

CANDIDATE NAME _____

CG _____



SERANGOON JUNIOR COLLEGE
JC2 PRELIM EXAMINATION 2015

H1 BIOLOGY
8875

Paper 1

**Thursday
27 Aug 2015**

1 hour

Additional materials:
Optical Mark Sheet

INSTRUCTIONS TO CANDIDATES

Write your name and CG in the spaces at the top of this page.

On the Optimal Mark Sheet, enter your name, subject title, test name, class. For your index number, enter your full NRIC number. Shade the corresponding lozenges on the OMS according to the instructions given by the invigilators.

AT THE END OF THE EXAMINATION, HAND IN BOTH THE OMS AND QUESTION PAPER.

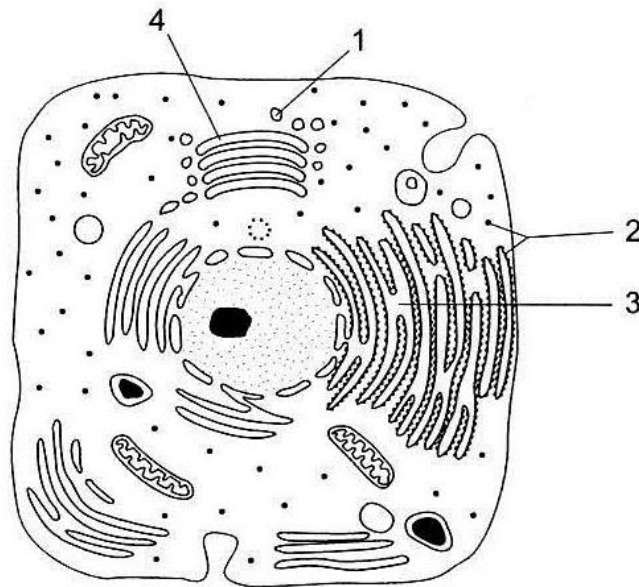
INFORMATION FOR CANDIDATES

There are **thirty (30) questions** in 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 OMS.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done on the question paper.

This question paper consists of 18 printed pages and 2 blank pages.

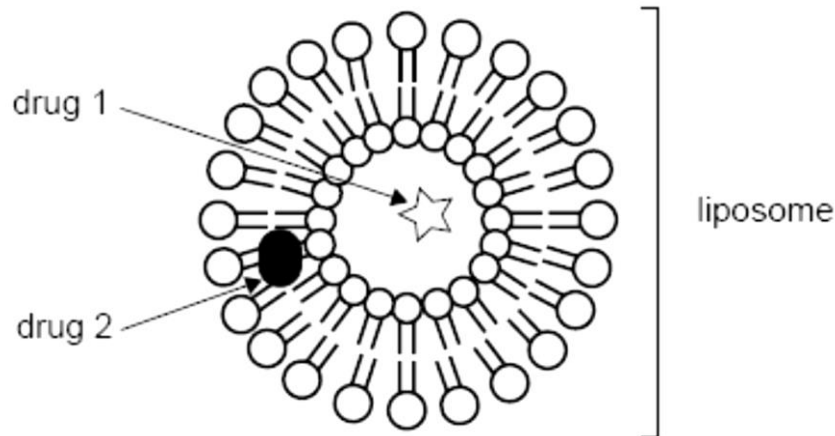
1) The figure below shows the structure of an animal cell.



Which of the following correctly identifies the functions of the labeled structures?

	Synthesizing polypeptides from amino acids	Transporting proteins	Carrying out glycosylation	Secreting digestive enzymes
A	2	1	4	3
B	1	4	2	3
C	2	3	4	1
D	1	3	2	4

- 2) Liposomes are spherical vesicles consisting of a single phospholipid bilayer. They can be designed to carry pharmaceutical drugs into cells. The figure below shows the structure of a liposome and two potential drugs, drug 1 and drug 2, that it can carry.



Which of the following statements are true?

- I. Liposomes can carry both hydrophobic and hydrophilic drugs.
- II. The interior of the liposome is aqueous.
- III. Liposomes are able to fuse with the cell surface membrane of a cell.
- IV. Liposome-based membranes have a rigid structure.

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

- 3) Egg whites are rich in the globular protein albumin. When egg whites are cooked, they turn opaque and solid.

