HWA CHONG INSTITUTION
JC2 Preliminary Examinations
Higher 1

CANDIDATE NAME		**CT GROUP**	**13S _____**
CENTRE NUMBER		**INDEX NUMBER**	

BIOLOGY

8875/01

Paper 1 Multiple Choice

24 September 2014

Additional Materials: Optical Mark Sheet

1 hour

INSTRUCTIONS TO CANDIDATES

1. Write your **name**, **CT group**, **centre number** and **index number** in the spaces provided at the top of this cover page.
2. Fill in your particulars on the Optical Mark Sheet. Write your **NRIC number** and shade accordingly.
3. There are **thirty** questions in 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 Optical Mark Sheet.
4. At the end of the paper, you are to submit **only** the Optical Mark Sheet.

INFORMATION FOR CANDIDATES

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.

Calculators may be used.

1 The distribution of membranes in the organelles of three cell types, a prokaryotic cell, a liver cell and an enzyme-secreting cell from the stomach, is determined. For each organelle, the amount of membrane is expressed as a percentage of the total amount of membrane in the cell.

Which row of values best represents the membrane distribution in the three cell types?

CM : cell membrane
IMM : inner mitochondrial membrane
rERM : rough endoplasmic reticulum membrane
OMM : outer mitochondrial membrane

	prokaryotic cell			liver cell			stomach cell		
	CM	rERM	IMM	rERM	OMM	IMM	rERM	OMM	IMM
A	99	0	0	35	7	28	60	16	4
B	99	0	0	35	7	28	60	4	16
C	52	12	36	60	7	28	35	4	16
D	52	12	36	60	28	7	35	4	16

2 Which statements about plant vacuoles are correct?

1 Vacuoles are surrounded by a single selectively permeable membrane.
2 Vacuoles are the main store of amino acids, especially in actively growing cells.
3 Water passes into vacuoles down a water potential gradient and this helps plant cells remain turgid.
4 The size of the vacuole(s) remains constant in proportion to the size of the cell, regardless of the water content of the cell.

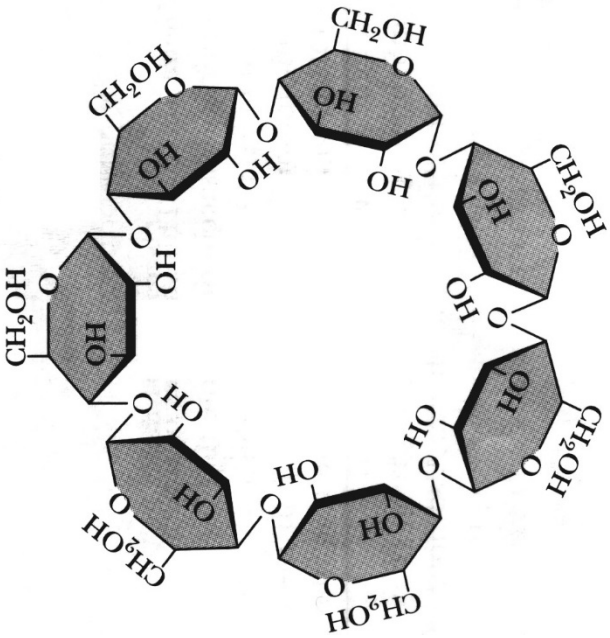
A 1 and 2

B 1 and 3

C 1, 3 and 4

D 2, 3 and 4

3 The diagram shows a circular oligosaccharide molecule.



In which other molecule can a similar glycosidic bond be found?

A lactose

B maltose

C sucrose

D cellulose

4 The hydrolysis of triglycerides leads to

1 the formation of products which are more soluble in water than triglycerides.
2 the formation of products which are less soluble in water than triglycerides.
3 an increase in pH.
4 a decrease in pH.

A 1 and 4

B 2 and 3

C 2 and 4

D 1 and 3

5 In an investigation, a solution of enzyme **X** is placed in a sealed bag made of selectively permeable membrane. The bag is then placed in a beaker of distilled water, and the distilled water is changed several times.

Samples of equal volume are then drawn from the bag at regular intervals. To each sample extracted, a fixed amount of substrate was added and the rate of reaction is determined by the number of bubbles formed over 10 minutes. The number of bubbles formed is observed to be inversely proportional to the duration the bag is immersed in distilled water.

Which is a valid conclusion that can be made from this investigation?

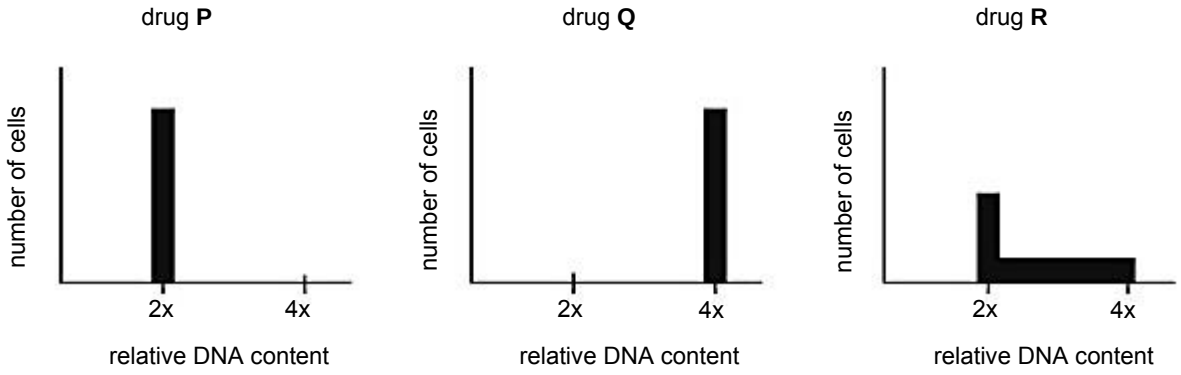
A Some enzyme **X** molecules have lost their secondary and tertiary structure after some time.

