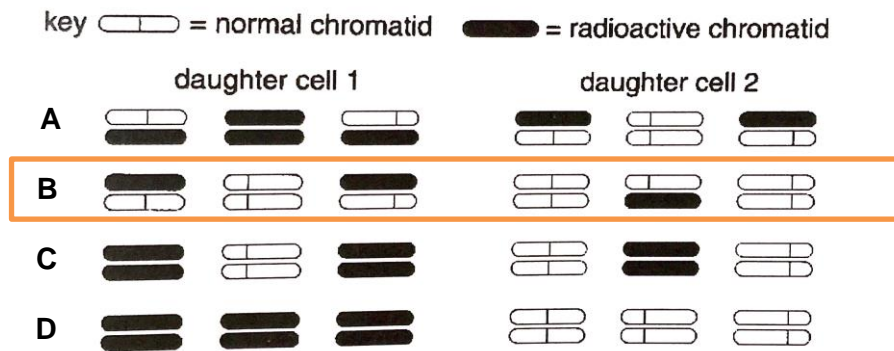
- A** 6 **B** 12 **C** 18 **D** 24
- 11 If the nucleus of a human motor neurone contains 6.8 picograms (pg) of DNA, what mass of DNA is the nucleus of an actively dividing human cell likely to contain at the end of interphase?
- A** 3.4 pg **B** 6.8 pg **C** 13.6 pg **D** 27.2 pg
- 12 Cells from a bacterial clone were grown for many generations on a medium in which all the nitrogen compounds contained only the isotope nitrogen 15 (^{15}N). Adenine comprised 36% of the nitrogen bases present. A sample of these bacteria was transferred to a medium in which the only nitrogen source was ^{14}N and was provided with conditions suitable for asexual reproduction. What was the percentage of guanine in the DNA?
- A** 14%
B 18%
C 28%
D 36%
- 13 If there were 34 amino acids and DNA only contained two types of nitrogenous bases, what would be the minimum number of bases per codon that could code for proteins?

A 3 B 4 **C 6** D 8

14 The following experiment was carried out.

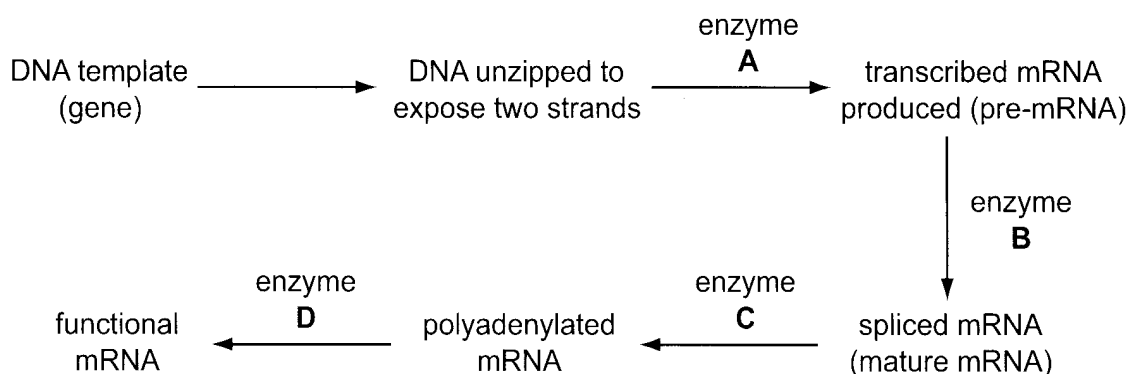
- 1 Haploid cells, containing three chromosomes each, were grown in a medium containing radioactive thymine, so that all the DNA was labelled.
- 2 Cells in early interphase were then transferred to a medium where the available thymine was not radioactive.
- 3 A single cell was immediately isolated and allowed to divide once. When the two daughter cells reached the next metaphase, they were fixed and their three chromosomes were inspected for radioactivity.

Which diagram represents the distribution of radioactivity at metaphase in the two daughter cells?



15 The production of functional mRNA is controlled by a series of enzymes.

Which enzyme catalyses the removal of introns during the production of functional mRNA?