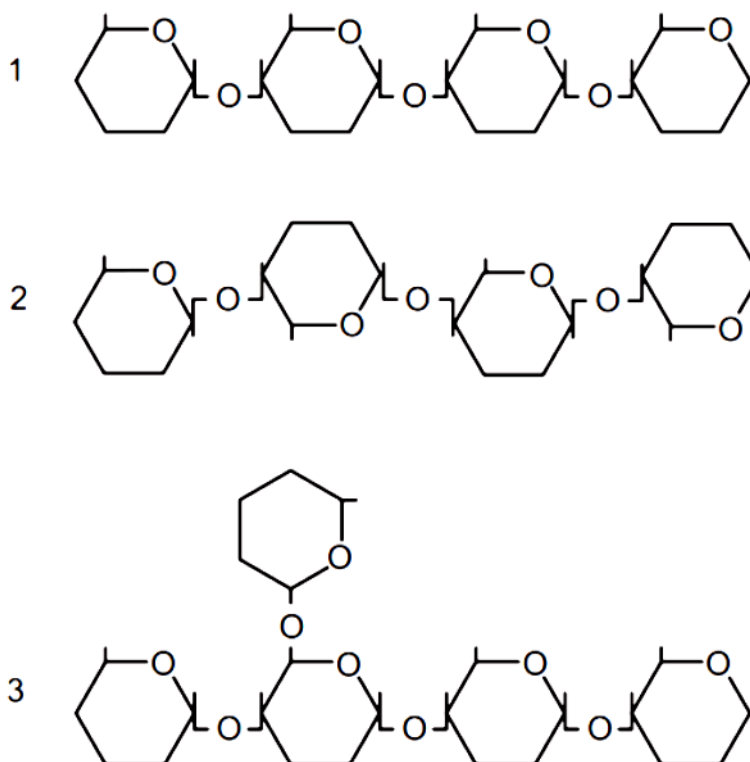
Which of the following statements provide an explanation for the observation to egg whites when cooked?

- A The disruption of hydrogen and ionic bonds between R groups of amino acid residues.
- B The disruption of peptide bonds between R groups of amino acid residues.
- C The disruption of hydrogen bonds between amino group and carboxyl groups of amino acid residues.
- D The disruption of peptide bonds of amino group and carboxyl group of amino acid residues.

4) Which statement about triglycerides is correct?

- A They are made up of three fatty acids combined with glycogen.
- B They are more saturated with hydrogen compared with phospholipids.
- C They form a bilayer in the membranes of cells.
- D They have a lower ratio of oxygen to carbon compared with carbohydrates.

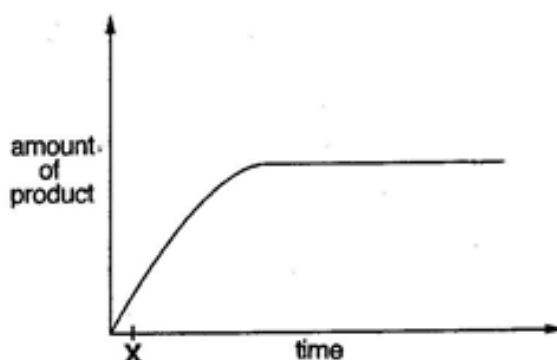
5) Diagrams 1, 2 and 3 show the structural formulae of three polysaccharides.



What are the names of these polysaccharides?

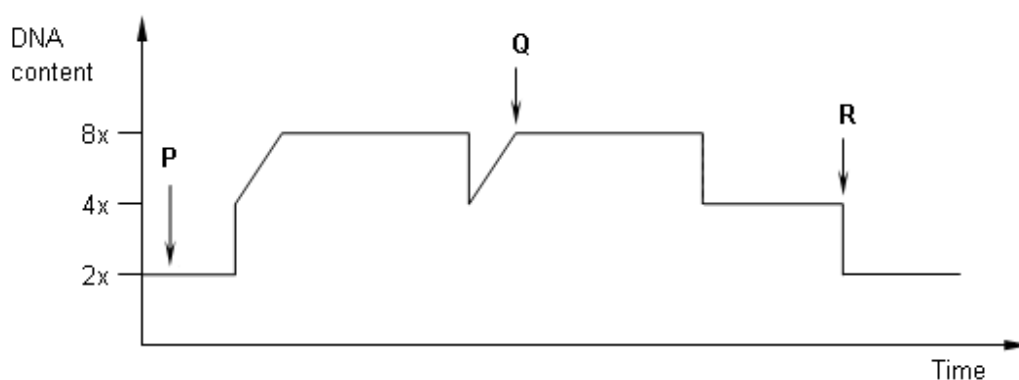
	1	2	3
A	Amylose	Cellulose	Glycogen
B	Amylose	Glycogen	Amylose
C	Cellulose	Glycogen	Cellulose
D	Glycogen	Amylose	Amylose

- 6) The graph below shows the amount of product formed in an enzyme-catalysed reaction over a certain period of time at 37° C.



