



HWA CHONG INSTITUTION
JC2 Preliminary Examinations
Higher 1

CANDIDATE NAME

--

CT GROUP

14S ____

CENTRE NUMBER

--	--	--	--

INDEX
NUMBER

--	--	--	--

BIOLOGY

Paper 1 Multiple Choice

Additional Materials: Optical Mark Sheet

8875 / 01

17 September 2015

1 hour

INSTRUCTIONS TO CANDIDATES

1. Write your **name** and **CT group** in the spaces provided at the top of this cover page.
2. Fill in your particulars on the Optical Mark Sheet. Write your **NRIC number** and shade accordingly.
3. 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 Optical Mark Sheet.
4. At the end of the paper, you are to submit **only** the Optical Mark Sheet.

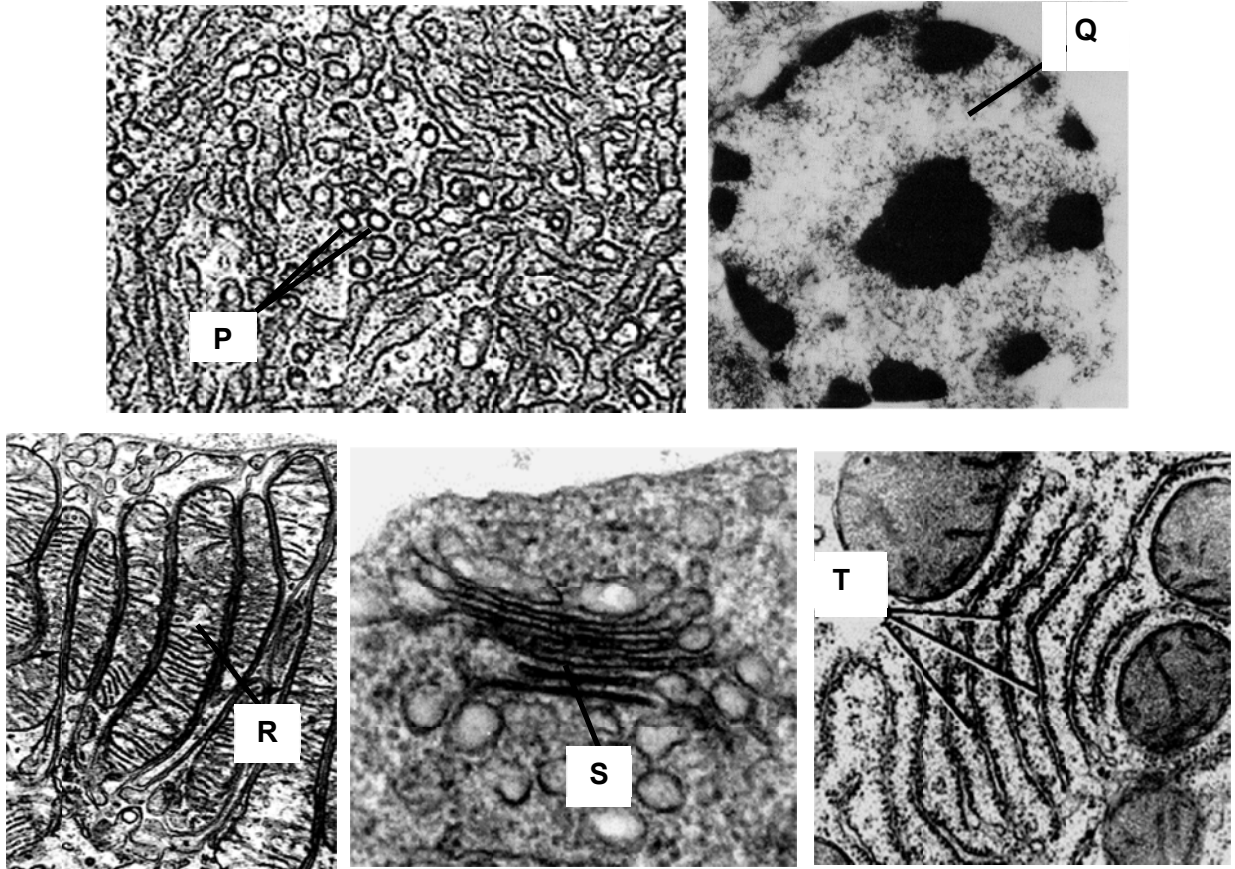
INFORMATION FOR CANDIDATES

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.

- 1 The following electron micrographs show various organelles **P** to **T** present in a liver cell.

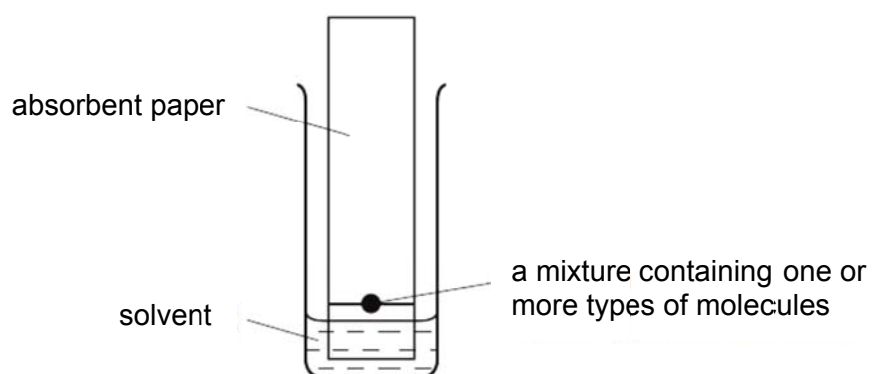


Radioactive amino acids are supplied to the liver cell to synthesise insulin receptors.

Which sequence shows the correct order in which these amino acids would be detected in the organelles during the synthesis of insulin receptors?

- A** Q → T → R → P → S
- B** Q → T → P → S
- C** T → P → S → R
- D** T → S → P

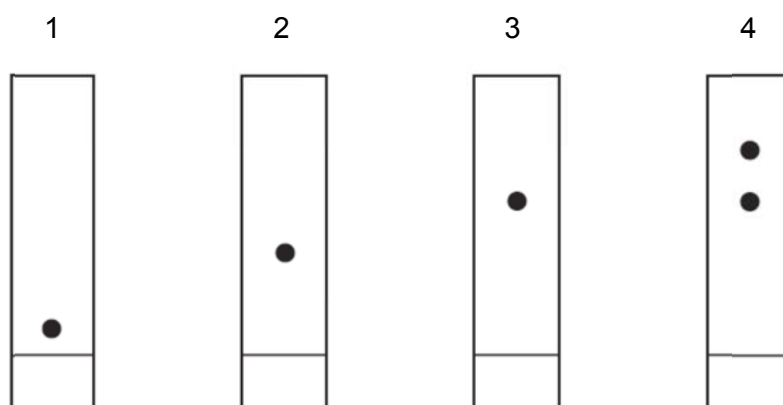
- 2 Chromatography is a technique used to separate molecules by their solubility. The diagram shows an apparatus used for this technique.