B More enzyme **X** molecules were inhibited by a non-competitive inhibitor present in the solution over time.

C Concentration of enzyme **X** decreases with time.

D Enzyme **X** is moving out of the bag at a slow rate.

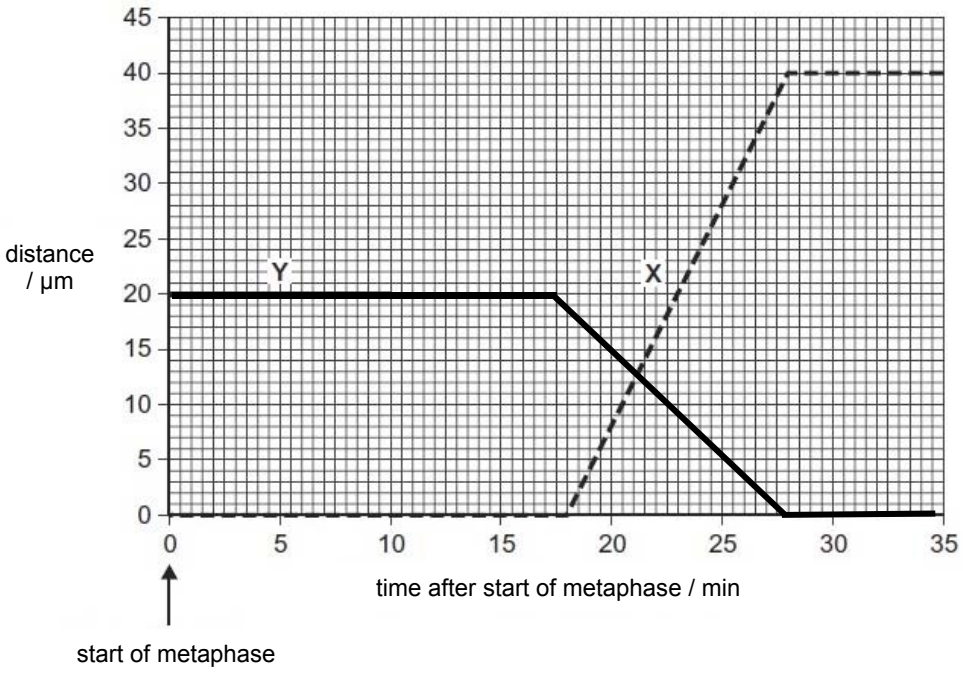
6 Three batches of cells at the start of G1 phase of the cell cycle were treated with three drugs **P**, **Q** and **R**. Each batch has the same number of cells. Untreated cells are expected to complete interphase within 24 hours. The relative DNA content of the treated cells was measured after 24 hours. The three graphs show the results obtained.



What is the effect of each drug on the cells?

	drug **P**	drug **Q**	drug **R**
A	blocks G1 phase	blocks S phase	blocks G2 phase
B	blocks G2 phase	blocks S phase	blocks G1 phase
C	blocks S phase	blocks G1 phase	blocks G2 phase
D	blocks G1 phase	blocks G2 phase	blocks S phase

7 The graph shows information about the movement of chromatids in a cell that has just started metaphase of mitosis.



Which row matches the stages happening at **X** and **Y** indicated?

	duration of metaphase / min	increasing distance at **X** is due to	measurement of **X**	measurement of **Y**
A	35	segregation of sister chromatids	distance between each chromatid and the pole	distance between chromatids
B	18	segregation of sister chromatids	distance between chromatids	distance between each chromatid and the pole
C	35	chromosomes align and segregate	distance between chromatids	distance between each chromatid and the pole
D	18	chromosomes align and segregate	distance between each chromatid and the pole	distance between chromatids

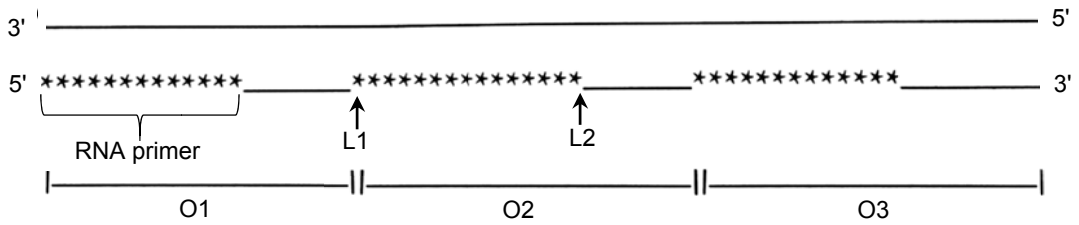
8 A 19-base pair long DNA was analysed to find the number of nucleotide bases in each of the polynucleotide strands. Some of the results are shown.

	number of nucleotide bases			
	A	C	G	T
strand 1				4
strand 2		7		5

How many hydrogen bonds are present in this DNA molecule?