16 Onion root tip cells were used to produce a range of hybrid species from cabbage and radish.

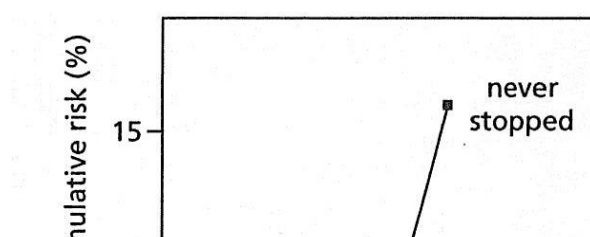
The table below shows the chromosome numbers in the parental species and the hybrids.

type of cell	number of chromosomes per cell
parental cabbage	18
parental radish	18
parental gametes	9
F ₁ hybrids	18
F ₁ gametes	9
F ₂ hybrids	18
F ₂ gametes	18
F ₃ hybrids	36

At which stage did the chromosomal mutation occur?

- A during the formation of the F₁ gametes
- B during the formation of the F₂ gametes**
- C during the fusion of the parental gametes
- D during the fusion of the F₁ gametes

- 17 Mortality due to lung cancer was followed in groups of males in the United Kingdom for 50 years. The cumulative risk of dying from lung cancer as a function of age and smoking habits for four groups of males is shown in the figure.



[Turn over

Which of the following best explains the trends observed in the graph?

- 1 The slower the rate of accumulation of mutations, the lower the cumulative risk.
- 2 When an individual stops smoking, he will undergo a decreased rate of mutation accumulation.
- 3 The presence of cigarette smoke will cause the accumulation of mutations to occur at an increased rate.
- 4 There is little risk of a non-smoker dying of lung cancer.

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

18 Which of the following is **not** true about cancerous cells?

- A** Ability to divide for a certain number of times.
- B** Ability to divide further when in contact with neighbouring cells.

- C** Inability to differentiate properly.
- D** Inability to exhibit anchorage dependence.

- 19** The table shows the blood group phenotypes resulting from crosses between different genotypes.

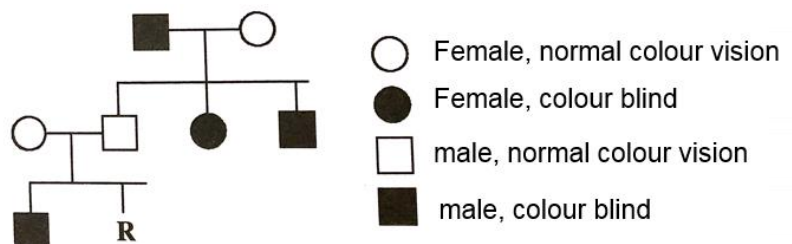
genotype of 1 st parent	genotype of 2 nd parent	
	$I^A I^A$	$I^A I^O$
$I^A I^O$	A	A and O
$I^B I^O$	A and AB	A, B, O and AB

Two parents have a son who has blood group A and phenylketonuria. One parent has blood group O and the other has blood group AB. Neither parent has phenylketonuria.

What is the probability that the second child of these parents will be a girl with blood group B who does not have phenylketonuria?

- A** 1 in 16 **B** 1 in 8 **C** 3 in 16 **D** 3 in 8

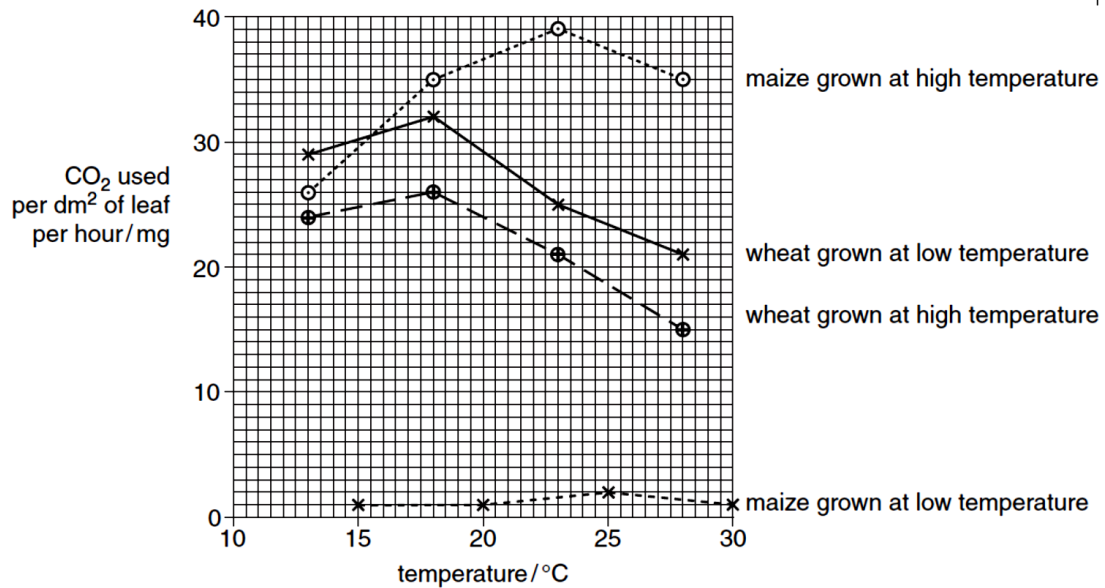
- 20** The diagram shows the inheritance of red-green colour blindness in a family. This condition is caused by a sex-linked recessive allele.



