

NAME: _____ CLASS: _____ INDEX: _____



CATHOLIC JUNIOR COLLEGE
JC2 PRELIMINARY EXAMINATIONS
Higher 1

BIOLOGY

Paper 1 Multiple Choice

8875/01

29th August 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 and/or shade your name, NRIC / FIN number and HT group on the Answer Sheet in the spaces provided unless this has been done for you.

There are **30 MCQ** 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 **2B pencil** on the separate **OMR Answer Sheet**.

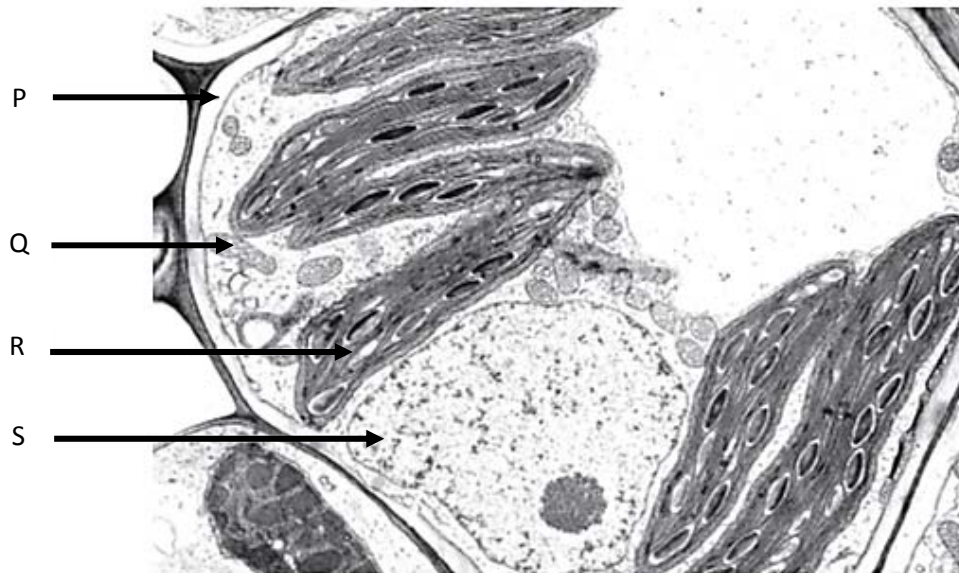
Read the instructions on the Answer Sheet very carefully.

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.

Calculators may be used.

1. The electron micrograph of a cell is shown below.

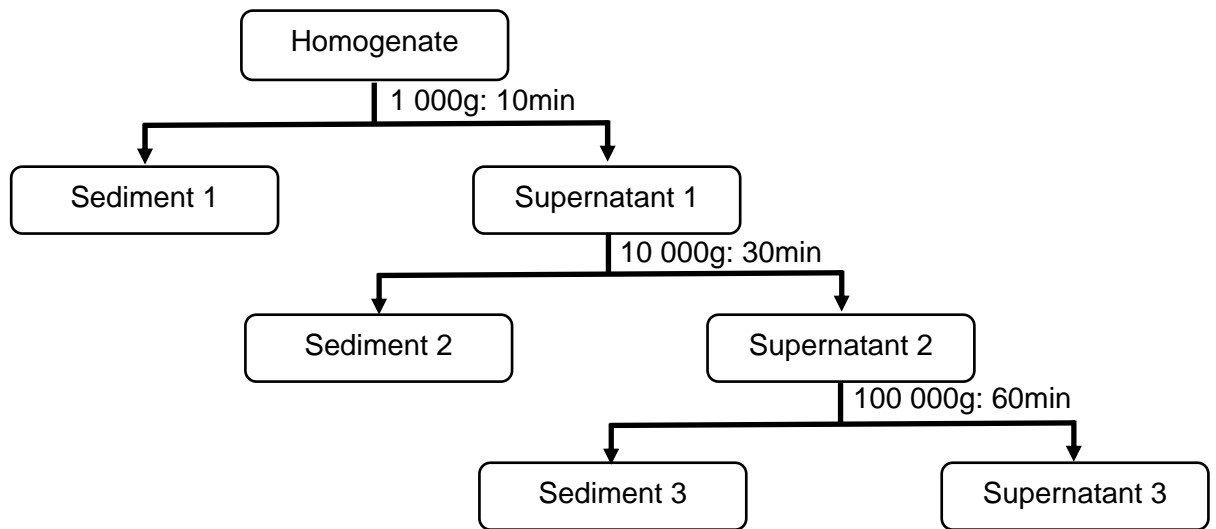


The electron micrograph of a cell is shown below.

Which of the following statements are true?

- 1 Structure P is found in all eukaryotic cells.
 - 2 Organelle Q contains hydrolytic enzymes.
 - 3 Organelle R contains starch.
 - 4 Organelle S contains heterochromatin but not euchromatin.
 - 5 Organelles Q, R and S contain RNA polymerase.
- A** 1 and 3 only
- B** 3 and 5 only
- C** 1, 3 and 5 only
- D** 2, 3 and 5 only

