



CATHOLIC JUNIOR COLLEGE
JC2 Preliminary Examinations
in preparation for General Certificate of Education Advanced Level
Higher 1

CANDIDATE
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BIOLOGY

8875/01

Paper 1 Multiple Choice

1 September 2015

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 index number and name on the Answer Sheet in the spaces 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 in 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.

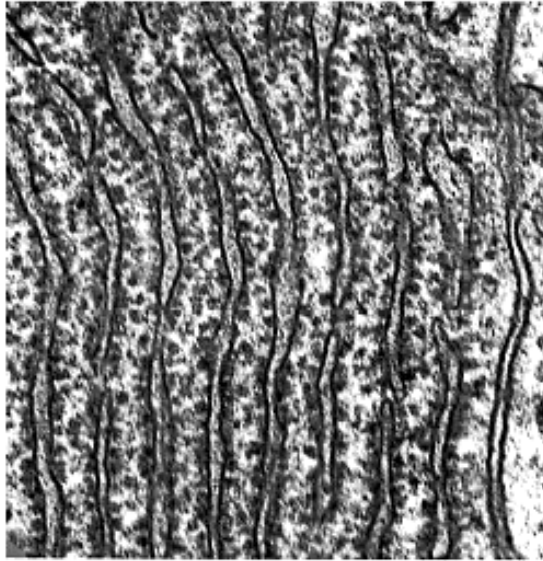
Any rough working should be done in this booklet.

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

This document consists of **21** printed pages and **1** blank page.

[Turn over

- 1 The electronmicrograph shows part of an organelle in a cell.



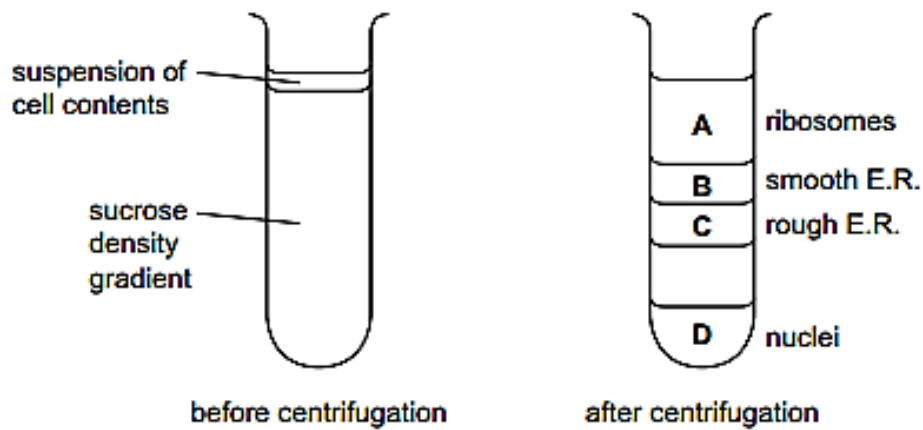
What describes a function of the tubules in the organelle shown?

- A** moving proteins to places where they are covered by phospholipid membranes for secretion outside the cell.
- B** modifying proteins and covering them with phospholipid membranes for secretion outside the cell
- C** producing proteins, covering them with phospholipid membranes and moving them for use inside the cell
- D** producing ribosomes and proteins and storing them in phospholipid membranes for use inside the cell

- 2 Sometimes scientists need to isolate organelles. This can be achieved by taking a number of cells and breaking their cell surface membranes to release the contents of the cells into a buffer solution.

In zonal centrifugation, the suspension of cell contents is placed on top of a sucrose density gradient. The tube is then placed in a centrifuge and spun at high speed. The heavier particles will move towards the bottom of the tube faster than lighter particles, as shown below.

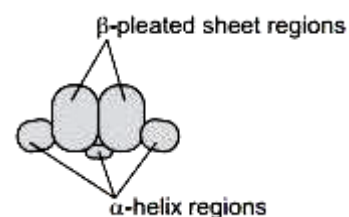
If a sample of intact prokaryotes had been added to a suspension of eukaryotic cell contents, where would you expect them to be found?



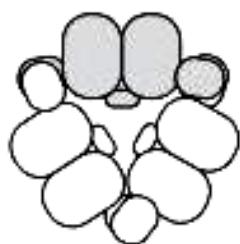
[Turn over

3 Approximately half of the total protein in a pea seed consists of the storage protein vicilin.

- Each molecule of vicilin is made up of three identical polypeptides.
- Each polypeptide is made up of two β -pleated sheet regions with linking α -helix regions, folded into the shape shown to the right.



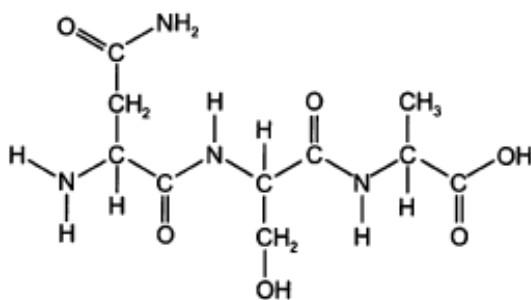
- This allows the three polypeptides to pack together into a compact, flat storage molecule, as shown below.



