



**ANGLO-CHINESE JUNIOR COLLEGE**  
**Preliminary Examination 2017**

**BIOLOGY**

**8875/01**

**HIGHER 1**

**25 August 2017**

**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.

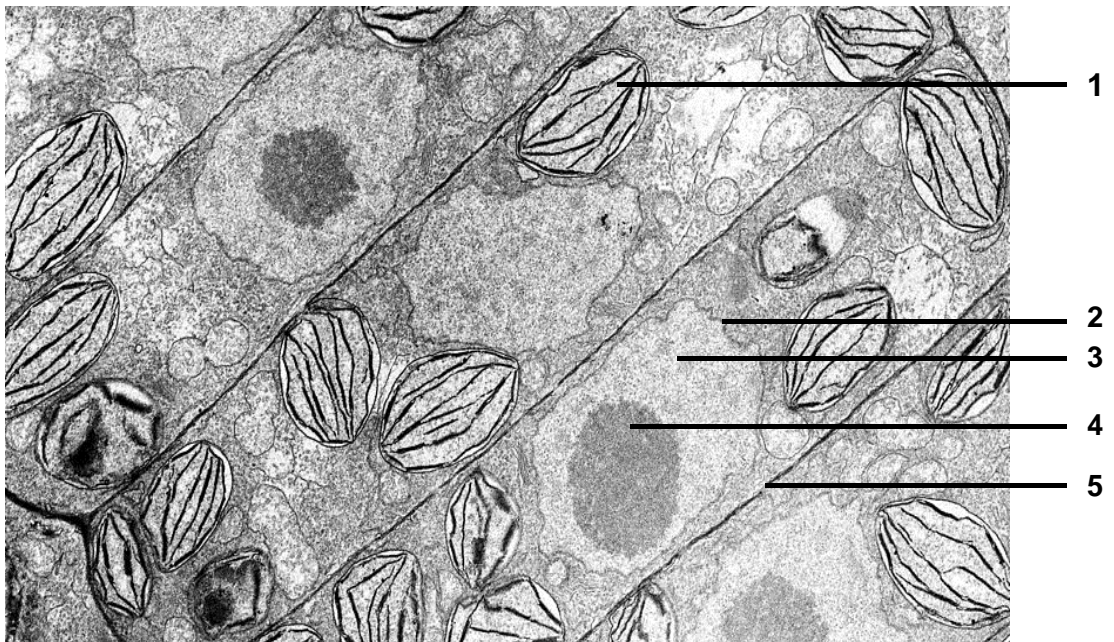
**Read the instructions on the Answer Sheet very carefully.**

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 **21** printed pages.

- 1 The electron micrograph shows root cells from the duckweed plant.

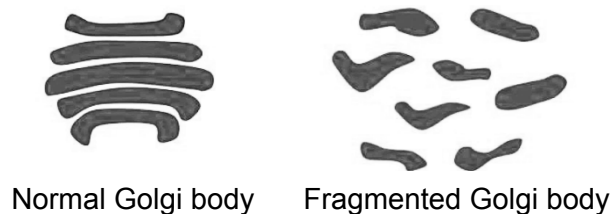


Which of the following options about structures 1 to 5 is correct?

	Contain ribosomal subunits	Contain tRNA	Contain phospholipids
<b>A</b>	1, 2, 3	3 only	1, 4
<b>B</b>	1, 3, 4	1, 3	2, 5
<b>C</b>	1, 3, 5	1, 2, 4	2, 4, 5
<b>D</b>	2, 4, 5	2, 4, 5	1, 3, 4, 5

- 2 Studies have shown that the formation of stable multi-layered flattened stacks appears to be essential for the proper functioning of the Golgi body. This structure is maintained by an intact microtubule network and a group of peripheral and integral proteins found on the cytoplasmic surface of Golgi membranes.

In some diseases, such as certain types of cancer and some neurodegenerative diseases, the structure of the Golgi body is fragmented as shown in the diagram. The fragments are unlinked and are dispersed in the cytoplasm.

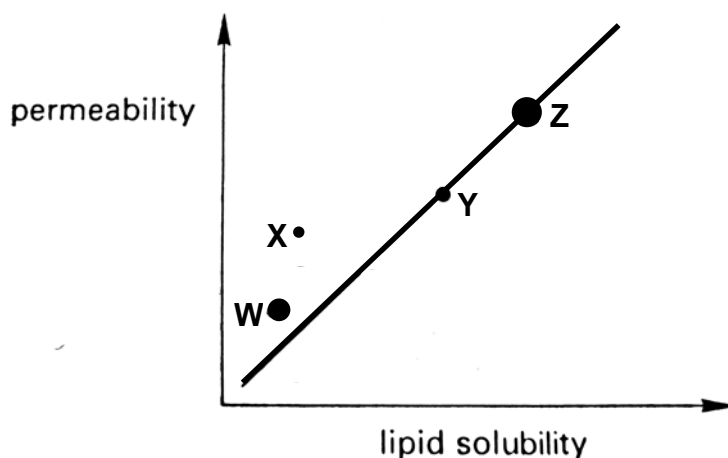


Which of the following are possible inferences from the information?

- 1 Fragmented Golgi bodies may result in the disorganisation of glycosyltransferases, leading to abnormal glycosylation of proteins linked to cancer.
- 2 Fragmented Golgi bodies are a consequence of mutated Golgi membrane proteins, resulting in the loss of attachment sites for cisternae to stack.
- 3 Fragmented Golgi bodies may result in the loss of attachment sites for transport vesicles from the rough endoplasmic reticulum, leading to unmodified proteins which are non-functional.
- 4 Fragmented Golgi bodies may result in reduction of sorting and processing of proteins for the maintenance of nerve cells, leading to their degeneration.

