

NANYANG JUNIOR COLLEGE  
JC 2 PRELIMINARY EXAMINATIONS  
Higher 1

CANDIDATE  
NAME

CLASS

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## BIOLOGY

**8875/01**

Paper 1 Multiple Choice

**September 2015**

**1 hour**

Additional Materials: Multiple Choice Answer Sheet

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### READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name and CT 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.

Calculators may be used.

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This document consists of **14** printed pages and **0** blank page.

**[Turn over**

- 1 Membranous sacs containing products of metabolism are formed by the endoplasmic reticulum in cells.

Where are these products used?

- A inside and outside the cell  
 B inside lysosomes only  
 C inside the cell only  
 D outside the cell only
- 2 Which correctly matches the functional and structural features of cellulose, collagen, glycogen and triglyceride?

		function	structure		
			fibrous	molecule held together by hydrogen bonds	branched chains
<b>A</b>	cellulose	support strengthening	✓	x	✓
	collagen		✓	✓	x
<b>B</b>	cellulose	support energy source	✓	✓	x
	triglyceride		x	x	x
<b>C</b>	collagen	strengthening storage	✓	✓	✓
	glycogen		x	x	✓
<b>D</b>	glycogen	storage energy source	x	✓	✓
	triglyceride		x	✓	x

key ✓ = true X = false

- 3 Ethylene glycol is a chemical used to prevent water from freezing. If ethylene glycol is swallowed accidentally, it is metabolised by an enzyme found in liver cells to produce a toxic product.

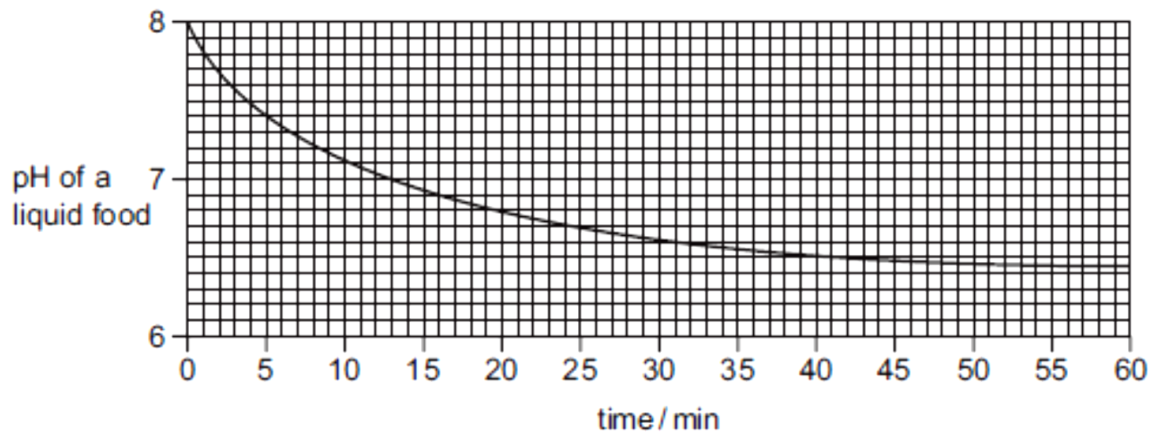
The enzyme normally catalyses the oxidation of ethanol to a harmless product.

People who have swallowed ethylene glycol are treated with large doses of ethanol. This prevents formation of a toxic product and allows the body to excrete the ethylene glycol.

Which statement describes why this treatment works?

- A Ethanol binds near the active site on the enzyme, altering its shape.  
 B Ethanol binds permanently to the active site of the enzyme, blocking it.  
 C Ethanol changes the tertiary structure of the enzyme, denaturing it.  
 D Ethanol is more likely to bind to the active site on the enzyme.

- 4 Lipase is a digestive enzyme produced by the pancreas that catalyses the hydrolysis of dietary lipids. The table shows how the pH of a liquid food containing a high proportion of lipids decreases over time.



Which statements are possible explanations of the results of the experiment between 50 and 60 minutes?

- 1 Enzyme concentration becomes the limiting factor.
- 2 Substrate concentration becomes the limiting factor.
- 3 All the enzyme active sites are saturated.
- 4 Denaturation of the enzyme by the products.
- 5 Products are acting as competitive inhibitors.

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

- 5 A student examined the cells in the growing region (meristem) of an onion root and obtained the data below.

stage	number of cells
interphase	886
prophase	73
metaphase	16
anaphase	14
telophase	11

What percentage of cells contain chromosomes that appear as two chromatids?

