



RIVER VALLEY HIGH SCHOOL

YEAR 6 PRELIMINARY EXAMINATION

CANDIDATE
NAME

CENTRE
NUMBER

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INDEX
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CLASS

H2 BIOLOGY

9648/01

Paper 1 Multiple Choice

27 September 2013

1 hour 15 minutes

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, centre number and index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions in this paper. Answer **all** questions. For each question, there are four possible answers, **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate **Answer Sheet**.

Read the instructions on the Answer Sheet carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done on the Question Paper.

Calculators may be used.

This Question Paper consists of **24** printed pages.

For each question, there are four possible answers, **A**, **B**, **C** and **D**.

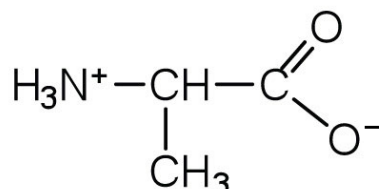
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

1. A ribosome consists of a large and a small subunit, each subunit containing ribosomal RNA (rRNA) complexed with protein.

Which sequence of events concerning ribosomes is correct?

- A** Within the nucleolus rRNA and protein are synthesised and subunits formed. They become membrane bound as they are exported through the nuclear envelope to the cytoplasm and RER.
- B** rRNA and protein are synthesised in the Golgi body and are transported to the nucleolus for subunit formation.
- C** rRNA is synthesised in the SER and proteins are synthesised by the RER. Subunit formation occurs within the cytoplasm for free ribosomes and within RER for attached ribosomes.
- D** rRNA synthesised within the nucleus is complexed with protein that has been imported from cytoplasm. The subunits formed are exported to the cytoplasm via the nuclear pores.

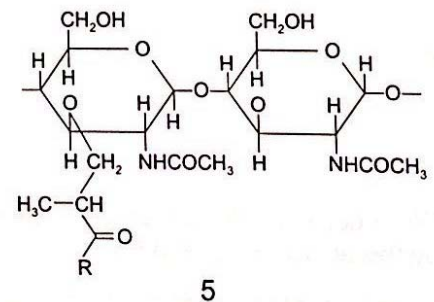
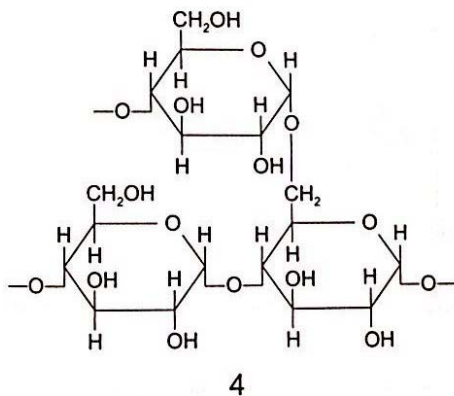
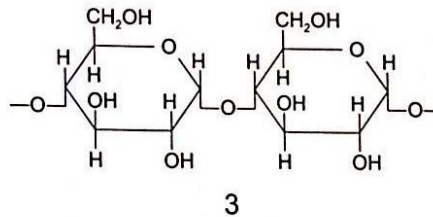
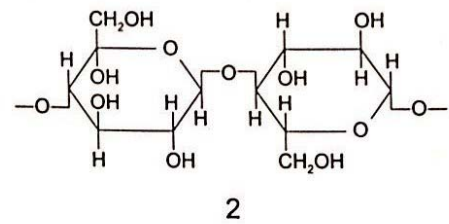
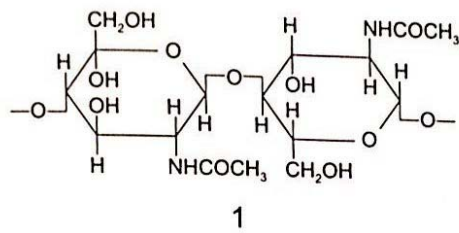
2. The diagram below shows the structure of an amino acid.



Which of the following are true about this amino acid?