What is true at time X?

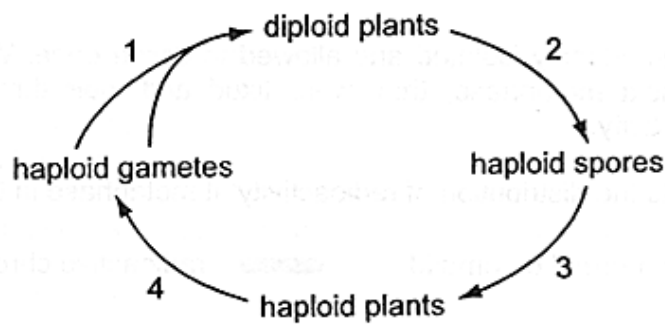
- A Most enzyme molecules will have free active sites.
 - B The number of unreacted substrate molecules is high.
 - C The number of enzyme-substrate complexes is low.
 - D The rate of enzymatic reaction is low.
- 7) The graph below represents the changes in the DNA content in a cell at different stages in the cell cycle.



At point P, the number of chromosomes in a cell is 20. What is the number of chromosomes in a cell at point Q and what are the events occurring at points Q and R?

	Number of chromosomes in the cell at point Q	Events at point Q	Events at point R
A	40	G ₂ phase	Cytokinesis
B	80	Prophase I	Telophase II
C	40	Prophase I	Telophase II
D	80	G ₂ phase	Cytokinesis

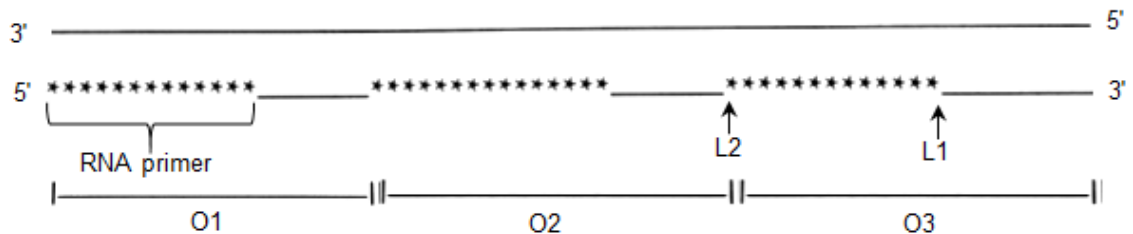
8) The diagram shows the life cycle of a type of plant.



When does meiosis occur?

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

9) The figure below shows the formation of a lagging strand from its DNA template before the removal of the RNA primer.



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

	First Okazaki fragment to be synthesised	Site of catalysis by DNA ligase
A	O1	L1
B	O1	L2
C	O3	L1
D	O3	L2

- 10)** A student obtained a sample of DNA molecule. mRNA was transcribed from this DNA molecule. He then separated the two strands of the DNA sample by adding NaOH. The base compositions of each strand - that of the mRNA and a foreign DNA strand were analysed. The results of the analysis are shown in the table below.

	A	G	C	T	U
DNA strand 1	19.1	26.0	31.0	23.9	0.0
DNA strand 2	24.2	30.8	25.7	19.3	0.0
DNA strand 3	20.5	25.2	29.8	24.5	0.0
mRNA	19.0	25.9	30.8	0.0	24.3

Which strand of DNA serves as a template for mRNA synthesis?

- A** Strand 1
- B** Strand 2
- C** Strand 3
- D** Strand 2 and 3

- 11)** The diagram below shows the entire coding region of an mRNA molecule with the codon AUG coding for the first amino acid.

5' – AUG CAC AAA GAC GGC CCG GCA CCC CCU AGA AAA UAA – 3'

A mutation occurred which resulted in a mutant polypeptide of 8 amino acids instead of the normal 11 amino acids. The sequence of the 8 amino acids in the mutant polypeptide and the sequence of the first 8 amino acids in the normal polypeptide were the same.

Assuming that the DNA contained no introns, which of the following mutation(s) could by itself result in the production of the mutant polypeptide?

- I.** Triple base insertion
- II.** Double base transition
- III.** Double base transversion
- IV.** Double base deletion

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

12) Which of the following is not a requirement for the mechanism of RNA splicing?

- A** Formation of a pre-mRNA-snRNP complex.
- B** Involvement of guanylyl transferase.
- C** 5' and 3' splice sites.
- D** Complementary base pairing between snRNAs with conserved sequences.