2. The figure below shows a centrifugation schematic of a rat liver cell.

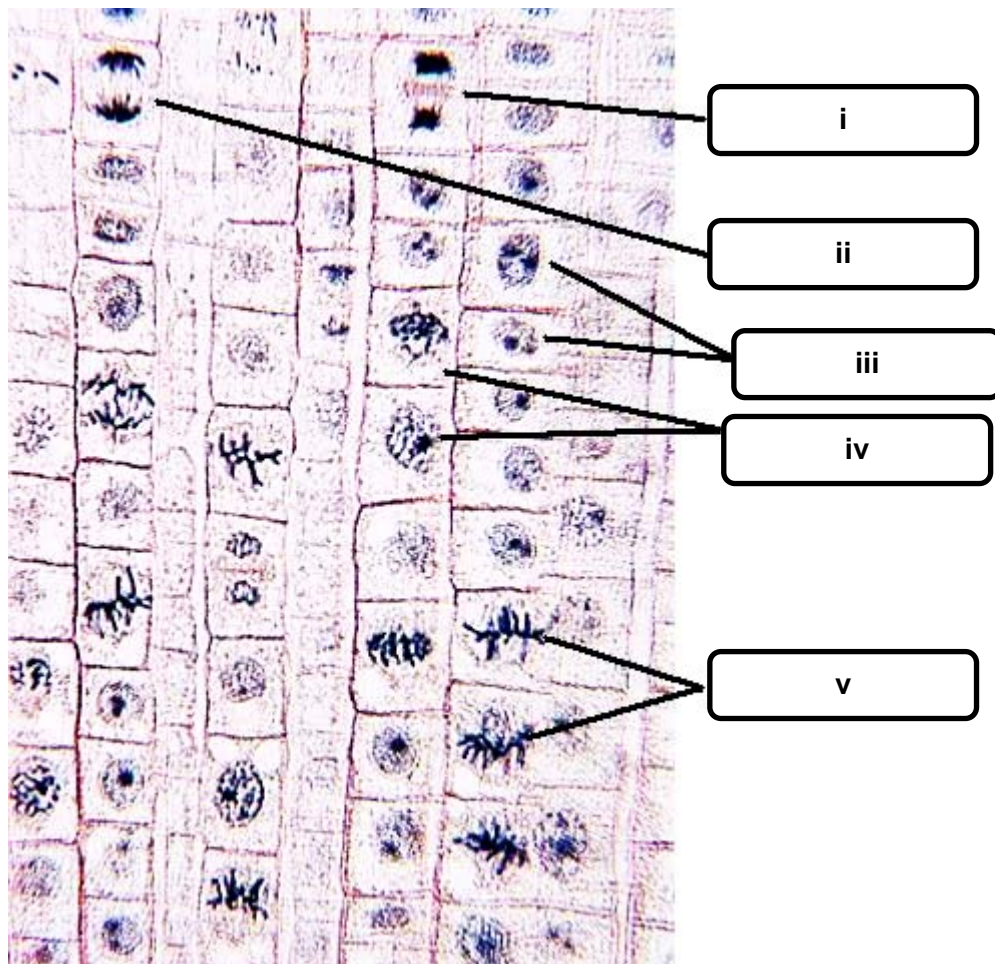


Which of the following statements is incorrect?

- A Sediment 1 contains organelles which are nucleic acid rich.
 - B Sediment 2 contains organelles with carbohydrate and nucleic acid.
 - C Supernatant 2 contains organelles that are the most dense amongst all other organelles.
 - D Supernatant 3 contains organelles that are involved in protein synthesis.
3. Which feature(s) of collagen is incorrect?
- 1 covalent bonds form between adjacent molecules
 - 2 each three-stranded molecule is held together by intramolecular hydrogen bonds
 - 3 every third amino acid in the polypeptide is small
 - 4 the primary structure is held together by peptide bonds

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

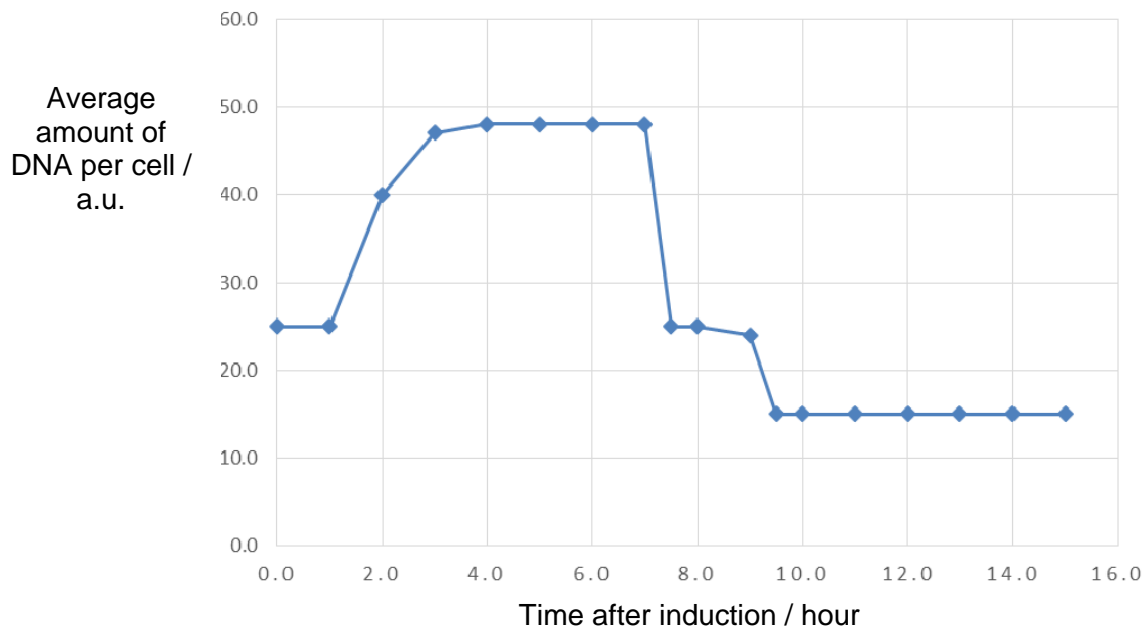
4. The diagram below shows the longitudinal section of a root tip.



Which of the following correctly outlines the sequence in the stages of cell division in the root tip

- A** $\text{iii} > \text{iv} > \text{v} > \text{ii} > \text{i}$
- B** $\text{iii} > \text{iv} > \text{i} > \text{v} > \text{ii}$
- C** $\text{iv} > \text{iii} > \text{v} > \text{ii} > \text{i}$
- D** $\text{iv} > \text{v} > \text{iii} > \text{i} > \text{ii}$

5. The figure below shows the average amount of DNA in a cell after induction.



Which of the following correctly accounts for the trends seen?