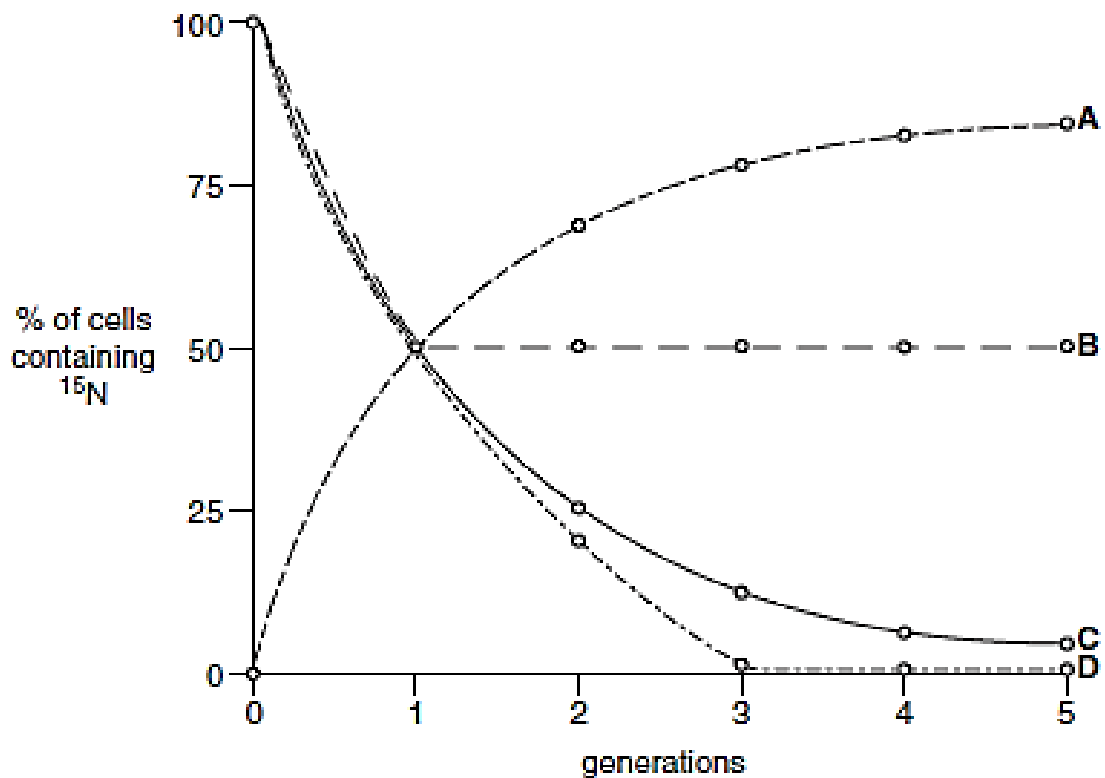
- A 97.5%  
 B 95.9%  
 C 8.9%  
 D 7.3%

6 Which type of sugar and types of bonds are found in a DNA molecule?

	Type of sugar	type of bonds
<b>A</b>	non-reducing	hydrogen and ionic
<b>B</b>	non-reducing	hydrogen and peptide
<b>C</b>	reducing	covalent and hydrogen
<b>D</b>	reducing	hydrogen and peptide

7 Bacteria were cultured in a medium containing heavy nitrogen ( $^{15}\text{N}$ ) until all the DNA was labelled. These bacteria were then grown in a medium containing only normal nitrogen ( $^{14}\text{N}$ ) for five generations. The percentage of cells containing  $^{15}\text{N}$  in each generation was estimated.

Which curve provides evidence that DNA replication is semi conservative?



8 The following events occur during transcription.

- 1 Bonds break between complementary bases.
- 2 Bonds form between complementary bases.
- 3 Sugar-phosphate bonds form.
- 4 Free nucleotides pair with complementary nucleotides.

Before the mRNA leaves the nucleus, which events will have occurred twice?

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

9 A synthetic mRNA molecule is made by using only two types of nucleotide, containing adenine and cytosine. How many different codons could it contain?

- A 2
- B 4
- C 8
- D 16

10 A mutation of a gene coding for an ion pump in cell surface membranes results in the substitution of one amino acid, arginine, by another, histidine.

The DNA triplet codes for the two amino acids are shown.