13) Cells taken from a human bone cancer multiplied readily in culture. Analysis showed that the cells were unable to produce the protein, RB.

Addition of RB to these cells reduced their rate of division.

Which of the following statement accounts for the observation?

- A** Both chromosomes in the cancer cell carry alleles for tumour suppressor gene.
- B** Both chromosomes in the cancer cell have the allele for tumour suppressor gene deleted.
- C** Both chromosomes in the cancer cell carry alleles for proto-oncogene.
- D** Both chromosomes in the cancer cell have the allele for proto-oncogene deleted.

14) A fisherman was surprised to catch a fish which had no scales (nude). To investigate the origin of this phenotype the nude fish was mated several times to fish with scales and the result of each cross was recorded. In the crosses of nude with scaled, a third phenotype appeared, which was later called linear. The linear phenotype has only a single line of scales down one side of the body.

The outcomes of these crosses are shown in the table.

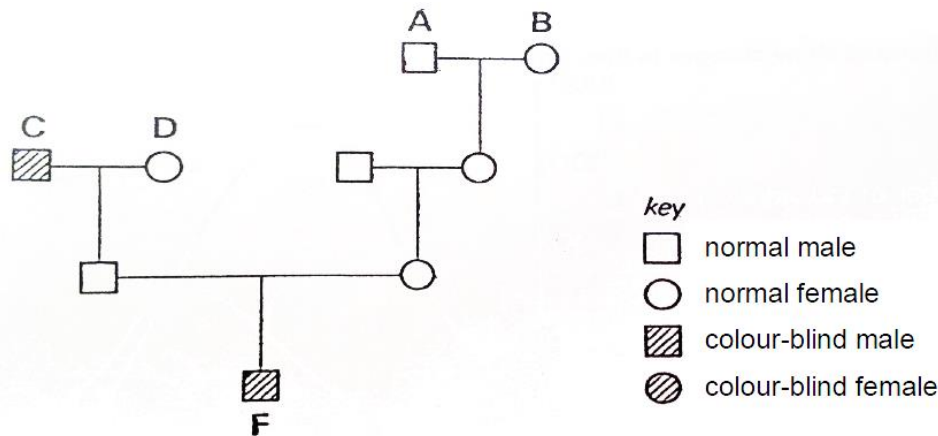
Cross	Parents	Offspring phenotype and ratio
1	scaled x nude	all offspring linear
2	linear x linear	1 scaled : 2 linear : 1 nude

Which of the following is conclusive from the above data?

- A** There is incomplete dominance between the nude and scaled phenotype.
- B** The environment is the reason for the loss of scales in the nude fish.
- C** All of the linear fish are homozygous.
- D** The nude fish are heterozygous.

- 15)** The diagram below shows the pedigree of a family carrying sex-linked allele for colour-blindness.

From which labeled member of his family did F inherit this disorder?



- 16)** A population of cats contains individuals with shortened tails known as Manx cats and individuals with normal tails known as non-Manx cats. Mating of two non-Manx cats always produced non-Manx cats. Mating of two heterozygous Manx cats always produced a mixture of Manx cats and non-Manx cats, where the number of Manx cats is usually twice that of non-Manx cats.

Which hypothesis is consistent with these observations?

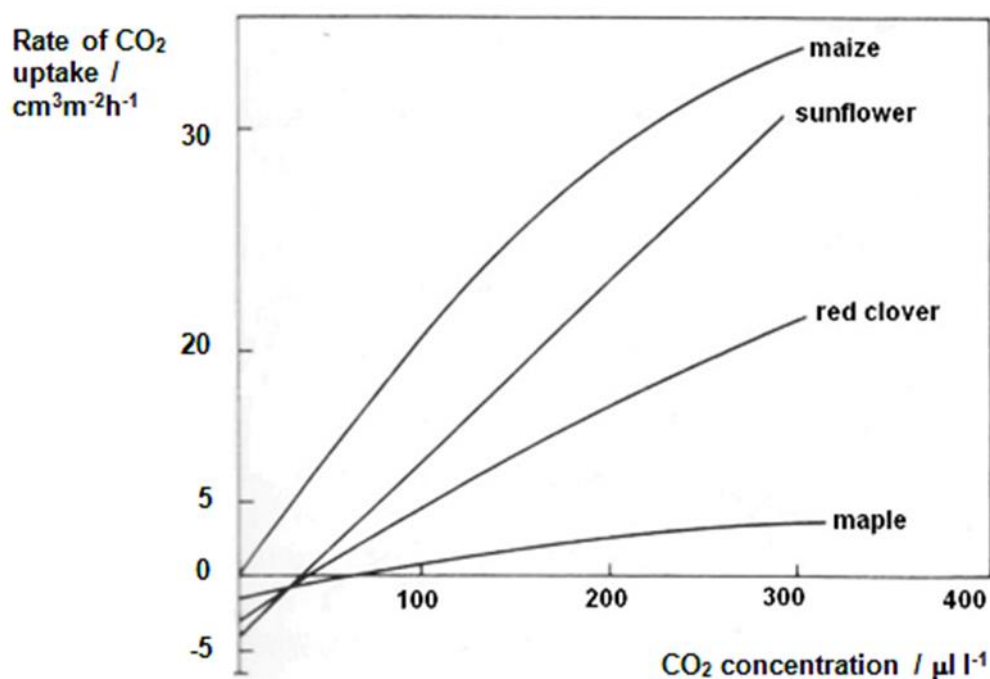
- A** The genes for shortened tails and normal tails are codominant.
- B** The genes for shortened tails and normal tails are sex-linked.
- C** The allele for shortened tails is dominant over the allele for normal tails and the homozygous dominant genotype results in death.
- D** The allele for shortened tails is dominant over the allele for normal tails and the homozygous recessive genotype results in death.

