

JURONG JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 1

CANDIDATE
NAME

CLASS

BIOLOGY

8875/01

Paper 1 Multiple Choice

15 September 2016

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name and class on the Answer Sheet in the spaces provided unless this has been done for you.

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** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

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

This document consists of **20** printed pages.

[Turn over

1 The electron micrograph of a cell is shown below.



Which statements are true?

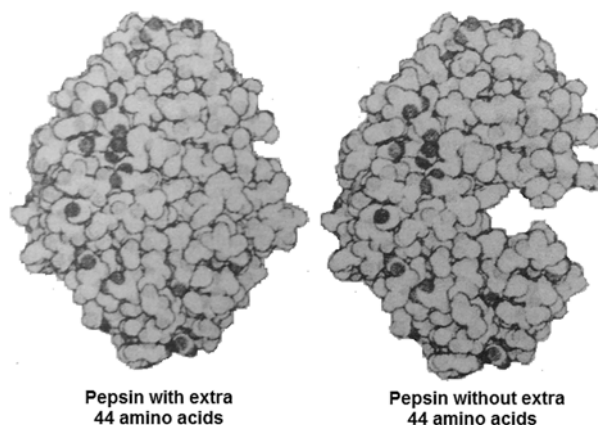
- 1 P is made up of phospholipids and amino acids.
- 2 Q and R are found in all eukaryotic cells.
- 3 One of the processes in R synthesises ATP.
- 4 S contains only euchromatin but not heterochromatin.
- 5 Q, R and S contain both RNA polymerase and double stranded DNA.

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

2 During the production of apple juice, enzymes are used to break down the components of cell walls. What will be the product of this hydrolysis?

- A** amylose
- B** maltose
- C** α -glucose
- D** β -glucose

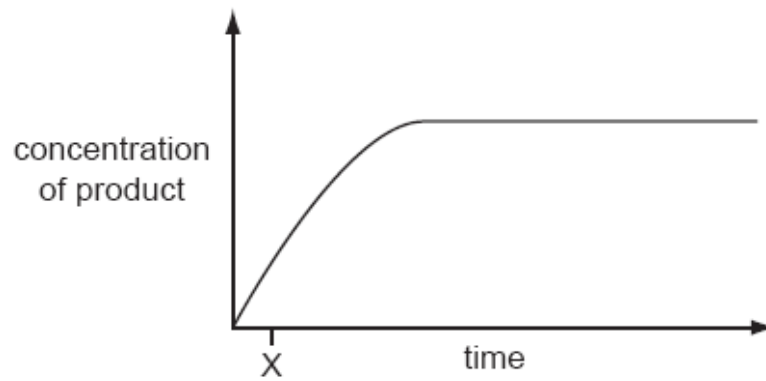
- 3 The R group of the amino acid serine is $\text{--CH}_2\text{--OH}$. The R group of the amino acid alanine is --CH_3 . Where would you expect to find these amino acids in a globular protein in aqueous solution?
- A Serine would be in the interior, and alanine would be on the exterior of the globular protein.
 - B Alanine would be in the interior, and serine would be on the exterior of the globular protein.
 - C Both serine and alanine would be in the interior of the globular protein.
 - D Both serine and alanine would be in the interior and on the exterior of the globular protein.
- 4 Protein-digesting enzymes are synthesised inside cells as inactive pro-enzymes, which are then activated outside the cell. Pepsin is synthesised with an extra 44 amino acids. This extra chain is removed in the stomach allowing the enzyme to digest proteins.



Which statement is incorrect?

- A There is a change in the tertiary structure of the protein molecule when the extra amino acids are removed.
- B Removal of the 44 amino acids is a hydrolysis reaction.
- C The extra 44 amino acids serve as competitive inhibitor, preventing the binding of the substrate to the active site of the enzyme.
- D The change in shape of the pepsin upon activation is due to a change in the primary structure.

- 5 The graph shows the course of an enzyme-catalysed reaction at 30°C.



What is true at time X?

