

Civics Group	Index Number	Name (use BLOCK LETTERS)
--------------	--------------	--------------------------

**H1**



**ST. ANDREW'S JUNIOR COLLEGE  
2016 JC2 Preliminary Examinations**

**H1 BIOLOGY**

**8875/1**

**Paper 1: Multiple Choice**

Tuesday

20 September 2016

1 hour 15 minutes

Additional Materials: Multiple Choice Answer Sheet  
Soft clean eraser (not supplied)  
Soft pencil (type B or HB is recommended)

**READ THESE INSTRUCTIONS FIRST**

Do not open this booklet until you are told to do so.

Write your name, civics group and index number on the multiple choice answer sheet in the spaces provided.

There are **30** 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 multiple choice answer sheet.

**INFORMATION TO CANDIDATES**

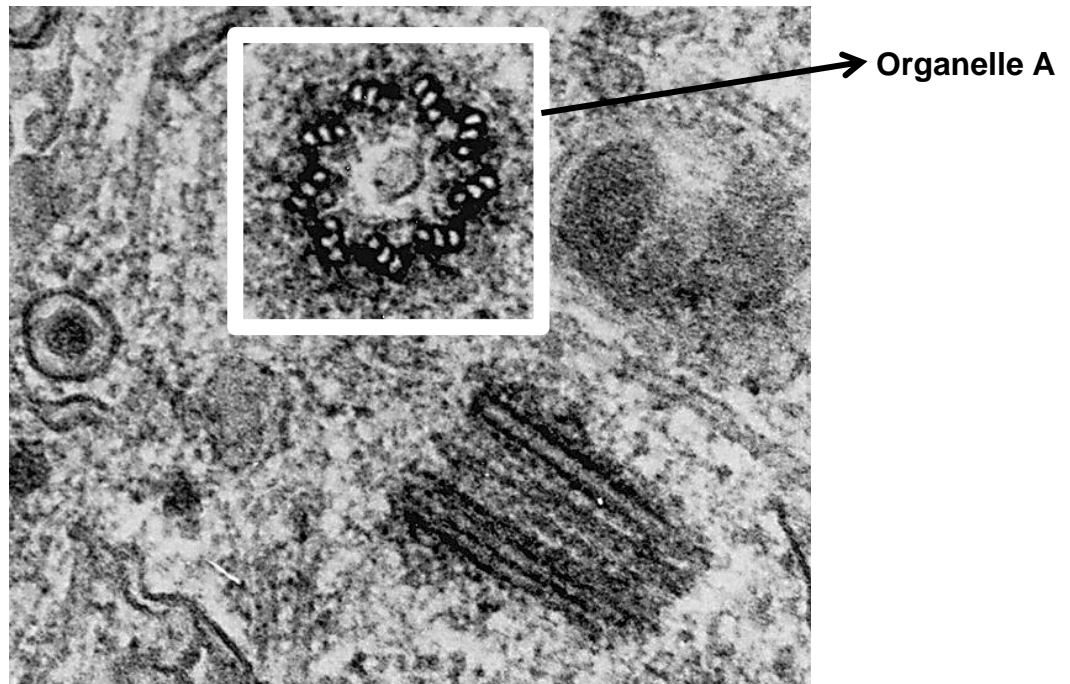
Each correct answer will score one mark. A mark will not be deducted for wrong answer. Any rough working should be done in this booklet.

At the end of the examination, submit the multiple choice answer sheet only.

This document consists of **18** printed pages.

**[Turn over**

- 1 The figure below shows an electron micrograph of a cross-section of an animal (rat) cell.