Arginine	GCA	Histidine	GTA
	GCG		GTG
	GCT		
	GCC		
	TCT		
	TCC		

Which mutation has occurred in the DNA?

- A Addition of an extra nucleotide
- B Replacement of a nucleotide with a purine base by one with a different purine base
- C Replacement of a nucleotide with a purine base by one with a pyrimidine base
- D Replacement of a nucleotide with a pyrimidine base by one with a different pyrimidine base

- 11** Two genes, Q and R, affect the size and pigmentation of the petals of flower.

Gene Q has two alleles,  $Q^L$  and  $Q^A$ . The genotype of  $Q^LQ^L$  produces large petals,  $Q^LQ^A$  produces small petals and in  $Q^AQ^A$ , petals are absent.

Gene R has two alleles, **R** produces a red pigment and is dominant over the allele **r** that produces no pigment.

Two plants, both heterozygous for both genes, are crossed.

How many phenotypes are expected in the next generation?

- A** 4
- B** 5
- C** 6
- D** 9

- 12** A cross between a round-leafed, tall plant and a round-leafed, dwarf plant produced the following offspring:

121 round-leafed, tall plants

124 round-leafed, dwarf plants

42 oval-leafed, tall plants

37 oval-leafed, dwarf plants

Key

**R** - round leaf

**r** - oval leaf

**T** - tall

**t** - dwarf

What were the genotypes of the parents?

- A**  $RrTt \times Rrtt$
- B**  $RrTt \times RRtt$
- C**  $RrTT \times Rrtt$
- D**  $RrTT \times RRtt$

- 13** The table shows the results of a series of crosses in a species of small mammal.

coat colour phenotype		
male parent	female parent	offspring
dark grey	light grey	dark grey, light grey, albino
light grey	Albino	light grey, white with black patches
dark grey	white with black patches	dark grey, light grey
light grey	dark grey	dark grey, light grey, white with black patches

What explains the inheritance of the range of phenotypes shown by these crosses?

- A** one gene with a pair of co-dominant alleles
- B** one gene with multiple alleles
- C** sex linkage of the allele for grey coat colour
- D** two genes, each with a dominant and recessive allele

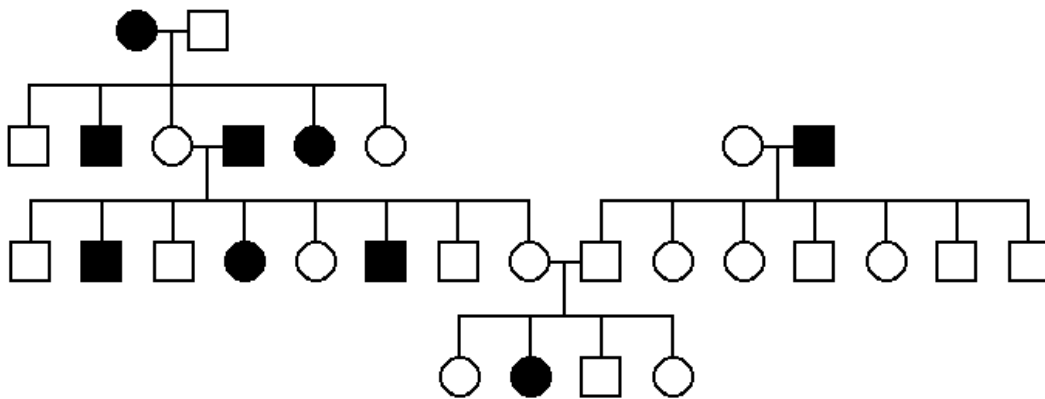
- 14** In *Drosophila*, the male is the heterogametic sex. The allele for white eyes is recessive and sex-linked.

A female which is heterozygous at this gene locus was mated with a normal male.

White eyes will be present in

- A** all the offspring
- B** all the male offspring but none of the female offspring
- C** none of the female offspring and 50% of the male offspring
- D** none of the male offspring and 50% of the female offspring

- 15** The inheritance of a genetic disease in a family is presented in a pedigree tree below.



What type of inheritance could this disease show?