Which row correctly describes the structure of vicilin?

	primary structure	secondary structure	tertiary structure	quaternary structure
A	amino acid sequence of one polypeptide	α -helix and β -pleated sheet regions of each polypeptide	association of three polypeptides	folding of each polypeptide
B	amino acid sequence of one polypeptide	α -helix and β -pleated sheet regions of each polypeptide	folding of each polypeptide	association of three polypeptides
C	association of three polypeptides	amino acid sequence of one polypeptide	α -helix and β -pleated sheet regions of each polypeptide	folding of each polypeptide
D	association of three polypeptides	amino acid sequence of one polypeptide	folding of each polypeptide	α -helix and β -pleated sheet regions of each polypeptide

- 4 The diagram shows the molecular structure of a peptide.



Which molecules would result from the complete hydrolysis of the peptide?

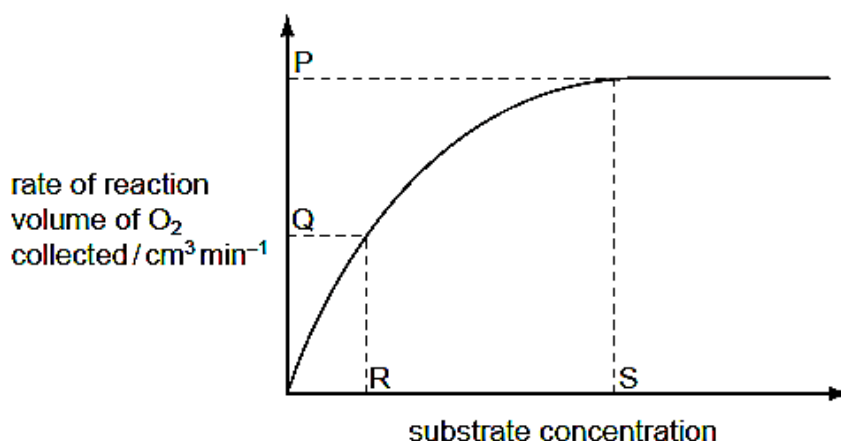
- A
-
- B
-
- C
-
- D
-

[Turn over

- 5 The diagram shows Liver tissue produces an enzyme called catalase which breaks down hydrogen peroxide into water and oxygen.



The rate of this reaction can be determined by measuring the volume of oxygen produced in a given length of time. Students added small cubes of fresh liver tissue to a range of hydrogen peroxide solutions and measured the volumes of oxygen produced. Their data were used to produce the graph showing how changing the concentration of hydrogen peroxide affected the rate of oxygen production.

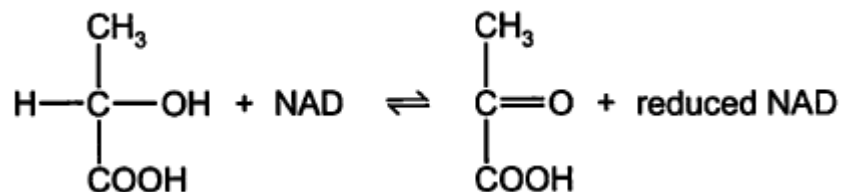


Which statements are correct?

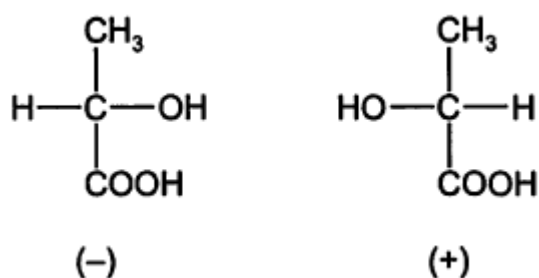
- I At P, the rate of reaction is limited by the concentration of enzyme.
- II At Q, all of the enzyme active sites are occupied by substrate molecules.
- III At Q, the rate of reaction is limited by the concentration of the substrate.
- IV At S, all of the enzyme active sites are occupied by substrate molecules.

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

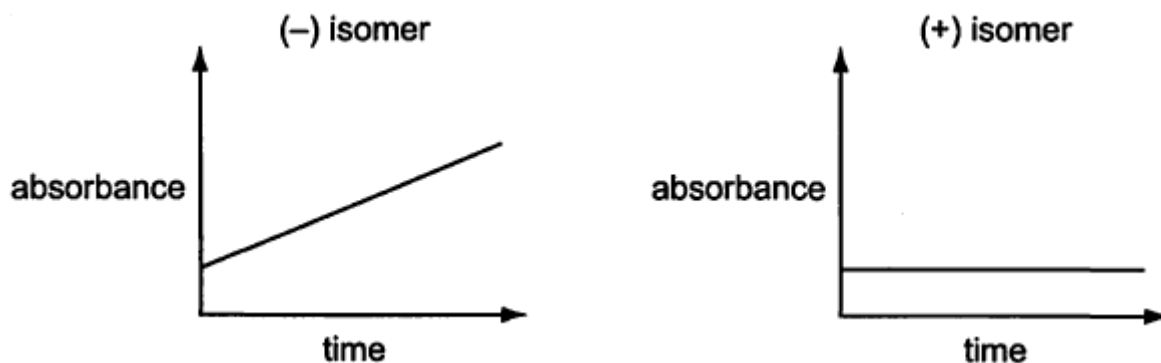
- 6 Lactic dehydrogenase catalyses the conversion of lactic acid to pyruvic acid as shown in the following equation.