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

- 3 The diagram shows the relationship between the size, lipid solubility and ability of molecules to cross the mammalian cell surface membrane. The diameter of the black circles in the diagram is proportional to the size of the molecules.



Which of the following could molecules W to Z represent?

	W	X	Y	Z
A	calcium chloride	methane	cholesterol	glucose
B	glucose	water	carbon dioxide	cholesterol
C	calcium chloride	water	glucose	cholesterol
D	glucose	methane	carbon dioxide	calcium chloride

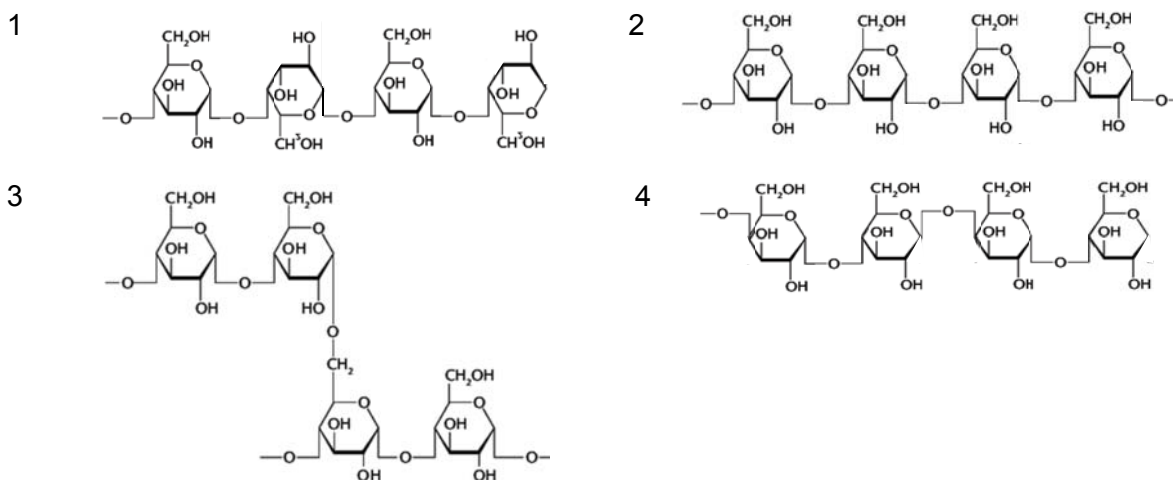
- 4 Plants are able to regulate their thylakoid membrane fluidity at different seasons of the year. In an investigation on thylakoid membrane fluidity in spinach leaves, three variables which influence membrane fluidity were measured at winter and summer.

Variable	Season X	Season Y
Percentage of saturated fatty acids	15.5	13.9
Average number of double carbon bonds per lipid	4.71	4.76
Lipid to chlorophyll ratio	2.9	2.1

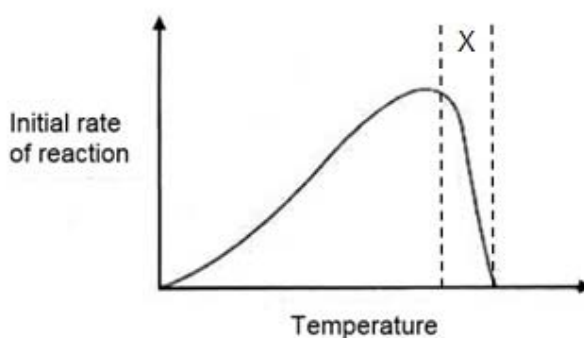
Which of the following correctly identifies season X, with the most possible explanation?

- A Winter; a higher lipid to chlorophyll ratio increases proportion of weak hydrophobic interactions resulting in a more fluid membrane at lower temperatures
- B Summer; a higher proportion of saturated fatty acids prevents phospholipids from moving too far apart at higher temperatures
- C Winter; a higher proportion of saturated fatty acids prevents phospholipids from packing too closely at lower temperatures
- D Summer; a higher number of kinks per lipid allows phospholipids to pack closely together at higher temperatures

- 5 Dextrins are a group of carbohydrates with low molecular weight, and are produced by hydrolysing starch or glycogen. Which of the following is/are **not** likely to be a segment from a dextrin molecule?



- A 1, 3 and 4 only  
 B 1 and 4 only  
 C 2 and 3 only  
 D 4 only
- 6 The diagram below shows the initial rate of reaction at different temperatures, using constant substrate and enzyme concentrations.



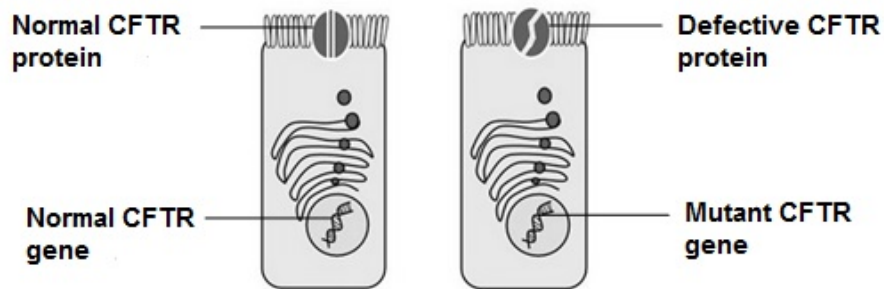
Which of the following is/are possible reason(s) for the decline shown in region X?