- 17) Which of the following statements are true with regards to cyclic and non-cyclic phosphorylation?

- I. Hydrolysis of ATP occurs in both cyclic and non-cyclic phosphorylation.
- II. Energy released from the electron transport chain is used to pump protons from the stroma into the thylakoid lumen.
- III. NADP^+ is oxidized in non-cyclic phosphorylation.
- IV. The products of non-cyclic phosphorylation are NADPH, ATP and oxygen.

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

- 18) The graph below shows the rate of photosynthesis of four different plants at different concentrations of carbon dioxide.



Which of the following conclusions can be made?

- I. At CO₂ concentrations below 150 μl l⁻¹, CO₂ concentration is the main limiting factor for all the plants.
 - II. CO₂ compensation point is around 40 μl l⁻¹ for sunflower and red clover, and it measures the light intensity when the rate of CO₂ uptake equals to the rate of CO₂ given off.
 - III. Maize has almost zero rate of respiration.
 - IV. Maple has the lowest amount of organic compound produced at CO₂ concentration of 200 μl l⁻¹.
- A I and IV only
 B I, III and IV only
 C II, III and IV only
 D II and III only

19) Mammalian liver cells were homogenised and the resulting homogenate centrifuged. Portions containing only mitochondria and cytosol (residual cytoplasm) were each isolated. Samples of each portion, and of the complete homogenate, were incubated in four ways:

- 1 with glucose;
- 2 with pyruvate;
- 3 with glucose plus cyanide; and
- 4 with pyruvate plus cyanide.

Cyanide inhibits carriers in the electron transport chain. After incubation, the presence or absence of carbon dioxide and lactate in each sample was determined. The results are summarised in the table below.

	samples of homogenate					
	complete		mitochondria only		cytosol	
	carbon dioxide	lactate	carbon dioxide	lactate	carbon dioxide	lactate
1 glucose	✓	✓	x	x	x	✓
2 pyruvate	✓	✓	✓	x	x	✓
3 glucose + cyanide	x	✓	x	x	x	✓
4 pyruvate + cyanide	x	✓	x	x	x	✓

x = absent, ✓ = present

Which statement can be concluded from the table?

- A** Carbon dioxide was not formed when mitochondria was incubated with glucose as there was no oxygen present.
- B** Both aerobic and anaerobic respirations were occurring in **3**.
- C** Lactate formation in mitochondria was inhibited by the presence of cyanide.
- D** The mode of action of cyanide would be similar to that of a cell experiencing anaerobic respiration.

- 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?

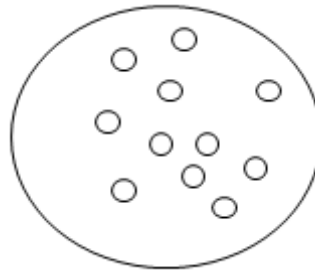
	lactate accumulation	NAD production	ATP production	pH of blood
A	yes	yes	yes	decreased
B	no	yes	yes	decreased
C	yes	no	no	increased
D	no	no	no	increased

- 21)** Which of the 2 primers can be used to amplify the sequence shown below by Polymerase Chain Reaction?