- A Most enzyme molecules have free active sites.
- B The number of available substrate molecules is high.
- C The number of enzyme-substrate complexes is low.
- D The rate remains the same if more enzyme is added.

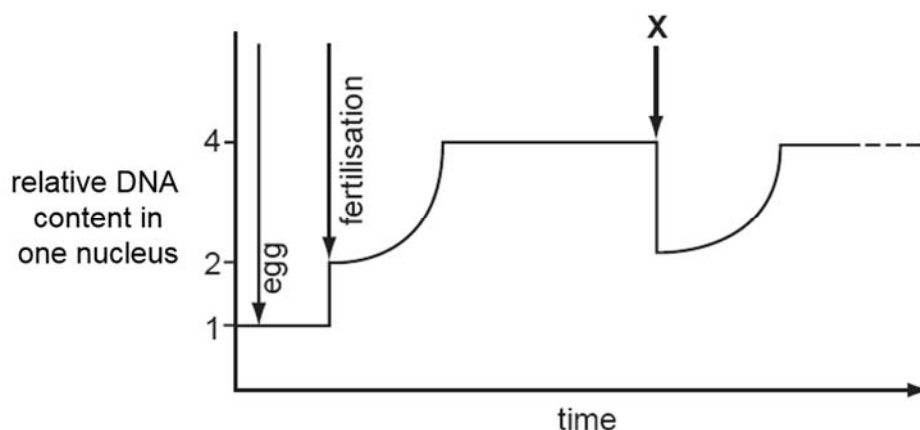
- 6 The diagram shows some *Allium sp.* plant cells in various stages of mitotic cell cycle labelled **W** – **Z**.

**W****X****Y****Z**

Which correctly describes the structure or behaviour of chromosomes at the various stages?

- A** The chromosomes at **W** are less condensed as compared to those at **Y**.
- B** The homologous chromosome pairs are separated to opposite poles of the cell during **X**.
- C** During **Y**, the chromosomes undergo semi-conservative DNA replication.
- D** The number of chromosomes per nucleus at **Z** is different from that at **W**.

- 7 The graph represents the changes in the quantity of DNA present in one nucleus at different stages in the life cycle.



What accounts for the change in the quantity of DNA at X?

- A division of centromere
 - B pulling of chromosomes to opposite poles of cell by spindle fibres
 - C formation of nuclear envelope around the chromosomes
 - D division of the cytoplasm into two equal parts
- 8 During the replication of DNA in eukaryotic cells, the following processes occur.
- 1 Free nucleotides are hydrogen bonded to those on the exposed strand.
 - 2 Hydrogen are broken between the complementary base pairs.
 - 3 The cell receives the signal to divide.
 - 4 Covalent bonds form between adjacent nucleotides on the same strand.
 - 5 The DNA double helix is unwound.

Which shows the correct order of some of the processes?

- A $3 \rightarrow 1 \rightarrow 2 \rightarrow 4$
- B $3 \rightarrow 2 \rightarrow 4 \rightarrow 5$
- C $5 \rightarrow 2 \rightarrow 1 \rightarrow 4$
- D $5 \rightarrow 2 \rightarrow 3 \rightarrow 1$

- 9 The following coding sequence is taken randomly from a bacterial genome.

3' – TTACGCTTCGAAATAGGAATATCATAGGCT-5'

Arg	CGU, CGC, CGA, CGG, AGA, AGG	Leu	UUA, UUG, CUU, CUC, CUA, CUG
Asp	GAU, GAC	Lys	AAA, AAG
Ile	AUU, AUC, AUA	Phe	UUU, UUC
Asn	AAU	Ala	GCG
Met	AUG	Ser	UCU, UCC, UCA, UCG, AGU, AGC
Glu	GAA	Tyr	UAU, UAC
Stop	UAG, UGA, UAA		

This sequence is cloned into a plasmid and transformed into a suitable host. What would be the first four amino acids of a peptide generated from this sequence as expressed by the host?