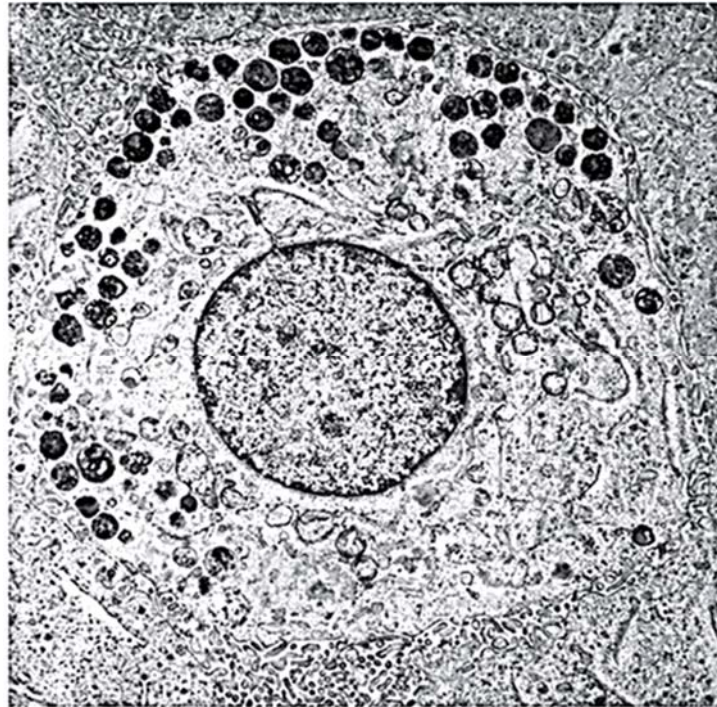


Which of the following describes organelle A?

- 1 9 triplets of microtubules arranged in a ring
  - 2 Inner membrane folded into cristae
  - 3 Synthesises spindle fibres during nuclear division
  - 4 Involved in aerobic respiration
- A** 1 only  
**B** 1 and 3 only  
**C** 2 and 3 only  
**D** 2 and 4 only
- 2 The table gives description of four membranous structures in a cell. Which structure is correctly matched to its function?

	Structure	Function
<b>A</b>	Extensive network of tubules bounded by a single membrane	Lipid synthesis
<b>B</b>	a spherical sac bounded by a single membrane	Protein modification
<b>C</b>	An organelle bounded by two membranes, the inner highly folded	Photosynthesis
<b>D</b>	a stack of elongated, curved sacs; each sac bounded by a single membrane	Protein synthesis

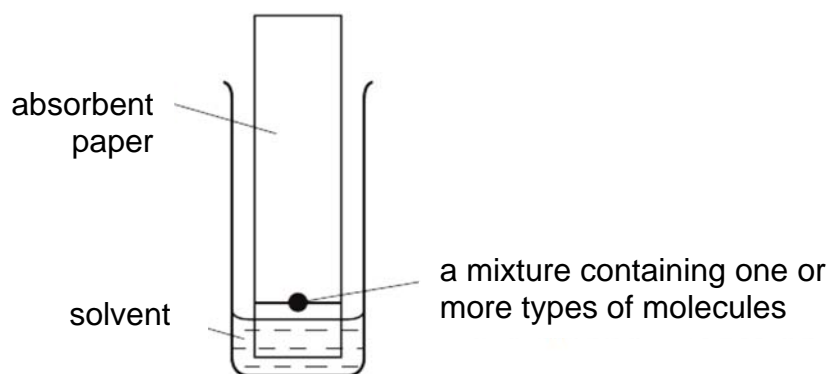
- 3 The electron-micrograph shows a cell magnified 5700 times.



What is the actual diameter of the nucleus?

- A 0.6  $\mu\text{m}$
- B 6  $\mu\text{m}$
- C 35  $\mu\text{m}$
- D 350  $\mu\text{m}$

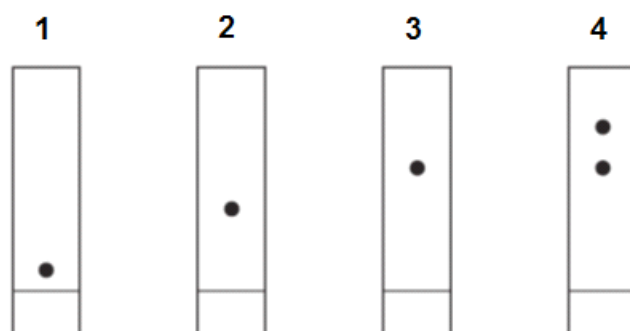
- 4 Chromatography is a technique used to separate molecules by their solubility. The diagram shows an apparatus used for this technique.



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.