	Time Frame after induction / hours	Ploidy level at the end of timeframe	Stage in Cell growth
A	0.0 to 1.0	2n	G2
B	1.0 to 3.0	4n	S
C	3.0 to 8.0	n	G2-Meiosis I
D	8.0 to 9.0	2n	Meiosis II

6. Which of the following is not required for transcription?

- A** Ribonucleoside triphosphates
- B** RNA polymerase
- C** RNA primer
- D** TATA box

7. A mutation had occurred on the template DNA strand which resulted in the polypeptide having the following sequence:

Met – Ser – Cys – Gly – Glu – Gln – His – Phe – Arg – Gly – Stop

The mRNA codon table is shown below.

First Letter	Second Letter				Third Letter
	U	C	A	G	
U	phenylalanine	serine	tyrosine	cysteine	U
	phenylalanine	serine	tyrosine	cysteine	C
	leucine	serine	stop	stop	A
	leucine	serine	stop	tryptophan	G
C	leucine	proline	histidine	arginine	U
	leucine	proline	histidine	arginine	C
	leucine	proline	glutamine	arginine	A
	leucine	proline	glutamine	arginine	G
A	isoleucine	threonine	asparagine	serine	U
	isoleucine	threonine	asparagine	serine	C
	isoleucine	threonine	lysine	arginine	A
	methionine	threonine	lysine	arginine	G
G	valine	alanine	aspartate	glycine	U
	valine	alanine	aspartate	glycine	C
	valine	alanine	glutamate	glycine	A
	valine	alanine	glutamate	glycine	G

If the normal non-mutated template DNA strand has the following sequence,

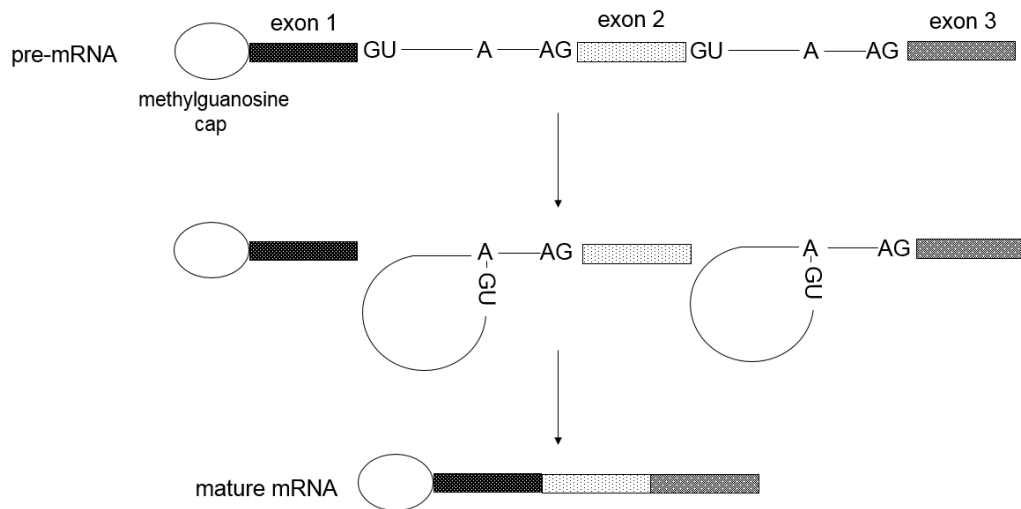
3' – TAC – TCA – ACA – ACC – TCT – TGT – CGT – GAA – GGC – CCA – ACT – 5'

Identify the mutation(s) that had occurred.

- A Single base pair substitution
- B Deletion
- C Addition
- D Deletion and addition

8. Which of the following statements about DNA replication is true?
- A During DNA replication, the synthesis of the leading strand occurs before that of the lagging strand.
 - B DNA polymerase III adds nucleotide pairs to the both the leading and lagging strands during elongation.
 - C During initiation, the enzyme helicase unzips and unwinds the DNA molecule for DNA replication to occur.
 - D DNA ligase catalyzes the formation of phosphodiester bonds between the 3' OH of the primer to the 5' phosphate group of the next Okazaki fragment.

9. The diagram shows part of an mRNA undergoing the process of splicing.

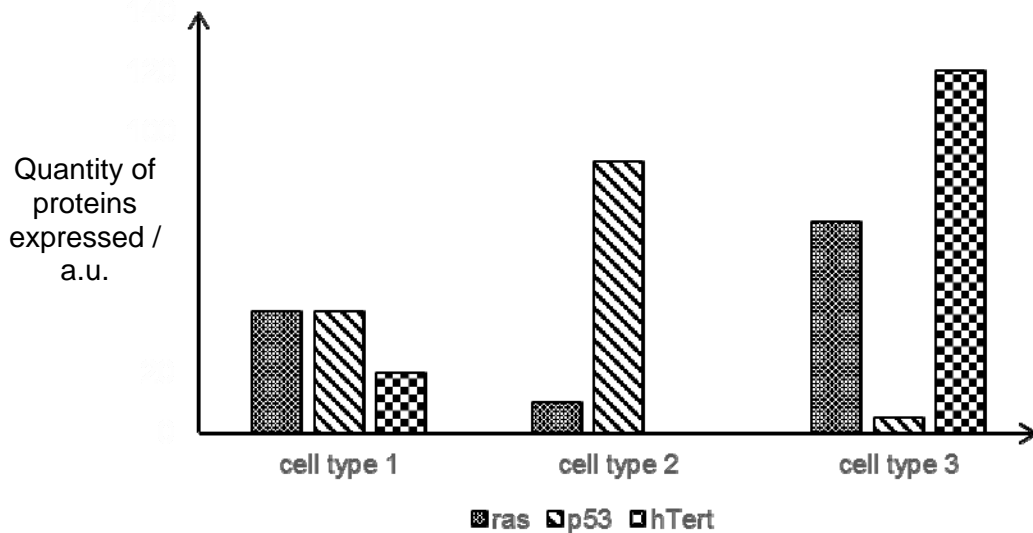


With reference to the diagram above, which statement(s) is / are related to the process shown?