A 31 **B** 48 **C** 39 **D** 57

9 The diagram shows a DNA template with the lagging strand prior to the removal of the RNA primers.



Which row correctly shows the events taking place during the synthesis of the lagging strand?

	first Okazaki fragment synthesised	site of phosphodiester bond formation catalysed by DNA ligase
A	O1	L1
B	O1	L2
C	O3	L1
D	O3	L2

10 A segment of a polypeptide chain is Arg – Gly – Ser – Phe – Val – Asp – Arg. It is encoded by the following segment of DNA:

strand 1	3’	G	G	C	T	A	G	C	T	G	C	T	T	C	C	T	T	G	G	G	G	A	5’
		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	
strand 2	5’	C	C	G	A	T	C	G	A	C	G	A	A	G	G	A	A	C	C	C	C	T	3’

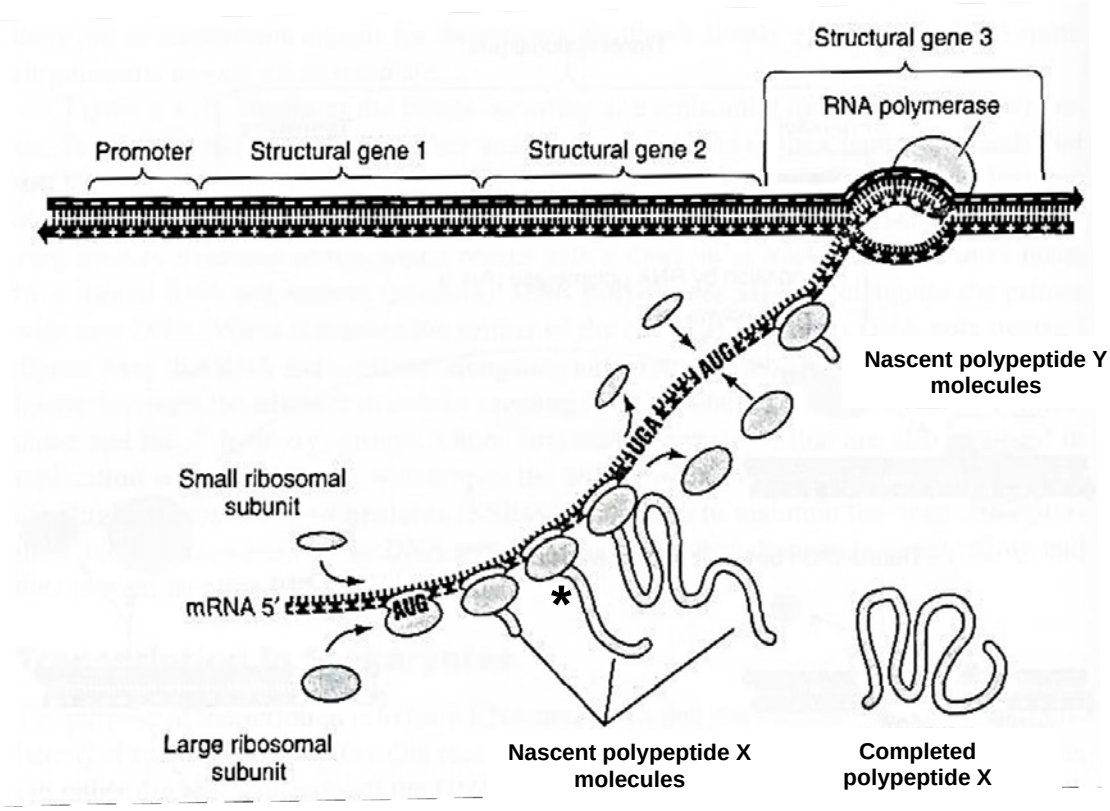
The genetic code

	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	STOP	STOP	A
	Leu	Ser	STOP	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

Using the genetic code, which row is correct?

	template strand	mRNA codon for Arg
A	1	AGG
B	1	GGA
C	2	GGC
D	2	AGG

11 The diagram shows gene expression in an organism.



Which statements are correct?

1 Structural gene 1 encodes protein **X**.
2 The first polypeptide **X** is always synthesised before the first polypeptide **Y**.
3 Synthesis of the polycistronic mRNA allows transcription and translation to be more efficient in this eukaryotic cell.
4 The asterisk (*) indicates the position of the first amino acid, methionine, in polypeptide **X**.

A 1 and 2

B 2 and 3

C 1, 2 and 4

D 1, 3 and 4

12 Which statements about cancer are correct?

1 Exposure to UV light from the sun always causes skin cancer.
2 Some viruses can cause cancer.
3 The mutation of genes controlling the cell cycle may cause cancer.
4 Inhaling too much carbon monoxide increases the risk of developing cancer.