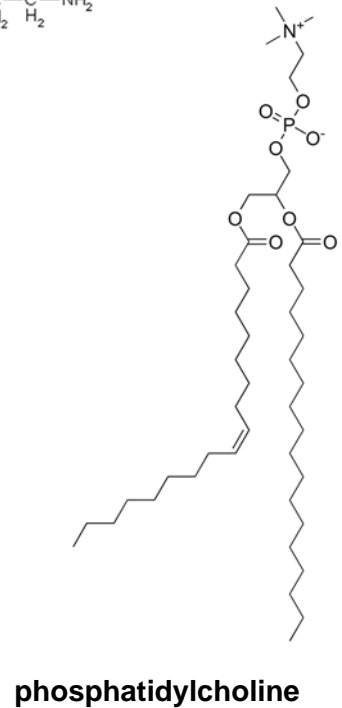
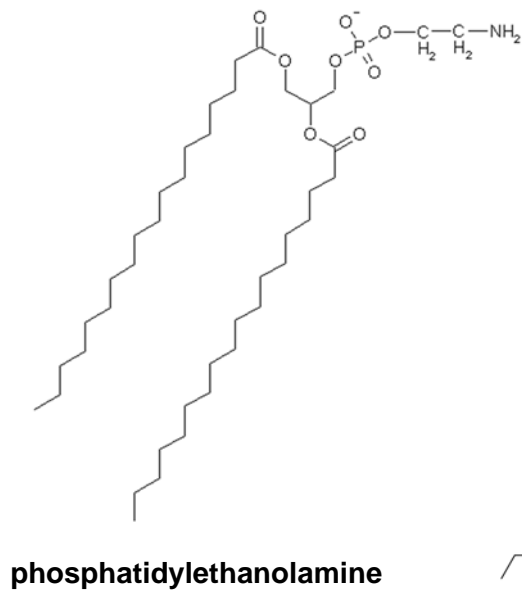
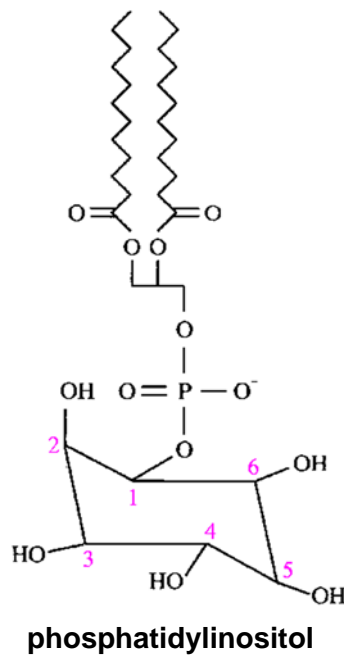
The diagram shows the chromatography results:



Which row shows the correct results?

	sucrose	cellulose	products of complete hydrolysis of sucrose	products of complete hydrolysis of cellulose
<b>A</b>	<b>4</b>	<b>3</b>	<b>1</b>	<b>2</b>
<b>B</b>	<b>3</b>	<b>4</b>	<b>2</b>	<b>1</b>
<b>C</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>D</b>	<b>2</b>	<b>1</b>	<b>4</b>	<b>3</b>

- 5 The diagram below shows three different phospholipids: phosphatidylcholine, phosphatidylethanolamine and phosphatidylinositol.



Which of the following statements is correct?

- A** Membranes with a higher phosphatidylcholine content are more fluid.
  - B** Phosphatidylinositol is unable to form a bilayer in an aqueous environment.
  - C** Only phosphatidylethanolamine is amphipathic.
  - D** Only phosphatidylinositol has two fatty acid side chains.
- 6 How many different types of oligopeptides, each composed of 6 amino acids, may be synthesized using the 20 common amino acids?
- A**  $6^4$
  - B**  $20^6$
  - C**  $6^{20}$
  - D**  $20^4$

- 7 Which row of molecules found in the cell surface membrane have their corresponding roles listed correctly?

	<b>Act as receptor sites for hormones</b>	<b>Form hydrogen bonds with water</b>	<b>Allow passage of ions</b>	<b>Cell to cell adhesion and recognition</b>
<b>A</b>	Glycoproteins and glycolipids	Phospholipids and glycoproteins	Glycoproteins and glycolipids	Glycoproteins and glycolipids
<b>B</b>	Glycoproteins and proteins	Phospholipids and glycoproteins	Glycoproteins and proteins	Glycoproteins and glycolipids
<b>C</b>	Glycoproteins and phospholipids	Glycoproteins and glycolipids	Glycoproteins and glycolipids	Glycoproteins and cholesterol
<b>D</b>	Glycoproteins and glycolipids	Glycoproteins and cholesterol	Glycoproteins and phospholipids	Glycoproteins and cholesterol

- 8 During the oxidative phosphorylation process in respiration, energy released from the transport of electrons along the electron transport chain, is used to transport  $H^+$  ions from the mitochondrial matrix to the intermembrane space through membrane proteins.