1. Non polar R group
2. Hydrophobic R group
3. Insoluble in water
4. Soluble in water
- A** 1 and 2 only
- B** 1, 2 and 3
- C** 1, 2 and 4
- D** All of the above

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



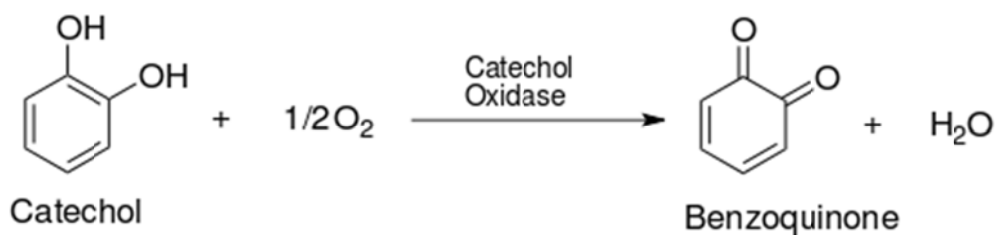
The polysaccharides can be described as below.

- Polysaccharide F is composed of β -glucose monomers with 1,4 glycosidic bonds
- Polysaccharide G is composed of α -glucose monomers with 1,4 and 1,6 glycosidic bonds
- Polysaccharide H is composed of N-acetylglucosamine and N-acetylmuramic acid monomers with β -1,4 glycosidic bonds
- Polysaccharide J is composed of α -glucose monomers with 1,4 glycosidic bonds
- Polysaccharide K is composed of N-acetylglucosamine monomers with β -1,4 glycosidic bonds

Which shows the correct pairings of polysaccharide descriptions and diagrams?

	Polysaccharide F	Polysaccharide G	Polysaccharide H	Polysaccharide J	Polysaccharide K
A	2	4	5	3	1
B	2	5	4	1	3
C	3	4	1	2	5
D	3	5	4	1	2

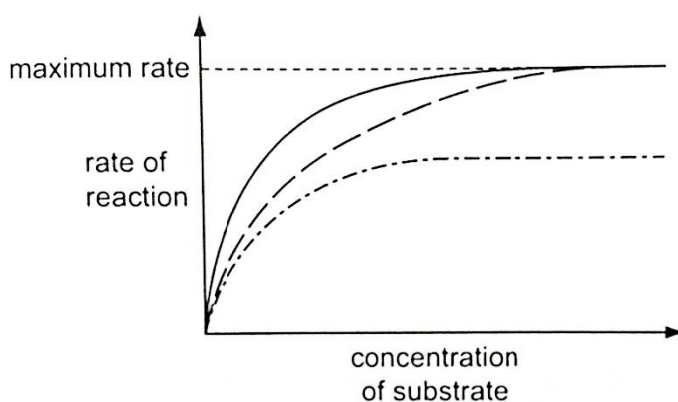
4. Catechol is oxidised to benzoquinone, as shown in the equation, resulting in darkening of peeled fruits.



Catechol oxidase is an enzyme which is inhibited by parahydroxybenzoic acid (PHBA) which is structurally similar to catechol.

It is also inhibited by phenylthiourea (PTU) which binds to a copper atom in the enzyme. The copper atom is essential for the oxidative activity.

The graph shows the rate of the reaction with and without inhibitors.



Which is the correct key to the curves?

	with PHBA	with PTU	uninhibited
A	-----	—————
B	—————	-----
C	-----	—————
D	-----	—————

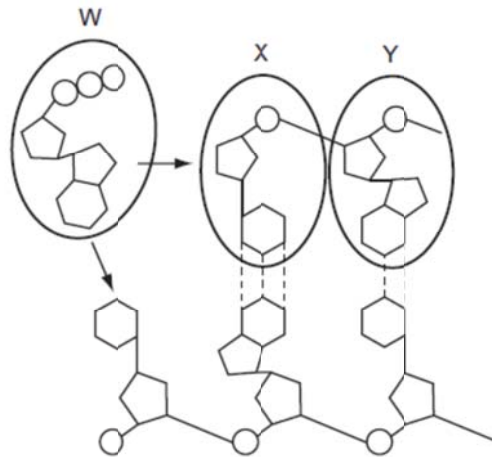
5. Messelson and Stahl found that in dividing cells, DNA is copied by semi-conservative replication. At the time of their discovery it was thought that DNA might be copied in one of three ways: semi-conservative, conservative and dispersive.

The bacteria were grown in culture containing heavy nitrogen, ^{15}N , until all the DNA was labelled. These bacteria were then transferred to a medium containing only light nitrogen, ^{14}N and allowed to replicate for two generations.

Which row shows the correct proportion of each type of DNA if DNA replication was conservative?

	All ^{14}N	Half ^{14}N , half ^{15}N	All ^{15}N
A	50%	50%	0%
B	0%	100%	0%
C	50%	0%	50%
D	75%	0%	25%

6. The diagram shows the synthesis of a polynucleotide. Molecule W is a nucleotide triphosphate.



Which statements are correct?