- 1 End product inhibition occurs to inhibit enzyme activity
- 2 Depletion of substrate at the end of the enzyme catalysed reaction
- 3 Disruption of intramolecular bonds in the enzyme
- 4 Change in ionic charges at the active site of the enzyme

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

- 7 Cystic fibrosis is a genetic disease caused by the synthesis of a defective form of the cystic fibrosis transmembrane conductance regulator (CFTR) protein found in epithelial cells that line the lungs, digestive tract, sweat glands, and genitourinary system. The CFTR protein is a transmembrane protein that transports chloride ions across the cell surface membrane.

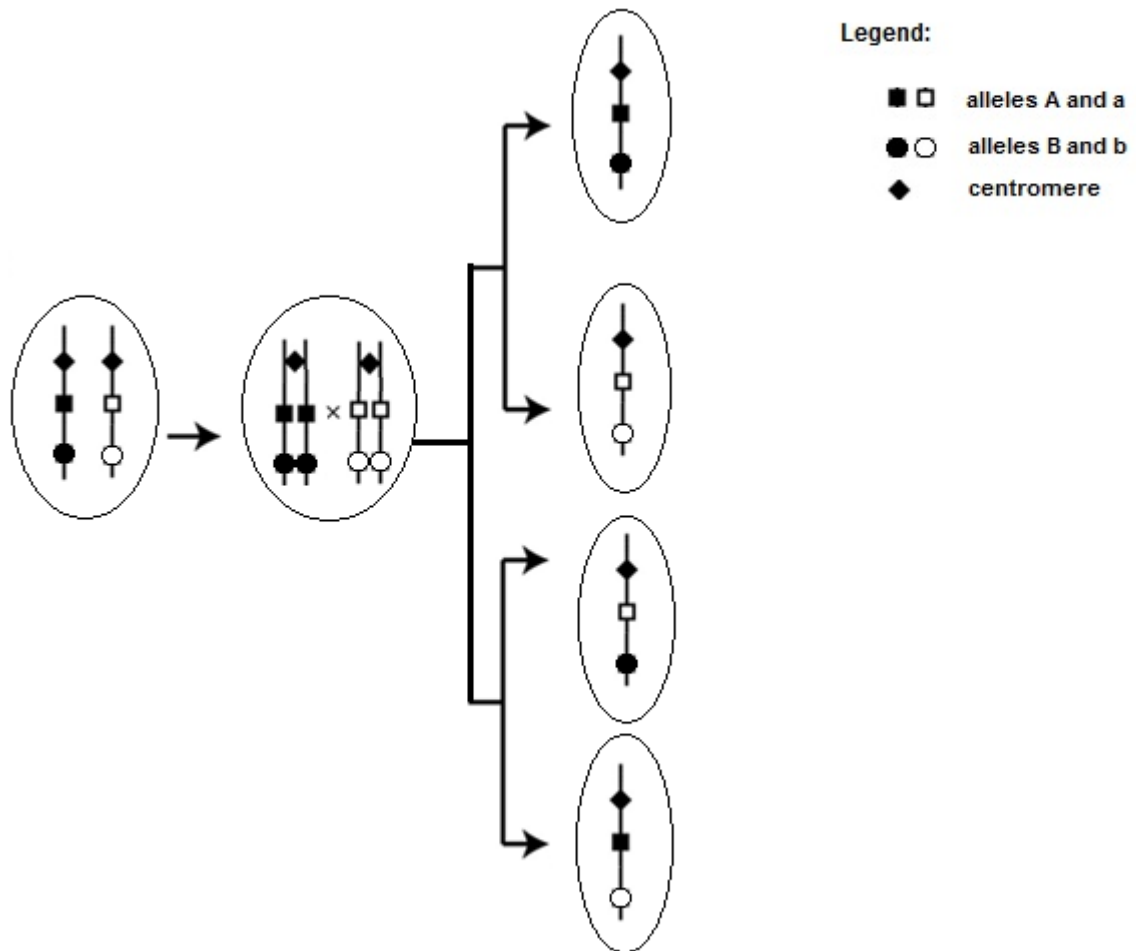
The diagram shows the difference between a normal CFTR protein and a type of defective CFTR protein.



Which of the following is the most likely explanation for the defective CFTR protein?

- A The mutation did not change the primary structure, but the bonds between the R-groups were altered, causing the tertiary structure to change.
  - B The mutation resulted in a change in the primary structure of the protein, causing a loss of  $\alpha$ -helices and the dislodging of the protein from the cell membrane.
  - C The mutation resulted in a shorter polypeptide, altering the bonds between the R-groups, causing the tertiary structure to change.
  - D The mutation resulted in a replacement of an amino acid in the primary structure, causing the channel in the protein to become more hydrophilic.
- 8 Which of the following correctly describes the cellular events that occur between anaphase and telophase in mitosis?
- A There is a decrease in protein synthesis to shorten the spindle fibres during anaphase to pull the chromosomes to opposite poles of the cell.
  - B Homologous chromosomes undergo independent assortment during anaphase to ensure equal division of the genetic material.
  - C Chromosomes become more compact to prevent entanglement between two nucleoli as they reform at telophase.
  - D The number of vesicles within the cytoplasm decreases during telophase as fragments of the nuclear membrane fuse to reform the nuclear envelope.

