



ANGLO-CHINESE JUNIOR COLLEGE
Preliminary Examination 2018

BIOLOGY

8876/01

HIGHER 1

28 August 2018

Paper 1 Multiple Choice

1 hour

Additional Material: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, pencil clips, highlighters, glue or correction fluid.

Write your name, centre number and index number on the Answer Sheet provided.

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 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.

This question paper consists of **19** printed pages.

- 1 The electron micrographs show two different types of cells (not shown to scale).



Cell A



Cell B

Which row matches the structures to their correct function?

	Structure in cell A	Structure in cell B	Function
A	3	7	Provide energy for the cells
B	1	5	Maintain the shape of the cells
C	2	6	Photosynthesize
D	4	6	Secrete proteins

- 2** The plasma membrane is the cell's protective barrier as it prevents foreign molecules from entering the cell. However, in drug research experiments, foreign molecules such as drugs or short DNA fragments need to be transported into the cell.

Electroporation is a technique used to increase the permeability of the membrane transiently by treating the cell with short electrical pulses.

Which statement most likely explains how electroporation works?

- A** The short electrical pulses denature the membrane proteins, allowing foreign molecules to pass through.
 - B** The short electrical pulses cause the foreign molecules to be attracted to the surface of the membrane.
 - C** Electricity increases the hydrophobic nature of foreign molecules, allowing them to pass through the hydrophobic core of the phospholipid membrane.
 - D** Electroporation causes the phospholipids to move apart to create pores for foreign molecules to pass through.
- 3** Some students came up with possible explanations of how proteins are secreted out of a prokaryotic cell.

Which is the best explanation?

- A** Proteins diffuse through the plasma membrane out of the cell.
- B** Protein channels allow proteins to pass through the plasma membrane.
- C** Exocytosis occurs when vesicles within the cell fuse with the plasma membrane.
- D** Prokaryotic cells lyse in order to release proteins into the environment.

4 Which row matches the descriptions of biological molecules to where they are found?

- 1 Polymer of glucose molecules linked by β -1,4 glycosidic bonds to form a straight chain
- 2 An unbranched and helical polymer of glucose molecules linked by α -1,4 glycosidic bonds
- 3 An amphipathic, phosphate-containing molecule

	1	2	3
A	Cell wall of eukaryotes only	Storage granules in animal cells	Plasma membrane of prokaryotes and eukaryotes
B	Cell wall of prokaryotes and eukaryotes	Storage granules in plant cells	Plasma membrane of eukaryotes only
C	Cell wall of prokaryotes and eukaryotes	Storage granules in animal cells	Plasma membrane of prokaryotes only
D	Cell wall of eukaryotes only	Storage granules in plant cells	Plasma membrane of prokaryotes and eukaryotes

5 How many of the following descriptions correctly relates the structure of a globular protein to its property?

- 1 Monomers are linked by peptide bonds to prevent the protein from denaturing
- 2 Amino acid residues with hydrophilic R groups face the exterior of the protein, allowing it to be soluble in water
- 3 Many hydrogen bonds present allow the protein to have high tensile strength
- 4 Bonds between the subunits of the protein allow it to be stored easily

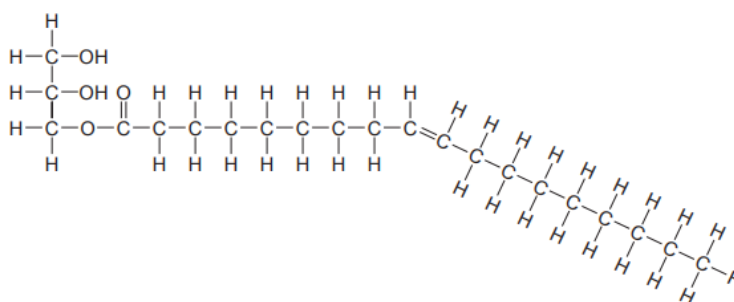
A 0

B 1

C 2

D 3

6 The diagram shows a molecule that has been partially broken down.



This molecule was then completely digested in a further reaction.

Which row correctly matches the products to the reaction?