1. The base in W could be the purine, adenine
2. The base in Y is the purine, guanine
3. The base in X is the pyrimidine, cytosine
4. The base in X could be the pyrimidine, uracil

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

7. Which statements about the genetic code are correct?
1. There is only one codon for the amino acid methionine.
 2. Codons act as 'stop' and 'start' signals during transcription and translation.
 3. Prokaryotes generally use the same genetic code as eukaryotes.
 4. Stop codons are 'UAA, UGG, UGA'.
 5. mRNA codons have the same nucleotide sequence as DNA triplet codes.
- A 1 and 2 only
- B 1 and 3 only
- C 1, 3 and 4
- D 2, 4 and 5

8. The petals of the morning glory flower are purple when the flower is in bud but become blue as the flower opens. The colour change is caused by an increase in pH of the vacuoles of the petal cells.

A mutation in a gene coding for a type of hydrogen ion (H^+) pump in the vacuole membranes of the petal cells results in flowers that are purple when open.

The difference in DNA sequence of the gene coding for the ion pump in plants with blue or purple flowers is shown below.

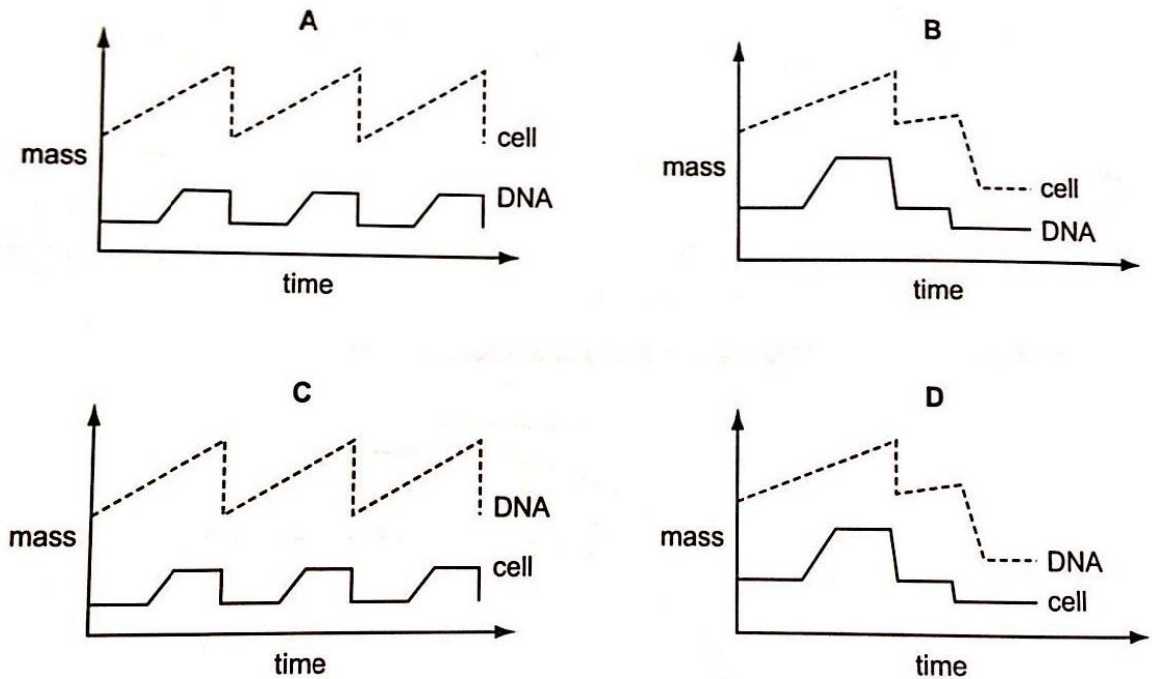
plant with blue flowers	-T-T-A-A-T-C-C-T-G-A-G-A-T-T-T-
plant with purple flowers	-T-T-A-A-T-C-C-T-G-C-T-G-A-G-A-T-T-T-

Which statements explain the purple colour of the flowers of the mutant plant?