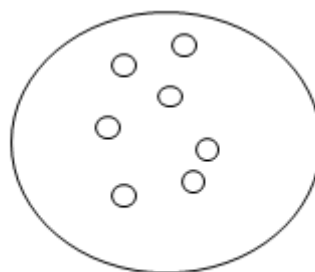
5' – GGAATTCGT -- // -- TATGCTACC – 3'

- A** 5' GGTAGCATA 3' & 5' GGAATTCGT 3'
- B** 5' ACGAATTCC 3' & 5' TATGCTACC 3'
- C** 5' TATGCTACC 3' & 5' GGAATTCGT 3'
- D** 5' ACGAATTCC 3' & 5' GGTAGCATA 3'

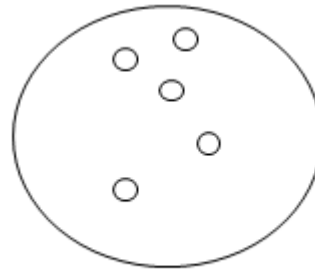
- 22)** The recombinant plasmids were transformed into *Escherichia coli* and the bacteria were grown on nutrient medium. The resulting master plate is shown in the diagram.



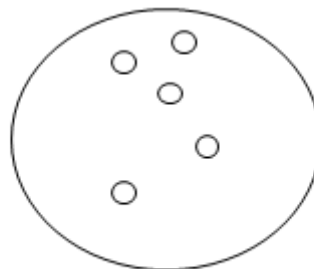
Transformed cells were selected by replica plating and grown on media containing different antibiotics.



medium with ampicillin



medium with tetracycline

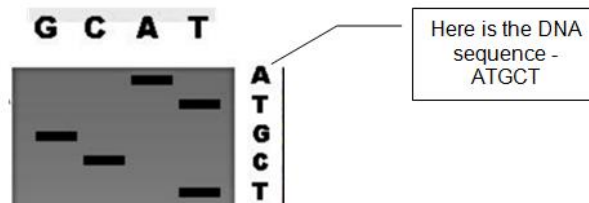


medium with ampicillin and tetracycline

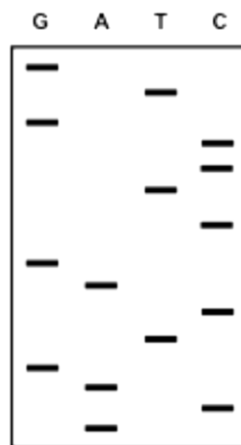
How many colonies in the master plate contain the recombinant plasmid?

- A** 1
- B** 2
- C** 5
- D** 7

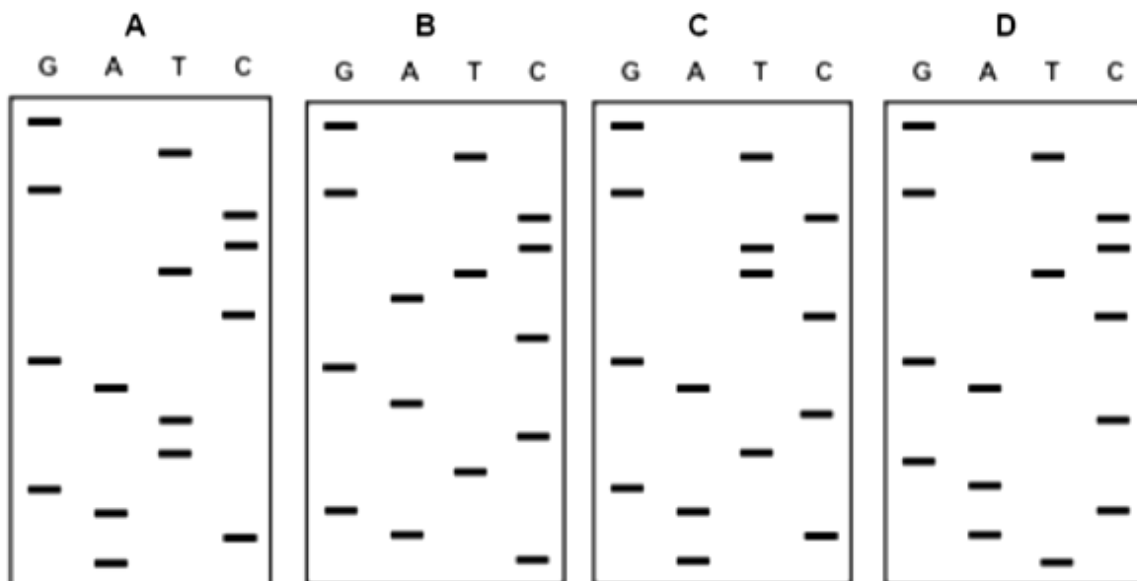
- 23) In people with a gene mutation where a base insertion has occurred, the protein formed has a very different primary structure. To identify the presence of this mutant allele, DNA nucleotide sequences were compared using gel electrophoresis. Read from the top to the bottom for the DNA sequence. Here's an example:



The electrophoresis result from the DNA of a normal allele of the gene is shown below.