A 1 and 2

B 1 and 3

C 2 and 3

D 3 and 4

13 In the plant *Antirrhinum*, two genes **A**/**a** and **B**/**b** affect leaf colour.

- The dominant allele, **A**, codes for yellow leaves and is lethal when homozygous.
- The recessive allele, **a**, codes for green leaves.
- The dominant allele, **B**, codes for chlorophyll production, giving green leaves.
- The recessive allele, **b**, results in white leaves and is lethal when homozygous.

When **both** alleles **A** and **B** are present, the leaves are yellow.

Which will be observed in the offspring produced by two heterozygous plants?

A 50% of the offspring will survive to reproduce.

B 3 out of 16 of the offspring will have white leaves.

C All the offspring with yellow leaves will not survive.

D Ratio of offspring with yellow leaves to offspring with green leaves is 2:1.

14 Two genes involved in determining the coat colour of goats are found on different chromosomes.

The colour gene C causes the hairs to have uniform colour and has three alleles.

- C^{DB} giving dark brown hairs
- C^{B} giving black hairs
- C^{MB} giving medium brown hairs

A dominant allele of the agouti gene (A^{G}) causes the development of white hairs between the coloured hairs giving the coat a shaded appearance.

The table shows the results of crosses between a male goat and 2 female goats.

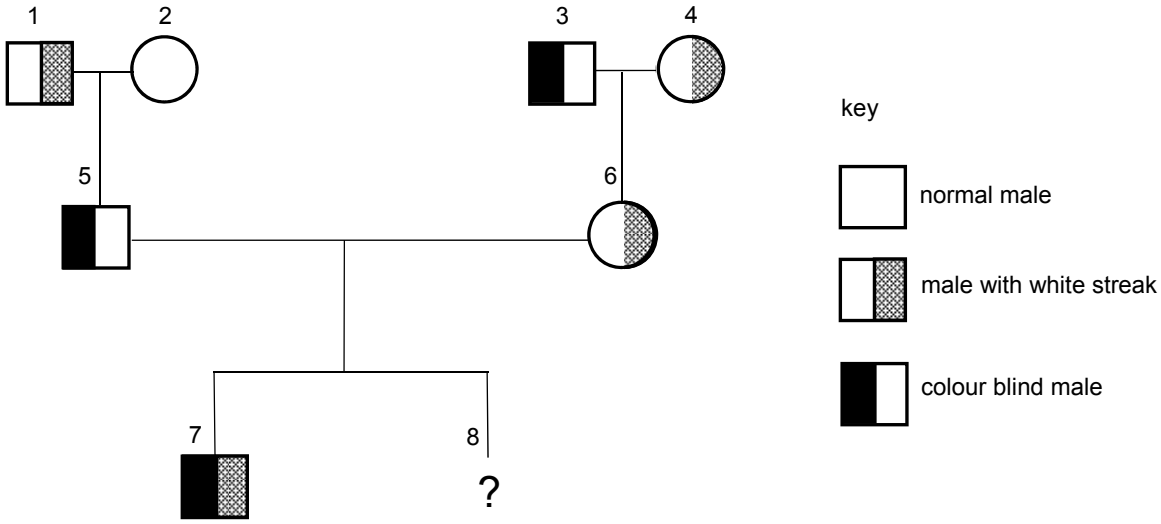
parents	offspring
black agouti male x uniformly dark brown female	50% uniform, 50% agouti; 50% dark brown, 50% black
black agouti male x medium brown agouti female	all agouti; 50% black, 50% medium brown

Which row shows the possible genotypes of the male and female parents?

	black agouti male	uniformly dark brown female	medium brown agouti female
A	$C^{B}C^{MB}A^{G}A^{G}$	$C^{B}C^{DB}A^{G}A^{g}$	$C^{MB}C^{MB}A^{G}A^{G}$
B	$C^{B}C^{MB}A^{G}A^{g}$	$C^{B}C^{DB}A^{g}A^{g}$	$C^{B}C^{MB}A^{G}A^{G}$
C	$C^{B}C^{DB}A^{G}A^{G}$	$C^{DB}C^{MB}A^{G}A^{g}$	$C^{B}C^{DB}A^{G}A^{g}$
D	$C^{B}C^{MB}A^{G}A^{g}$	$C^{B}C^{DB}A^{g}A^{g}$	$C^{MB}C^{MB}A^{G}A^{G}$

15 Colour blindness is controlled by a gene on the X chromosome. The allele for colour blindness, $\mathbf{X^b}$, is recessive to the allele for normal colour vision, $\mathbf{X^B}$. The gene controlling the presence of a white streak in the hair is not sex-linked, with the allele for the presence of a white streak, **H**, being dominant to the allele for the absence of a white streak, **h**.

The diagram shows a pedigree in which some of the individuals have colour blindness or have a white streak present in the hair.



What is the probability that individual 8 is a male with the same phenotype as individual 7?