As the solvent rises up the paper, the molecules with the greatest solubility in the solvent travel the greatest distances up the paper. When the solvent reaches the top of the paper, the paper is removed, dried and sprayed with a dye. The different molecules appear as coloured spots.

Chromatography was carried out on four different samples – sucrose, cellulose as well as the products of complete hydrolysis of sucrose and cellulose.

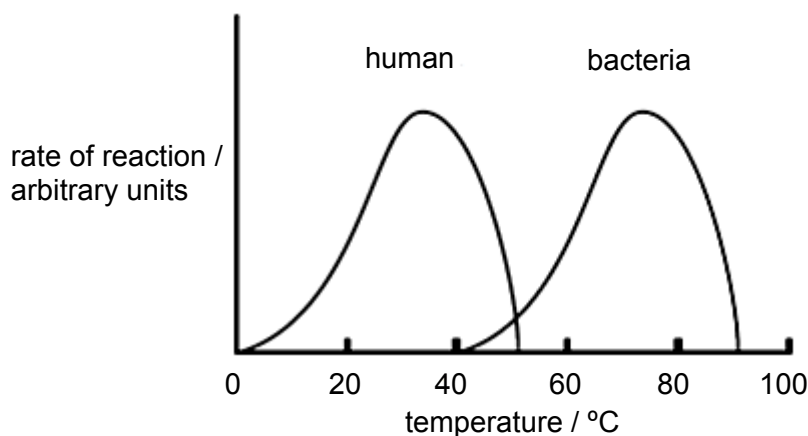
The diagram shows the chromatography results:



Which row shows the correct results?

	sucrose	cellulose	products of complete hydrolysis of sucrose	products of complete hydrolysis of cellulose
A	4	3	1	2
B	3	4	2	1
C	1	2	3	4
D	2	1	4	3

- 3 The rate of reaction of a typical human enzyme was compared with the rate of reaction of a typical enzyme taken from bacteria that live in hot springs. The rates of reaction were measured over the same range of temperatures. The data obtained is shown in the following diagram.



Which statement can be concluded?

- A** Typical human enzymes fail to act at temperatures above 50°C as they are denatured due to disruption of covalent bonds.
- B** The temperature coefficient for typical enzymes from bacteria that live in hot springs is two for temperatures between 45°C to 75°C.
- C** A denatured human enzyme would resume activity if reincubated at 20°C.
- D** Enzymes from bacteria that live in hot springs withstand temperatures up to 90°C as they have a low K_m value.
- 4 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.

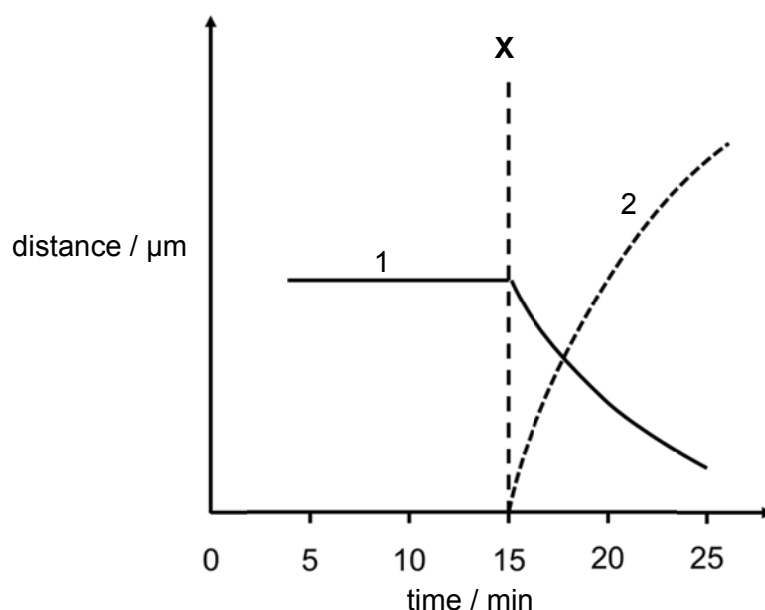
The enzyme normally catalyses the oxidation of ethanol to a harmless product.

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 dissolves the co-factor of the enzyme, making the enzyme non-functional.
- 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.

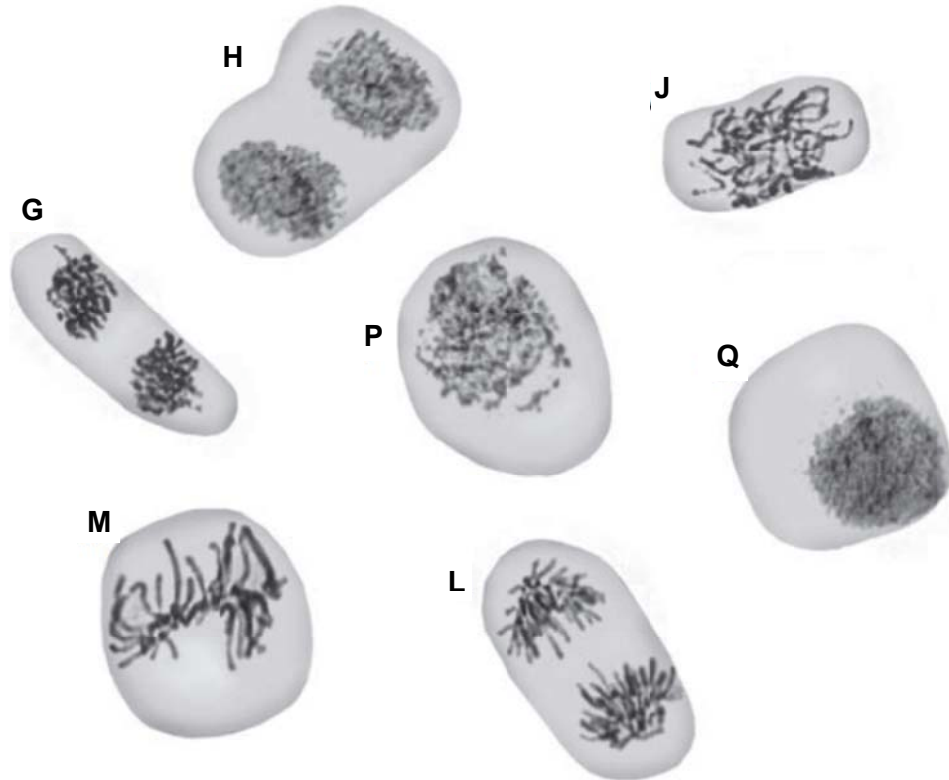
5 The graph shows measurements during one mitotic cell cycle.



