

**H1**ANDERSON JUNIOR COLLEGE  
HIGHER 1

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**BIOLOGY****8875/01**

Paper 1 Multiple Choice

**Friday 23<sup>rd</sup> September 2016**

Additional Materials: Multiple Choice Answer Paper

**1 hour  
30 marks**

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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, PDG and identification number on the Answer Sheet.

There are **forty** 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.

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.

## 2

- 1 Four students, A, B, C, and D, who observed a root hair cell from a plant using an electron microscope, were asked to confirm the presence or absence of described cellular structures within the cell.

Which student made the correct set of observations?

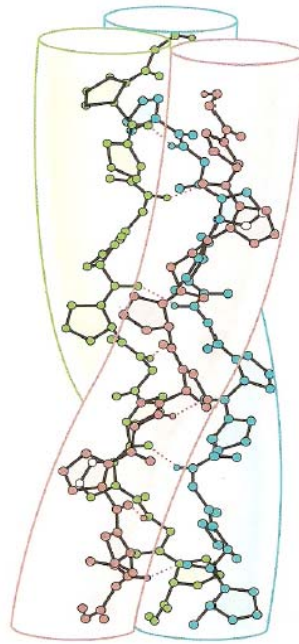
	Structure with a double membrane, inside which are stacks of flattened membranes	Area near the nucleus containing a pair of structures that are composed of microtubules	Structure with a double membrane with inner membrane infolded	Network of tubular-shaped membranous sacs with no ribosomes visible on outer surface of membranes
<b>A</b>	✓	✓	✓	X
<b>B</b>	✓	X	X	✓
<b>C</b>	X	✓	✓	✓
<b>D</b>	X	X	✓	✓

- 2 Which of the following statements correctly describe the presence of lipid, RNA and DNA in all or some of the organelles in a eukaryotic cell?

- 1 Ribosome has two of the three biomolecules.
- 2 Smooth endoplasmic reticulum has only one of the three biomolecules.
- 3 Golgi apparatus has two of the three biomolecules.
- 4 Nucleus is the only organelle in the cell that has all three biomolecules.

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

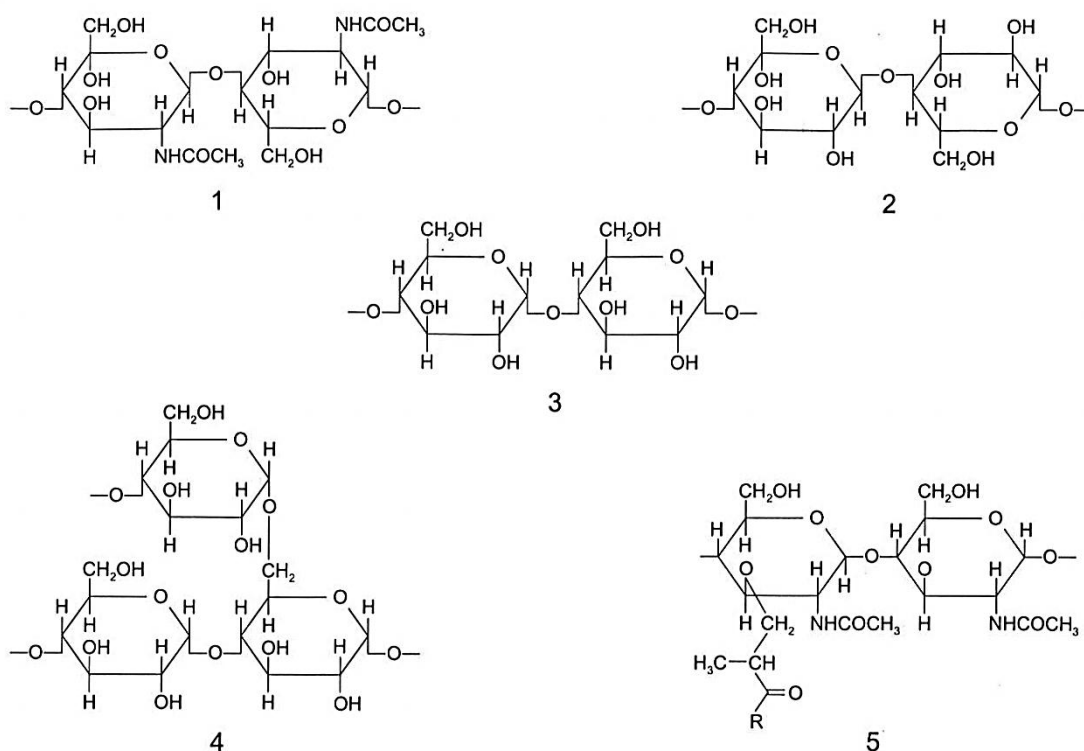
- 3 The molecule shown below is found in various parts of the human body, and is helical in structure.



What else is true of this molecule?

- A** Hydroxyl groups projecting in all directions from each chain allow hydrogen bonds to form and result in bundling of the chains to form microfibrils.
- B** Double bonds present in each chain allow the chains to adopt helical structure.
- C** Complementary base pairing occurs through the formation of hydrogen bonds between chains.
- D** The small size of the R-groups of amino acid residues in each chain allows the chains to come close together to form hydrogen bonds.

- 4 The diagrams show short sections of some common polysaccharides and modified polysaccharides.