Which diagram represents the DNA sequence for the mutant allele of this gene?



24) Which of the following is/ are the reasons that make embryonic stem cells particularly useful in medical research?

- 1** They can be fused together to form a zygote.
- 2** They have the characteristics of a pluripotent stem cell.
- 3** They will continue to divide indefinitely.
- 4** They can be stimulated by chemical signals to express particular genes.
- 5** They can only differentiate into a particular tissue.

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

25) Which of the following poses the greatest limitation to the Human Genome Project in the area of disease analysis?

- A** It is not possible to store the genomic information of all individuals.
- B** There is too large a genetic difference between individuals to determine the loci of genes of interest.
- C** Too few model organisms exist for comparative genomic studies to take place.
- D** Environmental factors and gene interactions in disease are not taken into account.

26) 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. A biotech company 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 thrived 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?

- I.** 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 increased. The Bt gene is now ineffective.
- II.** Corn is being attacked by other pests which are not killed by the Bt gene protein.
- III.** The Bt allele has undergone mutation. This mutation has had a selective advantage in seed fertility.

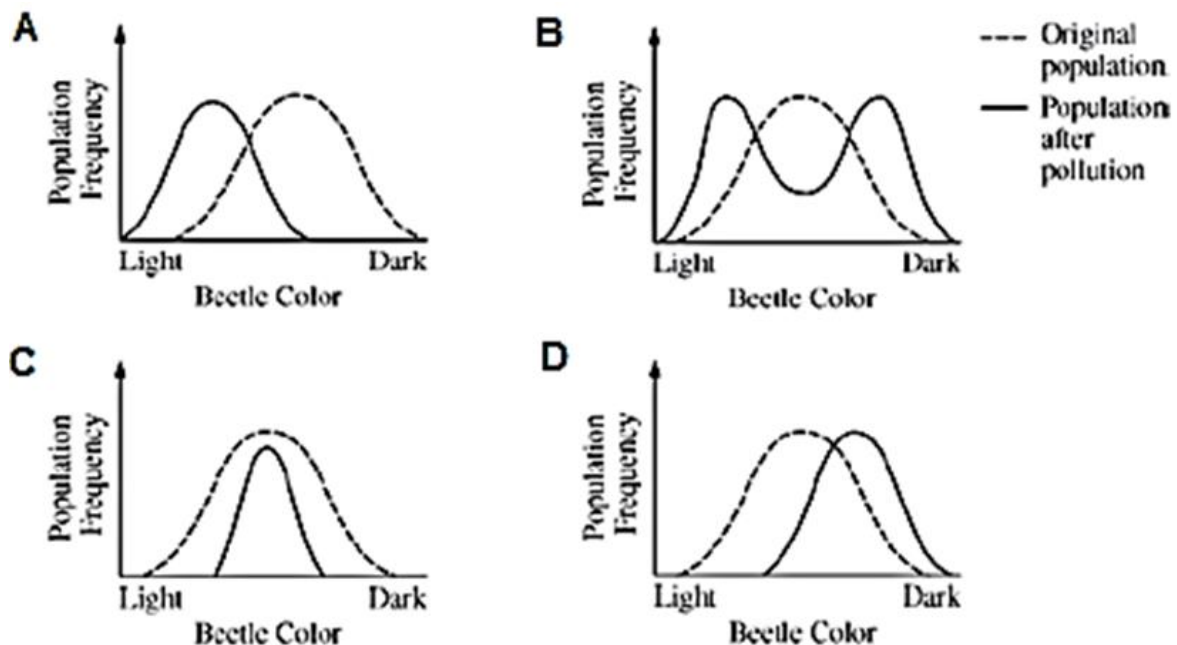
- A** I and II only
- B** I and III only
- C** II and III only
- D** All of the above

27) Which taxonomic group is correctly described?