- A Asn-Ala-Lys-Leu
 - B Met-Arg-Ser-Phe
 - C Met-Ile-Phe-Leu
 - D Leu-Arg-Phe-Glu
- 10 In the DNA sequence for sickle cell anaemia, adenine replaces thymine in a CTT triplet, forming the triplet CAT. During synthesis of the sickle cell haemoglobin molecule, the amino acid valine is incorporated instead of glutamic acid.

What is the anticodon in the transfer RNA molecule carrying this valine?

- A CAU
- B CUA
- C GAU
- D GUA

- 11** Tay-Sachs disease is characterised by abnormal accumulation of lipid related compounds, which results in deterioration of cognitive and motor abilities.

It is caused by an autosomal recessive mutation in the allele coding for hexosaminidase A (HEXA), an enzyme that regulates the metabolism of phospholipids.

The base triplets in part of the coding DNA sequences for a normal HEXA allele and a mutant Tay-Sachs allele, as well as their corresponding amino acids are shown.

Normal HEXA allele	CGT	ATA	TCC	TAT	GCC	CCT	GAC	
	Arg	Ile	Ser	Tyr	Gly	Pro	Asp	
Tay-Sachs allele	CGT	ATA	TCT	ATC	CTA	TGC	CCC	TGA
	Arg	Ile	Ser	Ile	Leu	Cys	Pro	

Which combination correctly describes the nature of mutation that results in the Tay-Sachs allele?

	Changes to nucleotide sequences	Alteration of reading frame	Length of polypeptide
A	Deletion of 2 bases	Yes	Shorter
B	Insertion of 2 bases	Yes	Longer
C	Substitution of 4 bases	No	Unchanged
D	Insertion of 4 bases	Yes	Longer

- 12** Chromosomal mutations were induced to produce a fertile hybrid species from cabbage and radish.

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

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

At which stage did the chromosomal mutation occur?

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

- 13 A genetic cross performed on the fruit fly, *Drosophila melanogaster*, involved two independently assorting genes.

gene	alleles
eye shape	bar (narrow) round
wing shape	normal vestigial (reduced)

The F₂ generation was observed to show the expected 9:3:3:1 phenotypic ratio, with the majority of the F₂ offspring possessing bar eyes and normal wings.

Two different individuals with bar eyes and normal wings were removed from the F₂ group and each subjected to a test cross. The ratios of the resulting phenotypes are shown below.

test cross x individual P = 1 bar eye, normal wing : 1 bar eye, vestigial wing

test cross x individual Q = 1 bar eye, normal wing : 1 round eye, normal wing

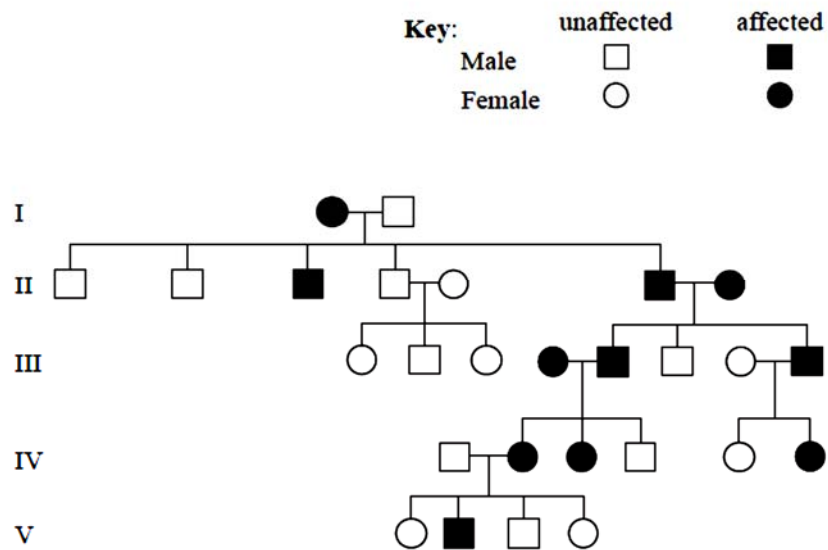
What is the expected phenotypic ratio for the offspring of a cross between individual P and individual Q?