The polysaccharides can be described as below.

- polysaccharide **F** is composed of  $\beta$ -glucose monomers with 1,4 glycosidic bonds
- polysaccharide **G** is composed of  $\alpha$ -glucose monomers with 1,4 and 1,6 glycosidic bonds
- polysaccharide **H** is composed of N-acetylglucosamine and N-acetylmuramic acid monomers with  $\beta$ -1,4 glycosidic bonds
- polysaccharide **J** is composed of  $\alpha$ -glucose monomers with 1,4 glycosidic bonds
- polysaccharide **K** is composed of N-acetylglucosamine monomers with  $\beta$ -1,4 glycosidic bonds

Which shows the correct pairings of polysaccharide descriptions and diagrams?

	polysaccharide <b>F</b>	polysaccharide <b>G</b>	polysaccharide <b>H</b>	polysaccharide <b>J</b>	polysaccharide <b>K</b>
<b>A</b>	2	4	5	3	1
<b>B</b>	2	5	4	1	3
<b>C</b>	3	4	1	2	5
<b>D</b>	3	5	4	1	2

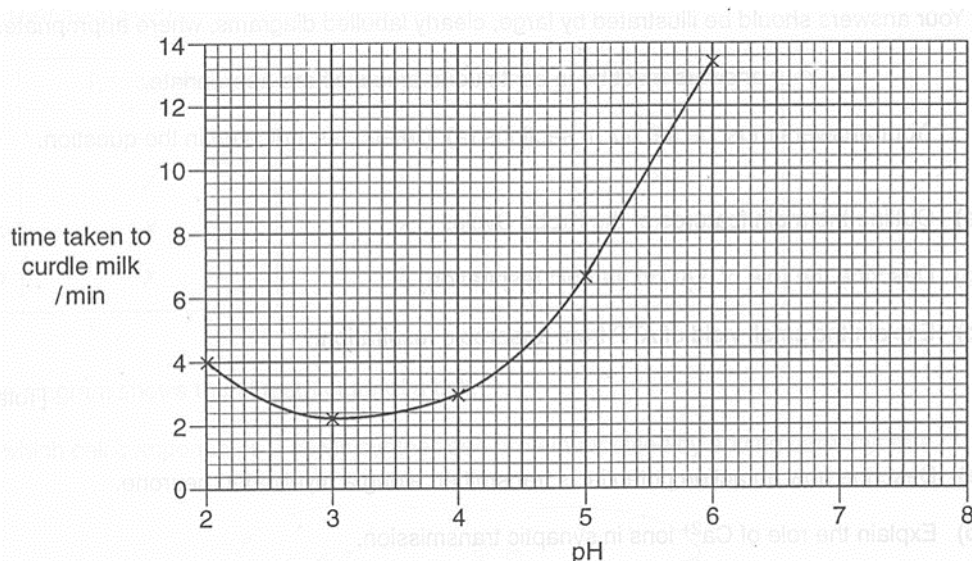
- 5 During an enzyme-controlled reaction a number of changes in conformation occur in the enzyme.

Which row shows the role of the different changes in conformation of an enzyme?

	sequence of an enzyme controlled reaction		
	induced fit of substrate →	enzyme / substrate complex →	product release
<b>A</b>	changes total free energy of reaction	helps release temporary bonds	helps temporary bond formation
<b>B</b>	helps temporary bond formation	changes total free energy of reaction	helps release temporary bonds
<b>C</b>	helps temporary bond formation	reduces activation energy	helps release temporary bonds
<b>D</b>	reduces activation energy	helps temporary bond formation	changes total free energy of reaction

- 6 Chymosin, from calf stomachs, has been used traditionally to break down milk protein to make milk curdle more quickly in cheese production.

An investigation is carried out to find the effect of pH on the activity of chymosin. The results are shown in the figure below



Which of the folk

1. R groups of acidic and basic amino acid residues in the enzyme are of the right charges at higher  $H^+$  concentration, allowing them to form ionic bonds.
2. The optimum pH is pH 6.
3. Generally, rate of reaction decreases as pH decreases.
4. The enzyme is denatured at pH 8.

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

- 7 What are the conditions in a human cell during anaphase?

	number of chromosomes	number of molecules of DNA migrating to each pole	spindle present	nuclear envelope present
<b>A</b>	46	46	no	yes
<b>B</b>	92	46	no	yes
<b>C</b>	46	92	yes	no
<b>D</b>	92	92	yes	no

- 8 Vincristine is a chemical which binds to the tubulin microtubules of the spindle and prevent them from functioning normally.

Which statements correctly describe the possible effects of vincristine on mitosis?

- 1 Chromosomes are unable to align singly along the metaphase plate.
- 2 Centromere of chromosomes are unable to divide and hence sister chromatids are unable to be pulled to opposite poles of the cell.
- 3 Centrioles fail to migrate to opposite poles of the cell.
- 4 One of the daughter cells does not have chromosomes while the other has two sets of chromosomes.

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

- 9 The table below shows a list of characteristics displayed by mutant strains of *E. coli* during DNA replication and the possible reasons.