- 1 RNA splicing occurs after the release of pre-mRNA from RNA polymerase.
 - 2 Spliceosome binds to the 3' splice site GU and the 5' splice site AG on the pre-mRNA.
 - 3 A RNA loop is formed on the pre-mRNA where the intron is excised.
 - 4 There can be more than one type of product formed from a single pre-mRNA.
- A 1 and 2
 - B 3 and 4
 - C 2, 3 and 4
 - D 1, 3 and 4

10. The coding region of a gene is 102 nucleotides long, including both the start and stop codons. Which of the following would be the most likely effect of a single nucleotide deletion at position 76 in the coding region?
- A Only the active site would be affected.
 - B The entire amino acid sequence of the polypeptide would change.
 - C There would be changes in only the first 25 amino acids.
 - D There would be changes in only the last 8 amino acids.
11. An chromosomal inversion will
- A always cause a mutant phenotype.
 - B interfere with translation of genes in the inverted region.
 - C likely cause a mutant phenotype if the inversion fall within a gene.
 - D halt transcripction in the inverted region because the chromosome is now in the opposite arrangement.
12. Cancer critical genes include *ras*, *p53* and *hTert*. *hTert* codes for human telomerase.

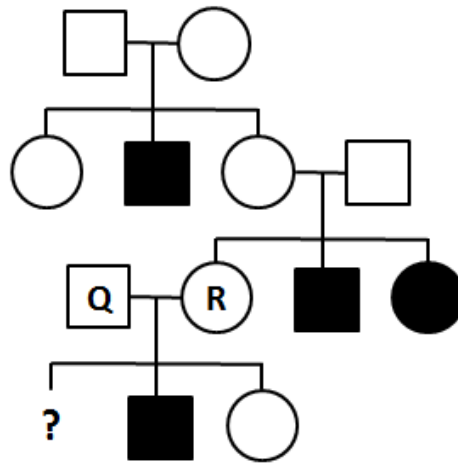
The levels of proteins expressed by each gene in three different cell types of a patient are shown in the graph. Only one cell type was taken from a malignant tumour.



Which statement is true?

- A Cell type 1 is not from the malignant tumour since balanced expression of *ras* and *p53* halts cell cycle progression.
- B Activation of telomerase will result in cell type 2 gaining immortality and becoming cancerous.
- C Cell type 3 is obtained from the malignant tumour as the cells will divide uncontrollably.
- D Gain-of-function mutation of *hTert* in cell type 1 will result in malignant tumour formation.

13. Adducted thumb syndrome is a condition where affected individual will have malformation of the thumb and upper limbs. The figure below show a pedigree chart of a family with the history of adducted thumb syndrome.



If individual Q and R give birth to a son, what is the possibility that their son will be affected by the condition?

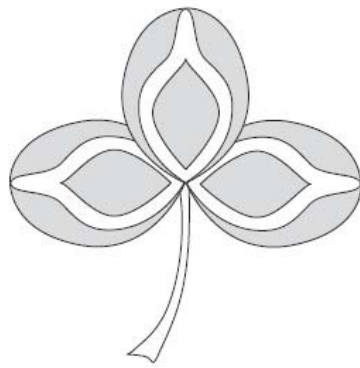
- A 0.125
 - B 0.25
 - C 0.50
 - D 0.75
14. In the breeding season, male Anole lizards court females by bobbing their heads up and down while displaying a colorful throat patch. Both characteristics are controlled by genes found on separate chromosomes. Anoles prefer to mate with lizards, which bob their heads fast and have red throat patches. These two alleles are dominant over their counterparts, slow bobbing and yellow throats.

A male lizard heterozygous for head bobbing and homozygous dominant for the red throat patch mates with a female that is also heterozygous for head bobbing but has yellow throat patches.

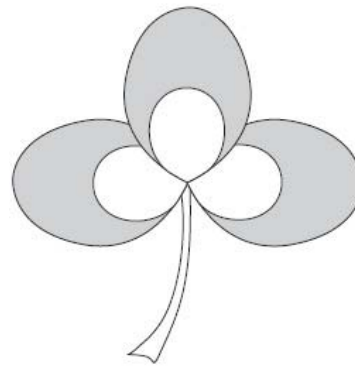
What percentage of the offspring has fast bobbing and red throat phenotype?

- A 25%
- B 50%
- C 75%
- D 100%

15. The white clover, *Trifolium repens*, is one of the plants found growing as a weed in many lawns. Leaves of the white clover are divided into three leaflets, which often have characteristic white patterns visible on their surface. The two basic forms of the pattern are a chevron and patch. The diagram below shows these two patterns.

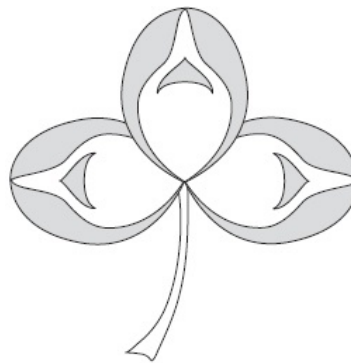


chevron pattern



patch pattern

If a pure-breeding clover plant with the chevron pattern is crossed with a pure-breeding plant with the patch pattern, the offspring have leaflets with a mixed chevron and patch pattern, as shown in the diagram below.



mixed pattern

Which row correctly describes the inheritance of leaflet patterns in white clover?