Two forms (isomers) of lactic acid exist, (-) and (+), as shown below.



Reduced NAD absorbs ultraviolet light. NAD does not. The activity of bacterial lactic dehydrogenase on two different isomers of lactic acid was compared. The absorbance of ultraviolet light was measured using an ultraviolet spectrophotometer. The graphs show the results.



What can be concluded about bacterial lactic dehydrogenase?

- A Molecules of both isomers fit the active site.
- B Molecules of neither isomer fit the active site.
- C The enzyme is specific to the (-) isomer.
- D The enzyme is specific to the (+) isomer.

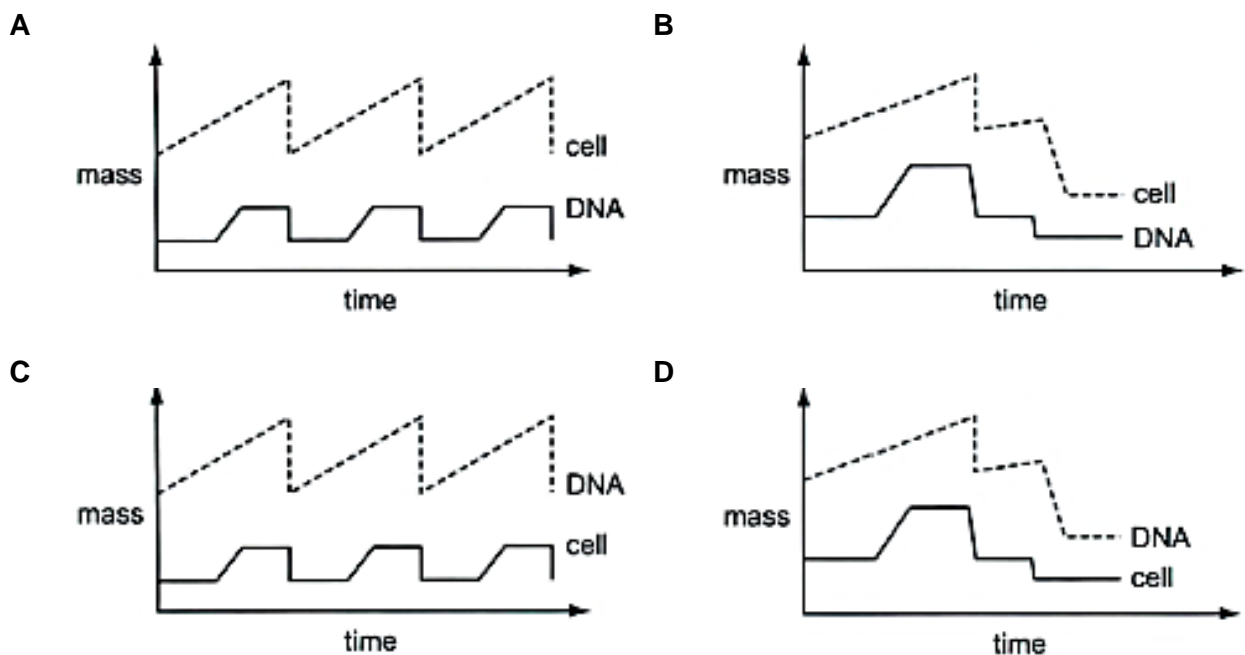
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- 7 The amount of DNA in a mammalian cell in early prophase I of meiosis is $4\mu\text{g}$. What is the amount of DNA in the same cell at G1 of Interphase?

A $1\mu\text{g}$
 B $2\mu\text{g}$
 C $4\mu\text{g}$
 D $8\mu\text{g}$

- 8 Cell division is the means of almost all growth and reproduction.

Which graph correctly represents a form of cell division that maintains genetic stability at the expense of variation?



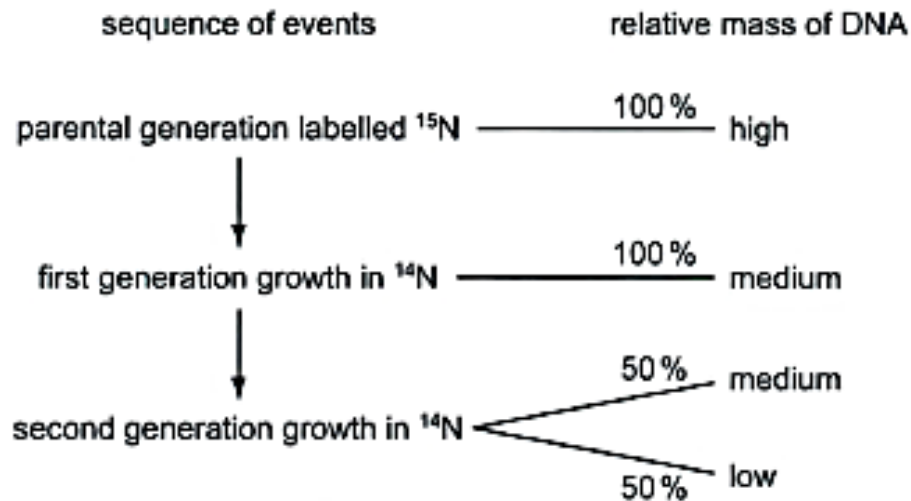
- 9 Which of the following statements about replication is **false**?