What is the behaviour of chromosomes from **X** onwards as illustrated by curves 1 and 2?

	behaviour of chromosomes	curve 1	curve 2
A	separation of sister chromatids	distance between the centromeres of sister chromatids	distance between centromeres of chromosomes and poles of spindle
B	separation of sister chromatids	distance between centromeres of chromosomes and poles of spindle	distance between the centromeres of sister chromatids
C	separation of homologous chromosomes	distance between centromeres of chromosomes and poles of spindle	distance between the centromeres of homologous chromosomes
D	separation of homologous chromosomes	distance between the centromeres of homologous chromosomes	distance between centromeres of chromosomes and poles of spindle

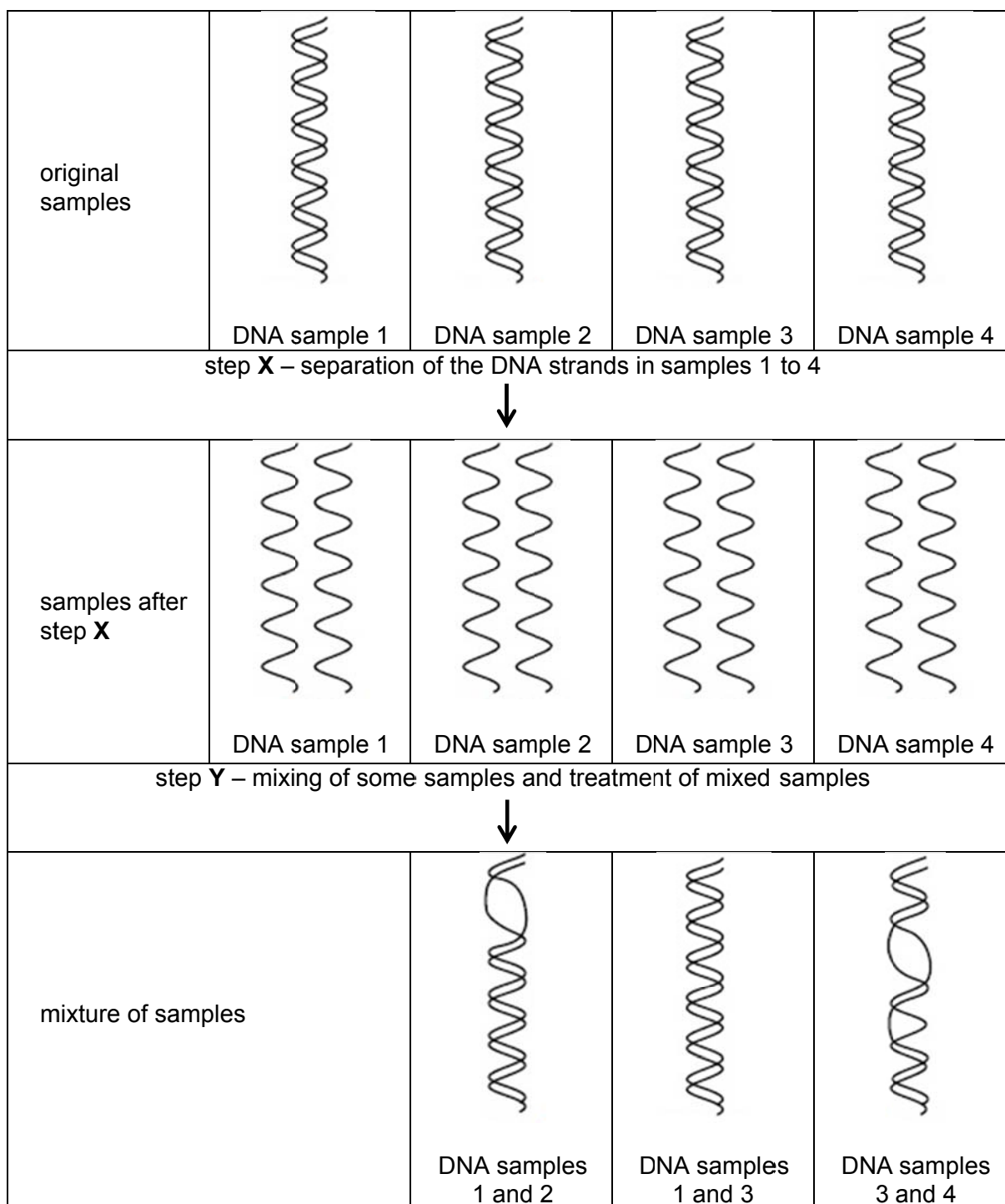
- 6 The diagram shows some of the events that take place during mitosis.



Which sequence of events is correct?

- A** **Q** → **P** → **J** → **M** → **L** → **G** → **H**
B **P** → **Q** → **M** → **G** → **J** → **L** → **H**
C **P** → **G** → **L** → **M** → **J** → **Q** → **H**
D **Q** → **H** → **J** → **P** → **L** → **G** → **M**
- 7 Which of the following is / are not factor(s) that increase(s) the chances of cancerous growth?
- 1 genetic predisposition
 - 2 non-transforming viruses
 - 3 non-ionizing radiation
 - 4 overexposure to sun
- A** 2 **B** 1 and 2 **C** 2 and 3 **D** 3 and 4

- 8 Samples of DNA were taken from four individuals and processed as shown in the flowchart.



Which conclusion is correct?

- A Samples 1 and 2 are from individuals belonging to the same species.
- B Treatment at step X included cooling each of the original samples.
- C Treatment of mixed samples at step Y included the addition of DNA helicase.
- D Individuals belonging to samples 1 and 3 are more closely related than individuals belonging to samples 3 and 4.

- 9** In an experiment similar to that of Meselson and Stahl, bacteria having DNA fully labelled with the heavy isotope of nitrogen (^{15}N) were transferred to a medium containing only the light isotope of nitrogen (^{14}N).