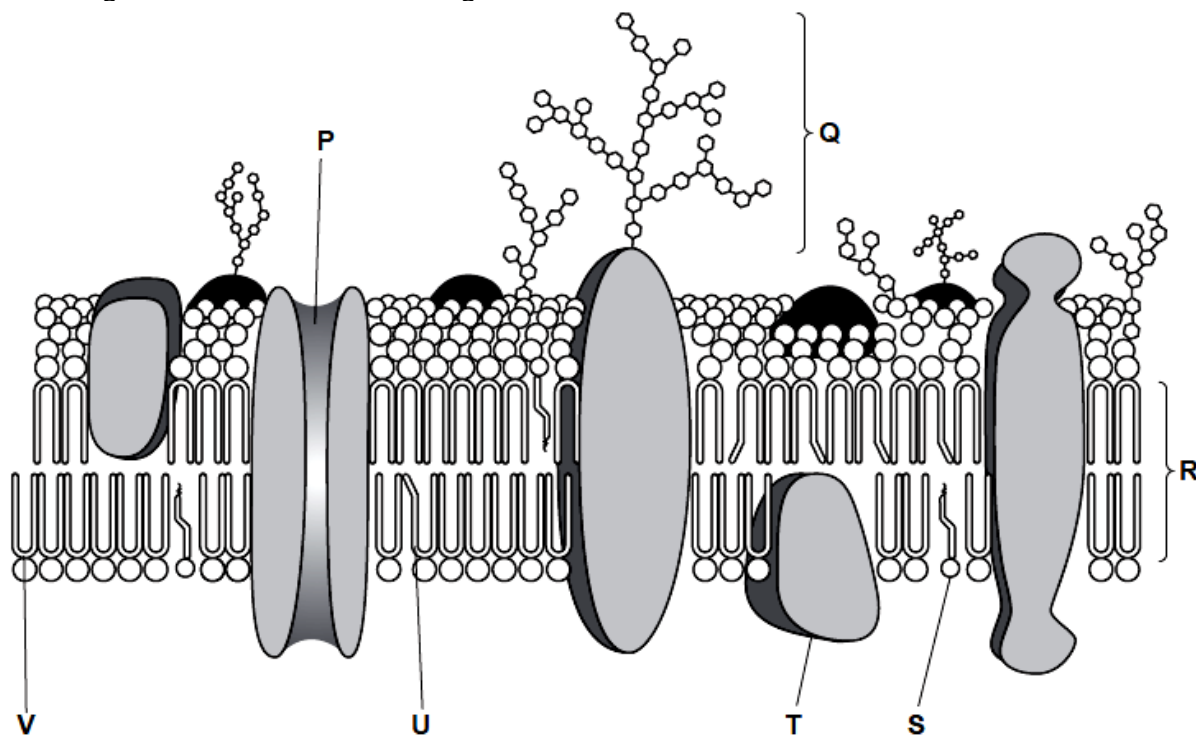
	number of alleles that determines the white patterns in the leaflets	mode of inheritance
A	2	codominance
B	2	dihybrid
C	> 2	codominance
D	> 2	dihybrid

16. The colour of body fat in the rabbits is controlled by a single gene with 2 alleles in a dominant and recessive fashion. The allele G codes for white body fat while g codes for yellow body fat. However, when rabbits are fed on a xanthophyll (photosynthetic pigment) free diet, it results in homozygous recessive rabbits producing white body fat.

Which of the following options show the correct combination of parental genotypes and corresponding offspring's phenotypes under different conditions?

	Parental Genotype	Type of Diet	Offspring phenotype
A	Gg X gg	Xanthophyll free	All white
B	gg X Gg	Standard	3 yellow: 1 white
C	GG X gg	Xanthophyll free	1 white : 1 yellow
D	Gg X Gg	Standard	All white

17. The diagram shows a section through a cell surface membrane from an animal cell.

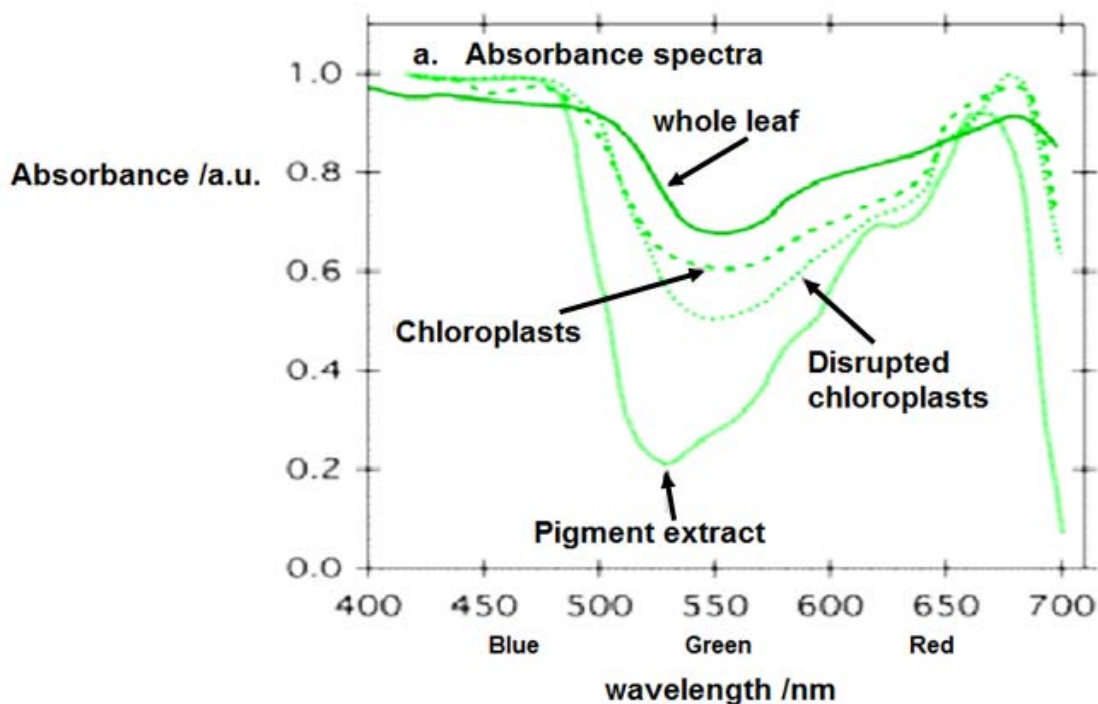


When compared to the more fluid cell surface membrane of a phagocytic cell, a number of differences in the membrane composition can be observed.