No.	Characteristics	Enzymes or functions affected by mutation
1	Okazaki fragments accumulate and DNA synthesis is never completed	DNA ligase activity is missing
2	Supercoils are found to remain at the regions that flank the replication bubbles	DNA helicase is hyperactive
3	Synthesis is very slow.	DNA polymerase keeps dissociating from the DNA and has to re-associate
4	No initiation of replication occurs.	The TATA box region at origin of replication deleted

Which of the reasons correctly explain the characteristics displayed by the mutant *E. coli* strains?

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

**10** What is the basis for the difference in the synthesis of the leading and lagging strands of DNA molecules?

- 1 The anti-parallel arrangement of the DNA strands.
- 2 RNA primers are required to initiate DNA elongation.
- 3 The template strands must be read from the 3' to 5' direction.
- 4 Binding of helicase at the origin of replication produces two replication forks.

**A** 1 and 3 only

**B** 2 and 3 only

**C** 2 and 4 only

**D** 1, 3 and 4 only

**11** The following template strand of a coding sequence is taken randomly from a bacterial genome.

3' – TTACGCTTCGAAATAGGAATATCATAGGCT-5'

Arg	CGU, CGC, CGA, CGG, AGA, AGG	Leu	UUA, UUG, CUU, CUC, CUA, CUG
Asp	GAU, GAC	Lys	AAA, AAG
Ile	AUU, AUC, AUA	Phe	UUU, UUC
Start	AUG	Ser	UCU, UCC, UCA, UCG, AGU, AGC
Stop	UAG, UGA, UAA	Tyr	UAU, UAC

This sequence is cloned into a plasmid and transformed into a suitable host. What would be the first four amino acids of a peptide generated from this sequence as expressed by the host?

**A** Met-Arg-Ser-Phe

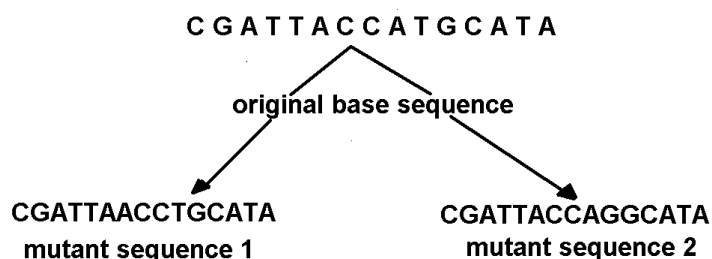
**B** Met-Arg-Ser-Lys

**C** Met-Ile-Phe-Leu

**D** Met-Tyr-Lys-Asp



12 The diagrams below show the results of two types of gene mutation.



Which one of the following shows the types of gene mutation producing mutant sequences 1 and 2?

	1	2
A	Addition	Deletion
B	Inversion	Substitution
C	Addition	Substitution
D	Substitution	Inversion

13 The statements listed below give information on the genetic control of hair curliness in dogs.

- Chromosome 27 contains the gene responsible for curliness of the dog hair
- The nucleotide sequence of the gene produces an enzyme with arginine at residue position 151 but small changes in the nucleotide sequence produces an enzyme with cysteine at this point.
- A dog may have both nucleotide sequences in its genome.
- A dog producing both enzymes will have 'wavy' coat of hair.
- At fertilisation, the dog inherits one set of chromosomes from each parent. Each set carries one of each form of the gene.

Which row matches each statement to the genetic term that it most closely describes?

	1	2	3	4	5
A	locus	genotype	allele	heterozygous	phenotype
B	locus	allele	heterozygous	phenotype	genotype
C	genotype	allele	heterozygous	phenotype	locus
D	locus	allele	genotype	phenotype	heterozygous

- 14 In pigeons, the alleles of the gene controlling eye colour are codominant.

Two separate crosses were carried out and the results were shown below.

Cross 1

Parental generation      black eye female      X      white eye male

F<sub>1</sub> generation                  grey eye females and black eye males

Cross 2

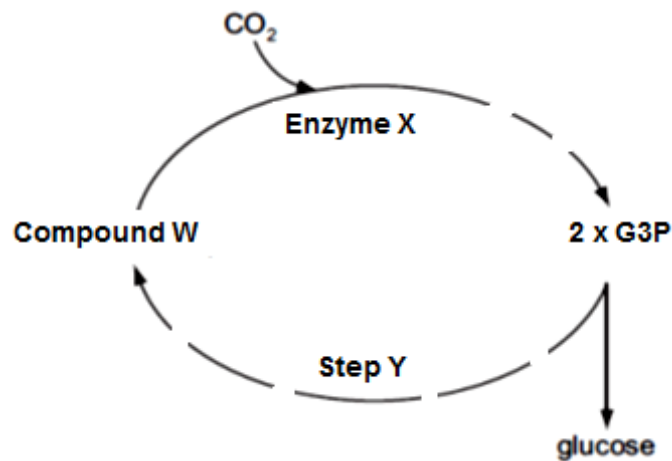
Parental generation      white eye female      X      black eye male

F<sub>1</sub> generation                  grey eye females and white eye males

What phenotypic ratio would be expected in the F<sub>2</sub> generation in the first cross?