A No ATP is utilized in the formation of phosphodiester bonds on the leading strand.
 B DNA polymerase I and III both need a free 3'OH to carry out their function.
 C Synthesis of the lagging strand occurs in a 3' to 5' direction.
 D On the lagging strand, primase is blocked by the action of helicase thus forming Okazaki fragments.

- 10** Messelson and Stahl investigated DNA replication by growing bacteria in culture containing heavy nitrogen, ^{15}N , until all the DNA was labelled.

These bacteria, the parental generation, were then transferred to a medium containing only light nitrogen, ^{14}N and allowed to replicate for two generations.

DNA was extracted from each generation of bacteria and its relative mass estimated. The flow diagram shows the results.



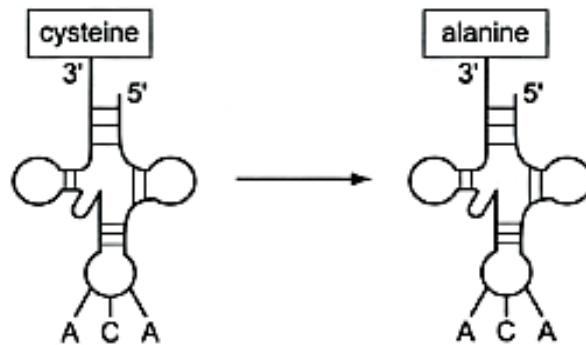
Which row explains the mass of DNA in the second generation grown in ^{14}N ?

	50% DNA molecules		50% DNA molecules	
	strand 1	strand 2	strand 1	strand 2
A	only ^{15}N	only ^{14}N	only ^{14}N	only ^{14}N
B	only ^{15}N	only ^{15}N	only ^{14}N	only ^{14}N
C	only ^{15}N	only ^{15}N	only ^{14}N	only ^{15}N
D	only ^{15}N	half ^{14}N , half ^{15}N	only ^{14}N	half ^{14}N , half ^{15}N

[Turn over

- 11 Transfer RNA combined with an amino acid is called amino-acyl tRNA. It is possible to chemically convert the amino acid cysteine into the amino acid alanine whilst it is still attached to its tRNA.

The altered amino-acyl tRNA still binds to UGU triplets on messenger RNA (mRNA), but now incorporates alanine into the resulting polypeptide instead of cysteine.



Which statement is correct?

- A A codon on the amino-acyl tRNA determines its specificity.
 - B Both the amino acid and the anticodon of an amino-acyl tRNA affect where it binds to mRNA.
 - C The amino acid of an amino-acyl tRNA does not influence its binding to mRNA.
 - D The codon-anticodon interaction is influenced by the amino acid on an amino-acyl tRNA.
- 12 The petals of the morning glory flower are purple when the flower is in bud but become blue as the flower opens. This colour change is caused by an increase in pH of the vacuoles of the petal cells.

A mutation in a gene coding for a type of hydrogen ion (H^+) pump in the vacuole membranes of the petal cells results in flowers that are purple when open.
The difference in DNA sequence of the gene coding for the ion pump in plants with blue or purple flowers is shown below.

Plant with blue flowers: -T-T-A-A-T-C-C-T-G-A-G-A-T-T-T-

Plant with purple flowers: -T-T-A-A-T-C-C-T-G-C-T-G-A-G-A-T-T-T

Which statements explain the purple colour of the flowers of the mutant plant?

- 1 A frameshift mutation alters the sequence of amino acids in the ion pump.
 - 2 The primary structure and the shape of the ion pump are altered.
 - 3 The activity of the ion pump is altered by changes in its shape.
 - 4 The mutant ion pump cannot pump H^+ ions into the vacuoles of the petal cells.
- A 1 and 2
 - B 1 and 4
 - C 2 and 3
 - D 3 and 4

- 13** 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?



- 14** Which statements about gene mutation are correct?

- 1 It can be brought about by exposure to ionising radiation.
- 2 It always produces dominant alleles.
- 3 It can increase the number of base pairs in a gene.
- 4 It can occur in both somatic and sex cells.

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

[Turn over

- 15** The inheritance of eye colour in fruit flies has been shown to be an example of sex linkage. Female fruit flies are XX and male fruit flies are XY.