Which is the most likely set of differences that will be observed in the phagocytic cell?

- A** A complete absence of component **Q** and a higher proportion of component **P**
- B** A higher proportion of component **S** and a higher proportion of component **T**.
- C** A lower proportion of component **V** and a higher proportion of component **U**.
- D** An increased distance across **R** and a higher proportion of component **V**

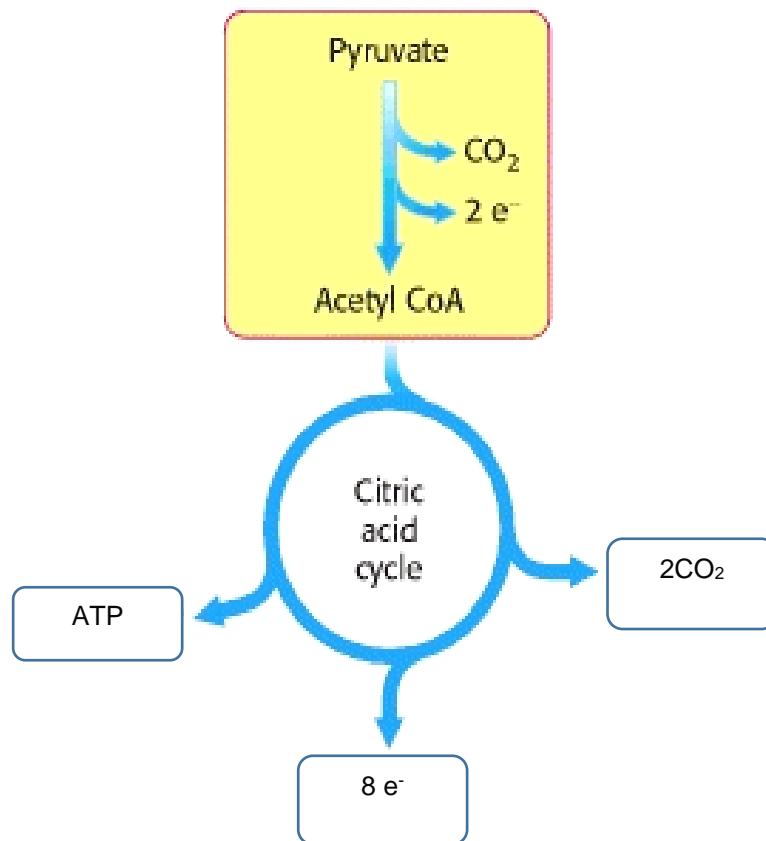
18. Which of the following statements about transport in the cell is incorrect?
- A Active transport is the movement of substances across the cell membrane against a concentration gradient.
 - B Diffusion is the mechanism by which movement of hydrophobic particles through a cell membrane down a concentration gradient.
 - C Receptor mediated endocytosis involves the binding of the substance to specific receptors and their subsequent passive entry into the cell.
 - D Bulk transport is a process which requires energy.
19. The figure shows the absorbance spectra of various components of a leaf.



What can be inferred from the data shown?

- A Absorbance is highest in 650-700 nm in all leaf components due to light harvesting complexes.
- B Whole leaf samples experience the least absorbance at 550 nm due to all green light being reflected.
- C Disrupted chloroplast samples have higher absorbance compared to chloroplasts due to a larger surface area for light capture.
- D Pigment extracts are the main agents of light harvesting due to the presence of carotenoids.

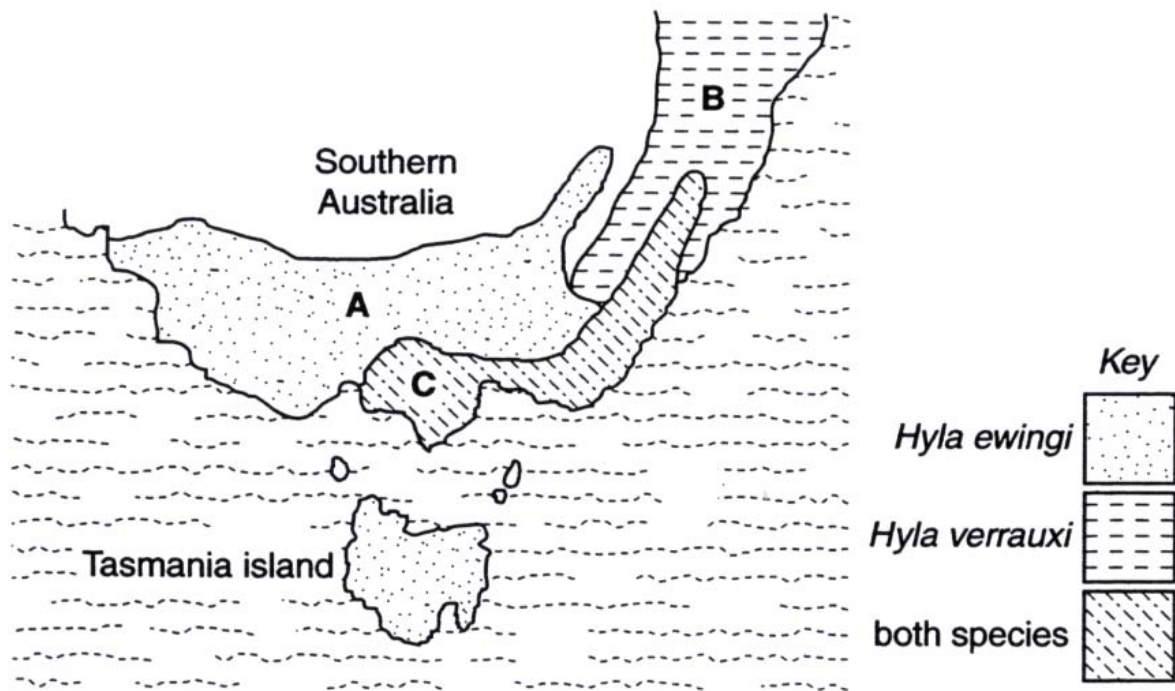
20. The figure below shows the part of the process of aerobic respiration.