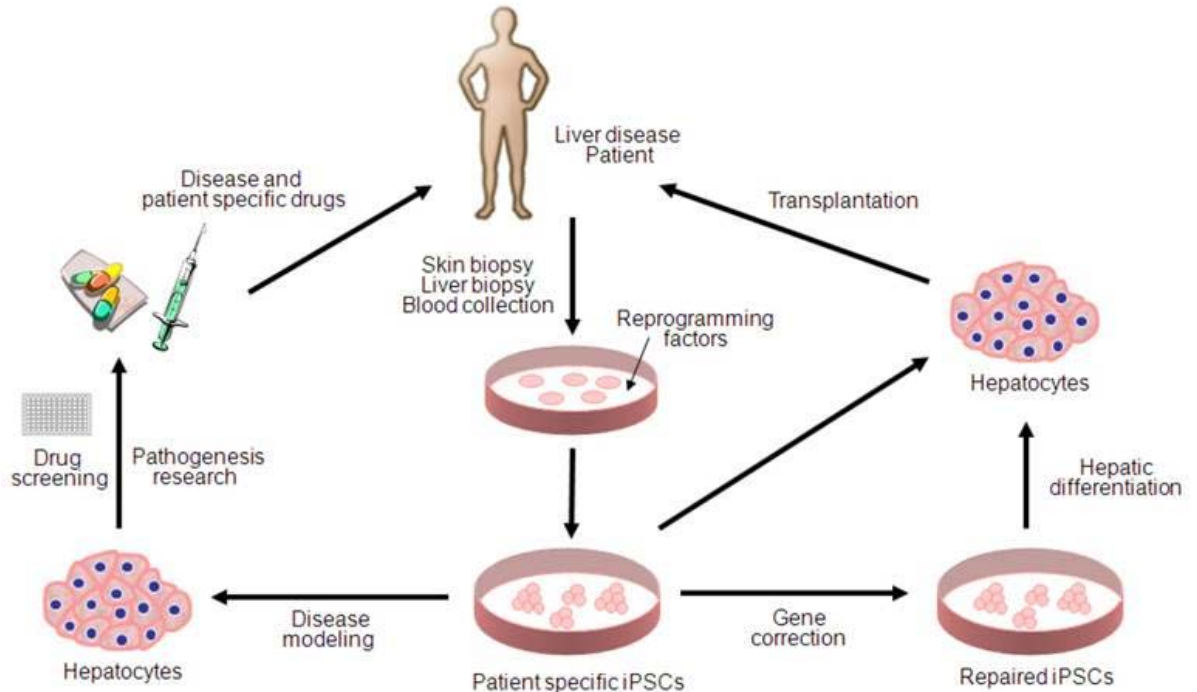
	Reaction	Products
A	Condensation reaction involving the addition of a water molecule	Glycerol, saturated fatty acid
B	Condensation reaction involving the removal of a water molecule	Glycine, unsaturated fatty acid
C	Hydrolysis reaction involving the addition of a water molecule	Glycerol, unsaturated fatty acid
D	Hydrolysis reaction involving the removal of a water molecule	Glycine, saturated fatty acid

7 Which statement is correct regarding the enzymatic activity of catalase under the following conditions?

- 1 Addition of a non-competitive inhibitor
- 2 Addition of pH13 buffer solution
- 3 Incubation at 10°C

- A** The hydrogen and ionic bonds between R groups of residues are broken in conditions 2 and 3, hence the rate of reaction decreases.
- B** The catalytic and binding residues in all active sites are affected in condition 1, hence the rate of reaction decreases.
- C** The chances of effective collisions to form enzyme-substrate complexes are low in condition 3, hence the rate of reaction decreases.
- D** The changes in the 3D conformation of enzymes are irreversible in conditions 1, 2 and 3, hence the rate of reaction decreases.

- 8 Induced pluripotent stem cells (iPSCs) are useful in regenerative medicine as they act as an effective replacement for human embryonic stem cells. The figure shows the potential applications of human iPSCs for liver diseases, such as disease modelling, drug discovery and cell replacement therapy.



Which statement could be concluded from the information provided?

- A As iPSCs are obtained and reprogrammed from somatic cells of the patient, the patient-specific iPSCs are genetically identical to the somatic cells.
- B The drawback of using iPSCs is that somatic DNA mutations remain in the original differentiated cells and these may potentially affect cellular function.
- C It is easier to obtain iPSCs compared to embryonic stem cells as iPSCs can be obtained from any differentiated somatic cell while embryonic stem cells can only be obtained from the inner cell mass of the blastocyst.
- D The reprogramming factors used to obtain patient specific iPSCs are transcription factors that induce the patient's cells to express genes that are characteristic of pluripotent stem cells.