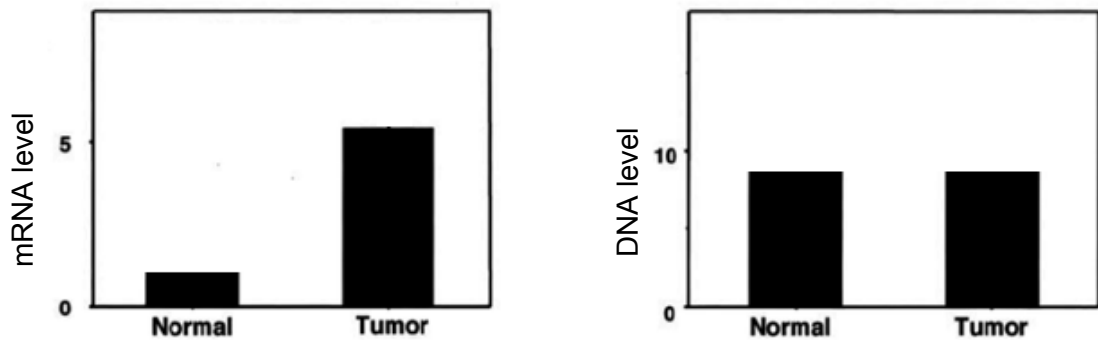
- 9 The diagram illustrates the daughter cells formed at the end of a meiotic cell cycle. Alleles A and a are represented by black and white boxes respectively. Alleles B and b are represented by black and white circles respectively. The centromere on the chromosome is represented by the diamond.



Which of the following statements about genetic variation can be concluded from the diagram?

- A Random assortment and segregation of homologous chromosomes result in different combinations of paternal and maternal chromosomes in the gametes.
- B Random assortment and segregation of homologous chromosomes in the presence of crossing over increases the allele frequency of a population.
- C Crossing over between non-sister chromatids of homologous chromosomes can result in new combinations of alleles on the chromosomes of the gametes.
- D Crossing over between non-sister chromatids of homologous chromosomes result in new alleles on the chromosomes of the gametes.

- 10 Gene expression profiling has identified a new risk locus in influencing susceptibility to human colorectal cancer. The diagram below shows the comparison of mRNA and DNA levels between tumours and adjacent normal tissues.



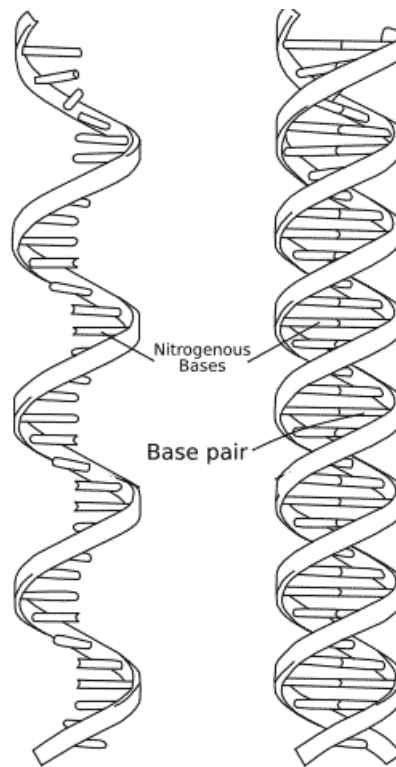
Which of the following are possible products of this gene?

- 1 Proteins involved in cell adhesion
- 2 Proteins involved in cell cycle progression
- 3 Protein involved in apoptosis
- 4 Proteins involved in DNA repair

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



11 The structures of two molecules are shown.



Which option best describes the structures and functions of these two molecules?

- A** Both molecules have phosphodiester, hydrogen bonds and hydrophobic interactions, allowing them to be stable molecules so that genetic information can be passed from one cellular generation to the next.
- B** Both molecules have nucleotides that allow for complementary base pairing with nucleotides in other molecules, hence allowing for genetic information to be passed from one cellular generation to the next.
- C** Both molecules have nucleotides that allow for complementary base pairing. However, complementary base pairing in one ensures accuracy during replication while in the other, it enables gene expression.
- D** Both molecules have covalent phosphodiester bonds between nucleotides. This ensures both molecules have increased stability and are not easily degraded by exonucleases.

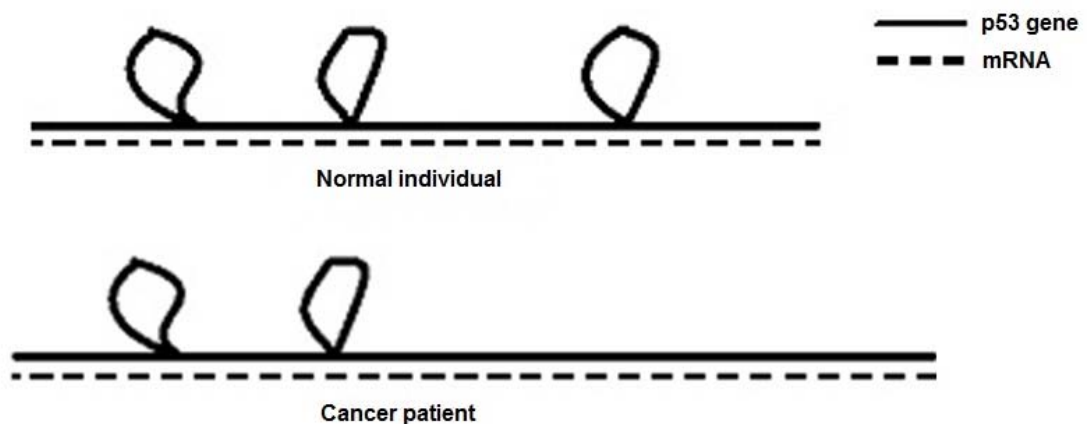
12 The list shows the stages in the cellular replication of DNA.

- 1 Formation of phosphodiester bonds between Okazaki fragments
- 2 Dissociation of DNA from histone proteins
- 3 Synthesis of RNA primers
- 4 Addition of deoxyribonucleotides
- 5 Separation of DNA double helix

Which is the correct sequence?