Which of the following statements is true of the significance of acetyl CoA?

- A** Acetyl CoA is the product of the link reaction and is subsequently brought into the mitochondria to enter the Krebs cycle
- B** Acetyl CoA is the entry point into the metabolic pathway of both carbohydrates and fats.
- C** Acetyl CoA is an energised molecule combined with Oxaloacetate, to yield 4 molecules of citric acid per molecule of Glucose.
- D** Electrons released in the formation of Acetyl CoA are used in the production of NADPH.

21. Two closely related species of frog, *Hyla ewingi* and *Hyla verrauxi* live in South Australia. The figure below shows the distribution of the tree frogs in Southern Australia.



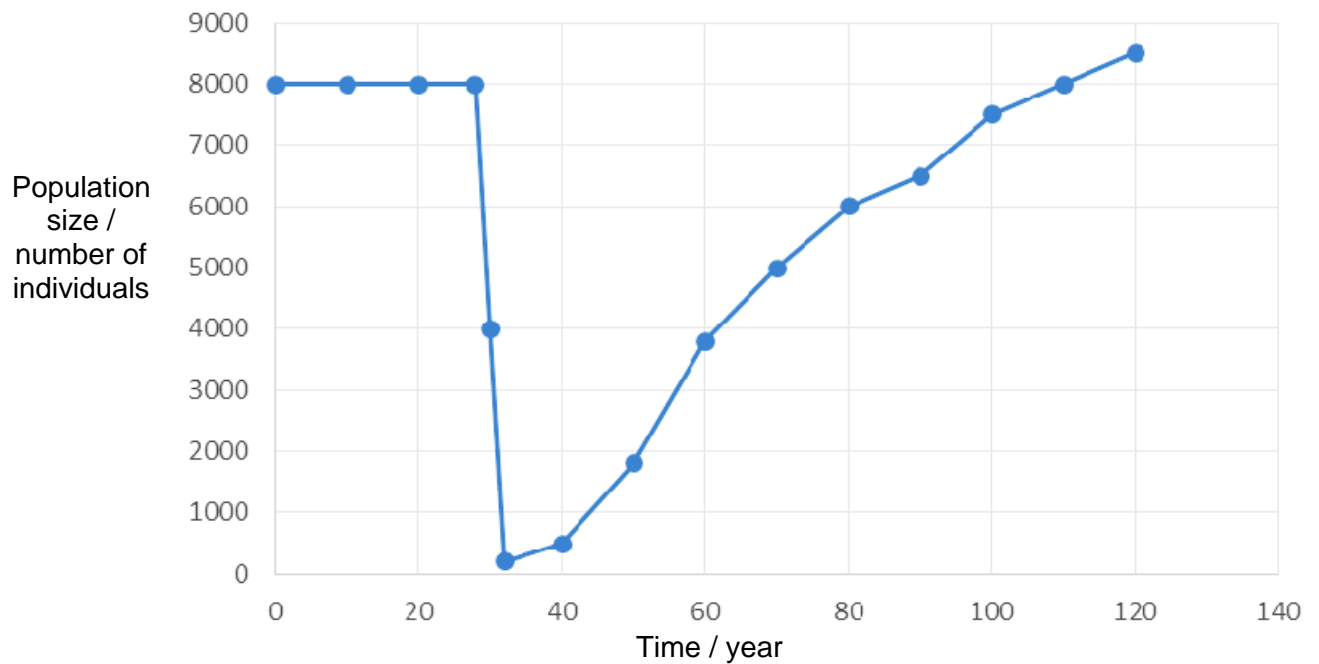
Hyla ewingi and *Hyla verrauxi* are two closely related species of tree frogs from southern Australia. Research from breeding studies and DNA sequence data has shown that they have weak genetic incompatibility.

Male frogs attract females of the same species for mating by their pulsing call. The pulse rate of the male calls of the two species is almost identical. However, when both species coexist within the same region, the calls of *H. ewingi* are quite different than those of *H. verrauxi*.

Which of the following can be correctly inferred from the data given?

- A Complete speciation has taken place between the two groups of frogs.
- B Allopatric speciation was probably the evolutionary mechanism at work.
- C Convergent evolution has seen the frogs in Tasmania similar to those in region A in Australia.
- D Sympatric speciation was probably the evolutionary mechanism at work.

22. The figure shows the population of a group of organisms in a fixed region over time.



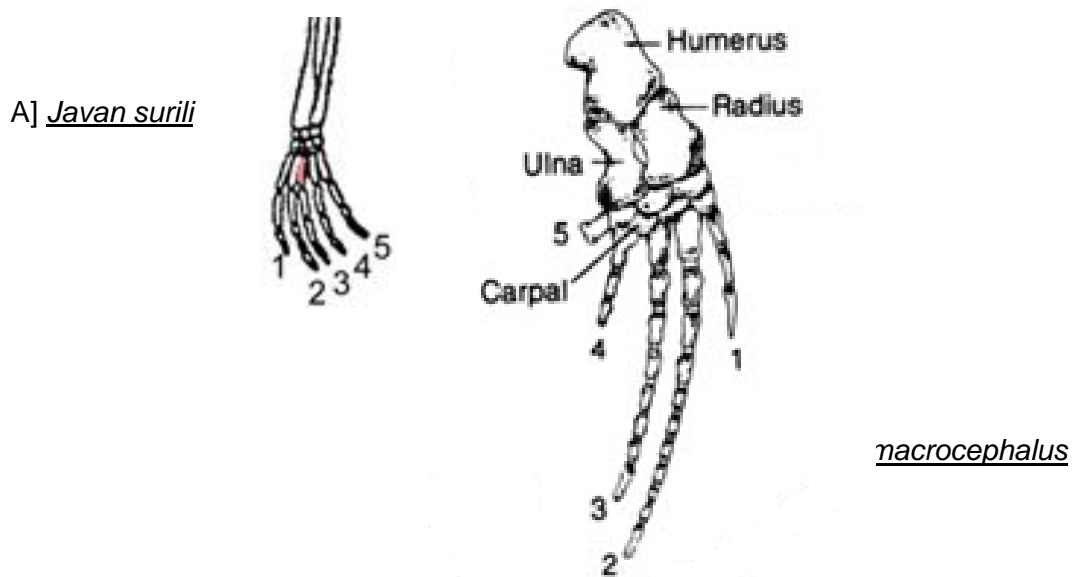
The following statements are derived from the data shown.