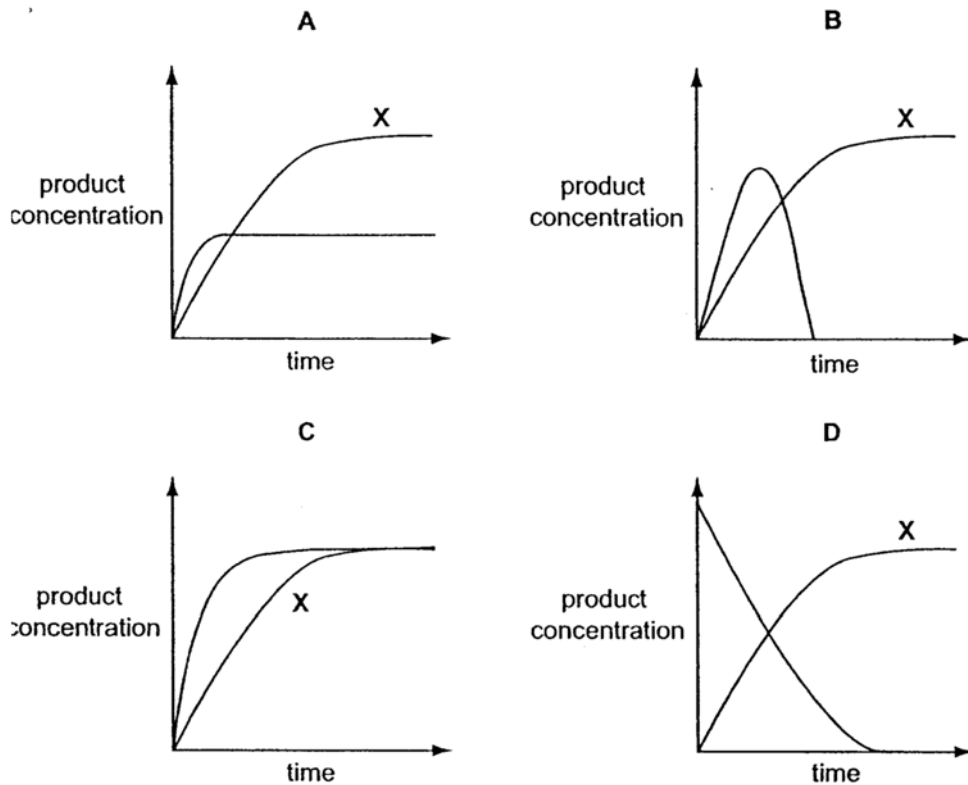
$H^+$  ions are also transported through ATP synthase from the intermembrane space back into the mitochondrial matrix.

Which of the following shows the correct membrane transport process involved?

	Transport $H^+$ ions from the mitochondrial matrix to the intermembrane space.	Transport of $H^+$ ions from intermembrane space back into the mitochondrial matrix through the ATP synthase
<b>A</b>	Facilitated diffusion	Facilitated diffusion
<b>B</b>	Facilitated diffusion	Active transport
<b>C</b>	Active transport	Facilitated diffusion
<b>D</b>	Active transport	Active transport

- 9 Two enzyme experiments were carried out. The first, experiment X, was carried out at a constant temperature of 37°C. During the second experiment, Y, the temperature was increased from 37°C to 80°C.

Which graph shows the results?



- 10 The diagram shows the chromosomes of one cell which has been squashed during mitosis



Which stage of mitosis is shown and how many chromosomes are there in the cells of this species at Prophase II of meiosis?

	Stage of mitosis	Number of chromosomes at Prophase II
<b>A</b>	Anaphase	5
<b>B</b>	Anaphase	10
<b>C</b>	Metaphase	5
<b>D</b>	Metaphase	10

- 11 The sequence of DNA bases

GGCAATTGGAAACGAATACCCAGT

codes for the following sequence of amino acids.

*glycine-asparagine-tryptophan-lysine-arginine-isoleucine-proline-serine*

A mutant organism, in which one of the bases was deleted and then inserted at a different point in the DNA molecule, produced a peptide with the following sequence:

*glycine-asparagine-tryptophan-asparagine-glutamine-isoleucine-proline-serine*

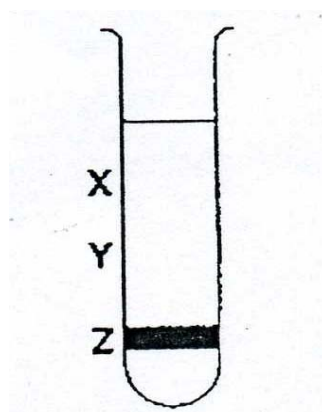
Which base was removed by this mutation?