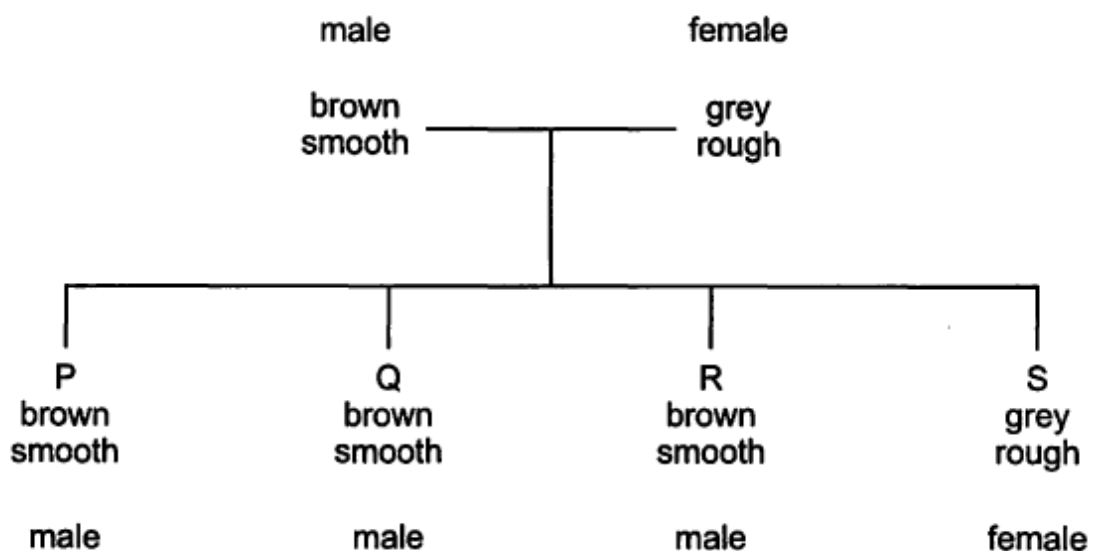
A student carried out a cross between a pure-breeding red-eyed female and a pure-breeding white-eyed male.

All the offspring had red eyes. In order to confirm the presence of the white-eye allele in the F1 generation, test crosses were performed for both males and females of the F1 generation.

Which observation provides evidence of sex linkage of eye colour in fruit flies, rather than the normal autosomal pattern of inheritance?

- A** an offspring phenotypic ratio of 1 red-eyed female : 1 white-eyed female : 1 red-eyed male: 1 white-eyed male from the test crosses with the F1 females.
 - B** an offspring phenotypic ratio of 1 red-eyed female : 1 white-eyed male from the test crosses with the F1 males.
 - C** an offspring phenotypic ratio of 1 red-eyed fly : 1 white-eyed fly from the test crosses with the F1 males.
 - D** no male offspring in the F1 generation had the same eye colour as the male parent from the original cross.
- 16** In a species of mammal, one pair of alleles is responsible for the inheritance of hair colour and another pair controls hair texture. The allele for brown hair is dominant to the allele for grey hair and the allele for smooth hair is dominant to the allele for rough hair.

The diagram shows the results of crossing a male showing the dominant phenotype with a female showing the recessive phenotype.



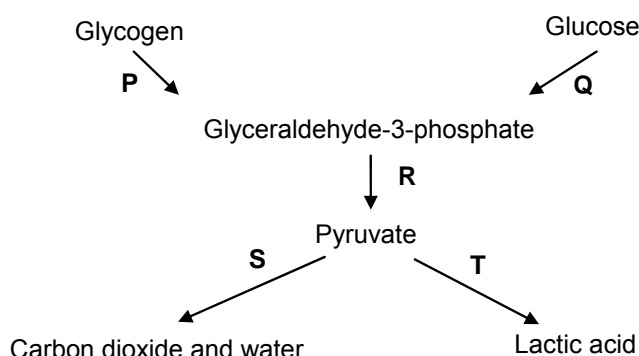
If P is crossed with a female with the same genotype as P, what are the chances of the offspring having brown smooth hair?

- A** 1 in 1 (100%)
- B** 3 in 4
- C** 9 in 16
- D** 1 in 2

17 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 *Dendeanthema* 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.

18 With reference to the diagram below, relate processes P, Q, R, S, T to statements (i), (ii) and (iii).

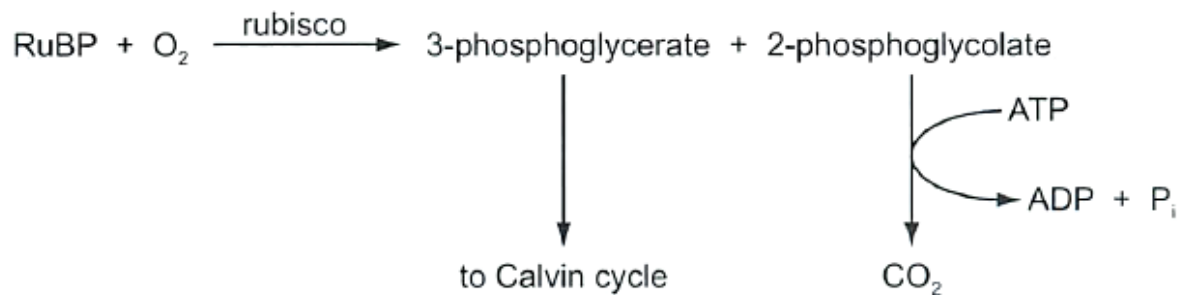


- (i) NAD is regenerated without the use of the electron transport system
- (ii) ATP is synthesised via substrate level phosphorylation
- (iii) It can take place under anaerobic conditions.