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

13 mRNA was isolated from a normal individual and a patient suffering from cancer. The mRNA was allowed to hybridise with the *p53* gene. The schematic diagram shows the results of the hybridisation process under the electron microscope.



Which of the following could be a possible explanation why the patient is suffering from cancer?

- A** A point mutation had occurred in the intron leading to the failure to excise one intron, hence leading to a longer dysfunctional protein being translated.  
**B** A point mutation had occurred in the intron leading to an exon being excised, hence leading to a shorter dysfunctional protein being translated.  
**C** A point mutation had occurred leading to the failure of spliceosome to recognise splice sites leading to the excision of the wrong intron, leading to a dysfunctional protein being translated.  
**D** Gene amplification had occurred leading to the multiple copies of a trinucleotide repeat in an intron, hence causing splice site to be misread due to frameshift mutation, leading to a longer dysfunctional protein being translated.

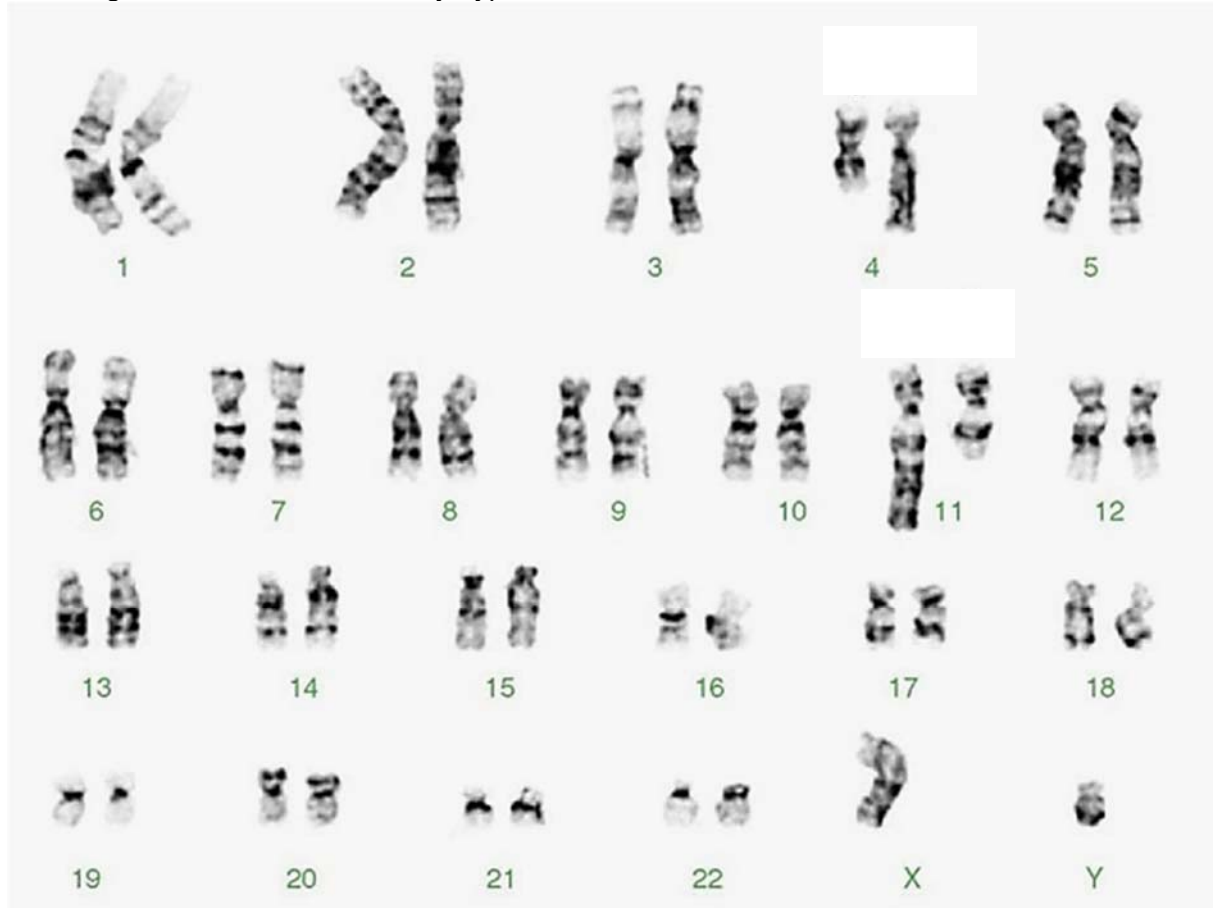
- 14 Many of the most effective antibiotics used in modern medicine are compounds made by fungi that inhibit bacterial protein synthesis. Among the most commonly used drugs are Chloramphenicol, Cycloheximide and Rifampicin. The results of the exposure to eukaryotic and prokaryotic cells to the above three drugs are shown.

Anti-microbial drug	Chloramphenicol	Cycloheximide	Rifampicin
Eukaryotic animal cell	Truncated polypeptides were found in mitochondria only	Truncated polypeptides were found in cytosol	No protein synthesized
Prokaryotic cell	Truncated polypeptides were found in the cytosol	Truncated polypeptides were found in the cytosol	No protein synthesized

Which of the following shows the correct combination of the possible drug mechanisms of the above drugs?