- A 1 black-eyed male: 1 white-eyed male: 2 grey-eyed females
  - B 1 black-eyed male: 1 white-eyed male: 1 grey-eyed female: 1 black-eyed female**
  - C 1 black-eyed male: 1 grey-eyed male: 1 white-eyed female: 1 black-eyed female
  - D 2 black-eyed males: 1 grey-eyed female: 1 white-eyed female
- 15 Which of the following is not an example of how the environment can have an effect on the phenotype?
- A The enzyme that synthesizes black pigments in rabbits do not function well at higher temperatures.
  - B Babies who have Phenylketonuria are fed a diet low on amino acid phenylalanine so that they don't produce toxic compounds in the body.
  - C Expression of red-green colour blindness in humans depends on whether you are male or female.**
  - D Determination of role of bees in a bee colony depends on the nutrition they receive.

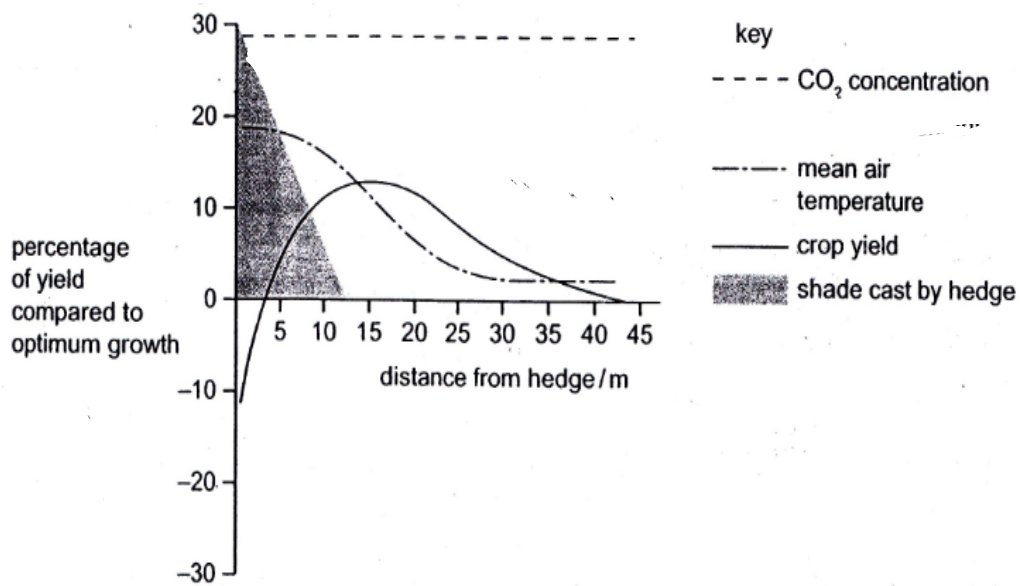
- 16 The figure below summaries some key reactions which occur in the Calvin cycle. The dashed lines indicate that there is more than one reaction present.



Using the figure above and your knowledge of Calvin cycle, determine which one of the following statements below is true.

- A Compound **W** is expected to accumulate if carbon dioxide concentration increases under low light intensity.
- B** Products released from Enzyme **X** is expected to accumulate when light intensity is low.
- C G3P is expected to accumulate when light intensity is low.
- D ATP from substrate level phosphorylation is required for Step **Y** to proceed and Compound **W** to be formed.

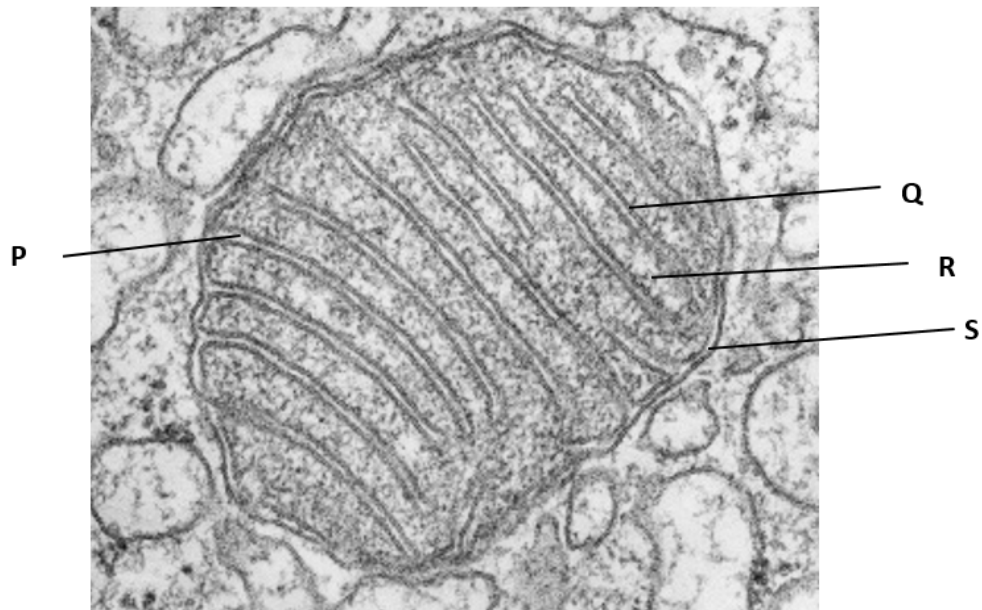
- 17 In the diagram researchers superimposed the changes in four environmental factors on a graph of crop yield against distance from a hedge.



Which factor is most likely to have been the limiting factor in crops 8m and 25m from the hedge?