What is the probability that individual **R** will be a colour-blind boy?

- A** 0 **B** 0.125 **C** 0.25 **D** 0.5

- 21** Young maize and wheat plants were grown to maturity at high and low temperatures. The rate of photosynthesis in each of these mature plants was measured at different temperatures. The rate of photosynthesis was measured as the amount of CO_2 dm^3 of leaf per hour. The results are shown in the graph below.



What information can be concluded from the graph above?

- 1 For plants grown at high temperature, the rate of photosynthesis is optimum at 25°C in maize and 18°C in wheat.
- 2 For plants grown at high temperature, maize had a greater increase in rate of photosynthesis compared to wheat until optimum temperature was reached.
- 3 The rate of photosynthesis was affected more significantly in maize plants than in wheat plants grown at low temperatures.
- 4 Low temperatures slowed down the formation of membranes in maize plants but not in wheat plants which caused a decrease in lamellae formation.

A 2 and 3 only

B 1 and 4 only

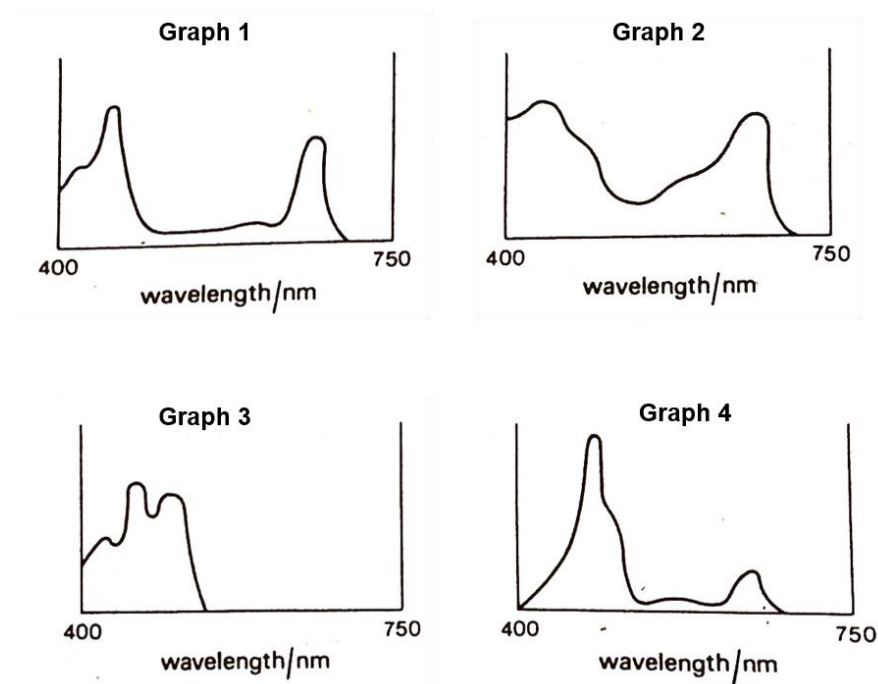
C 1, 2 and 3 only

D All of the above

- 22** Three of the four graphs below show the absorption spectra of photosynthetic pigments. The other graph shows the action spectrum of photosynthesis for a plant containing those pigments.

The x-axes show wavelength. Three of the y-axes show the percentage light absorbed while the other shows the rate of photosynthesis measured by the rate of evolution of oxygen.

[Turn over



Which one of the following series identifies the four graphs?