- A all bar eye, normal wing
 - B 1 bar eye, normal wing : 1 bar eye, vestigial wing
 - C 3 bar eye, normal wing : 1 bar eye, vestigial wing
 - D 3 bar eye, normal wing : 1 round eye, normal wing
- 14 A man with blood type B, whose mother is blood type O, marries a woman with blood type AB. Which are possible blood groups for their children?

- 1 A
- 2 B
- 3 AB
- 4 O

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

- 15 The pedigree chart shows the inheritance of a genetic disease in a family. What is the nature and inheritance of the allele that causes this disease?



- A dominant and sex linked
- B dominant and non-sex linked
- C recessive and sex linked
- D recessive and non-sex linked

- 16** In mice, the gene for 'dappled' coat (**D**) and its recessive allele for 'plain' coat (**d**), are located on the X chromosome. The gene for 'straight' whiskers (**W**) and its recessive allele for 'bent' whiskers (**w**), are autosomal.

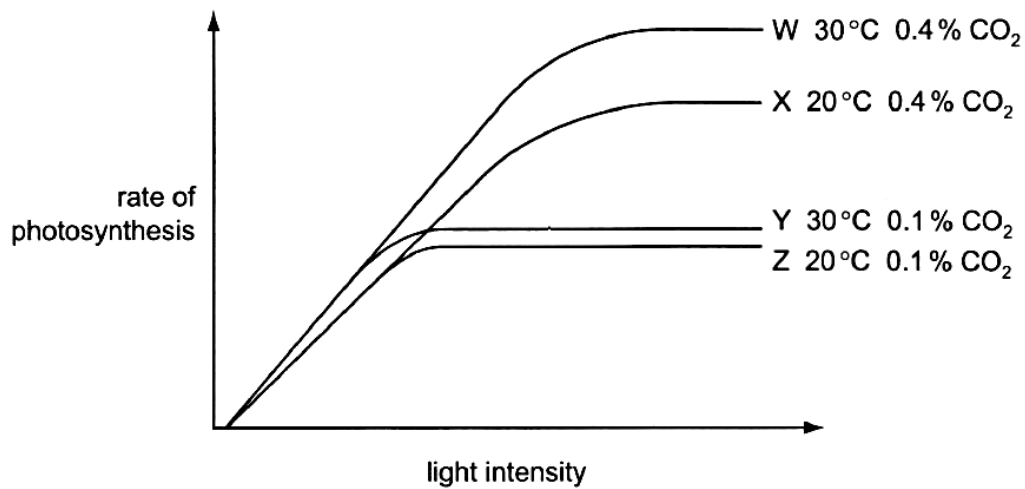
A male mouse with plain coat and bent whiskers was mated on several occasions to the same female and the large number of offspring consisted of males and females in equal numbers in all combinations of phenotypes, as shown in the table.

<i>offspring</i>
dappled, straight whiskers
dappled, bent whiskers
plain, straight whiskers
plain, bent whiskers

If X^D represents an X chromosome carrying the allele for 'dappled' coat and X^d represents an X chromosome carrying the allele for 'plain' coat, what is the genotype of the female parent?

- A** $X^D X^D WW$
- B** $X^D X^D Ww$
- C** $X^D X^d WW$
- D** $X^D X^d Ww$
- 17** Some photosynthetic organisms contain chloroplasts that lack photosystem II that are able to survive. The best way to detect the lack of photosystem II in these organisms would be
- A** to test for carbon fixation in the dark.
- B** to test for liberation of oxygen in the light.
- C** to test for presence of starch.
- D** to determine if they have thylakoids in the chloroplasts.