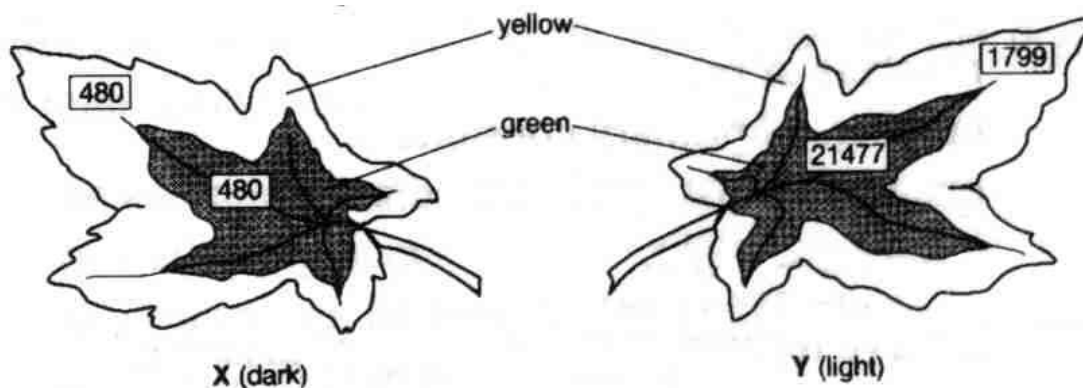
- I** Autosomal dominant
- II** Autosomal recessive
- III** Sex-linked dominant
- IV** Sex-linked recessive

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

- 16 In plants adapted to cold conditions, their cell surface membranes change as the weather gets colder, allowing the plants to carry out exocytosis.

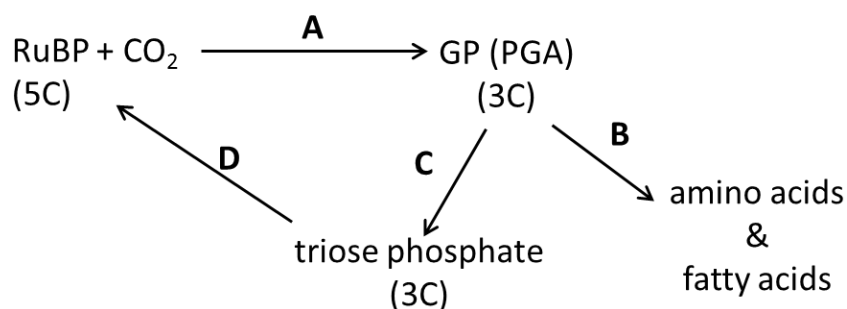
Which change occurs in their cell surface membranes?

- A a decrease in the ratio of proteins to saturated phospholipids
  - B a decrease in the ratio of unsaturated phospholipids to saturated phospholipids
  - C an increase in the ratio of proteins to unsaturated phospholipids
  - D an increase in the ratio of unsaturated phospholipids to saturated phospholipids
- 17 Variegated leaves of a plant were supplied with radioactive carbon dioxide ( $^{14}\text{CO}_2$ ) during an experiment. Leaf X was kept in the dark and leaf Y was kept in the light. At the end of the experiment, the radioactivity in the leaves was measured. The results (in arbitrary units) are shown in the boxes in the diagrams.



What is the most likely explanation for the level of radioactivity found in the yellow zone of leaf Y?

- A Photosynthesis occurs but no storage of starch occurs in this zone.
  - B Photosynthesis proceeds slowly in the absence of chlorophylls a and b.
  - C Products of photosynthesis are transported into the yellow zone.
  - D Radioactive carbon dioxide diffuses into the leaf and accumulates there.
- 18 The diagram shows stages in the light independent reaction of photosynthesis.



At which stage is most of the reduced NADP oxidised?



- 19** A metabolic poison rotenone was added to a mixture of homogenized cells with intact chloroplasts. It is discovered that rotenone can bind irreversibly to the electrons carriers on the thylakoid membrane in chloroplasts and alter their conformational shape.

In what way would the Calvin cycle be affected by rotenone poisoning?

- A** Calvin cycle will stop, as the accumulation of triose phosphate will create feedback inhibition on glucose formation.
- B** The rate of Calvin cycle will decrease due to the accumulation of glycerate-3-phosphate.
- C** The rate of Calvin cycle will increase since electrons can flow directly to final electron acceptor to form reduced NADPH.
- D** There will be no effect since Calvin cycle is an enzyme-controlled process.

- 20** ATP can be formed in the following ways.

- 1** Oxidative phosphorylation in the electron transport system
- 2** Glycolysis

In the complete oxidation of one molecule of glucose, approximately what percentage of ATP comes from 1?