9 Which statements regarding stem cells are true?

- 1 Researchers can induce embryonic stem cells to differentiate into various cells and tissue types to repair damaged tissue.
- 2 The use of embryonic stem cells for research can be an ethical challenge as the continued destruction of embryos could desensitise medical communities to the destruction of life.
- 3 One of the normal functions of blood stem cells in a living organism is the transplantation of such stem cells from normal healthy bone marrow donors to leukemia patients for treatment.
- 4 Blood stem cells can potentially differentiate into neurones under appropriate chemical signals.

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

10 Which statement(s) about DNA polymerases and RNA polymerases is/ are correct?

- 1 They read the DNA template in the 3' to 5' direction.
- 2 They unwind and unzip double-stranded DNA.
- 3 They read the terminator sequence and stop adding nucleotides to nucleic acid chains.
- 4 They bind to the same specific sequences to start their processes.

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

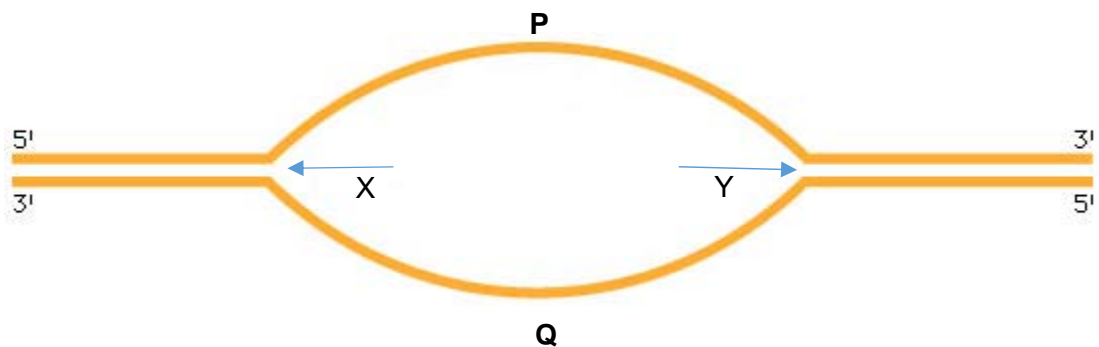
11 The following steps describe a method to study the structure and localisation of protein kinase c in yeast cells.

- tRNAs with anticodon AAG were isolated and chemically modified to carry their specific fluorescent amino acids.
- During translation, chemically modified amino-acyl tRNAs bind to the large ribosomal subunit.
- Fluorescent amino acids are incorporated into the elongating polypeptide chain.
- After translation, the polypeptide chain folds into its native conformation and the positions of the fluorescent amino acids can be detected and studied.

Which of the following describes a condition which will allow the above method to be carried out?

- A** Peptidyl transferase is specific to the fluorescent amino acid and the elongating polypeptide chain in order to catalyse the formation of a peptide bond.
- B** Synthetic amino-acyl tRNA synthetase is specific to the fluorescent amino acid and chemically modified tRNA in order to form modified amino-acyl tRNA.
- C** The ribosome is specific to the mRNA sequence in order to synthesise protein kinase c.
- D** Chemically modified amino-acyl tRNA is specific to the P site of a large ribosomal subunit in order to add the fluorescent amino acid to the elongating polypeptide chain.

12 Which statement describes the process shown?



- A** Both DNA template strands P and Q are used to synthesise leading strands towards direction X.
- B** Both DNA template strands P and Q are used to synthesise leading strand and lagging strand respectively towards direction X.
- C** The DNA daughter strand synthesised using template strand P has only one primer while the daughter strand synthesised using DNA template strand Q has multiple primers.
- D** As the replication fork opens towards direction Y, more Okazaki fragments are synthesised using DNA template strand Q.

- 13 The following table shows the codons and their corresponding amino acids.