- A** Adenine
- B** Guanine
- C** Cytosine
- D** Thymine



- 12 The genome of an organism can be altered by chromosomal aberrations as well as gene mutations. Which of the following statements is **false**?
- A Gene mutations involve insertion, deletion, substitution and translocation.
  - B Chromosomal aberrations are usually more harmful to the organism than gene mutations.
  - C Gene mutations only occur within a chromosome, whereas chromosomal aberrations may occur between chromosomes.
  - D Chromosomal aberrations can occur when the homologous chromosomes or sister chromatids of a chromosome fail to be pulled apart by spindle fibres.
- 13 A culture of bacteria had all its DNA labelled with the heavy isotope of nitrogen,  $^{15}\text{N}$ . The culture was then allowed to reproduce using nucleotides containing normal  $^{14}\text{N}$ . The DNA was examined using a centrifuge after one generation and again after two generations.

The diagram shows the position of the DNA band at **Z** in the centrifuge tube when the DNA was first labelled.



In which pattern would the DNA be found after the first and after the second cell generations?

	After first generation	After second generation
<b>A</b>	Half at <b>X</b> and half at <b>Y</b>	Quarter at <b>X</b> and at <b>Z</b> and half at <b>Y</b>
<b>B</b>	Half at <b>X</b> and half at <b>Z</b>	Quarter at <b>X</b> and at <b>Z</b> and half at <b>Y</b>
<b>C</b>	All at <b>X</b>	Half at <b>X</b> and half at <b>Y</b>
<b>D</b>	All at <b>Y</b>	Half at <b>X</b> and half at <b>Y</b>

14 Which of the following is correct?

	mRNA processing	Process	Function
<b>A</b>	mRNA splicing	Spliceosomes cut the 3' end of the intron and joins it to the branch point sequence. Intron is then cut at the 5' end to release the lariat. Exons are ligated together.	To make the coding sequence continuous for translation into primary structure of proteins.
<b>B</b>	5' capping	A modified guanosine nucleotide is added to the 5' end of the mRNA via 5'-5' triphosphate bridge after the completion of transcription.	To allow attachment of ribosomes to the 5' cap of mRNA, positioning the mRNA on the ribosome for translation initiation.
<b>C</b>	Addition of poly-A tail	Poly(A) polymerase adds 30 – 200 adenine nucleotides at the 3' end of the mRNA after the cleavage of the pre-mRNA 10 – 35 nucleotides downstream from the polyadenylation signal.	To facilitate transport of mature mRNA across the nuclear envelope into the cytoplasm.
<b>D</b>	5' capping	A modified guanosine nucleotide is added to the 5' end of the mRNA, catalysed by mRNA guanylttransferase. Cap-binding proteins then bind to it.	To increase stability of mRNA as it protects it from degradation by endonucleases.

15 Which of the following observations support the development of cancer as a multistep process?

- 1 The incidence of cancer increases with age.
- 2 People who inherited predisposing mutations have higher risk of developing cancer.
- 3 The lag time that often separates exposure to a cancer-causing agent and the development of cancer.

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

16 The pedigrees show the inheritance of two genetically transmitted diseases.

Key:



female

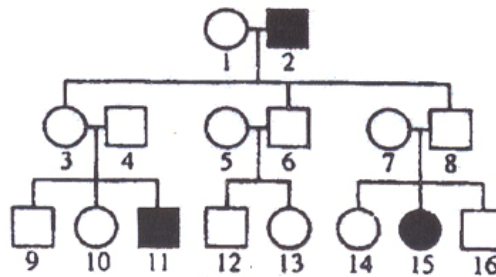


male

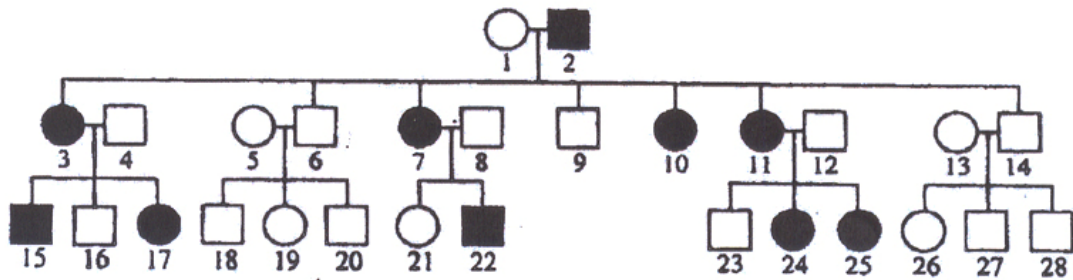


affected individuals

### Galactosaemia



### Hypophosphataemic rickets



Which row correctly describes the mode of inheritance of galactosaemia and hypophosphataemic rickets?