	Limiting Factor	
	8m from hedge	25m from hedge
A	CO <sub>2</sub> concentration	Light intensity
B	Light intensity	Mean air temperature
C	Mean air temperature	Mean air temperature
D	Light intensity	CO <sub>2</sub> concentration

18 The figure below shows an electron micrograph of a mitochondrion.



Match the following processes with each of the labelled sites **P – S**.

- 1 Oxidative decarboxylation
- 2 Lowering of pH
- 3 Protein synthesis
- 4 Electron flow
- 5 Formation of oxidised co-enzymes of dehydrogenase

	<b>P</b>	<b>Q</b>	<b>R</b>	<b>S</b>
<b>A</b>	1,3,5	2	4,5	3
<b>B</b>	2	4,5	1,3	2
<b>C</b>	1,5	3,4	2	1
<b>D</b>	2	4	1,3,5	2

P & S the same?

**19** Two test tubes containing the following contents are shown below:

**Tube 1:**

Radioactive glucose solution + yeast cells suspension + oxygen + antimycin

**Tube 2:**

Radioactive glucose solution + yeast cells suspension + oxygen

Radioactive glucose has all its six carbons made of radioactive  $^{14}\text{C}$ . The initial radioactivity measured for the glucose in each test tube is 60 arbitrary units.

Antimycin is an electron transport chain inhibitor.

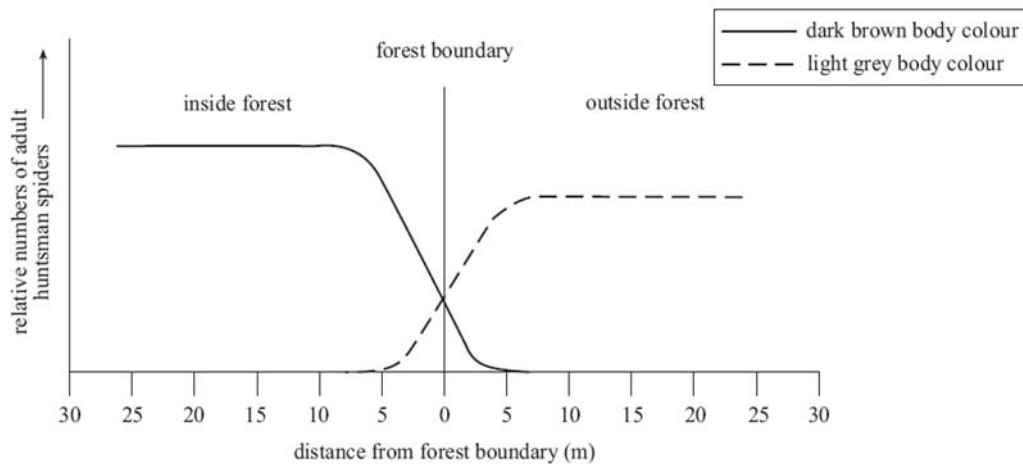
If the gaseous product and the aqueous products are tested using a radioactive meter after all the glucose has been metabolised, what would be the final observed readings?

	<b>Tube 1</b> (radioactivity measured/ arbitrary units)		<b>Tube 2</b> (radioactivity measured/ arbitrary units)	
	<b>aqueous products</b>	<b>gaseous products</b>	<b>aqueous products</b>	<b>gaseous products</b>
<b>A</b>	0	60	40	20
<b>B</b>	20	40	0	60
<b>C</b>	40	20	0	60
<b>D</b>	40	20	60	0

**20** A mutation is most likely to have a selective advantage if

- A** it is a gain of function mutation.
- B** it is a loss of function mutation.
- C** the environment changes.
- D** the environment remains stable.

21 The graph below shows the distribution of huntsman spiders at a forest boundary:



One species of huntsman spider (*Isopeda isopedella*) varies in body colour from dark brown to light grey. In one community at the forest boundary, two populations of this species were found. Some were found living inside the forest and others were found living just outside the forest. The relative numbers of dark brown adult spiders and light grey adult spiders found at certain distances from the forest boundary are shown in the graph above.

Which of the following can be **least** inferred from the graph?