	U	C	A	G	
U	UUU } Phe UUC } UUA } Leu UUG }	UCU } Ser UCC } UCA } UCG }	UAU } Tyr UAC } UAA } Stop UAG } Stop	UGU } Cys UGC } UGA } Stop UGG } Trp	U C A G
C	CUU } Leu CUC } CUA } CUG }	CCU } Pro CCC } CCA } CCG }	CAU } His CAC } CAA } Gln CAG }	CGU } Arg CGC } CGA } CGG }	U C A G
A	AUU } Ile AUC } AUA } AUG }	ACU } Thr ACC } ACA } ACG } Met	AAU } Asn AAC } AAA } Lys AAG }	AGU } Ser AGC } AGA } Arg AGG }	U C A G
G	GUU } Val GUC } GUA } GUG }	GCU } Ala GCC } GCA } GCG }	GAU } Asp GAC } GAA } Glu GAG }	GGU } Gly GGC } GGA } GGG }	U C A G

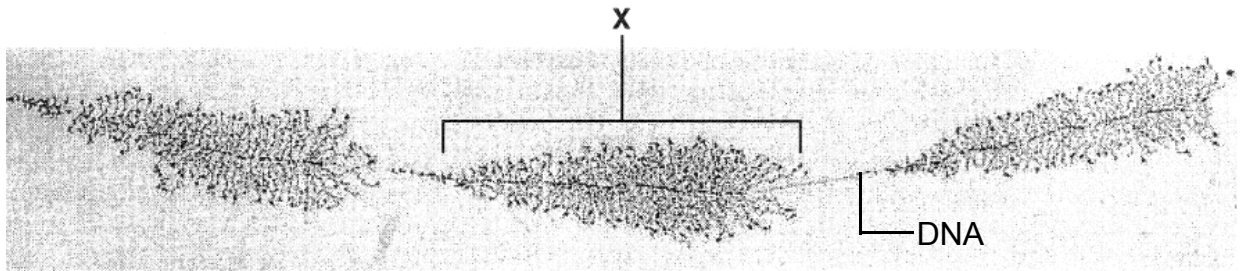
The DNA sequence is taken from part of a gene:

...TAC GTT AAT AAC CCT GAG GGC TAA TGT...

Which of the following mutations will result in the same phenotype as the original sequence?

- A** ...TAC GTG ATT AAC CCT GAG GGC TAA TGT...
- B** ...TAT GTT AAT AAC CCT GAG GGC TAA TGT...
- C** ...TAC GTT AAT AAC CCT GAG GGC TAA TTT...
- D** ...TAC GTC AAT AAC CCT GAG GGC TAA TGT...

- 14 A process known as DNA amplification increases the number of rRNA genes in frog eggs before fertilisation. The figure shows the transcription of the genes coding for rRNAs at adjacent positions along the chromosome.



Which of the following statements could **not** account for structure X?

- 1 Elongating polypeptide chains form structure X as ribosomes read the mRNA strand.
 - 2 Structure X is thicker on the right side as RNA polymerase reads the template strand from left to right.
 - 3 There are multiple pre-mRNAs synthesized simultaneously in structure X as there are many promoters.
 - 4 Structure X is highly condensed heterochromatin.
- A 1, 3 and 4 B 2, 3 and 4 C 1 and 4 only D 2 and 3 only
- 15 Elephants have been found to be resistant, though not immune, to cancer. They are four times less likely to develop cancer as compared to humans. Elephants have 40 copies of the *p53* gene while humans only have two. In addition, three genes which code for DNA repair proteins have been found to be very active.

What do these observations suggest?

- A All DNA mutations in the elephant are repaired.
- B When elephants develop cancer, it is due to environmental causative factors such as excessive exposure to UV light.
- C The occurrence of cancer is due to the *p53* oncogene, which stimulates the cell to divide rapidly, bypassing the cell cycle checkpoints.
- D There is large amount of *p53* proteins in an elephant cell which prevent cells with mutations from moving past the cell cycle checkpoints.

- 16** A species of lizards, Whiptail lizards, reproduce only by parthenogenesis. This mode of asexual reproduction allows females to produce offspring alone, without the genetic contribution of a male.

Scientists are worried that this species may become endangered as a result of climate change.

Which statements support the scientists' concerns?

- 1 Offspring of parthenogenetic species are genetically identical.
- 2 Parthenogenesis produces too few offspring for a viable population.
- 3 Genetic contribution of a male is required in order for the offspring to survive.
- 4 In asexual reproduction, meiosis does not occur to produce genetically different gametes.