	Galactosaemia	Hypophosphataemic rickets
<b>A</b>	Autosomal dominant	Sex-linked recessive
<b>B</b>	Autosomal recessive	Sex-linked dominant
<b>C</b>	Sex-linked recessive	Autosomal recessive
<b>D</b>	Sex-linked dominant	Autosomal dominant

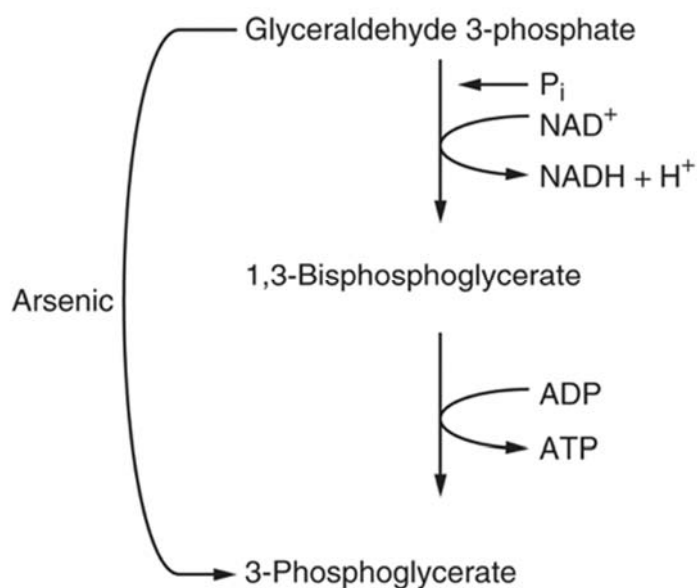
- 17** In tomato plants, flower colour is controlled by a pair of alleles having different coding base sequences. One of the alleles codes for yellow flowers while another allele codes for white flowers.

When pollen from a tomato plant with yellow flowers was transferred to a pure-bred plant with white flowers, offspring plants with yellow flowers and plants with white flowers were produced in approximately equal numbers (in the  $F_1$  generation).

Which of the following statements is/are correct?

- 1** The two alleles are located on different chromosomes.
  - 2** The allele coding for yellow flowers is dominant to the allele coding for white flowers.
  - 3** The frequency of the allele coding for white flowers in the offspring plant population is 75%.
  - 4** Repeated transfer of pollen from an  $F_1$  offspring plant with yellow flowers to the parent plant with yellow flowers will never produce plants with white flowers.
- 
- A** 2 and 3 only
  - B** 3 and 4 only
  - C** 1, 2 and 3 only
  - D** 2, 3 and 4 only

- 18 The diagram shows the effect of arsenic on the metabolism of glyceraldehyde-3-phosphate. What is the net yield of ATP molecules from the conversion of one glucose molecule to two pyruvate molecules in the presence of arsenic?



- A 0  
B 1  
C 2  
D 3

- 19 A researcher prepared four test tubes with the following contents:

Test tube	Contents of test tube
1	Mammalian cells + radioactive glucose
2	Mammalian cells + radioactive glucose + antimycin
3	Yeast cells + radioactive glucose
4	Yeast cells + radioactive glucose + antimycin

Radioactive glucose has all its six carbons made of radioactive  $^{14}C$ .

Antimycin is an inhibitor of electron transport chain.

Which of the following correctly compares the relative volume of radioactive  $CO_2$  produced by the 4 test tubes upon complete hydrolysis of a fixed amount of the radioactive glucose?

- A  $(1 = 3) > 4 > 2$   
B  $(1 = 3) > (2 = 4)$   
C  $4 > 2 > (1 = 3)$   
D  $(2 = 4) > (1 = 3)$

20 Which of the following is true about both cyclic and non-cyclic photophosphorylation?

- 1 Establishes an electrochemical gradient across the thylakoid membrane
- 2 Involve photosystem II
- 3 Require oxygen as the final electron acceptor
- 4 Photolysis of water occurs

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

21 The figure below shows how a metalmark moth mimics a jumping spider. It does so by having hairs on both its hind wings and forewings.



Which of the following statements **best** explains the evolution of spider mimicry in metalmark moth?

- A Genetic variation in hair growth on wings exists in the moth population due to mutations.
- B Moths with hairy wings experience a higher selection pressure than moth without hairy wings.
- C Moths mutate their genes to grow hairs on their wings in order to mimic spiders and escape predation.
- D Moths with hairs on their wings leave behind a higher proportion of offspring than moths without hairy wings.