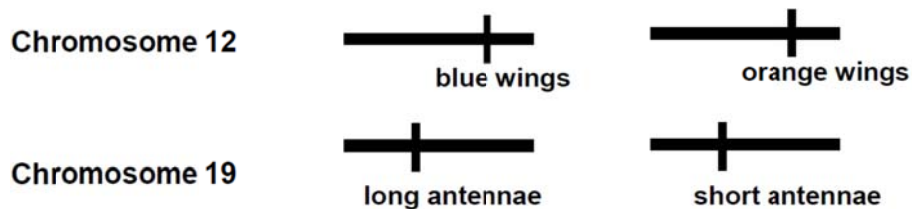
1. A frameshift mutation alters the sequence of amino acids in the ion pump.
 2. The primary structure and the shape of the ion pump are altered.
 3. The activity of the ion pump is altered by changes in its shape.
 4. The mutant ion pump cannot pump H^+ ions into the vacuoles of the petal cells
- A 1 and 2
- B 1 and 4
- C 2 and 3
- D 3 and 4

9. Cell division is the means of almost all growth and reproduction.

Which graph correctly represents a form of cell division that maintains genetic stability at expense of variation?



10. A certain (hypothetical) organism is diploid, has either blue or orange wings as the consequence of one of its genes, and has either long or short antennae as a result of a second gene, as shown below.



If an organism is heterozygous for both genes, what will be the possible chromosomes and alleles found in one of her eggs?

- A Two chromosomes 12 with blue and orange wings alleles.
- B Chromosome 12 with an orange wings allele and chromosome 19 with long antennae allele.
- C Chromosome 19 with both orange wings allele and short antennae allele due to crossing over.
- D Chromosome 12 with blue and orange wings alleles and chromosome 19 with long and short antennae alleles.

11. When a bacterial cell infected by a lambda phage gets co-infected with another lambda phage at a later point in time, this may not result in the death of the bacterial cell. Which of the following statement(s) is a possible mechanism(s) for the phenomenon?
1. One of the viruses makes a larger number of phages.
 2. The transcription and translation of viral DNA is not initiated.
 3. A repressor protein is synthesised to shut down replication of the phage.
 4. Mutation of host genome results in the inability of lambda phage to enter host cell.
- A 2 only
 B 2 and 3 only
 C 1 and 4 only
 D 1 and 3 only

12. Genetic diversity in bacteria is maintained by all of the following except
- A mutation
 - B transformation
 - C transduction
 - D binary fission

13. Which of the following is / are true about *trp* and *lac* operons?

	<i>trp</i> operon	<i>lac</i> operon
1.	produces polycistronic mRNA	produces monocistronic mRNA
2.	repressor binds to operator	repressor binds to promoter
3.	inducible	repressible
4.	transcription occurs in the presence of tryptophan	transcription occurs in the absence of glucose

- A 2 only
 B 1 and 4 only
 C 1, 2 and 4
 D None of the above

14. Use your knowledge and the information provided to work out which description of telomeres and telomerase reverse transcriptase (TERT) is correct.

	telomeres	telomerase reverse transcriptase (TERT)
A	Present in eukaryotes	Use RNA as a template to make single stranded DNA
B	Present in eukaryotes	Inhibits the loss of telomeres from DNA during semi-conservative replication
C	Present in prokaryotes	Inhibits the loss of telomeres from DNA during semi-conservative replication
D	Present in prokaryotes	Uses RNA as a template to make single stranded DNA

15. Which of the following statements about eukaryotic transcription are correct?
1. Attachment of RNA polymerase to promoter is achieved by interaction of transcription factors.
 2. Enhancers and silencers are DNA sequences found downstream of structural genes and can regulate gene expression.
 3. Attachment of activator proteins to enhancers increases the basal activity of the promoter.
 4. Attachment of repressor proteins to silencers suppresses the basal activity of promoter.
- A** 1 and 2 only
- B** 3 and 4 only
- C** 1, 2 and 3
- D** 1, 3 and 4

16. The table shows a comparison of some aspects of the genomes and protein-coding genes of the prokaryote bacterium *Escherichia coli* and the eukaryote fungus *Saccharomyces cerevisiae*.

	<i>E. coli</i>	<i>S. cerevisiae</i>
Genome length / base pairs	4 640 000	12 068 000
Number of protein-coding genes	4300	5800
Proteins with roles in:		
metabolism	650	650
energy release / storage	240	175
membrane transport	280	250
transcription	240	400
translation	180	350
cell structure	180	250

Which of the following statement(s) accounts for the differences in the number of protein-coding genes?