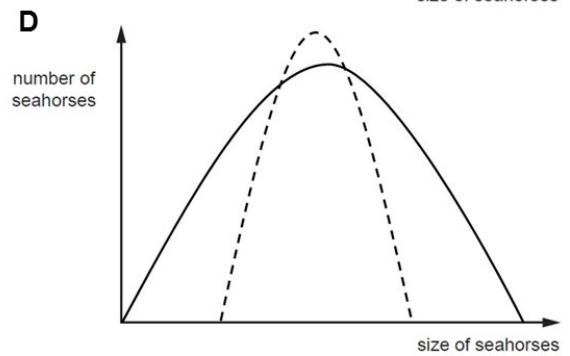
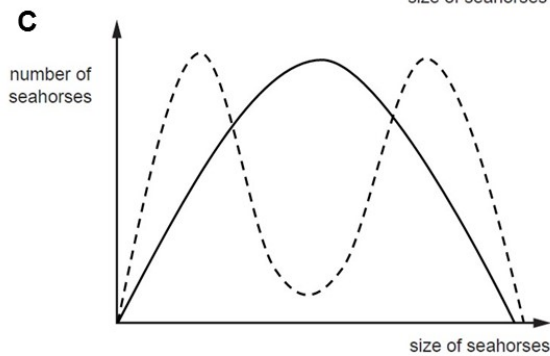
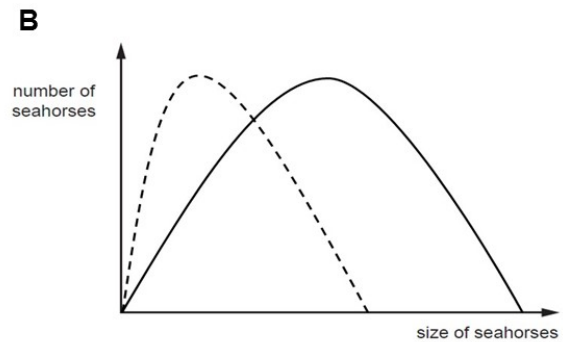
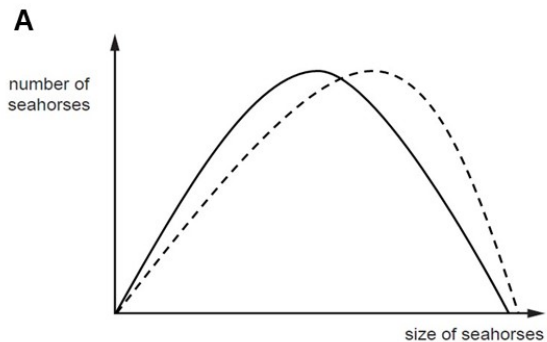
- A The type of selective advantage inside the forest is different from the type of selective advantage outside the forest.
- B The plateau in the population number as seen inside the forest and outside the forest is due to competition among the adult spiders for limited resources.
- C The lower plateau of spider population outside the forest compared to that of inside the forest is due to the presence of additional selection pressure existing outside the forest.
- D** Dark brown huntsman spiders are not eaten by birds inside the forest as their colour allows them to camouflage and hence provides a selective advantage.

- 22** The seahorse, *Hippocampus*, is an unusual small fish. It gives birth to live young and it is the male rather than the female that becomes pregnant.

In one species of seahorse, large females within a population mate with large males and small females mate small males. Few medium-sized individuals are produced and they have a low survival rate.

Which graph shows the effect of natural selection on size of seahorses after a fixed period of time?

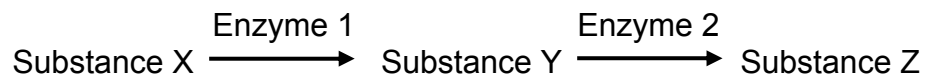
Legend: — Original population — — — after selection



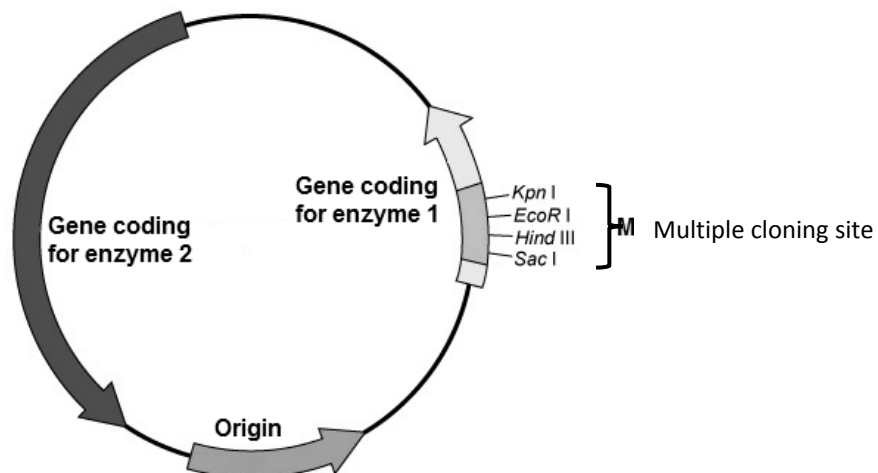
Ans: C



- 23 The metabolic pathway shown below is utilised by a species of bacteria to produce substance Z, which is essential for the replication of the bacterial chromosome. When provided with substance X or substance Y, wild-type bacteria are able to synthesise substance Z.



The following plasmid was used as a vector for the human insulin gene.



The transformed cells were plated onto an agar plate containing only substance Y. Which of the following replica plates have to be prepared in order to identify the colony containing recombinant bacteria?

The plasmid *alr* has genes for enzyme 1 and 2 but enzyme 1 gene is disrupted with insertion of the insulin gene. Therefore even if the X is included in the agar plates, X cannot be converted to Y. Therefore the agar plate was included with Y, which can be converted to Z with enzyme 2. This means that the bacterial chromosome can replicate and the bacteria can divide to produce a colony.