	<i>Absorption spectra</i>			<i>Action spectrum</i>
	Chlorophyll a	Chlorophyll b	Carotenoids	
A	1	4	3	2
B	2	1	3	4
C	4	2	1	3
D	3	2	4	1

23 Lactate circulates from respiring muscle tissue to the liver.

Which of the following will initially be synthesised from lactate in the cytoplasmic cells?

- A** 3C sugar phosphate
- B** acetylcoenzyme A

C fatty acids

D pyruvate

- 24** In active mammalian muscle, the oxidation of 1g of fat requires 2 litres of oxygen and approximately 2 cm³ of water is produced. For each litre of oxygen used, 1 cm³ of the water produced is lost in the expired air.

What is the net water gain to the body from the complete oxidation of 100g of fat?

A 0

B 10 cm³

C 100 cm³

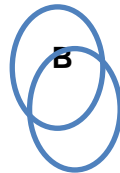
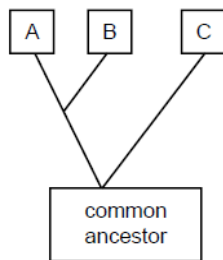
D 200 cm³

- 25** Cytochrome-c is a protein found in most organisms. The amino acid sequence of this protein varies between species. The number of differences in the amino acid sequences in the protein of cytochrome-c between three species of chordate A, B and C are shown in the table below.

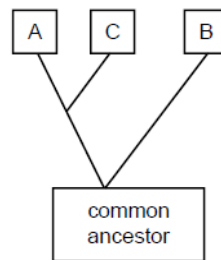
	Species B	Species C
Species A	11	3
Species B		10

Based on this evidence, the phylogenetic tree that best represents the possible evolutionary relationships between the three species is

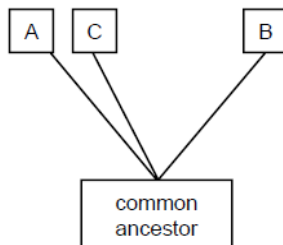
A



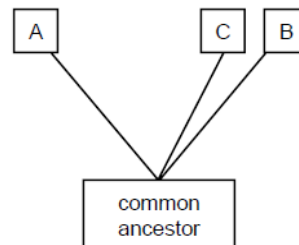
B



C



D

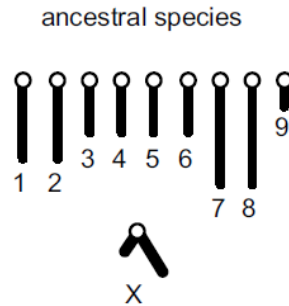


- 26** I
c

chromosomes, the loss of whole or parts of chromosomes, and rearrangement of the genetic material within chromosomes.

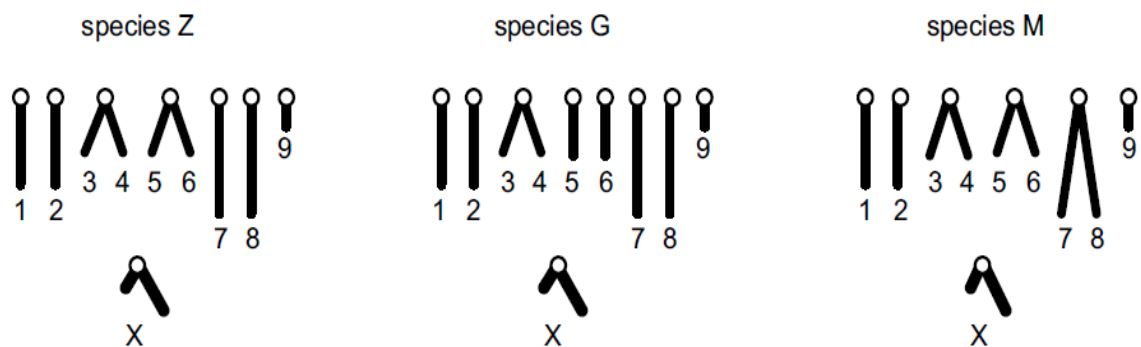
One ancestral species has the following haploid set of chromosomes.

occurred to
together of



As the changes in chromosomes accumulate, a number of different species can result from a single ancestral species.

Three species that have evolved from the ancestral species shown above have the haploid sets of chromosomes shown below.