A 0.125

B 0.25

C 0.5

D 0.75

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

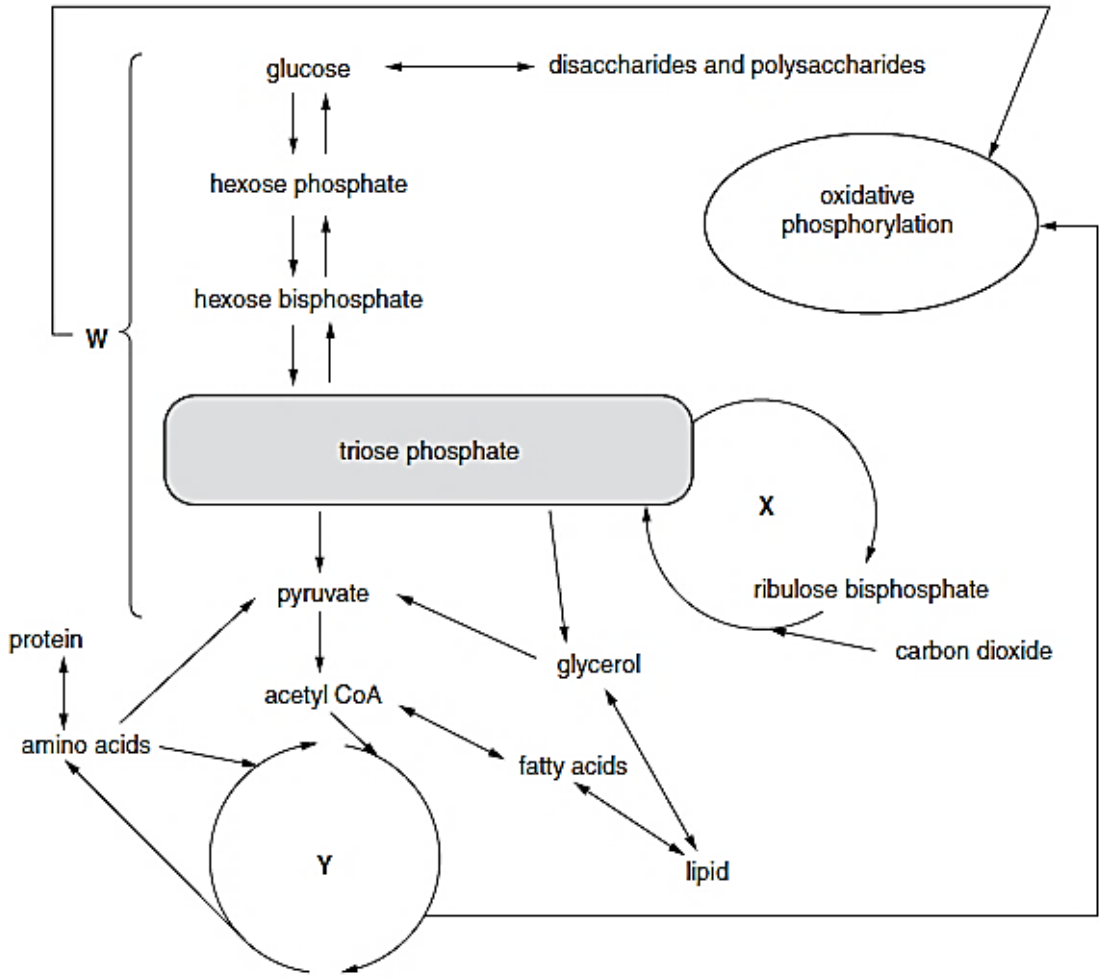
A Anthocyanins and anthoxanthins are vacuolar pigments, whereas xanthophylls and carotenes are pigments found in membrane-bound organelles known as plastids. These, together with molecules known as co-pigments, are responsible for the variation observed in petal colour in *Dendranthema.*

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.

17 The diagram represents some of the reactions that take place in a leaf cell.



Which statement explains why the three reaction pathways **W**, **X** and **Y** are able to work independently of one another in the same leaf cell?

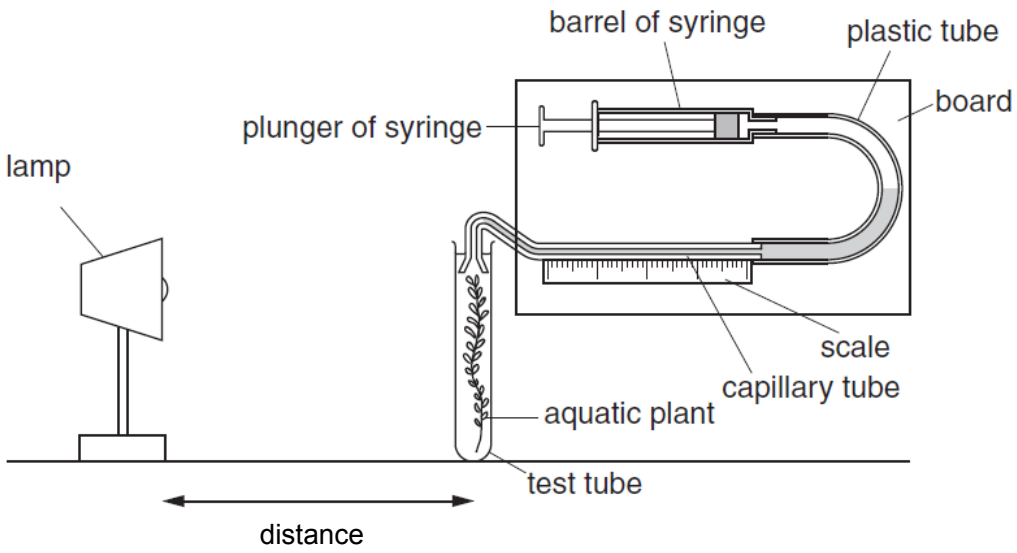
A **W**, **X** and **Y** are separated by membranes, allowing for the maintenance of different conditions for enzymes to function.