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

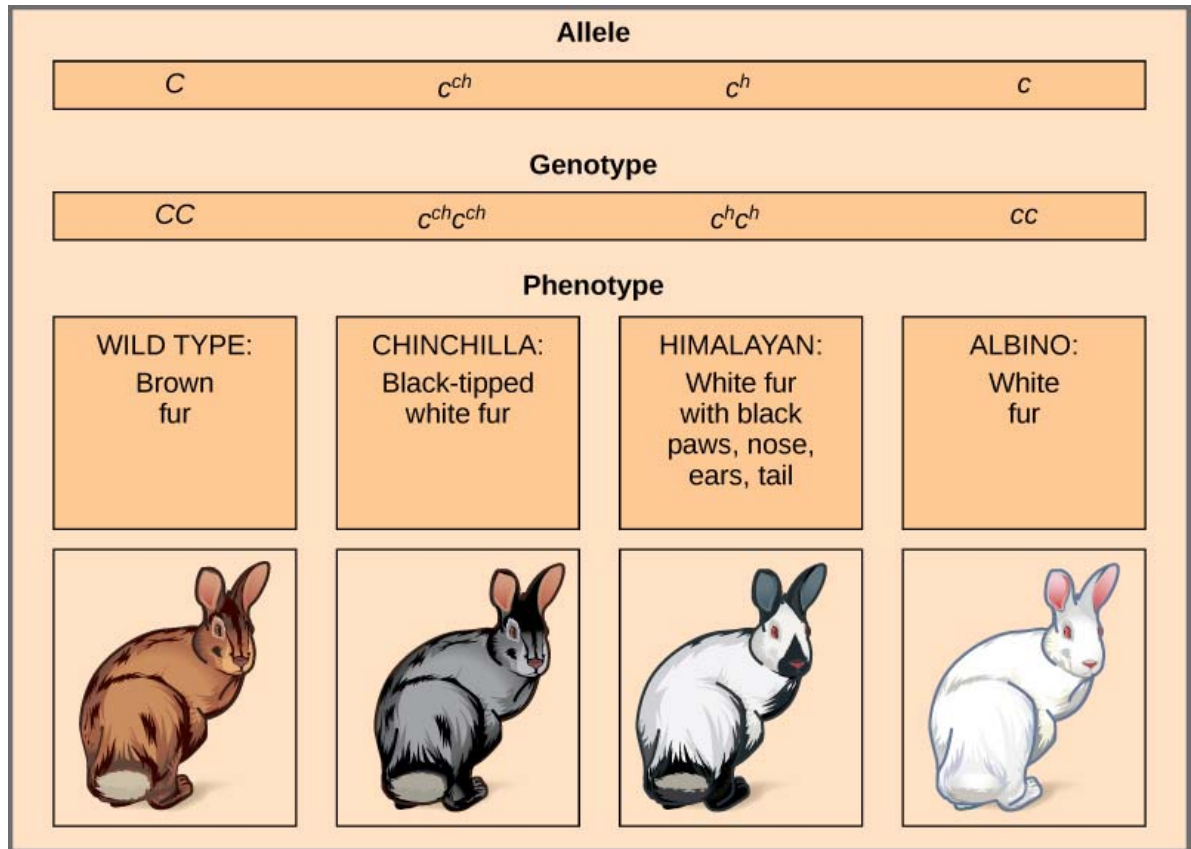
- 17** A student examined a slide of an onion root tip and obtained the following results.

Stage	Number of cells
Interphase	886
Prophase	73
Metaphase	16
Anaphase	14
Telophase	11

What percentage of the cells contain chromosomes that do not appear as sister chromatids?

- A** 95.9%
- B** 91.1%
- C** 88.6%
- D** 2.5%

- 18 Rabbits carry the *C* gene which is required for the development of pigments in their fur. The alleles show a hierarchy of dominance when present in heterozygous individuals as shown in the figure. The order of dominance of these alleles, in descending order, is *C*, *c^{ch}*, *c^h*, *c*.