	Chloramphenicol	Cycloheximide	Rifampicin
<b>A</b>	Inhibits the peptidyl transferase activity of the 70S ribosomes	Inhibits elongation by binding the E site of the ribosome hence preventing the release of tRNA	Inhibits the transcription of DNA by blocking the movement of RNA polymerase on DNA
<b>B</b>	Inhibits the peptidyl transferase activity of the 80S ribosomes	Inhibits elongation by binding the E site of the ribosome hence preventing the release of tRNA	Inhibits the transcription of DNA by blocking the movement of RNA polymerase on DNA
<b>C</b>	Inhibits elongation by binding the P site of the ribosome hence preventing the formation of peptidyl tRNA	Inhibits elongation by binding the A site of the ribosome hence preventing the release of tRNA	Inhibits translation by binding to the small ribosomal subunit
<b>D</b>	Inhibits elongation by binding to mRNA and preventing ribosomal translocation	Inhibits elongation by binding the P site of the ribosome hence preventing the release of polypeptide	Inhibits translation by binding to the binding site of large ribosomal subunit

- 15 The diagram shows a human karyotype.



The person who has this karyotype is a male with

- A aneuploidy
  - B polyploidy
  - C chromosomal translocation
  - D chromosomal amplification
- 16 Which of the following would cause phenotypic variation among organisms of the same genotype?
- A Crossing over
  - B Independent assortment
  - C Exposure to different environments
  - D Different varieties of the same species

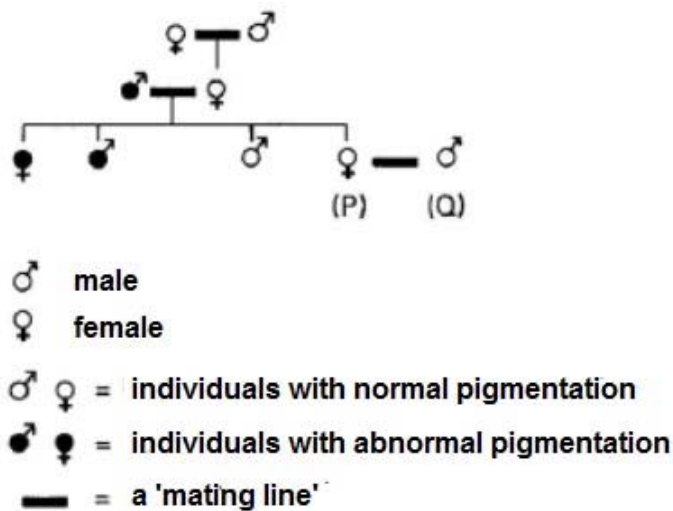
- 17** In a cross between red haired cattle and white haired cattle, the offspring produced are always a colour called roan (light red). If the roan cattle are interbred, they produce white, roan and red offspring.

In rabbits, several different coat colours are observed – agouti, chinchilla, himalayan and albino.

Based on the above observations, how many alleles are possibly controlling the coat colour in cattle and rabbits?

	Cattle	Rabbits
<b>A</b>	2	2 or 3
<b>B</b>	2	3 or 4
<b>C</b>	3	2 or 3
<b>D</b>	3	3 or 4

- 18** In a species where the female is homogametic, a sex-linked allelic pair controls pigmentation. The following results were obtained during the course of a breeding experiment.

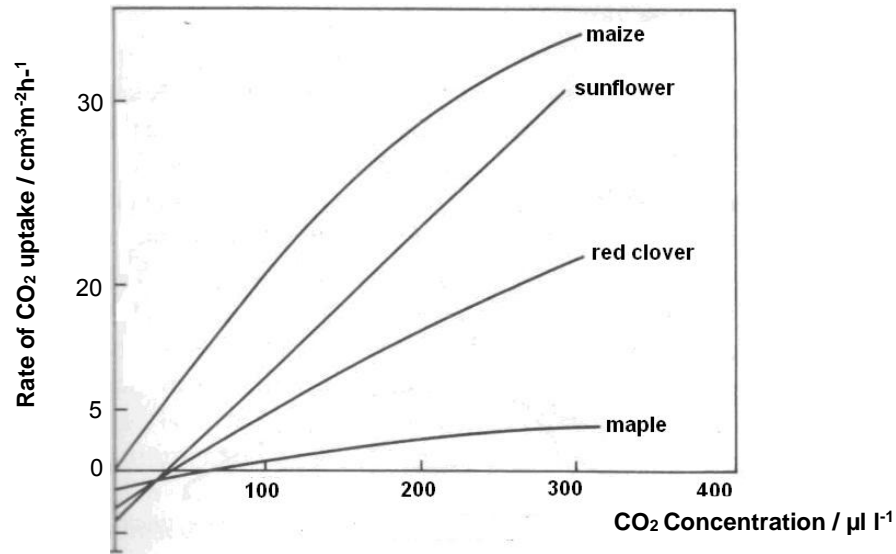


Which one of the following ratios of offspring will be produced when P and Q are bred together?

- A** 2 females (both normal): 2 males (both abnormal)  
**B** 2 females (both carriers): 2 males (both normal)  
**C** 2 females (1 carrier, 1 abnormal): 2 males (1 normal, 1 abnormal)  
**D** 2 females (1 carrier, 1 normal): 2 males (1 normal, 1 abnormal)

- 19** Which of the following is the final pathway followed by all carbon atoms derived from the oxidation of carbohydrates, lipids and proteins in the presence of oxygen?
- A** Calvin cycle
  - B** Electron transport system
  - C** Krebs cycle
  - D** Oxidative phosphorylation
- 20** Glucose, made from six radioactively-labelled carbon atoms, is fed to yeast cells in the absence of oxygen. How many molecules of radioactive alcohol are formed from each molecule of the glucose?
- A** 1                      **B** 2                      **C** 3                      **D** 6
- 21** Dinitrophenol is a metabolic poison that can lodge within the thylakoid membranes of chloroplasts. It then provides an alternative route for  $H^+$  ions to diffuse across the thylakoid membranes. In what way will the Calvin cycle be affected in chloroplasts poisoned by dinitrophenol?
- A** No change in rate as Calvin cycle occurs in the stroma and not at thylakoid membranes.
  - B** The rate of Calvin cycle will increase as pH in the stroma will decrease towards the optimum for enzymes involved in the cycle.
  - C** The rate of Calvin cycle will decrease with the accumulation of glycerate-3-phosphate.
  - D** The rate of Calvin cycle will decrease with the accumulation of glyceraldehyde-3-phosphate.