B **W**, **X** and **Y** are separated by membranes, allowing for the formation of separate proton gradients to synthesise ATP.

C **X** occurs only in the absence of light unlike both **W** and **Y**.

D Only **X** and **Y** can take place in the absence of oxygen.

18 A student carried out an experiment to investigate the effects of light intensity on the rate of photosynthesis in an aquatic plant, using the apparatus shown.



The student decided to measure the rate of photosynthesis by measuring the gas produced over a 5 minute period. The gas is collected in the capillary tube and the length of the bubble measured. Her results may not be accurate because

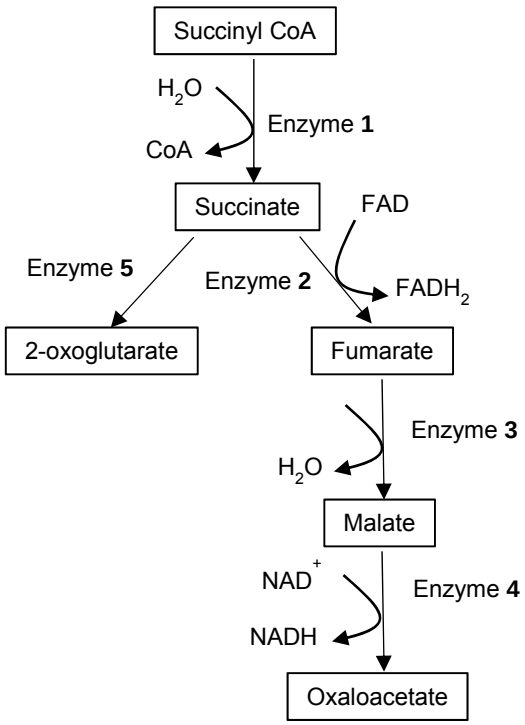
A oxygen produced through oxidative decarboxylation dissolves in water, resulting in a larger air bubble.

B some of the oxygen is used in oxidative phosphorylation, resulting in a smaller air bubble.

C carbon dioxide given off by the plant changes the pH of the solution, thus decreasing the rate of light-dependent reaction.

D photolysis of water results in a drop in the total volume of water and thus a larger air bubble.

19 The diagram shows part of a metabolic pathway in cellular respiration. Each reaction in the pathway is catalysed by a different enzyme numbered **1** to **5**. A high concentration of oxaloacetate inhibits enzyme **2**.



Which will occur in the presence of a high concentration of oxaloacetate?

1 Positive feedback will occur, resulting in the production of more fumarate and malate.
2 Oxidative phosphorylation will cease.
3 Krebs cycle will proceed despite a high concentration of oxaloacetate to form less 2-oxoglutarate.
4 Link reaction will occur with oxidative decarboxylation taking place in the mitochondrial matrix to produce more acetyl-CoA.

A 2 only

B 2 and 3

C 1 and 4

D 1, 3 and 4

20 Trematol is a metabolic poison derived from the white snake root. Cows eating this plant concentrate the poison in their milk. The poison inhibits liver enzymes that convert lactate to other compounds for metabolism.

Which row illustrates the events that occur in an exercising athlete who consumed the trematol-tainted milk?

	lactate accumulation	NAD production	ATP production	pH of blood
A	yes	yes	yes	decreased
B	no	yes	yes	decreased
C	yes	no	no	increased
D	no	no	no	increased

21 Newspaper is made from cellulose. It will only produce a smooth, straight tear when torn in one orientation.

Which structural feature of cellulose accounts for this?

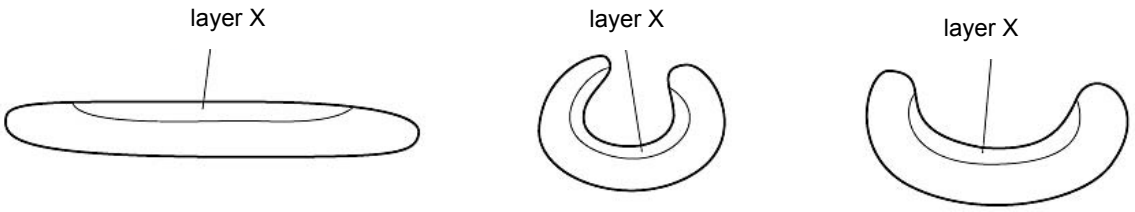
A Cellulose is made up of long, linear chains.

B Cellulose chains have projecting hydroxyl groups for cross-links to form between chains.

C Cellulose is composed only of β-glucose.

D Cellulose chains run parallel to one another.

22 Xerophytes are plant species that are adapted to survive in dry environments. The diagram shows three xerophytic leaves of the same plant species in three different conditions **P**, **R** and **S**.