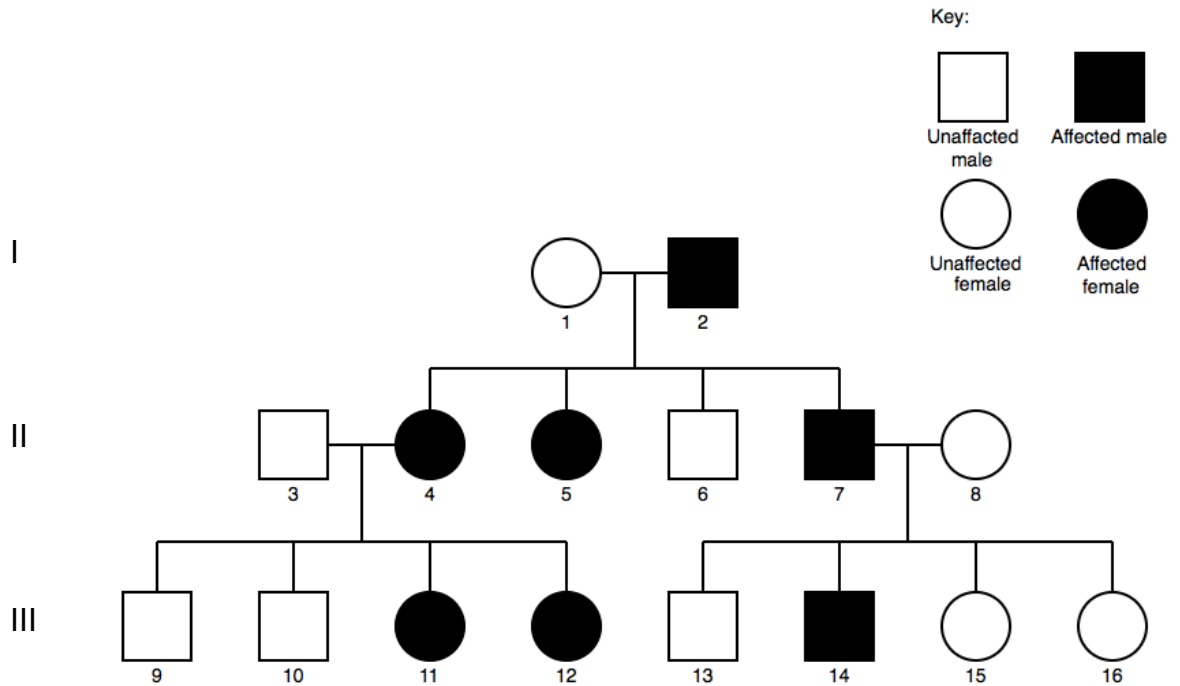


A scientist observed that the fur on the paws, noses and ears of Himalayan rabbits tends to be black while the rest of its body tends to be white. The scientist extracted a section of skin from the ear of a Himalayan rabbit and cultured the follicle cells. He discovered that when the cells are exposed to temperatures between 15°C and 25°C, they synthesise certain pigments. However, at temperatures beyond 35°C, these pigments are not synthesised.

Which statement best explains the results of the scientist's experiments?

- A** Temperatures beyond 35°C alter the structure of the pigments produced by the skin cells, hence the rest of the Himalayan rabbit's body tends to be white.
- B** The Himalayan phenotype is a result of the *c^h* allele that produces a temperature-sensitive gene product which controls the production of the pigments.
- C** Multiple alleles of the *C* gene can give rise to white fur with black patches or white fur under different temperatures.
- D** The Himalayan phenotype is an example of incomplete dominance where it is an intermediate of the chinchilla (*c^{ch}c^{ch}*) and albino (*cc*) genotypes.

- 19 The diagram shows the pedigree for the inheritance of polycystic kidney disease which is hereditary.



Assuming that the letters R and r denote dominant and recessive alleles respectively, what is the mode of inheritance for this disease and the possible genotype of individual 11?

	Mode of inheritance	Genotype of individual 11
A	Autosomal dominant	RR
B	Autosomal recessive	rr
C	X-linked dominant	$X^R X^r$
D	X-linked recessive	$X^r X^r$

- 20 An organism is heterozygous at four gene loci on different chromosomes. Its genotype is AaBbCcDd.

What is the chance that a particular gamete from this organism has the genotype abcd?

- A** 1 in 2
- B** 1 in 4
- C** 1 in 8
- D** 1 in 16

- 21 The electron micrograph shows structures found in a cell.



Which row matches the events occurring at the labelled structures?