- i. Bottleneck event has taken place Year 30 to 35
- ii. Genetic variation has been fully restored by Year 110
- iii. Allele frequency steadily increases due to genetic drift
- iv. Founder effect has taken place from Year 28 onward

Which statements can be concluded as true?

- A** i only
- B** ii only
- C** i, ii & iii only
- D** i, iii & iv only

23. The following figure shows the anatomy of the left front appendages of the two vertebrates.



Which one of the following correctly describes the type of structures seen and their evolutionary connection?

	Type of structures	Ancestry	Type of evolution
A	Homologous	Different ancestor	Convergent Evolution
B	Homologous	Common ancestor	Divergent Evolution
C	Analogous	Different ancestor	Convergent Evolution
D	Analogous	Common ancestor	Divergent Evolution

24. *lacZ* gene is a genetic marker found in the plasmid which can be used in genetic engineering.

What is the function of *lacZ* gene in a cloning vector?

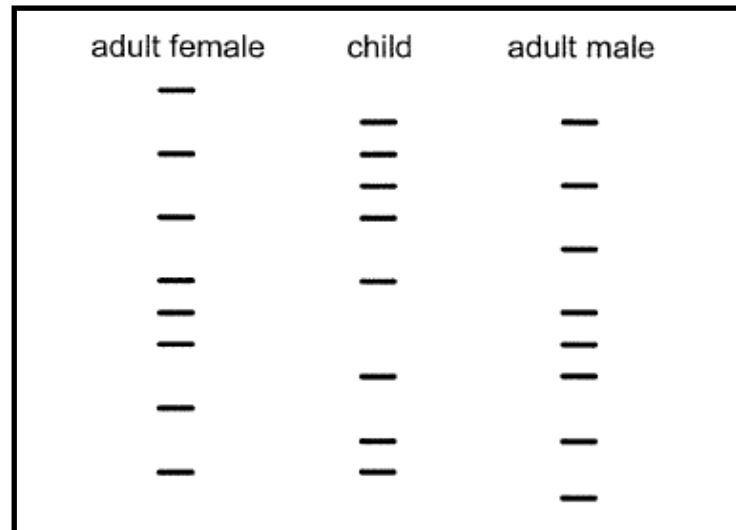
- A** Express *lac* repressor
- B** Distinguish between introns and exons
- C** Break down lactose to galactose and glucose
- D** Screen for cells with the recombinant plasmid

25. PCR is commonly used to amplify DNA.

What is the expected effect on the PCR reaction as a result of adjustments that increase the temperature of the annealing phase and the length of the extension phase?

	precision	yield
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

- 26.** The diagram shows the results of a DNA analysis for victims of an airplane crash, carried out by gel electrophoresis. The DNA of three individuals was profiled.



What is the most likely conclusion from these results?

- A** The child cannot be related to either the male or female
 - B** The female cannot be the child's mother
 - C** The male cannot be the child's father
 - D** The male and female could be the child's parents
- 27.** The Human Genome Project facilitated genetic testing of individuals and renewed emphasis on ethical and social implications.

Which of the following statements correctly describe unintended consequences of genetic testing?

- 1 discovery of wrongly attributed paternity
- 2 unauthorised publication of genetic test results
- 3 psychological stress after receiving genetic test results
- 4 social stigmatisation of genetically predisposed individuals

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

28. Which of the following shows the correct developmental potency of the following stem cells.

	Haematopoietic stem cells	Zygotic stem cells	Embryonic stem cells	Neural stem cells
A	Multipotent	Pluripotent	Totipotent	Unipotent
B	Multipotent	Totipotent	Pluripotent	Unipotent
C	Multipotent	Pluripotent	Totipotent	Multipotent
D	Multipotent	Totipotent	Pluripotent	Multipotent

29. Cows can be genetically modified (GM) by inserting growth hormone genes. Which of the following are valid concerns about GM cows that produce more meat per mass of feed given?

- 1 Introduction of foreign gene may result in production of secondary metabolites which may be toxic to humans who consume them.
- 2 Antibiotic resistance genes in vectors used in GM cows may be passed to the cows, causing them to become resistant to antibiotics.
- 3 GM cows may escape and out-compete the wild populations of bovine species due to their higher rate of growth.
- 4 The meat produced by GM cows is of lower quality than non-GM cows.
- 5 GM cows may pass the foreign gene to their offspring.

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

30. Which statement supports the view that genetically engineered animals could help to solve the demand for food in the world?

- A** Transgenic pigs and sheep are produced to express higher levels of growth hormone.
B Biomedical applications of genetically engineered animals have also become routine within the pharmaceutical industry, for drug discovery, drug development and risk assessment.
C Cloning of either extinct or endangered species such as thylacine and woolly mammoth helps to retain genetic diversity in small populations.
D By inserting genes from sea anemone and jellyfish, zebrafish have been genetically engineered to express fluorescent proteins.

END OF PAPER