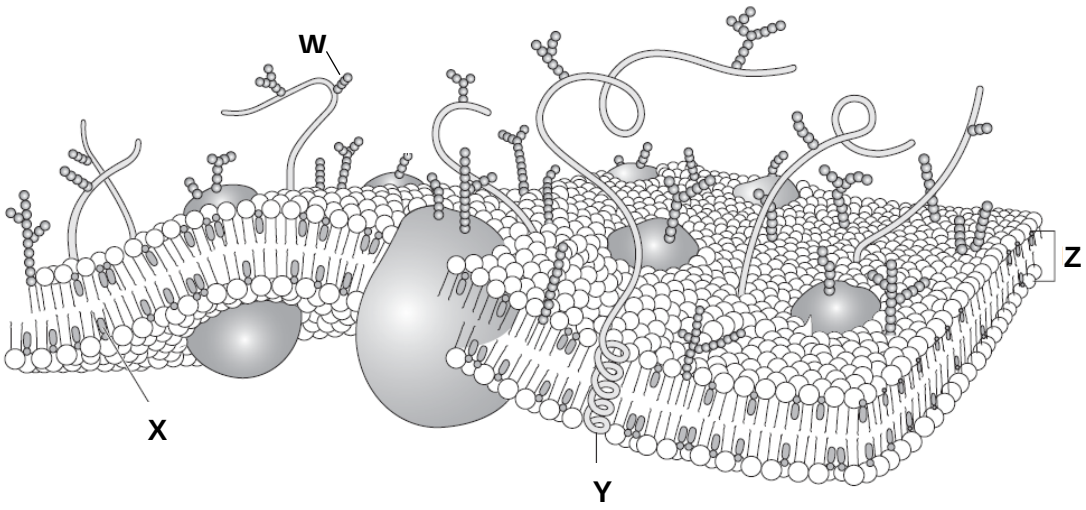


P **R** **S**

Which description of the water potential of the cells in layer X is correct?

	water potential of cells in layer X		
	P	**R**	**S**
A	less negative than **R** and **S**	more negative than **P** and **S**	more negative than **P**
B	less negative than **S**	more negative than **P**	less negative than **P**
C	more negative than **R**	less negative than **S**	less negative than **R**
D	more negative than R and **S**	less negative than **P**	more negative than **P**

23 The diagram shows a phospholipid bilayer with structures **W**, **X**, **Y** and **Z** labelled.



Which statements are true?

1 **W** increases the permeability of the membrane to polar and charged particles by binding to proteins of the extracellular matrix.
2 **X** reduces the permeability of the membrane to polar and charged particles by reducing transient pore formation.
3 **Y** has a hydrophilic pore to facilitate diffusion of polar and charged particles without the use of ATP.
4 **Z** has a hydrophobic core to facilitate the transport of polar and charged particles without the use of ATP.

A 1 and 3

B 1 and 4

C 2 and 3

D 3 and 4

24 Which was **not** recognised by Charles Darwin?

A DNA transmission is a mechanism of inheritance.

B Descent with modification is the outcome of evolution.

C Variation among individuals in a population can lead to speciation.

D Ecological interactions play an important role in evolution.

25 There is a lack of native placental mammals in Australia because

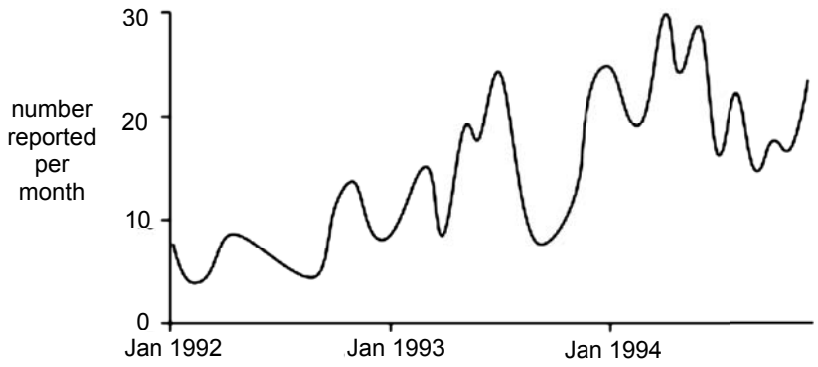
A marsupial mammals are well adapted to their niches.

B the environmental conditions did not provide any selective pressures for the evolution of placental mammals.

C widespread disease eradicated placental mammals in Australia at an early stage of their evolution.

D continental drift and geographical isolation prevented an invasion by placental mammals.

26 The graph shows the change in the number of bacterial samples from some New York hospitals were resistant to the antibiotic vancomycin in 1992 to 1994. Forty samples were taken each month from randomly selected patients who had become infected with bacteria in the hospital.



Which statement most accurately describes the cause of the changes in the frequency of the vancomycin resistant phenotype?