- 22 The diagram below shows the rate of photosynthesis of four different plants at different concentrations of carbon dioxide.



Which of the following conclusions can be made?

- 1 At CO<sub>2</sub> concentrations below 150  $\mu\text{l l}^{-1}$ , CO<sub>2</sub> concentration is the main limiting factor for all the plants.
- 2 CO<sub>2</sub> compensation point is around 40  $\mu\text{l l}^{-1}$  for sunflower and red clover, and it measures the light intensity when the rate of CO<sub>2</sub> uptake equals to the rate of CO<sub>2</sub> given off.
- 3 Rate of CO<sub>2</sub> uptake was zero for maize at CO<sub>2</sub> concentration of 0  $\mu\text{l l}^{-1}$  as the amount of CO<sub>2</sub> released from respiration is used for photosynthesis.
- 4 Of the four plants, maple has the lowest amount of organic compound produced at CO<sub>2</sub> concentration of 200  $\mu\text{l l}^{-1}$ .

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

- 23** Vancomycin is an antibiotic which inhibits the growth of bacteria by interfering with the action of bacterial transpeptidase, thus preventing the proper synthesis of the bacterial cell wall. Bacteria with a weakened cell wall lyses under osmotic pressure.

In response to increased bacterial resistance to vancomycin, scientists modified the chemical structure of vancomycin to confer it with two additional antibacterial mechanisms. The modified antibiotic can also inhibit bacterial transglycosylase, another enzyme involved in cell wall synthesis. The modifications also allow the antibiotic to bind to bacterial plasma membrane and disrupt it, hence increasing membrane permeability.

Medical institutions reserve the use of such new antibiotics to last-resort cases where other antibiotics are unable to treat the infection.

Which of the following statements explain why it is difficult for bacterial resistance against the modified vancomycin to evolve?

- 1 Most strains of bacteria would be susceptible to one of the three mechanisms of the modified vancomycin.
- 2 The proportion of alleles conferring resistance in the gene pool of a bacterial population would only increase slowly due to a short replicative cycle.
- 3 A bacterium cell would require mutations in at least three different genes to gain resistance to the modified vancomycin.
- 4 Due to controlled usage in the medical setting, selection pressure for resistant strains is likely to be weak.

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



- 24** The greater prairie chicken (*Tympanuchus cupido*) used to be an abundant species in North America. With the conversion of tallgrass prairies to agriculture cropland, the loss of their native habitat have led to rapid population decline in the greater prairie chicken.

The following table shows the change in population size of greater prairie chickens in the state of Illinois (USA) over three decades. Analyses of the average number of alleles per gene locus, as well as the success rates of egg hatching, are also shown in the table.

Year	Population size / n	Average number of alleles per gene locus	Success rate of egg hatching / %
1962	2,000	5.2	91
1994	46	3.7	38

Scientists were concerned with the population decline in greater prairie chickens. Which of the following explains why it is a cause for concern?

- A** When the average number of alleles per gene locus decreases from 5.2 to 3.7, the population is no longer able to evolve by natural selection.
- B** When the average number of alleles per gene locus decreases, changes in environmental conditions may easily lead to extinction of the population.
- C** The population size is inversely related to the level of genetic diversity in the population of greater prairie chickens as a result of inbreeding.
- D** The level of genetic diversity in the population is inversely related to the success rate of egg hatching of greater prairie chickens, which further affects the population size.

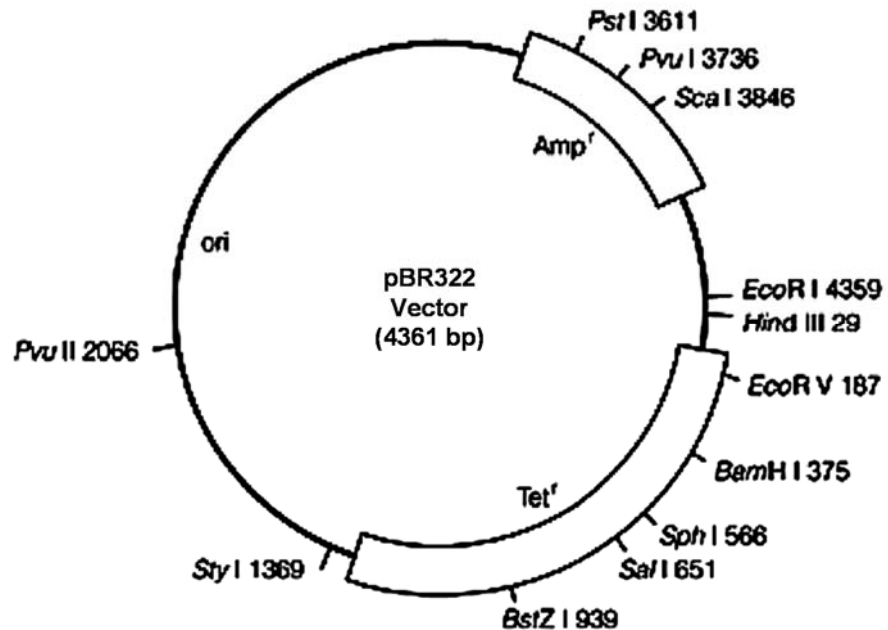
- 25** The phylogenetic relationship of four different species – human, whale, pigeon and the house lizard – was investigated. Part of the amino acid sequence for the cytochrome c protein found in the different species was analysed and is shown in the following table (the letters denote different amino acids).