	(i)	(ii)	(iii)
A	R	S	T
B	T	R	Q
C	None of the above	S	R
D	S	Q	None of the above

[Turn over

- 19** Rubisco is the carbon dioxide-fixing enzyme. One rubisco molecule has right active sites where carbon dioxide fixation occurs, with each active site catalysing only three reduction reactions per second.

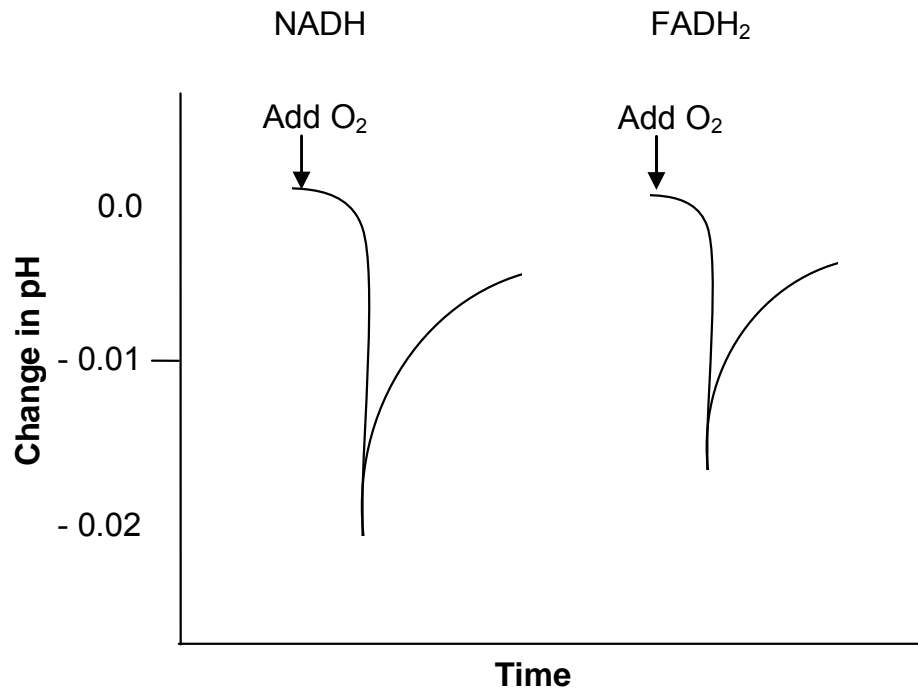


The enzyme also catalyses, at the same active sites, the addition of oxygen to ribulose biphosphate (RuBP). This reaction is favoured when oxygen concentrations in the leaf are high and carbon dioxide concentrations are low.

Which of the facts is paired with the correct explanation?

	fact	explanation
A	On very hot, dry days stomata close to prevent water loss.	This reduces the availability of oxygen, increasing the production of 3-phosphoglycerate.
B	Plants synthesise large volumes of rubisco.	This may be an adaptive response to compensate for low concentrations of oxygen.
C	Processing 2-phosphoglycolate will eventually release carbon dioxide.	This will increase the rate of reduction and increase the rate of RuBP regeneration, increasing the rate of photosynthesis.
D	Rubisco is an inefficient photosynthetic enzyme.	This is because the rate of carbon dioxide reduction can be decreased by the competitive binding of oxygen molecules to the active site.

- 20** Isolated mitochondria were incubated with NADH in one experiment and an equal amount of FADH_2 in another experiment. The mitochondria were initially deprived of oxygen. The pH of the intermembrane space was then monitored as a known quantity of oxygen was added. The results are shown in the graph.

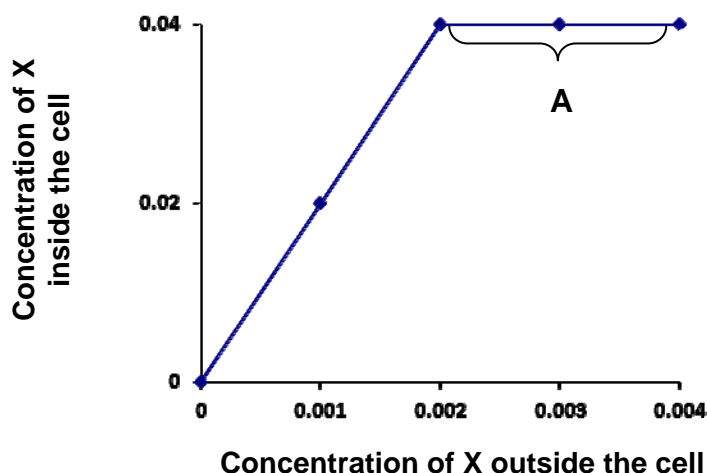


Which of the following can be concluded based on the results?