- 22** Which of the following correctly describes the type of sequences used when investigating closely related and distantly related species?

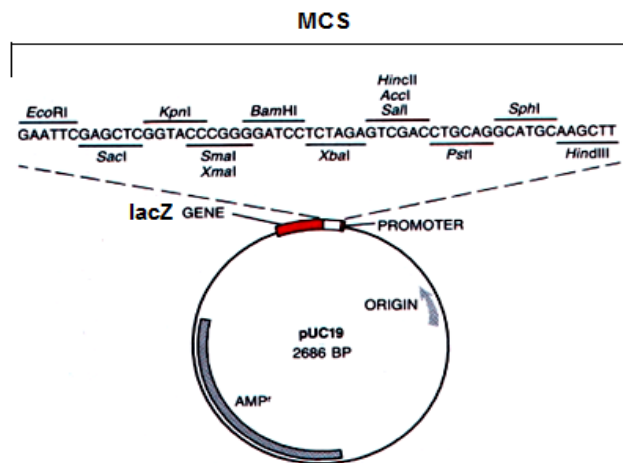
	Closely related species	Distantly related species
<b>A</b>	DNA sequences which more conserved, such as those found within non-coding sequences	DNA sequences which evolve more quickly, such as those found within coding sequences that codes for proteins that are biologically important for survival.
<b>B</b>	DNA sequences which more conserved, such as those found within coding sequences that codes for proteins that are biologically important for survival	DNA sequences which evolve more quickly, such as those found within non-coding sequences
<b>C</b>	DNA sequences which evolve more quickly, such as those found within coding sequences that codes for proteins that are biologically important for survival.	DNA sequences which are more conserved, such as those found within non-coding sequences
<b>D</b>	DNA sequences which evolve more quickly, such as those found within non-coding sequences	DNA sequences which are more conserved, such as those found within coding sequences that codes for proteins that are biologically important for survival

- 23** Which of the following are examples of anatomical homology?

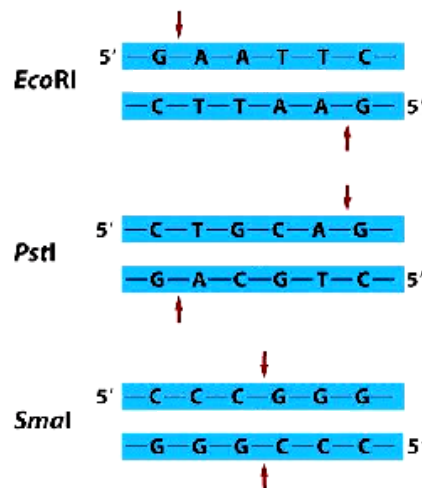
- 1** Manatees possess vestigial toe nails on their flippers which no longer serve any purpose.
- 2** The pharyngeal gill pouches in fish develop into gills while the pharyngeal gill pouches in humans develop into jaw and ear structures.
- 3** Porcupines are covered in stiff, sharp spines which are derived from mammalian hair.
- 4** Both pufferfishes and some species of frogs puff themselves up with air in order to look bigger to deter predators.

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

- 24 The figure shows the plasmid map of pUC19, which includes the positions of the origin of replication (ORI), multiple cloning site (MCS) and two genes – AMP<sup>r</sup> and lacZ. pUC19 is used for the production of human anti-thrombin III (hATIII) in the bacterium *E. coli*.



The restriction sites of three particular restriction enzymes, *EcoRI*, *PstI* and *SmaI* are shown below.



Which of the following can be concluded from the figures?

- 1 It is possible to ensure that the gene is inserted into pUC19 in the correct orientation by using both *EcoRI* and *PstI* to cleave pUC19 and the hATIII cDNA.
  - 2 pUC19 cleaved with *EcoRI* can anneal to hATIII cDNA cleaved with *PstI* as both restriction enzymes generate single-stranded overhangs of the same length.
  - 3 The use of *SmaI* will require an additional step of ligating linkers to the ends of pUC19 and hATIII cDNA.
  - 4 Colonies of *E. coli* transformed with recombinant pUC19 will survive on agar plates containing ampicillin and X-gal, giving a blue appearance.
- A 1 and 3  
 B 1 and 4  
 C 2 and 3  
 D All of the above



- 25** Human insulin can now be obtained using genetic engineering.

Which of the following are possible explanations to why functional insulin cannot be produced simply by inserting a recombinant plasmid with an insulin cDNA into a bacteria host?