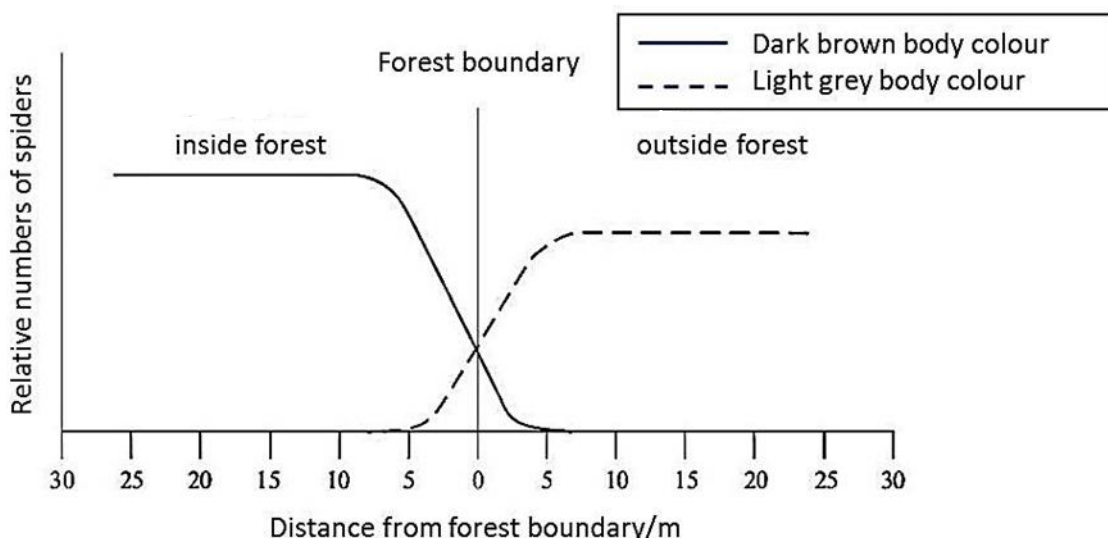
	Taxonomic group	Size of group	Number of similarities between members of the group	Ancestry of members of group
A	kingdom	large	few	recently shared a common ancestor
B	species	small	many	recently shared a common ancestor
C	species	large	few	distantly shared a common ancestor
D	kingdom	small	many	distantly shared a common ancestor

28) In a hypothetical population of beetles, there is a wide variety of colour, matching the range of coloration of the tree trunks on which the beetles hide from predators. The graphs below illustrate four possible changes to the beetle population as a result of a change in the environment due to pollution that darkened the tree trunks.

Which of the following graphs includes the most likely change in the coloration of the beetle population after pollution?



29) The graph below shows the distribution of huntsman spiders at a forest boundary.



One species of huntsman spider (*Isopeda isopedella*) varies in body colour from dark brown to light grey. In one community at the forest boundary, two populations of this species were found. Some were found living in the leaf litter inside the forest and others were found living in the grass just outside the forest. The relative numbers of dark brown adult spiders and light grey adult spiders found at certain distances from the forest boundary are shown in the graph above.

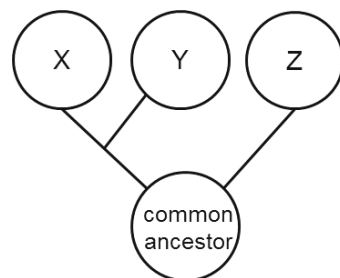
Which of the following would be the best explanation for this distribution?

- A The two populations of spiders were once different species.
- B The two populations of spiders were unable to interbreed and individuals were adapting to suit their habitats.
- C The differences in the two habitats had changed the physical appearance of individual spiders.
- D A particular body colour provided a selective advantage to spiders in a particular habitat.

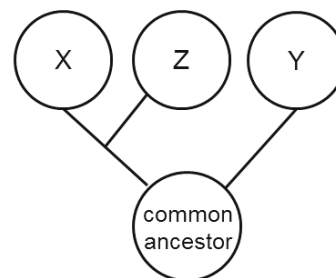
- 30)** Cytochrome c is a protein found in most organisms. The amino acid sequence of this protein varies between different species and can be used to determine evolutionary relationships. The table shows the numbers of differences in the amino acid sequences of cytochrome c between three species (X, Y, and Z).

	species Y	species Z
Species X	8	2
Species Y	0	9

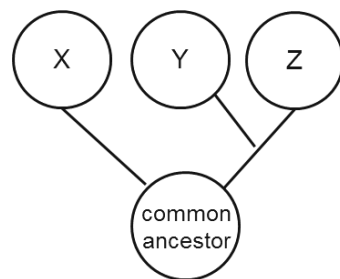
Which diagram best represents the evolutionary relationships between species X, Y and Z?



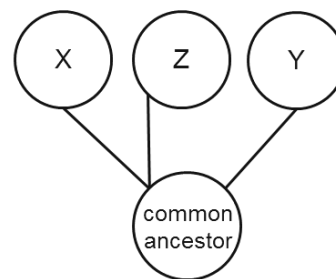
A



B



C



D

BLANK PAGE

BLANK PAGE