The bacteria were allowed to reproduce for two generations in this medium.

Which statement would be true of the DNA of the second generation?

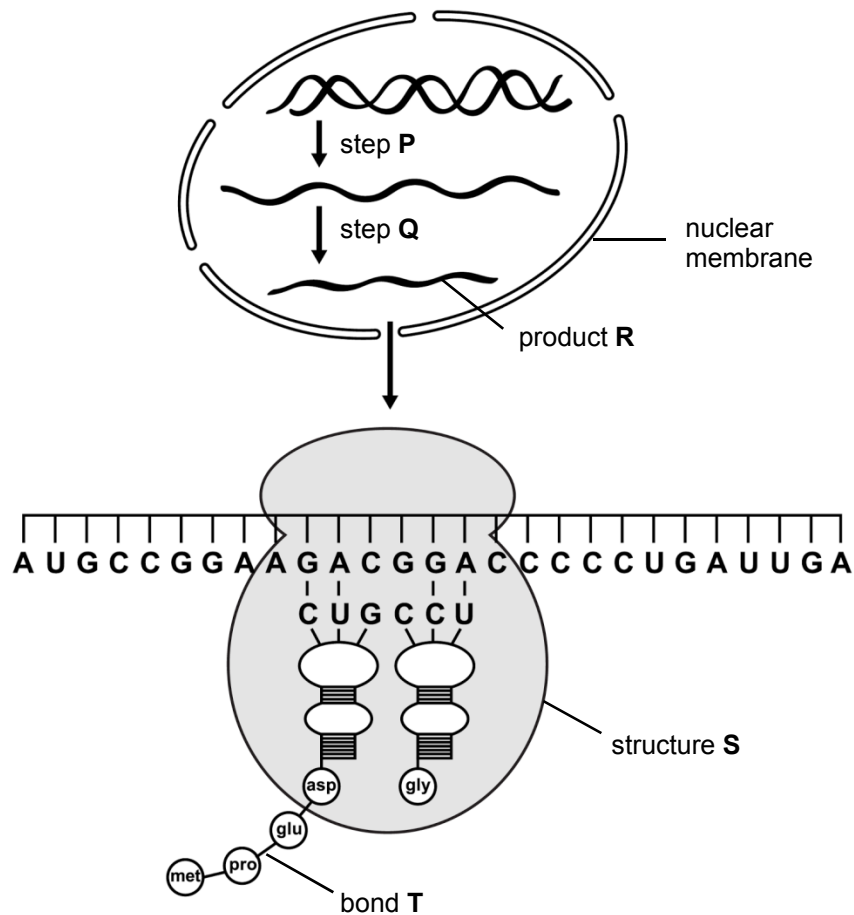
- A** All DNA molecules will consist entirely of ^{14}N nucleotides.
- B** 25% of DNA molecules will have ^{14}N and ^{15}N nucleotides and 75% will have ^{14}N nucleotides only.
- C** 50% of DNA molecules will have ^{14}N nucleotides only and 50% will have half ^{15}N and half ^{14}N nucleotides.
- D** 50% of DNA molecules will have ^{14}N nucleotides only and 50% will have ^{15}N nucleotides only.

- 10** Which statement(s) about RNA is / are correct?

- 5 It is less stable than DNA as it contains a ribose sugar that lacks a 2' OH group.
- 6 It is able to form double-stranded regions with some areas of base pairing.
- 7 It is a polymer of purine and pyrimidine joined by phosphodiester bonds.
- 8 It is synthesised in the 5' to 3' direction where the 5'-phosphate group of the growing RNA strand is joined to the 3'-hydroxyl group of an incoming nucleotide.

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

11 The diagram outlines the production of protein in a cell.



Which statements are correct?

- 1 DNA involved has the base sequence TACGGCCTTCTGCCTGGGGGACTAACT.
- 2 RNA polymerase is active during step P and removal of exons by spliceosome occurs at step Q to give product R.
- 3 Bond T is synthesised by RNA found in structure S.
- 4 The mRNA shown will code for a protein containing eight amino acids.

A 1 and 4

B 3 and 4

C 1, 2 and 3

D 1, 3 and 4

- 12** Haemoglobin consists of four polypeptide chains. In normal adult haemoglobin, two of these are beta chains, each comprising 146 amino acids. Variations exist in the amino acid composition of these chains, resulting in different kinds of haemoglobin. One of these variants is called haemoglobin S.

The first seven amino acids in the beta chains of these two haemoglobins are given below. The amino acids at each of the remaining positions are the same for both kinds of haemoglobin.

position of amino acid in haemoglobin chain:	1	—	2	—	3	—	4	—	5	—	6	—	7...
normal adult haemoglobin:	val	—	his	—	leu	—	thr	—	pro	—	glu	—	glu...
haemoglobin S:	val	—	his	—	leu	—	thr	—	pro	—	val	—	glu...

The genetic code for the amino acids in these sequences, coded for by the template strand of DNA, is shown in the following table.

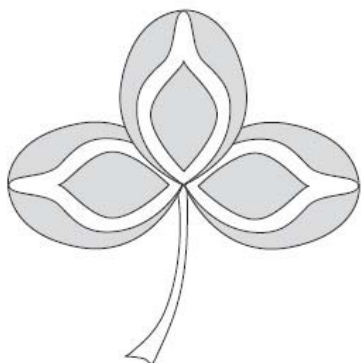
DNA triplet	amino acid	DNA triplet	amino acid
CAA or CAG or CAT or CAC	val	TGA or TGG or TGT or TGC	thr
GTA or GTG	his	GGA or GGG or GGT or GGC	pro
AAT or AAC or GAA or GAG or GAT or GAC	leu	CTT or CTC	glu

Using the information provided above, which statement(s) is/are true about normal adult haemoglobin and haemoglobin S?

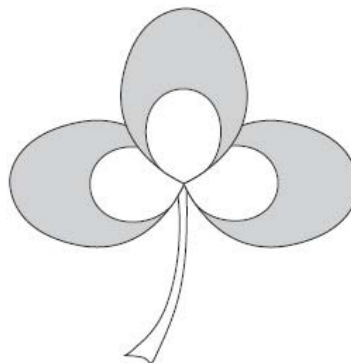
- During transcription of normal haemoglobin, the mRNA codon sequence could be CAC for amino acid 2 and GAA for amino acid 7.
- Haemoglobin S could be the result of a single base mutation in the DNA of normal adult haemoglobin.
- A deletion of nucleotide 12 would not change the fourth amino acid in the sequence of normal adult haemoglobin.