	X	Y	Z
A	$\text{ADP} + \text{Pi} \rightarrow \text{ATP}$	$\text{ADP} + \text{Pi} \rightarrow \text{ATP}$	$\text{NADPH} \rightarrow \text{NADP}^+ + \text{H}^+ + 2\text{e}^-$
B	$\text{ATP} \rightarrow \text{ADP} + \text{Pi}$	$\text{ATP} \rightarrow \text{ADP} + \text{Pi}$	$\text{NADP}^+ + \text{H}^+ + 2\text{e}^- \rightarrow \text{NADPH}$
C	$\text{NAD}^+ + \text{H}^+ + 2\text{e}^- \rightarrow \text{NADH}$	$\text{H}_2\text{O} \rightarrow 2\text{H}^+ + 2\text{e}^- + \frac{1}{2}\text{O}_2$	$\text{CO}_2 + \text{RuBP} \rightarrow 2\text{PGA}$
D	$\text{FAD} + 2\text{H}^+ + 2\text{e}^- \rightarrow \text{FADH}_2$	$2\text{H}^+ + 2\text{e}^- + \frac{1}{2}\text{O}_2 \rightarrow \text{H}_2\text{O}$	$\text{Acetyl CoA} + \text{Oxaloacetate} \rightarrow \text{Citrate}$

22 Photophosphorylation in the chloroplasts of plant cells results in the synthesis of ATP. Which processes require the use of ATP formed from photophosphorylation?

- 1 Formation of triose phosphate sugars for the biosynthesis of glucose.
- 2 Activation of glucose in glycolysis, so that it can be used in further reactions.
- 3 Regeneration of RuBP, the starting compound of the Calvin cycle.
- 4 Secretion of cellulose which makes up the plant cell wall.

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

23 Through a series of energy transfers, chemiosmosis results in the generation of ATP during aerobic respiration and photosynthesis.

Which of the following describe the conditions necessary for the chemiosmotic synthesis of ATP in both processes?

- 1 The transport of a lipid-soluble molecule against its concentration gradient.
- 2 The presence of oxygen as a final electron and proton acceptor.
- 3 The impermeability of the phospholipid bilayer to substances which are polar or charged.
- 4 The transmembrane nature of electron carrier proteins.
- 5 The provision of a pore which allows the facilitated diffusion of molecules.

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

24 During an investigation on the process of cellular respiration, scientists isolated different components of a cell and placed them into different tubes as follows:

Tube 1: Cytoplasm only

Tube 2: Intact mitochondria only

Tube 3: Mitochondrial matrix only

Tube 4: Cytoplasm and intact mitochondria

Excess glucose is added to each of the tubes and incubated for one hour. Which of the tubes would have a continuous production of ATP during the incubation period?

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

- 25** Due to various human activities, there are many species that have become endangered. As these species face a reduction in population size, they are at risk of becoming extinct. It is found that the endangered species lose their genetic variation as the population size is reduced. Should the endangered population size increase, the genetic variation will not increase much within the next hundred years.

Which of the following statements is **not** true?

- A** A population would need to accumulate many heritable mutations over many generations in order to increase its genetic variation.
- B** As the population size of the endangered species is reduced, there will be a loss of alleles due to the death of the individual organisms.
- C** Epidemics could kill the endangered species easily as the population has low genetic variation, increasing their chance of extinction.
- D** As the population size is reduced, sexual reproduction with random mating within the endangered species will increase heterozygosity, resulting in higher relative fitness in the population.
- 26** Which of the following statement(s) explain(s) why population is the smallest unit that can evolve?
- 1 Selection pressures at a particular location where the population is living in, will result in the survival of the fittest.
 - 2 An individual may accumulate genetic changes within its lifetime.
 - 3 Natural selection changes the frequency of alleles within a population.
 - 4 Natural selection will induce mutations in the individual so as to allow adaptation.
- A** 1, 2, 3 and 4 **B** 1 and 3 **C** 2 and 3 **D** 1 only

- 27** A population of green anole lizards (*Anolis carolinensis*) is native to the trees in Florida in the United States of America (USA). They tend to occupy the lower branches of the trees which are thicker, instead of the higher branches which are thinner and snap more easily.