- I** Upon the addition of oxygen, only oxidative phosphorylation occurred.
 - II** Electron transfer was initiated by the addition of oxygen.
 - III** 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.
 - IV** The rapid decline in pH indicates that protons were pumped into the intermembrane space when oxygen was available.
- A** I only
B II and IV only
C II, III and IV only
D All of the above

[Turn over

- 21 Substance **X** is actively transported into cells. Equal-sized samples of cells were placed in media containing different concentrations of **X** for an hour. The intracellular concentration of **X** was then measured. All other metabolic conditions were maintained at the optimum level. The graph below shows the results.



From the information given above, which one of the following would account for the region of the graph labelled A?

- A A respiratory inhibitor had been introduced.
 - B All the active transport carriers had been operating at their maximum rate.
 - C The active transport carriers had been inactivated by a non-competitive inhibitor.
 - D As the internal concentration of **X** rose, more of the substance **X** was metabolised.
- 22 Which structure enables the molecule to fulfil its biological role?
- A Amylopectin has some 1,6 branches between α -glucose monomers to give a long, coiled molecule.
 - B Amylose has mainly 1,4 glycosidic bonds between α -glucose monomers giving tensile strength.
 - C Cellulose has some 1,6 glycosidic bonds between β -glucose monomers to link long, strong fibrils.
 - D Glycogen has many 1,6 branches between α -glucose monomers giving many easily accessible ends of chains.

- 23** 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	✓	✓	✓
B	✓	✓	X
C	✓	x	✓
D	x	✓	✓

key

✓ = true

x = false

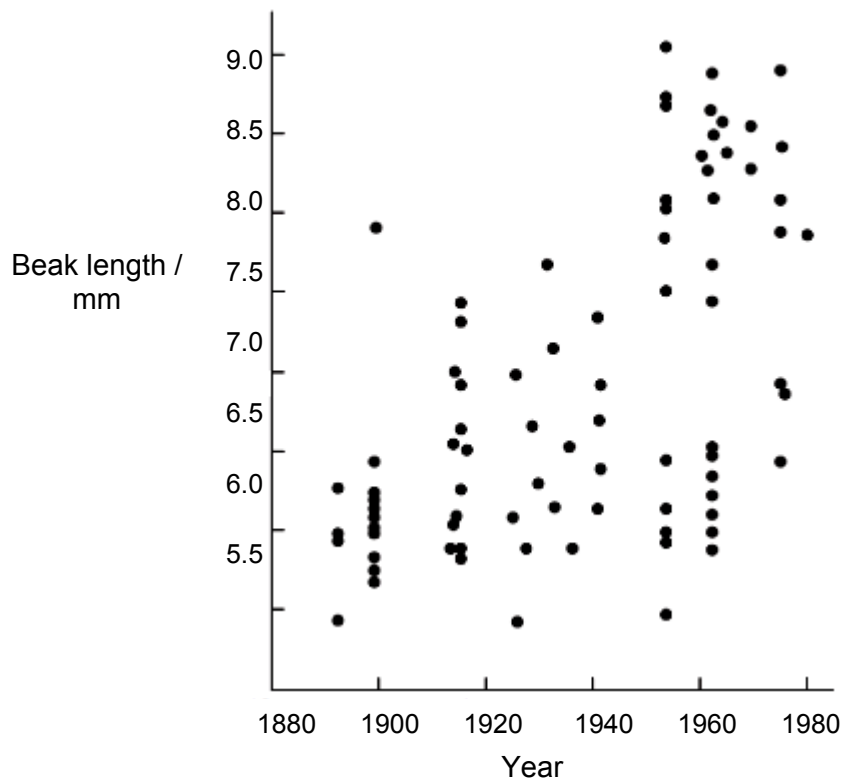
- 24** Which of the following is not a limitation of the use of fossil records as evidence for evolution?

- A** Fossils are damaged and incomplete
- B** Some organisms may not form fossils.
- C** Fossils are found in different sedimentary rock layers.
- D** Fossils present in inaccessible areas are not available to us for study.

[Turn over

- 25** The soapberry bug, *Jadera haematoloma*, uses its long beak to penetrate the fleshy fruit of the native soapberry tree to feed on the seeds at the centre. The bug also feeds on the fruit of the introduced golden rain tree.

Investigators measured the beak length of the soapberry bugs over eighty years. The results are shown in the graph.



From this information, it would be reasonable to conclude that

- A** the golden rain tree was introduced around 1970.
- B** no long-beaked bugs existed prior to the introduction of the golden rain tree.
- C** the diameter of the golden rain tree fruit acted as a selection pressure on beak length.
- D** the response of an individual golden rain tree to predation by soapberry bugs would be to grow larger fruit.

26 A family exhibits a rare autosomal recessive disease, which is caused by a point mutation that abolishes an *EcoR*I restriction site in the genome. To ascertain the genotype of family members, researchers did the following:

- (i) amplify a 1.8 kb region of this area using PCR;
- (ii) cut the PCR products with *EcoR*I; and then
- (iii) separate the DNA fragments on an agarose gel.