- A Replica plate containing substance X only This plate gives negative results (no bacteria growth) because enzyme 1 gene is disrupted. This plate is necessary to confirm that enzyme 1 gene has been disrupted in the previous plate with only Y.
- B Replica plate containing substance X and Y
- C Replica plate containing substance Y and Z
- D Replica plate containing substance Z only

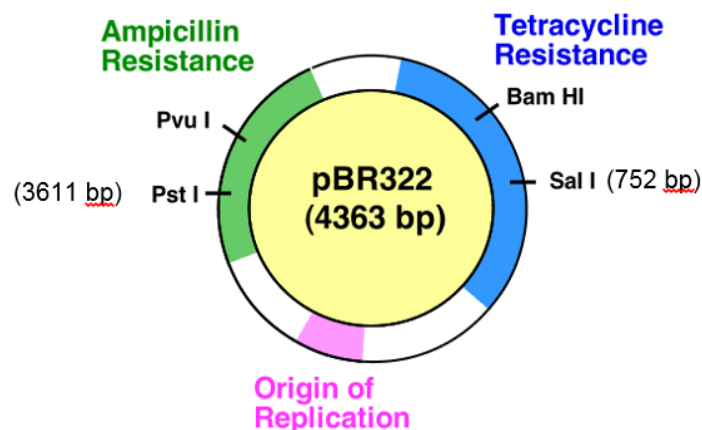
- 24 The list shows some steps in the process of producing genetically engineered *Escherichia coli* that secretes human growth hormone (hGH).

- P** introns removed by spliceosomes
- Q** plasmid DNA cut with restriction enzyme
- R** reverse transcriptase used to make mRNA into cDNA
- S** cloning of plasmids
- T** addition of DNA coding for a signal sequence to allow passage of hormone through bacterial cell membrane.
- U** pre-mRNA produced by transcription
- V** plasmid linked to hGH gene by ligase

What is the correct order of steps in this process?

- A** P → T → Q → V → S → U → R **Must start with pre-mRNA**
- B** R → P → S → Q → V → U → T **Must start with pre-mRNA**
- C** S → Q → P → V → U → T → R **Must start with pre-mRNA**
- D** U → P → R → T → Q → V → S

- 25 The figure below shows an ampicillin-resistant, tetracycline-resistant plasmid, pBR322 (not drawn to scale). In the preparation of a *Drosophila* genomic library, pBR322 is cleaved with *Pst*I before it is ligated with *Pst*I-digested *Drosophila* DNA. The resulting mixture is then used to transform *E. coli*.

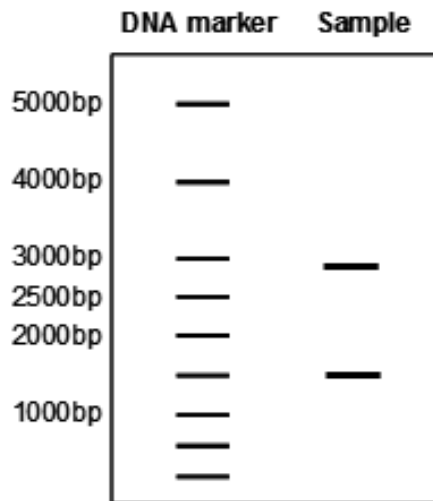


A recombinant plasmid, pBR322, containing the inserted *Drosophila* gene of 726 bp in size, was isolated. It was then subjected to digestion with *Sal*I and *Pst*I. The DNA fragments are then separated by size through gel electrophoresis and the sizes of the separated fragments are determined by comparison to a DNA marker.

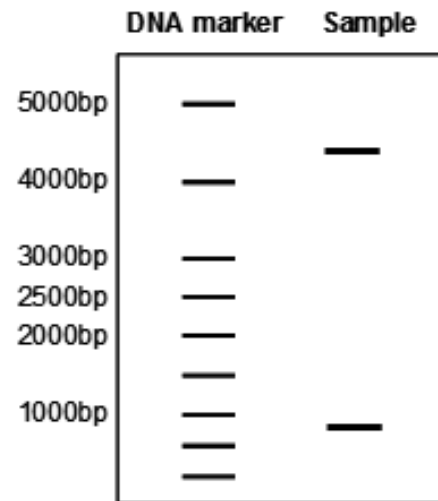
Which of the following gel electrophoregrams shows the correct sizes of the separated fragments?