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

- 13** The white clover, *Trifolium repens*, is one of the plants found growing as a weed in many lawns. Leaves of the white clover are divided into three leaflets, which often have characteristic white patterns visible on their surface. The two basic forms of the pattern are a chevron and patch. The diagram below shows these two patterns.

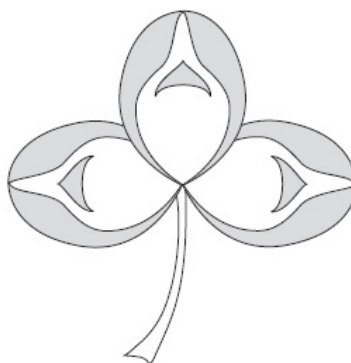


chevron pattern



patch pattern

If a pure-breeding clover plant with the chevron pattern is crossed with a pure-breeding plant with the patch pattern, the offspring have leaflets with a mixed chevron and patch pattern, as shown in the diagram below.

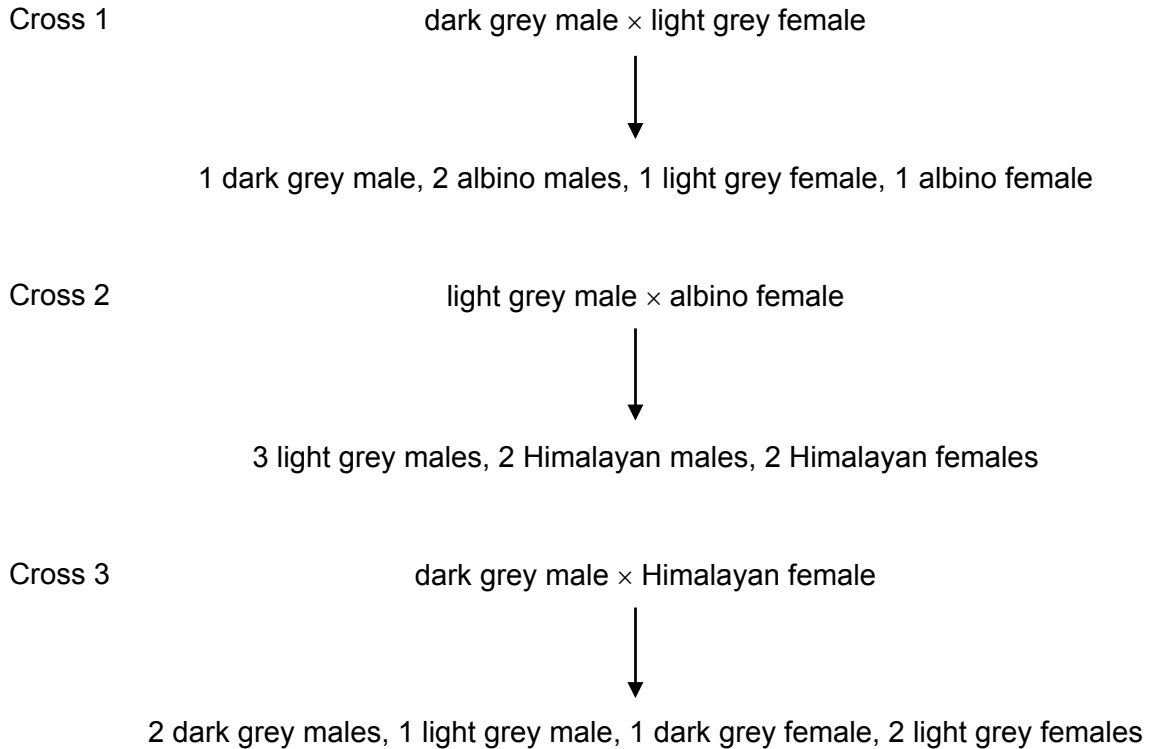


mixed pattern

Which row correctly describes the inheritance of leaflet patterns in white clover?

	number of alleles that determines the white patterns in the leaflets	mode of inheritance
A	2	codominance
B	2	complete dominance
C	> 2	codominance
D	> 2	complete dominance

- 14 The diagram shows the results of a series of crosses in rabbits.



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

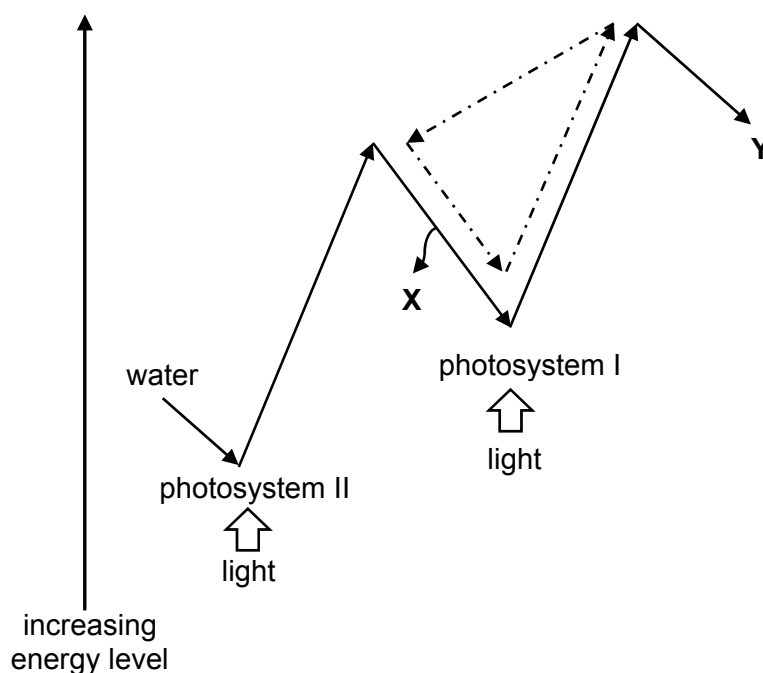
- A a pair of codominant alleles
- B one gene with multiple alleles
- C sex linkage of the allele for grey coat colour
- D two genes, each with a dominant and recessive allele
- 15 In the breeding season, male Anole lizards court females by bobbing their heads up and down while displaying a colorful throat patch. Both characteristics are controlled by genes found on separate chromosomes. Anoles prefer to mate with lizards, which bob their heads fast and have red throat patches. These two alleles are dominant over their counterparts, slow bobbing and yellow throats.