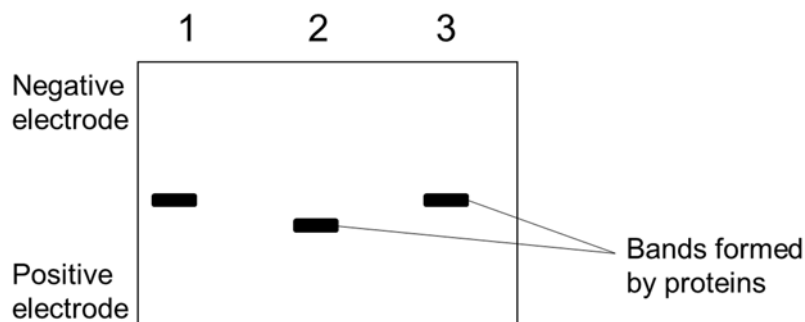
- 1** The bacteria have no spliceosome.
- 2** The bacteria will not be able to perform cleavage of polypeptide.
- 3** The bacteria will not be able to add disulfide bonds to the polypeptide chain.
- 4** The recombinant plasmid does not contain prokaryotic promoter.

- A** 4 only
- B** 1 and 2 only
- C** 2, 3 and 4 only
- D** All of the above

- 26** Which of the following primers would allow copying of the single stranded DNA sequence 5' ATGGTACCCTAAGTC 3'?

- A** 5' ATGGT 3'
- B** 5' TACCA 3'
- C** 5' CTGAA 3'
- D** 5' GACTT 3'

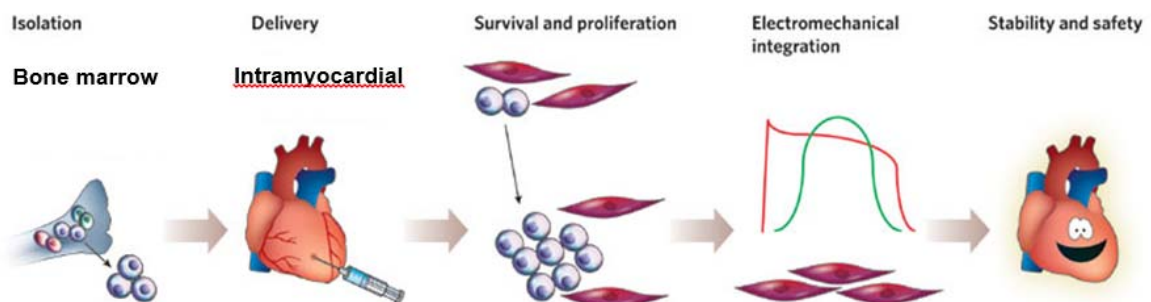
- 27** The diagram shows the results of electrophoresis of the human growth hormone protein extracted from three different individuals.



A mutation occurred in individual 2. Which one of the following can best account for the different banding pattern?

- A** A polar amino acid has been replaced by a non-polar amino acid.
- B** A polar amino acid has been replaced by a positively-charged amino acid.
- C** A negatively charged amino acid has been replaced by a non-polar amino acid.
- D** A non-polar amino acid has been replaced by a negatively-charged amino acid.

- 28 Which of the following poses the greatest limitation of the Human Genome Project in disease analysis?
- A It is not possible to store the genomic information of all individuals.
  - B There is too large a genetic difference between individuals to determine the loci of genes of interest.
  - C Too few model organisms exist for comparative genomic studies to take place.
  - D Environmental factors and gene interactions in disease are not taken into account.
- 29 Stem cells hold promises for repairing damaged tissues. Recently the use of bone marrow blood stem cells has helped in cardiac repair as shown in the diagram below.



Which of the following conventional notion of stem cells is/are challenged as a result of this experiment?

- 1 The ability of stem cells to self-renew by mitosis.
  - 2 The role of the local tissue environment in stem cell differentiation.
  - 3 The adult stem cells are undifferentiated.
  - 4 The multi-potency of bone marrow blood stem cells.
- A 3 only.
  - B 4 only.
  - C 3 and 4
  - D All of the above
- 30 In terms of containment (prevention of genetic pollution of wild plant or non-GM crop populations), which of the following is an advantage of chloroplast transformation (introducing foreign genes into chloroplasts of host plants) over nuclear transformation?
- A Chloroplasts are surrounded by a double membrane.
  - B There are no chloroplasts in pollen of most plant species.
  - C Chloroplasts are smaller than the nucleus.
  - D There is no DNA in chloroplasts