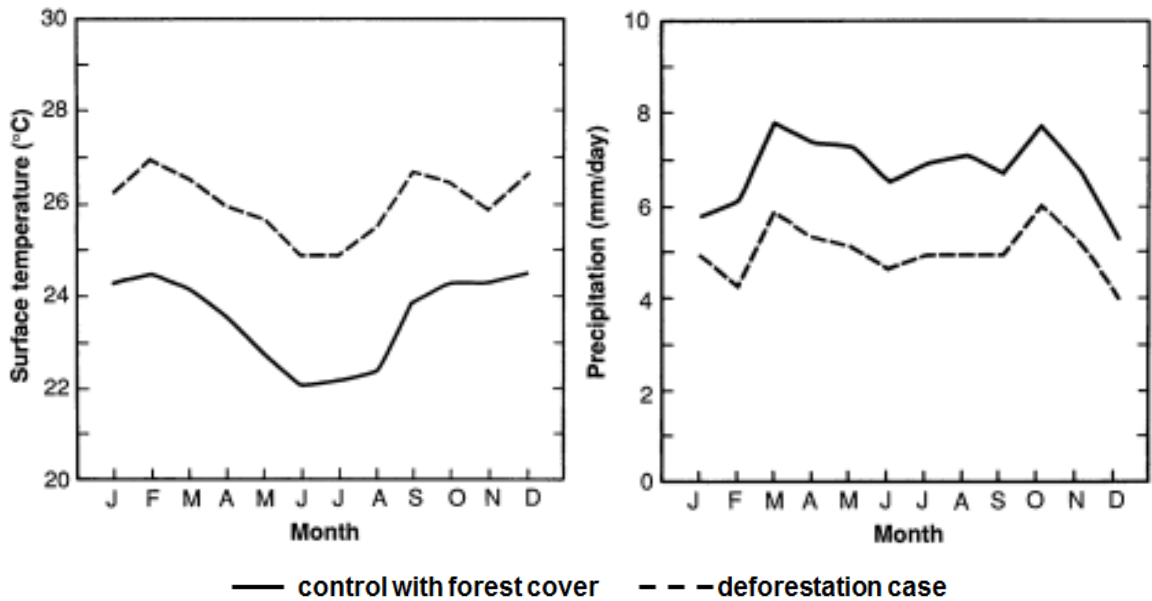
In the 1950s, the brown anole lizards (*Anolis porcatius*) from Cuba were introduced into Florida. These lizards are larger and heavier than the green anole lizards and also prefer the lower branches. Both the green and brown anole lizards feed on flying insects that fly around the branches. The adults of both species also tend to feed on the hatchlings of the other species.

Studies have shown that after 20 years, the green anole lizards have occupied the higher branches. Their toe pads are also larger than before, with sticky scales so that they can perch on the higher branches.

Which statement best explains how the evolution of the green anole lizard in Florida has occurred?

- A** Mating between the green and brown anole lizards during the 20 years results in the green anole lizards having larger toe pads and sticky scales, on which natural selection could act upon.
- B** Within the original green anole lizard population, there were some individuals that already had larger toe pads and sticky scales, on which natural selection could act.
- C** Green anole lizards climbed onto higher branches as the brown anole lizards could not do so.
- D** Green anole lizards which live longer usually leave more offspring since they have more reproductive opportunities.

- 28 Scientists created a simulation of the effects of Amazon deforestation on the climate. In the simulation, an area of the tropical forest was replaced by a pasture of grass. The simulation provided monthly data on the temperature of the ground surface (surface temperature) and rainfall (precipitation) over a year-long period.



Which statements could explain these data?

- 1 Grass is a more effective carbon sink than trees.
- 2 The removal of forest cover disturbed the soil layers and resulted in carbon emissions.
- 3 Without the trees, the reduced transpiration rate resulted in less water vapour released into the atmosphere.
- 4 Increase in surface temperature could lead to increase in the rate of evaporation.

A 1 and 2

B 1 and 3

C 2 and 3

D 2 and 4

- 29 Which row correctly matches the human activity to its corresponding effect due to climate change?

	Human activities	Effects
A	Over-hunting of animals	Reduction in biodiversity
B	Usage of more cars	More wild animals killed on the expressways
C	Burning of forests in West Sumatra, Indonesia	Heavy rains and heat waves in different parts of the world
D	Pollution from toxic runoff from factories	Bleaching of coral reefs

- 30 Which of the following consequences resulted from an increase in global temperatures?

- 1 Many populations of the European butterfly species moved northwards by 35 – 240km.
- 2 *Aedes aegypti*, previously limited to low-lying areas, is observed at 2200m above sea level in Colombia.
- 3 Malaria is a growing public health threat to residents in the highlands.
- 4 Insect species in the higher latitudes increased their reproductive rate.

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

H1

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