A male lizard heterozygous for head bobbing and homozygous dominant for the red throat patch mates with a female that is also heterozygous for head bobbing but has yellow throat patches.

What percentage of the offspring has fast bobbing and red throat phenotype?

- A 25% B 50% C 75% D 100%

- 16** The diagram outlines the light-dependent stage of photosynthesis in which products **X** and **Y** are formed.



Which statements are true?

- 1 PSI has a higher energy level due to higher light intensity.
- 2 Electrons from PSII will always be used to form **Y**.
- 3 Water is always necessary for the formation of **X**.
- 4 Cyclic flow of electrons results in the formation of **X**.
- 5 Non-cyclic photophosphorylation is needed for oxidation of **Y**.

A 2 and 4

B 3 and 5

C 1, 3 and 5

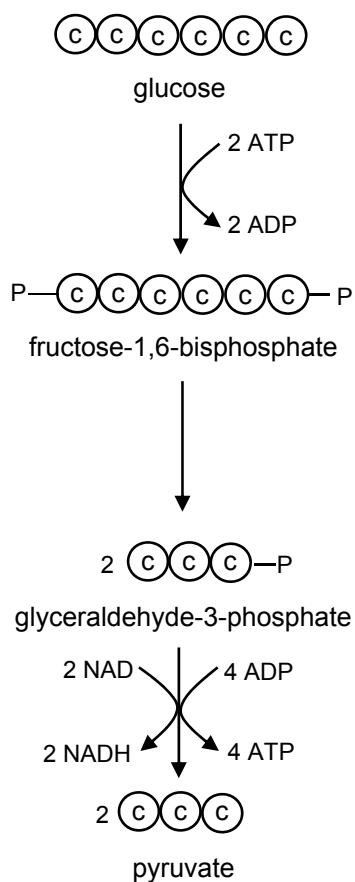
D 2, 3 and 4

- 17** The more sunlight a plant receives, the higher the photosynthetic rate.

If light intensity is kept uniformly high, which of the following statements is true of the rate of photosynthesis?

- A** Carbon dioxide is limiting when temperature is high while carbon dioxide concentration is high.
- B** Carbon dioxide is limiting when temperature is high while carbon dioxide concentration is low.
- C** Temperature is limiting when temperature is low while carbon dioxide concentration is low.
- D** Temperature is limiting when temperature is high while carbon dioxide concentration is low.

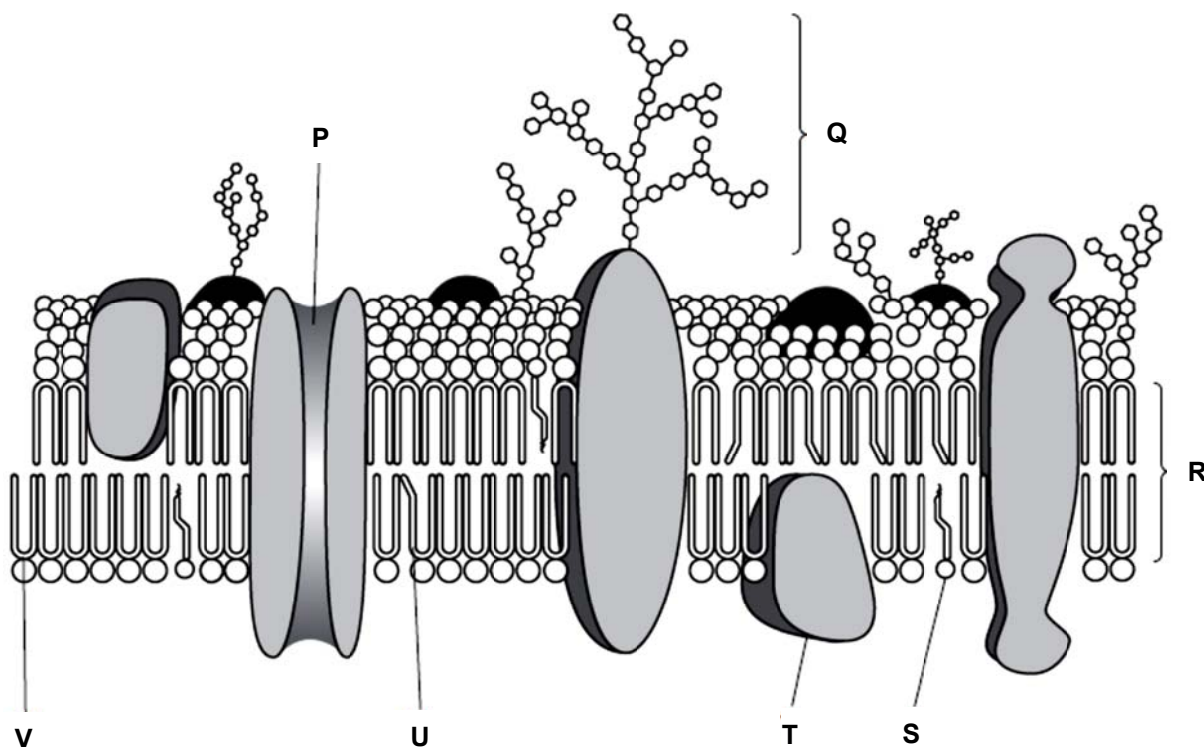
- 18 The flowchart shows some of the crucial steps in the glycolytic pathway involving one glucose molecule.



Which shows the correct arrangement of the respective molecules according to the number of ATP produced upon completion of aerobic respiration?

- A reduced NAD < glucose < glyceraldehyde-3-phosphate
- B reduced NAD < glyceraldehyde-3-phosphate < glucose
- C glyceraldehyde-3-phosphate < glucose < reduced NAD
- D glucose < glyceraldehyde-3-phosphate < reduced NAD

- 19 The diagram shows a section through a cell surface membrane from an animal cell.

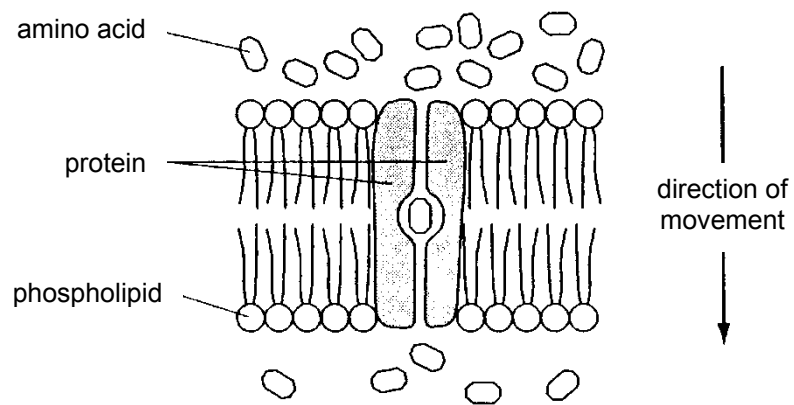


When compared to the more fluid cell surface membrane of a phagocytic cell, a number of differences in the membrane composition can be observed.