Species	Amino acid sequence of cytochrome c			
Human	I F V G I K K K E E	R A D L I A Y L K K	A T N E	
Whale	I F A G I K K K G E	R A D L I A Y L K K	A T N E	
Pigeon	I F A G I K K K A E	R A D L I A Y L K Q	A T A K	
House Lizard	I F A G I K K K A E	R A D L I A Y L K D	A T S K	

Which of the following statements regarding the evolutionary relationships of these four species is true?

- A** Pigeons are unrelated to all the other three species due to differences in forelimb anatomy.
- B** House lizards and humans are the most closely related due to similarities in forelimb anatomy.
- C** Humans are more closely related to whales than to pigeons based on molecular homology seen in cytochrome c.
- D** Whales are more closely related to pigeons than house lizards based on molecular homology seen in cytochrome c.

- 26 The pBR322 vector is used to clone a eukaryotic gene, which has been digested by the restriction endonuclease *Bam*HI.



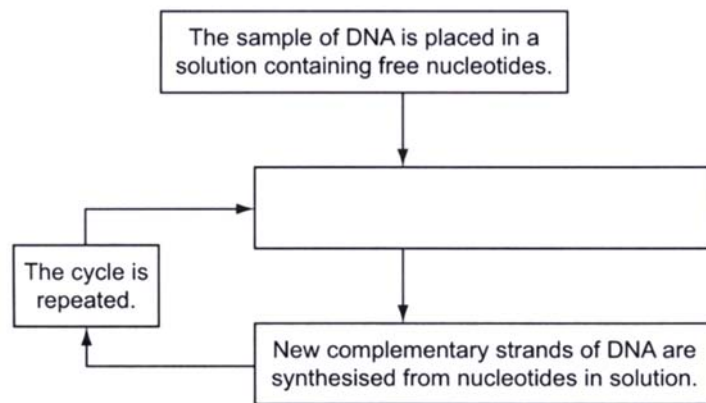
Following transformation, bacterial cells were grown in four different media, as shown below:

- 1 Nutrient broth containing ampicillin
- 2 Nutrient broth containing tetracycline
- 3 Nutrient broth containing ampicillin and tetracycline
- 4 Nutrient broth without ampicillin and tetracycline

Which of the following media would bacterial cells containing the recombinant plasmids grow in?

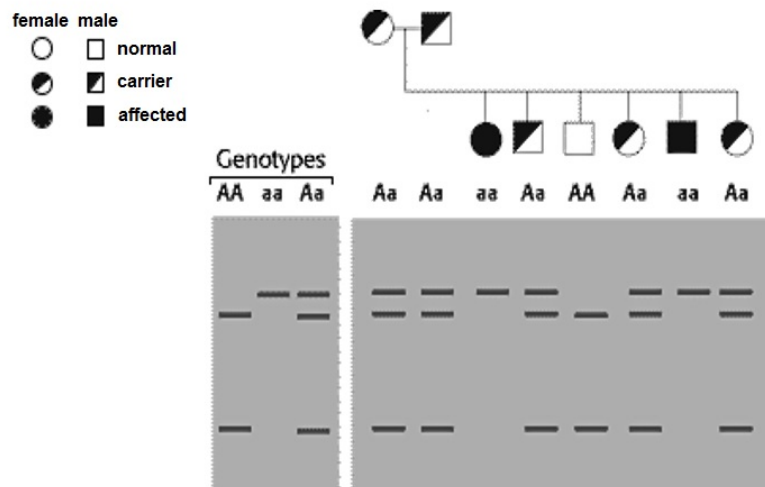
- A 1 and 2 only
- B 1 and 4 only
- C 2 and 3 only
- D 4 only

- 27 The polymerase chain reaction is summarised in the flowchart below.



Which statement completes the flow chart?

- A Complementary strands of DNA are separated.
  - B Free nucleotides are added to the ends of parental DNA strands.
  - C Small sections of DNA are formed.
  - D Strands of DNA bind to RNA primers.
- 28 Sickle-cell anaemia is an autosomal, recessive human disease. A hypothetical pedigree for parents, each heterozygous for the sickle-cell allele, is shown in the figure below.



Based on the above analysis, which of the following statements is true?

- A The sickle-cell anaemia is caused by a mutation resulting in a gain of a new restriction site.
- B The sickle-cell anaemia is caused by a mutation resulting in a loss of an existing restriction site.
- C The sickle-cell anaemia is caused by a mutation where 3 bases are inserted in between the restriction sites.
- D The fragments generated from the normal allele is a result of cutting at more than three restriction sites.

- 29 Which of the following is a correct statement about obtaining human embryonic stem cells for research?
- A Removal of these cells is considered to be ethically acceptable as normal development of the embryo is not inhibited.
  - B The cells must be removed at an early stage of development from a region of the blastocyst known as the inner cell mass.
  - C The cells must be removed within a day following the successful fertilisation of the ovum by the sperm, and after checking for normal mitotic division.
  - D The region of the blastocyst from where the cells are removed is an area that develops at a later stage into the placenta.
- 30 Which of the following genetic modifications would **not** decrease the quantity of chemicals sprayed onto crop plants by farmers?
- A Fungal resistance
  - B Herbicide resistance
  - C Insect resistance
  - D Viral resistance

**ACJC Prelim 2017**  
**H1 Biology Paper 1 (8875/01) Answers**

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