- A** 25%
- B** 50%
- C** 80%
- D** 90%

- 21** Red light can only penetrate about 10m through water, but blue and green wavelengths can penetrate more than twice that distance.

Pigments which can absorb light of one colour and use the energy to emit light of another colour are called 'fluorescent'. Many reef corals living at depths between 10 and 20m fluoresce red.

Some fish living between 10 and 20m also have pigments which fluoresce red. These pigments often surround the eyes and form patches on the body and fins, in patterns unique to each species.

Which of these suggested reasons could explain the selective advantage of fluorescence for these fish?

- 1** Fluorescent patches provide camouflage.
- 2** Recognition of their own species avoids interbreeding with other species.
- 3** The fluorescent patches do not attract predators more than 10m away.

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

**22** Deer mice are small, ground-dwelling rodents. They normally have dark coats.

Some paler coated mice have been observed in an area where new sand hills were formed between 8000 and 15 000 years ago. The sand hills are sparsely covered with scrubby plants. Studies have shown that the change in coat colour was due to a mutation in a gene, causing a single amino acid deletion from the protein for the coat colour pigment. This mutation seems to be spreading through the population.

Which statement most fully explains how the evolution of this species at this site has occurred?

- A** Better camouflage increases the chance of survival by reducing predation.
- B** Deer mice which live longer usually leave more offspring since they have more reproductive opportunities .
- C** The occurrence of the mutation provided new variation on which natural selection can act.
- D** The paler colour gives better camouflage against the background of the new sand hills.

- 23** The diagram shows part of the aligned DNA sequences for the same gene in six species of aquatic mammals.

Fin whale	TAAACCCCAATAGTCACAAAACAAGACTATTCGCCAGAGTACTACTAGCAAC
Humpback whale	TAAACCCTAATAGTCACAAAACAAGACTATTCGCCAGAGTACTACTAGCAAC
Sperm whale	TAAACCCAGGTAGTCATAAAACAAGACTATTCGCCAGAGTACTACTAGCAAC
Beaked whale	TAAACCTAAATAGTCTCAAAAACAAGACTATTCGCCAGAGTACTACTAGCAAT
Dolphin	TAAACTTAAATAATCCCAAAAACAAGATTATTCGCCAGAGTACTATCGGCAAC
Porpoise	TAAACCTAAATAGTCCTAAAACAAGACTATTCGCCAGAGTACTATCGGCAAC

Which is a correct assumption when using this information as evidence for evolutionary relationships?

- A** Differences and similarities in DNA sequences reflect evolutionary relationships.
  - B** DNA sequences in different genes from the same six species will suggest different evolutionary relationships.
  - C** Point mutations in DNA sequences are not acted on by natural selection.
  - D** Mutations that do not change amino acid sequences in proteins are important for natural selection.
- 24** Many types of evidence, including homology, can provide evidence in support of Darwin's theory of natural selection.

Which statement does **not** provide support?

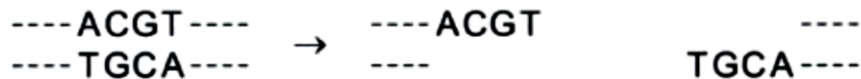
- A** The allele for sickle cell haemoglobin that gives resistance to malaria is more frequent in malarial areas.
- B** The distribution of the variants of the A blood group antigen reflects human migration patterns.
- C** The homozygous condition of the sex-linked allele for a non-functional blood clotting protein is rare.
- D** The molecular structure of ATP is almost identical in all eukaryotes.

- 25** BamHI is a restriction enzyme produced by *Bacillus amyloliquefaciens*. It recognises the specific nucleotide sequence GGATCC. *B. amyloliquefaciens* is susceptible to attack by viruses known as bacteriophages.

Which statement describes the natural function of BamHI?

- A** BamHI enzymatic modification of nucleotides occurs in all the GGATCC nucleotide sequences of *B. amyloliquefaciens*, to protect the DNA from degradation by bacteriophage enzymes and prevent its nucleotides being used for viral nucleic acid synthesis.
- B** Infectivity rate is lowered when *B. amyloliquefaciens* is subjected to invasion by bacteriophages that have double-stranded DNA as their genetic material, since BamHI can recognise and cleave specific viral nucleotide sequences.
- C** Restriction fragments produced as a result of BamHI binding to and cleaving DNA at all sites within the bacterial cell that have a GGATCC nucleotide sequence, prevent integration of bacteriophage nucleic acid into the bacterial genome.
- D** Transcription and translation of the *B. amyloliquefaciens* gene encoding the BamHI enzyme is followed by secretion of the enzyme into the external environment, where it has antibacterial action against non-related bacterial species.