The most likely order of evolution of these species is

- A ancestral species, species Z, species G, species M.
- B ancestral species, species G, species M, species Z.
- C ancestral species, species M, species G, species Z.
- D ancestral species, species G, species Z, species M.**

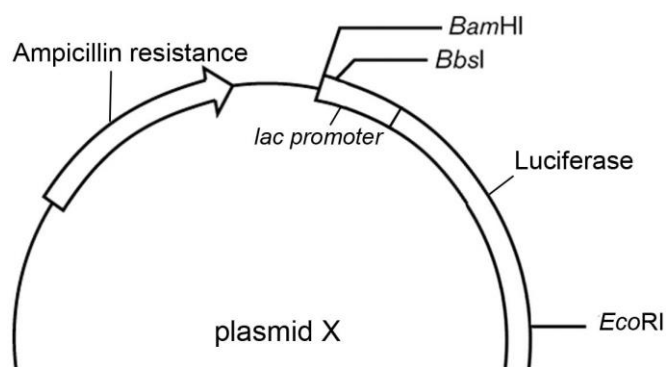
- 27 Corn is a major crop grown in Europe. In the past, it was either ruined by attack from the corn borer larvae or intensively sprayed with pesticides each year. The biotech company Novartis gained approval to insert a *Bt* gene into corn. This gene codes for a protein that kills the larvae feeding on the corn. The genetically engineered *Bt* corn initially survived without the addition of any pesticides, but later suffered damage from pests again.

Which of the following are possible reasons why the *Bt* corn is again under attack from pests

- 1 A strain of resistant larvae has emerged as a chance mutation. The frequency of the gene conferring resistance as well as the number of larvae with resistance has decreased.
- 2 Corn is being attacked by other pests which are not killed by the protein encoded by the *Bt* gene.
- 3 Mutations in corn may have led to the loss of the *Bt* allele.

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

28 Plasmid X can serve as a vector for the insertion of genes to be cloned.



[Turn over

Which of the following options will allow the selection of the colonies containing the recombinant form of plasmid **X**?

	Selection medium	Phenotype of colonies that contain the inserted gene
A	Containing ampicillin and lactose	White colonies
B	Containing ampicillin and luciferase	Colonies that emit light
C	Containing ampicillin, lactose and luciferin	White colonies
D	Containing ampicillin, lactose and luciferin	Colonies that emit light

- 29** It has been found that stem cells transferred from the intestinal lining to the bc produce all of the different types of blood cell instead of intestinal cells. Which explains this?

A All stem cells are totipotent.

[Turn over

B Environmental factors change the expression of specific genes.

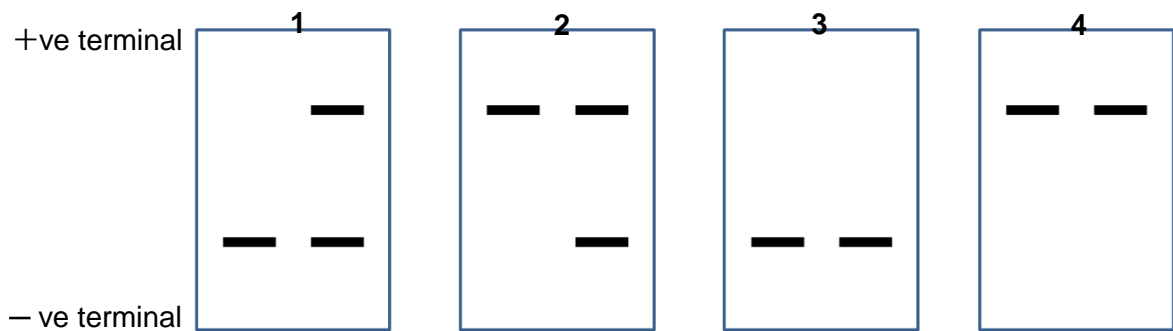
C Specific genes are destroyed by endonucleases.

D Specific genes are hidden by condensation of some chromosomes.

- 30** Cystic fibrosis (CF) is an autosomal recessive genetic disorder. An individual must have two copies of the mutated CFTR gene to express the disease phenotype. One of the most common CF-causing mutation resulted in a loss of phenylalanine located at position 508 of the protein.

The DNA sequence of the CF locus from the offspring of 2 carriers are removed and separated by gel electrophoresis.

Which pattern of bands corresponds to two of the offspring that are phenotypically normal?



A 1 only

B 2 only

C 1 and 3

D 2 and 4

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