Which is the most likely set of differences that will be observed in the phagocytic cell?

- A** A complete absence of component **Q** and a higher proportion of component **P**.
- B** A higher proportion of component **S** and a higher proportion of component **T**.
- C** A lower proportion of component **V** and a higher proportion of component **U**.
- D** An increased distance across **R** and a higher proportion of component **V**.

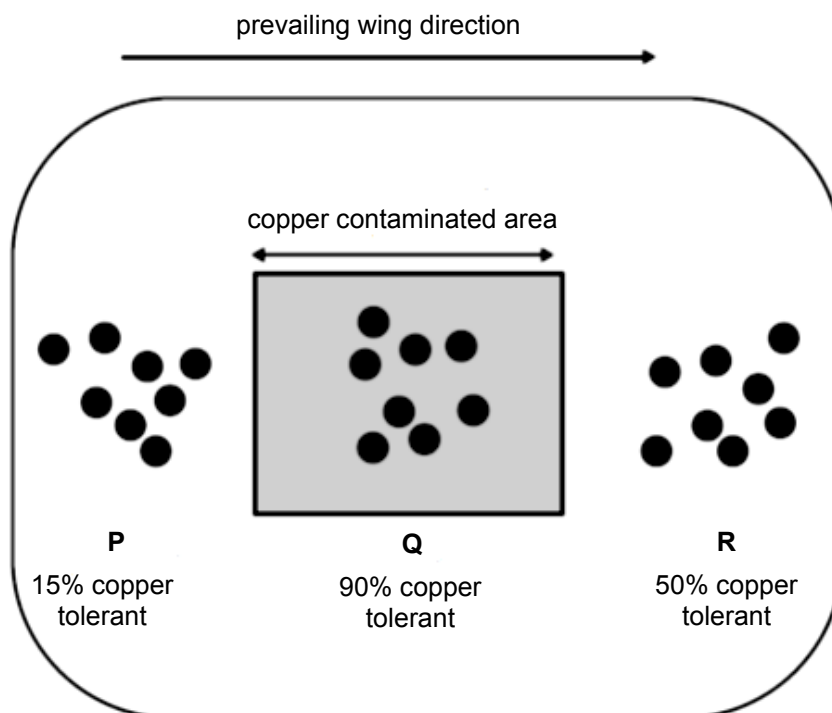
- 20 The diagram represents part of a cell surface membrane through which amino acid molecules are moving.



Which correctly explains this movement?

- A Active transport through a carrier protein
- B Facilitated diffusion through a channel protein
- C Pinocytosis through the cell surface membrane
- D Simple diffusion through the phospholipid bilayer

- 21 Copper tolerance in grass is genetically determined. The following is a diagrammatic representation of an aerial view of a region found in Great Britain that includes:
- a section of copper contaminated soil (shaded grey)
 - populations of grass growing in areas **P**, **Q** and **R** (solid circles)
 - percentage of copper resistant plants in areas **P**, **Q** and **R**.



It is reasonable to conclude from the information that

- A** all plants in the copper contaminated area would be homozygous at the gene locus for copper tolerance.
- B** high levels of copper tolerance would be a selective advantage for all plants in areas **P**, **Q** and **R**.
- C** the difference in copper tolerance between populations in areas **P** and **R** is the result of mutation.
- D** gene flow is occurring between populations in areas **Q** and **R**.

- 22** In some autosomal recessive conditions in humans, the homozygous recessive genotype results in death before reproductive age. Despite this, the allele for the recessive trait is maintained in the population.

Which explains the maintenance of the recessive allele in the population?

- A** Mutation
 - B** Migration between populations
 - C** The heterozygote is biologically fitter than either of the homozygous genotypes.
 - D** Individuals with the homozygous dominant genotype produce more offspring in each generation.
- 23** Which of the following ideas were **not** part of Darwin's theory of evolution by natural selection?
- 1 Acquired variation is inherited.
 - 2 Variation between individuals arises by gene mutation.
 - 3 Organisms produce more offspring than the environment can support.
 - 4 Only those individuals best adapted to the environment survive and reproduce.
 - 5 Regions that encode portions of the polypeptide that are vital for structure and function are less likely to incur mutations.
- A** 1, 2 and 5
 - B** 1, 3 and 4
 - C** 2, 3 and 5
 - D** 2, 4 and 5

- 24** Genetic engineers use restriction enzymes to cut DNA into shorter fragments. The restriction site of *EcoRI* is shown in the table. The symbol * denotes the position of the cut.

restriction enzyme	restriction site (read in 5' to 3' direction)
<i>EcoRI</i>	$ \begin{array}{ccccccc} \text{G}^* & & \text{A} & & \text{A} & & \text{T} & & \text{T} & & \text{C} \\ & & & & & & & & & & \\ \text{C} & & \text{T} & & \text{T} & & \text{A} & & \text{A} & & \text{G}^* \end{array} $

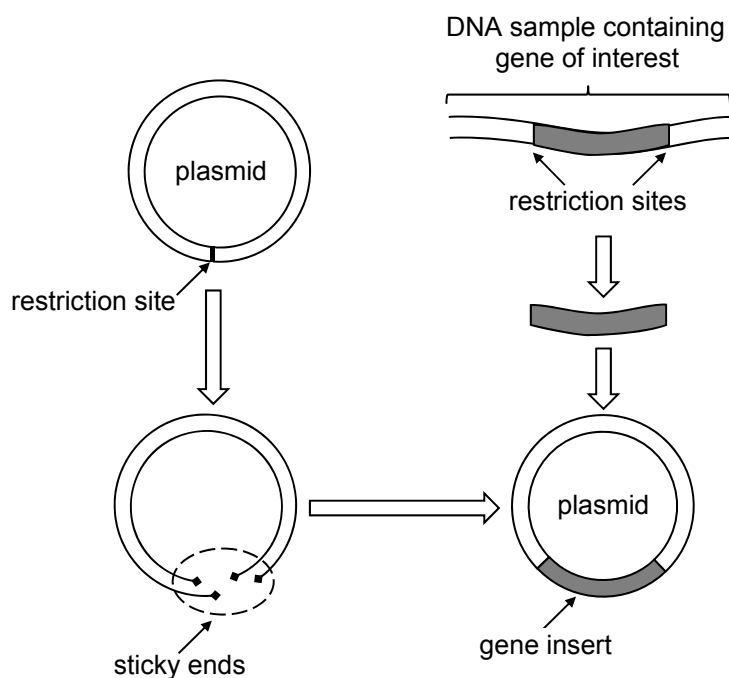
Consider the double-stranded DNA sequence shown below:



Adding *EcoRI* to a solution containing one copy of this double-stranded DNA produces

- A** two fragments of double-stranded DNA, each with a sticky end.
- B** four fragments of single-stranded DNA, each with a sticky end.
- C** two fragments of double-stranded DNA, each with blunt ends.
- D** four fragments of single-stranded DNA, each with blunt ends.