The results of such an experiment are shown in Fig. 26 below, using DNA obtained from each of the five family members.

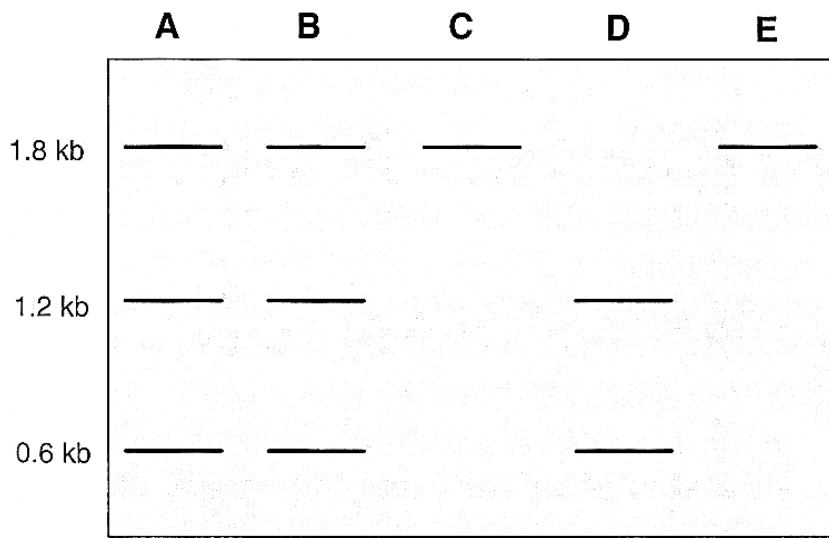


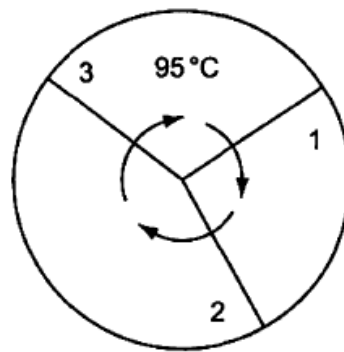
Fig. 26

Which family members have the disease?

- A** **A and B**
- B** **C and E**
- C** **D only**
- D** **A, B and D**

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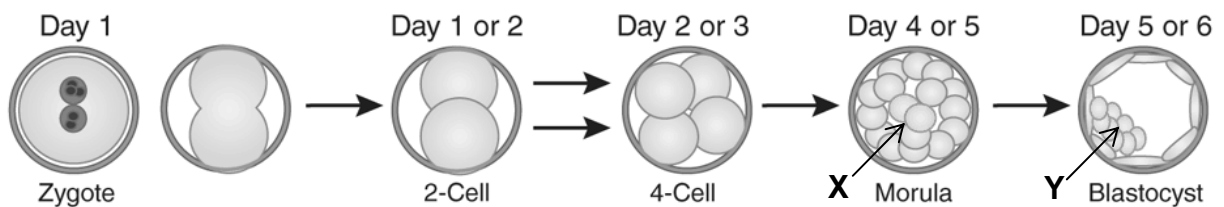
27 The diagram represents the stages of a polymerase chain reaction.



Which row shows the events happening at stages 1, 2 and 3?

	1	2	3
A	binding of primers at 55°C	polymerization at 72 °C	denaturing of DNA
B	denaturing of DNA at 72°C	binding of primers at 55°C	polymerisation
C	polymerization at 55 °C	binding of primers at 72°C	denaturing of DNA
D	polymerization at 55 °C	denaturing of DNA at 72°C	binding of primers

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

- 29** Developing fish eggs can be treated to produce a diploid egg. In salmon, such eggs have been fused with haploid salmon sperm to give infertile triploid salmon.

Reproductive organ tissue from diploid trout was transplanted into newly hatched triploid salmon. This tissue matured as the fish grew and the salmon successfully produced viable trout sperm or eggs which resulted in young trout.

Which fish(es) could be seen as genetically modified?

- 1 Salmon providing eggs for treatment
- 2 Trout providing reproductive organ
- 3 Young triploid salmon
- 4 Young trout

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

- 30** Which can best be considered to be a social implication of genetically modified (GM) crop plants?

- A** There is evidence that genes for herbicide resistance have spread from (GM) oilseed rape to nearby weed species although there is no evidence that these hybrids have persisted in the environment.
- B** In some studies, the number of beneficial insects has been reduced in areas where insect resistant GM Bt corn has been grown, however in other studies, there has been no effect or the number of beneficial insects has increased.
- C** Pressure placed by people on a multinational GM seed company has caused them to pledge that they will never develop a 'suicide' gene that prevents farmers from growing seed collected from last year's crop.
- D** In some countries, government regulations have been put in place to prevent farmers planting GM crops close to non-GM and organic crops to prevent GM pollen from reaching the crops.

ANSWERS:

1	A	2	D	3	B	4	D	5	D
6	C	7	B	8	A	9	C	10	A
11	C	12	C	13	A	14	D	15	B
16	C	17	B	18	B	19	D	20	C
21	B	22	D	23	A	24	C	25	C
26	B	27	A	28	B	29	A	30	C