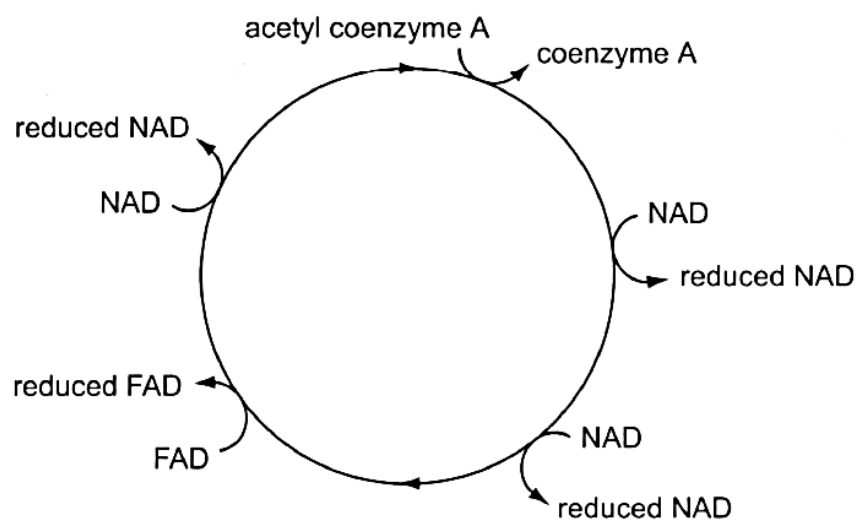
- 18 The diagram shows the results of an investigation into the effect of changing light intensity on the rate of photosynthesis at two different carbon dioxide concentrations and two different temperatures.



Which factor is limiting the rate of photosynthesis shown on curve **X** at high light intensities and which curve supports this?

- A** Carbon dioxide concentration, curve **Y** supports as a decrease in carbon dioxide concentration decreases the photosynthetic rate.
- B** Carbon dioxide concentration, curve **Z** supports as the photosynthetic rate becomes constant at lower light intensities.
- C** Temperature, curve **W** supports as an increase in temperature increases the photosynthetic rate.
- D** Temperature, curve **Z** supports as the photosynthetic rate becomes constant at lower light intensities.

19 The diagram shows the reactions of the hydrogen carriers in the Krebs cycle.

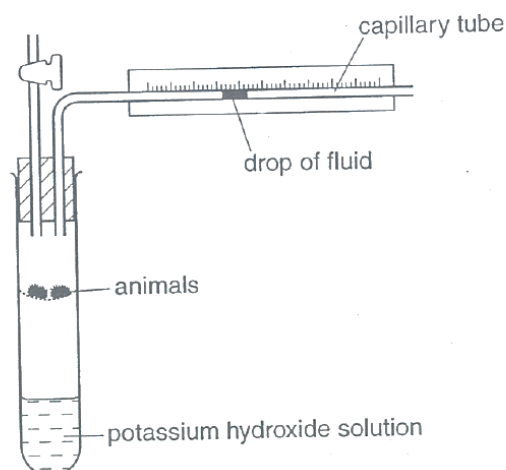


The average yield of ATP, in oxidative phosphorylation, is 3 molecules from each molecule of reduced NAD and 2 molecules from each molecule of reduced FAD.

What is the average yield of ATP, in oxidative phosphorylation, from the hydrogen carriers reduced in the Krebs cycle, from one molecule of glucose?

- A 11
- B 22
- C 34
- D 36

20 A respirometer was set up to investigate the rate of respiration as shown below.

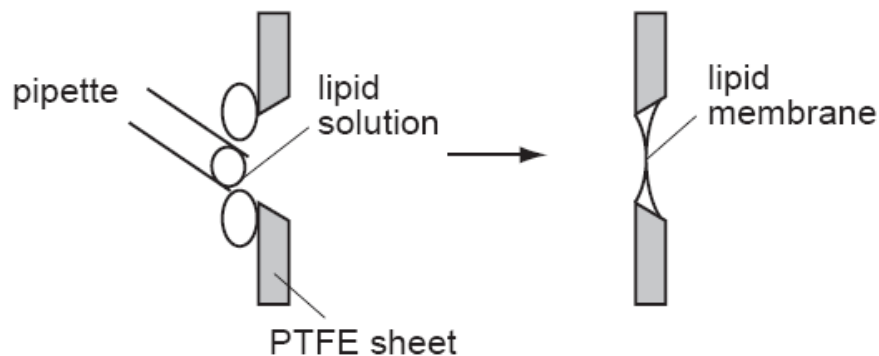


At the end of the experiment, it was found that the drop of fluid significantly moved to the left more than expected. Mitochondria from the animals were isolated to investigate the cause.