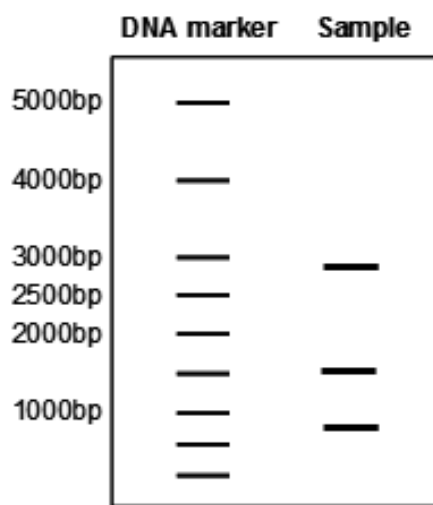
A



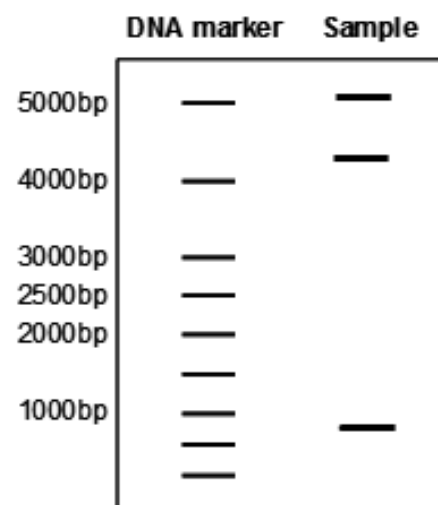
C



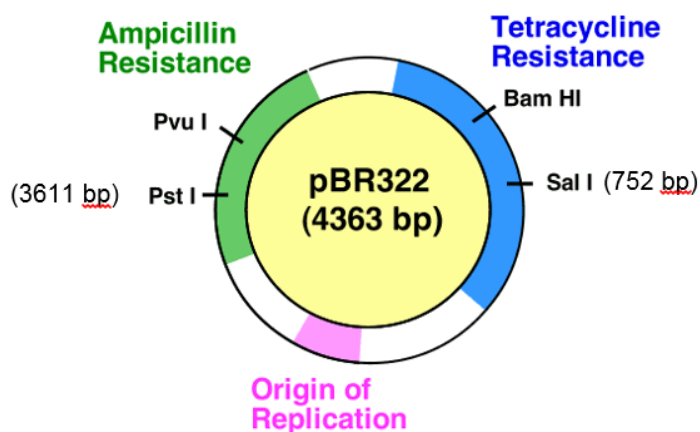
B



D



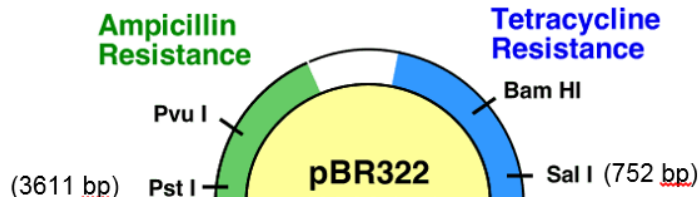
Ans: B



*Drosophila* gene of 726 bp in size was inserted at *Pst*I restriction site. 752bp indicated at *Sal*I site is the number of bp from origin of replication. Then pBR322 was digested with *Sal*I and *Pst*I. 3 fragments is expected as there are 2 *Pst*I sites and 1 *Sal*I site. So only B and D are possible answers. D is eliminated as there cannot be a 5k bp fragment. Therefore B is the answer.

Explaining B: The 3 fragments sizes are approximately 2800bp, 1500bp and 700 bp.

The 2800bp –



The 1500bp –



The 700 bp refers to the *Drosophila* gene of 726 bp.

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

adult female	child	adult male
—	—	—
—	—	—
—	—	—
—	—	—
—	—	—
—	—	—
—	—	—
—	—	—

What is the **most** likely

- 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. All of child's bands either match the mother or father.**

- 27 Which of the following is a suitable source to locate stem cells?

- A Human blastocyst contains embryonic stem cells
- B Umbilical cord blood contains hematopoietic stem cells
- C Liver contains multipotent stem cells
- D All of the above**

- 28** In bone marrow, pluripotent stem cells can be distinguished from precursors of blood cells which are synthesising proteins by the chromatin and organelles that they contain.

What are the features seen in cells that are synthesizing large quantities of protein?

	chromatin	ribosomes	Golgi size
<b>A</b>	clumped	few	large
<b>B</b>	clumped	many	small
<b>C</b>	dispersed	few	small
<b>D</b>	dispersed	many	large

- 29** In some countries where rice is eaten, the lack of  $\beta$ -carotene in the diet can lead to blindness.

Golden rice has had two genes added to it, to make it produce  $\beta$ -carotene. Seed has been available since 2004, but people are cautious about the growth of genetically modified crops, fearing that these genes could be transferred to other plants.

Which of these possible reasons is the best argument for allowing cultivation of golden rice?

**Examiner's comments:** Most demanding. Many chose B. Whatever controls were put in place for the cultivation of rice, it is unlikely that all gene transfer could be prevented.

- A** Many plants already produce carotene, so gene transfer will not be a problem.
- B** Cultivation will be strictly controlled, so no gene transfer will occur.
- C** Cultivation will occur in countries geographically remote from protesters against genetic modification.
- D** Cultivation will occur in developing countries where people are unlikely to object.
- 30** Which uses of information from the human genome project are generally considered to be unethical?

- |          |   |
|----------|---|
| <b>1</b> | an insurance company only giving cheap rates to people with genetic predispositions to fewer diseases <b>predispositions do not mean the person will suffer from the disease.</b> |
| <b>2</b> | genetic archaeologists identifying the earliest forms of genes to show evolutionary relationships   |
| <b>3</b> | cytologists developing tests for only some defective genes  |
| <b>4</b> | doctors only giving specific drugs to block the actions of faulty genes to carriers of those genes  |
| <b>5</b> | genetic counsellors giving specific lifestyle information only to people genetically predisposed to risks   |
| <b>6</b> | parents choosing embryos for implantation only after ante-natal tests for   |

acceptable genes meaning embryos with unacceptable genes will be discarded.  
This is unethical.

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- A 1 and 3
- B 1 and 6**
- C 2 and 5
- D 3 and 4

## Answer scheme

Qns	Ans
1	D
2	A
3	D
4	A
5	C
6	A
7	D
8	B
9	B
10	A
11	A
12	B
13	B
14	B
15	C
16	B
17	B
18	D
19	C
20	C

Qns	Ans
21	D
22	C
23	A
24	D
25	B
26	D
27	D
28	D
29	A
30	B