- 26** The restriction enzyme *Tai1*, cuts DNA as shown.



Which of the plasmids below can be cut using restriction enzyme *Tai1*, in order to allow DNA to be inserted into the circular plasmid without loss of any part of the plasmid?

- A** ----TAACGTAC----CTCAAGCT----  
----AATGCATG----GAGTTCGA----
- B** ----TTAACGTA----CACGTGGT----  
----AATTGCAT----GTGCACCA----
- C** ----ACGTACGT----TCCACGTA----  
----TGCATGCA----AGGTGCAT----
- D** ----ACCTAGGT----CCACCTGA----  
----TGGATCCA----GGTGGACT----

**key**

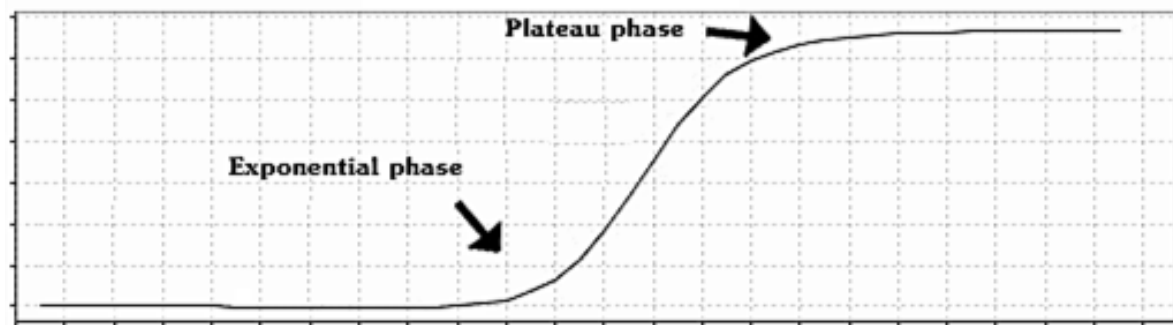
---- other nucleotides  
The rest of the plasmid  
does not contain this  
restriction site.

27 Which statements are goals of the human genome project (HGP)?

- 1 To map the positions of all the genes on all the human chromosomes. This would help to identify the location of many genes that can cause disease.
- 2 To obtain the sequence of all the DNA nucleotides on all the human chromosomes. This would enable particular sequences to be patented so that advancements could be made in gene therapy.
- 3 To allow the various centres sequencing the DNA nucleotides on all the human chromosomes to share results on the internet. This would ensure that the data were publicly available.
- 4 To develop techniques and technological tools for use in the sequencing project. This would lead to faster sequencing of sections of the human genome and improvements in mapping.

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

28 During the process of polymerase chain reaction (PCR), the amount of DNA synthesised can be traced using fluorescent probes and the measurements are shown in the following plot. The process initially goes through an exponential phase, followed by a plateau phase eventually.



Which of the following statements is **true**?

- A During the exponential phase, the number of DNA molecules synthesized after 15 cycles is  $15^2$ .
- B During the exponential phase, the temperature is always maintained at the optimum temperature of  $72^{\circ}\text{C}$  hence there is rapid amplification.
- C During the plateau phase, the reaction mixture is being depleted of ribonucleotides.
- D During the plateau phase, *Taq* polymerase may be denatured.

- 29** Which of the following statements is false about hematopoietic stem cells?
- A** Hematopoietic stem cells can differentiate into all specialised cells.
  - B** Hematopoietic stem cells can differentiate into all blood cell types.
  - C** Hematopoietic stem cells can be found in the bone marrow.
  - D** Hematopoietic stem cells are able to reproduce continually.
- 30** Marker genes are often inserted into genetically engineered crop plant cells, along with desired genes. Bacterial antibiotic resistance genes are sometimes used as marker genes. These may include short DNA repeats to make them unstable so that they are quite quickly eliminated by the genetically engineered crop plant cells.

Which is not a reason why elimination of such marker genes is favoured?

- A** It is theoretically possible for the antibiotic resistance marker gene in human food to pass to bacteria in the human gut.
- B** It is difficult to carry out repeated transformations using the same antibiotic.
- C** The antibiotics may affect the growth and differentiation of the fields of crop plants.
- D** There are a few such antibiotic resistance marker genes available.