Which is a possible observation made about the mitochondria which best explains the results?

- A** Cytochrome *b* in the electron transport chain was non-functional.
- B** Higher than normal amount of cristae observed.
- C** Proton pump is decoupled from the electron carriers.
- D** ATP synthase was not-functional.

- 21** Lipid membranes can be formed in the laboratory by painting phospholipids over a PTFE sheet with a hole in it. Such a lipid membrane is impermeable to water-soluble materials including charged ions such as Na^+ or K^+ .



In one experiment with Na^+ ions, no current flowed across the membrane until a substance called gramicidin was added which allows the current to flow.

What is the characteristics of gramicidin?

- A** a carbohydrate molecule found only on the outside of the membrane
 - B** a non-polar lipid which passes all the way through the membrane
 - C** a protein molecule with both hydrophilic and hydrophobic regions
 - D** a protein molecule which has only hydrophobic regions
- 22** Which statement about fluid mosaic model of membrane structure is correct?
- A** The less unsaturated the fatty acid chains of the phospholipids, the lower the freezing point of the membrane.
 - B** The more unsaturated the fatty acid chains of the phospholipids, the more fluid the membrane.
 - C** The increase in temperature would result in the phospholipid being more tightly packed.
 - D** The lower the temperature, the more fluid the membrane.

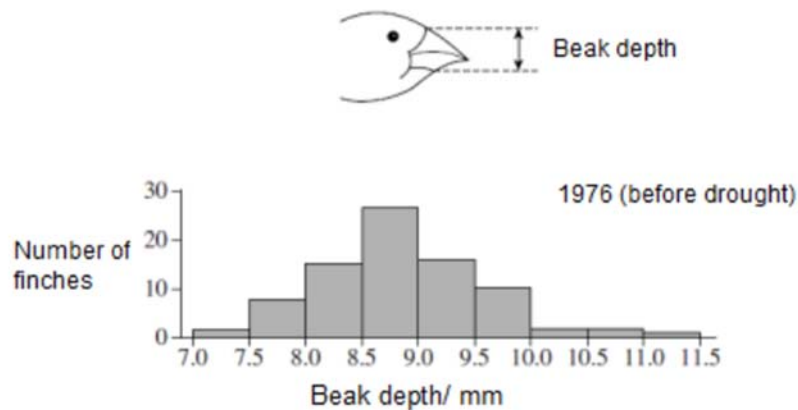
- 23** In 1954, copper waste in the Finniss River in Australia killed numerous fish. This caused various species in the area to die out. However, one species, the black-banded rainbow fish, increased in numbers. The black-banded rainbow fish have modified gills that enable the fish to filter and remove the copper before it enters their body.

With respect to the black-banded rainbow fish it is reasonable to conclude that

- A** a mutation occurred in their population in 1954.
 - B** the ability of their gills to remove copper already existed in 1954.
 - C** the high levels of copper in the water changed the structure of their modified gills.
 - D** their genomes are identical with those of the other species of fish that existed in 1954.
- 24** The ground finch, *Geospiza fortis*, is a species of bird which lives on a small isolated island. These finches show variation in the size of their beaks and feed on seeds from different species of plants.

In 1977 there was a severe drought on the island. This killed many species of plants that the finches feed on. One species of food plant survived and produced large seeds.

The graph shows the distribution of beak sizes of the finch population before the drought. Beak size was measured by the depth of the beak, as shown in the diagram.