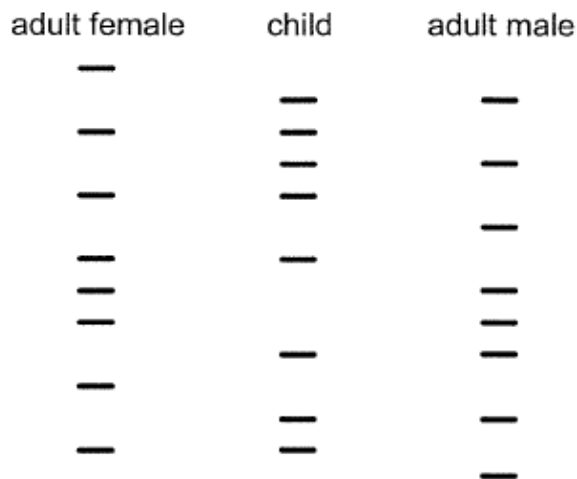
- 25** The diagram shows the process used to insert a foreign gene into a plasmid. The recombinant plasmid is taken up by the bacterium *Escherichia coli* and allowed the bacterium to synthesise protein typically made in other organisms.



Which of the following conditions is necessary for this technique to work?

- A** cDNA made from an RNA template of the gene of interest is used.
- B** The entire stretch of DNA that contains the gene of interest, including the introns and exons, is used.
- C** Selection for antibiotic resistance is done before mixing the plasmid with the bacterial cells.
- D** A selectable marker gene is inserted along with the gene of interest to measure the success of transformation.

- 26** The diagram shows the results of a DNA analysis, carried out by electrophoresis. The DNA of three individuals was profiled.



What is the **most** likely conclusion from these results?

- A** The child cannot be related to either the male or female.
 - B** The female cannot be the child's mother.
 - C** The male cannot be the child's father.
 - D** The male and female could be the child's parents.
- 27** PCR is commonly used to amplify DNA.

What is the expected effect on the PCR reaction as a result of adjustments that increase the temperature of the annealing phase and the length of the extension phase?

	precision	yield
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

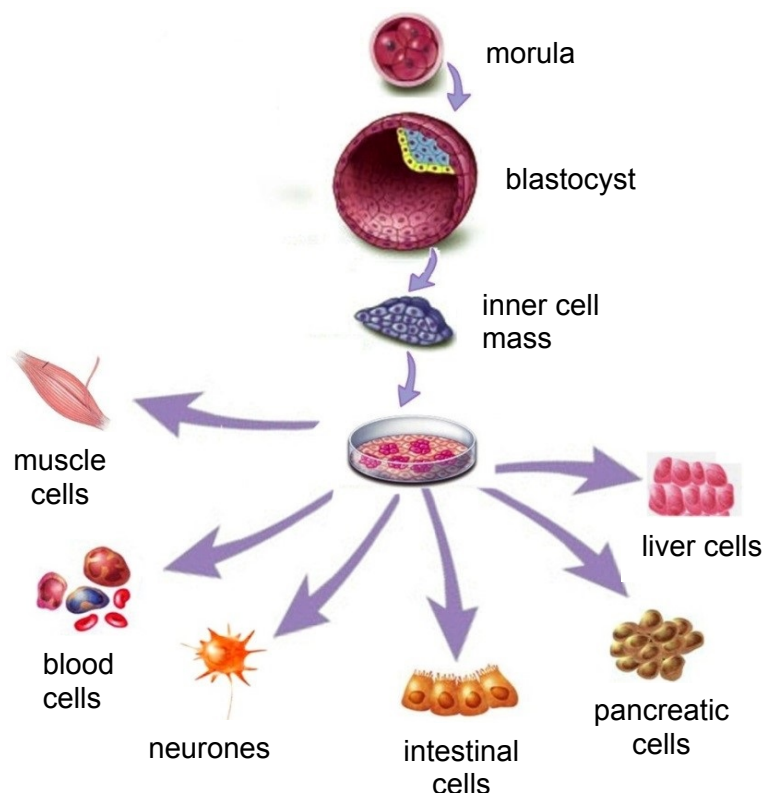
- 28** The Human Genome Project facilitated genetic testing of individuals and renewed emphasis on ethical and social implications.

Which correctly describes unintended consequences of genetic testing?

- 1 discovery of wrongly attributed paternity
- 2 unauthorised publication of genetic test results
- 3 psychological stress after receiving genetic test results
- 4 understanding an individual's susceptibility to genetic disorders

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

- 29 The diagram shows the process of stem cells differentiating into their various cell types.



Which statements are true?

- 1 Neurones possess less genes than cells isolated from the inner cell mass.
- 2 All cells in the blastocyst are totipotent.
- 3 Stem cells differentiate to muscle cells and liver cells due to different environmental cues.
- 4 The potential of pancreatic cells and the intestinal cells to differentiate is equal.

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

- 30 Which statement supports the view that genetically engineered animals could help to solve the demand for food in the world?

- A** Transgenic pigs and sheep are produced to express higher levels of growth hormone.
- B** Biomedical applications of genetically engineered animals have also become routine within the pharmaceutical industry, for drug discovery, drug development and risk assessment.
- C** Cloning of either extinct or endangered species such as thylacine and woolly mammoth helps to retain genetic diversity in small populations.
- D** By inserting genes from sea anemone and jellyfish, zebrafish have been genetically engineered to express fluorescent proteins.

--- END OF PAPER ---

[BLANK PAGE]

Copyright acknowledgements:

Acknowledgement is herein given to third-party sources for the use of third-party owned material protected by copyright in this document which is administered internally for assessment purposes only.