A effect of artificial selection

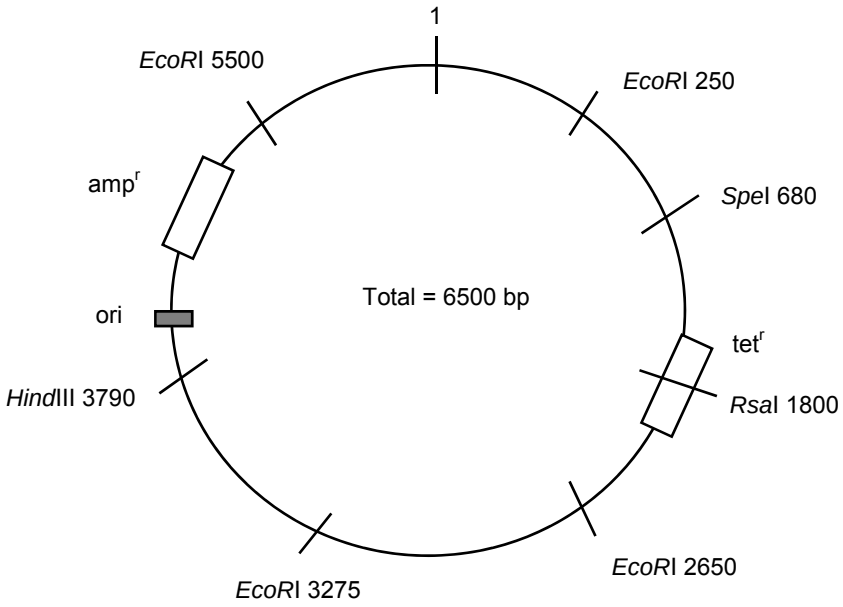
B effect of natural selection

C purely due to genetic drift

D purely due to random sampling effects

Use the following information to answer **questions 27** and **28**.

A gene of 1250 base pairs (bp) coding for resistance to leafspot disease in a plant was inserted into a plasmid using the enzyme *Rsa*I. The diagram shows a map of the plasmid.



27 The recombinant plasmid was cut with *Eco*RI, and the restriction fragments were separated by gel electrophoresis.

Which fragments would appear on the gel?

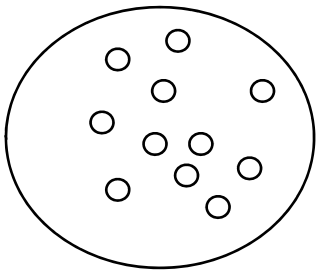
A 1250 bp, 2225 bp, 2400 bp, 3650 bp

B 2650 bp, 3275 bp, 3650 bp, 5500 bp

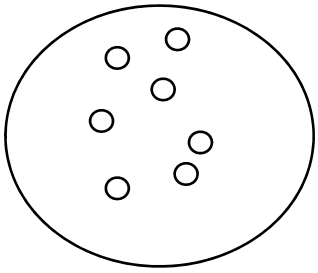
C 250 bp, 2650 bp, 3275 bp, 5500 bp

D 625 bp, 1250 bp, 2225 bp, 3650 bp

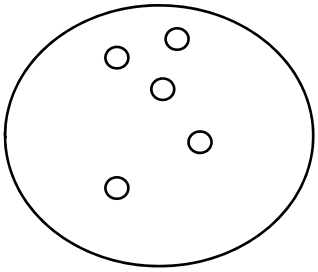
28 The recombinant plasmids were transformed into *Escherichia coli* and the bacteria were grown on nutrient medium. The resulting master plate is shown in the diagram.



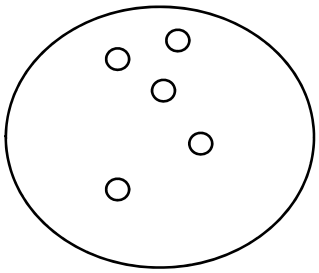
Transformed cells were selected by replica plating and grown on media containing different antibiotics.



medium with ampicillin



medium with tetracycline



medium with ampicillin and tetracycline

How many colonies in the master plate contain the recombinant plasmid?

A 2

B 4

C 5

D 7

29 A piece of mouse DNA sequence is to be amplified by PCR.

5’ AGAGGGCGGT CCGTATCGGC CAATCTGCTC ACCACTAAGC 3’

Which pair of primers should be used?

A	5’ AGAGGGCGGT3’	5’ CGTTAGTGGT 3’
B	5’ CCGTATCGGC 3’	5’ TGGTGATTCG 3’
C	5’ CCGTATCGGC 3’	5’ GCTTAGTGGT 3’
D	5’ AGAGGGCGGT3’	5’ GCTTAGTGGT 3’

30 Wild sunflowers are considered to be weeds by many farmers in the USA. They hybridise readily with sunflowers grown as crops. Two experiments involving wild sunflowers gave the following results:

- Up to 42% of the seeds produced by wild sunflowers growing at the margins of a commercial sunflower field were hybrids.
- The hybrid offspring of wild sunflowers and experimental sunflowers produced 50% more seeds than ordinary wild sunflowers. The experimental sunflowers had been genetically engineered to produce insecticide.

Which of the following are the potential ecological hazards of growing a genetically engineered crop, such as sunflowers?

1 The hybrid offspring increases the chances of spreading resistance to the wild sunflowers leading to higher chances of invasiveness of the hybrid offspring.
2 Wild sunflowers become resistant because they hybridise readily, becoming more invasive.
3 There is a chance of the hybrid offspring spreading quickly because more seeds are produced, leading to ecological imbalance.

A 1 only

B 2 only

C 1 and 2

D 2 and 3

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