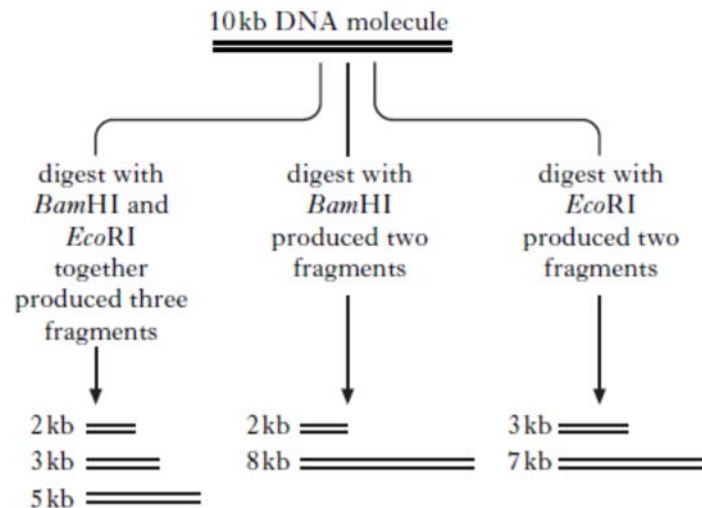
Which row correctly describes the evolution of beak size of the ground finch?

	Selection pressure	Change to beak size after the drought	Type of selection
A	type of plant	increase	disruptive
B	seed size	increase	directional
C	drought	decrease	stabilising
D	predator	decrease	directional

- 25 Many types of evidence, including homology, can provide evidence in support of Darwin's theory of natural selection.

Which statement does **not** provide support?

- A The allele for sickle cell haemoglobin that gives resistance to malaria is more frequent in malarial areas.
 - B The distribution of the variants of the A blood group antigen reflects human migration patterns.
 - C The homozygous condition of the sex-linked allele for a non-functional blood clotting protein is rare.
 - D The molecular structure of ATP is almost identical in all eukaryotes.
- 26 A piece of DNA was digested using the restriction enzymes *Bam*HI and *Eco*RI. The results are shown below.



Which is the correct restriction map that can be drawn from these results?

- A
- B
- C
- D

27 Some of the goals of the Human Genome Project are:

- to determine the sequence of the entire human genome
- to identify all the genes in the human genome
- to find the locus of all the genes on the 46 human chromosomes.

What are some ethical concerns arising from the goals stated?

- 1 Anthropologist tracing the ancestry of human populations.
- 2 Parents choosing embryos for implantation only after tests for acceptable genes.
- 3 Insurance company offering cheaper rates to people with genetic disposition to fewer diseases.
- 4 Scientists developing tests for only some disease-causing genes.
- 5 Genetic counselors giving advice to people who are genetically pre-disposed to risks.

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

28 Adult stem cells are found in many tissues that require frequent cell replacement such as the skin, the intestine and the blood.

A bone marrow stem cell cannot be induced to produce a skin cell and a skin stem cell cannot be induced to produce a blood cell.

Which statement explains this?

- A** Different adult stem cells have different genes.
- B** Genes required for the differentiation to another cell line are not expressed.
- C** Genes not required for a particular cell line are removed from the stem cells.
- D** Different types of protein required for various cell lines are produced from alternative RNA splicing in different adult stem cells.

29 The genetically engineered super salmon was created from Atlantic salmon stocks and are capable of growing to a large size in 14 months.

Which is **not** an intended feature from the genetically engineered salmon?

- A** They may not survive well in the wild.
- B** They are prone to further mutations.
- C** They will produce sterile offspring with wild salmon.
- D** They may replace wild salmon population.

30 Which is **not** an argument against growing genetically modified corn?

- A** Bt toxin expressed in genetically modified corn plant effectively kills several types of insects when ingested.
- B** Some Bt corn expresses the gene in pollen that is wind-dispersed to other field grown with different types of crop.
- C** Consumption of genetically modified corn could potentially cause allergies in a small number of individuals.
- D** Bt toxin genes in genetically modified corn plant are transferred to related weed species via crop-to-weed hybridisation, forming superweed.