1. Many catabolic pathways for using carbon compounds in prokaryotes.
 2. The presence of introns.
 3. The presence of membrane-bound organelles in eukaryotes.
 4. The use of histones to package DNA in eukaryotes.
- A 1 only
- B 1 and 2 only
- C 2, 3 and 4
- D 1, 3 and 4
17. Which statement(s) about tumour suppressor genes is **not** correct?
1. Tumour suppressor genes act in a genetically dominant manner.
 2. There are fewer tumour suppressor genes known than oncogenes.
 3. Tumour suppressor genes normally become oncogenes by mutations that eliminate their normal activity.
 4. Tumour suppressor genes can be responsible for some familial cancers.
- A 1 only
- B 3 only
- C 1 and 3 only
- D 2 and 4 only

18. 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
19. In mice, the gene for 'dappled' coat (**D**) and its recessive allele for 'plain' coat (**d**), are located on the X chromosome. The gene for 'straight' whiskers (**W**) and its recessive allele for 'bent' whiskers (**w**) are autosomal.

A male mouse with plain coat and bent whiskers was mated on several occasions to the same female and the large number of offspring consisted of males and females in equal numbers in all combinations of phenotypes, as shown in the table.

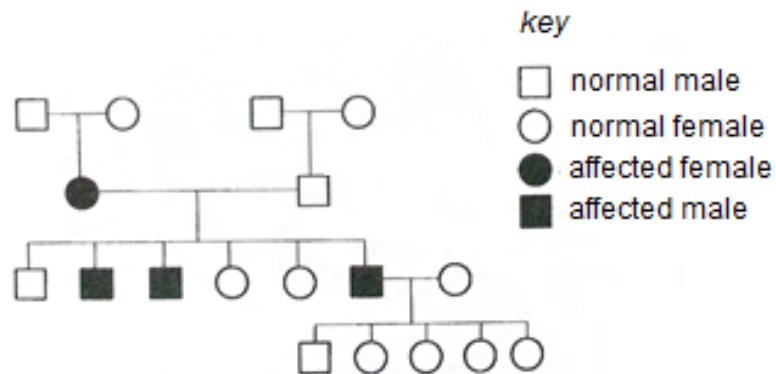
Offspring
Dappled, straight whiskers
Dappled, bent whiskers
Plain, straight whiskers
Plain, bent whiskers

If this female mouse is mated to a male with dappled coat and bent whiskers.

What proportion of the offspring would have at least one dominant allele at each gene locus?

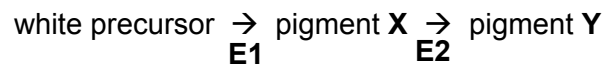
- A 1/8
 B 3/8
 C 1/4
 D 3/4

20. The family tree shows the inheritance of a human defect.



What is the most likely genetic basis for the occurrence of this defect?

- A Autosomal recessive
 - B Autosomal dominant
 - C Sex-linked recessive
 - D Sex-linked dominant
21. The foxglove plant has three different coloured flowers - purple, pink and white. Coloured pigment is synthesised enzymatically from a white precursor as shown below:



Two genetically identical plants with white flowers were crossed. This produced an F₁ generation with 2170 white-flowered, 530 purple-flowered and 180 pink-flowered plants.

The alleles are represented by the following symbols:

- R**: no production of pigment **r**: production of pigment
- B**: purple pigment **b**: pink pigment

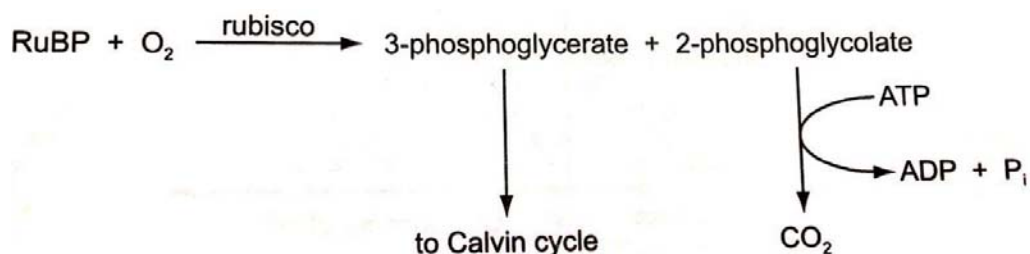
Which statement correctly describes the relationship between the two genes?

- A Dominant epistasis in which the epistatic allele is **B**.
- B Recessive epistasis in which the epistatic allele is **b**.
- C Dominant epistasis in which the epistatic allele is **R**.
- D Recessive epistasis in which the epistatic allele is **r**.

22. Which statement concerning chrysanthemum plants, of the genus *Dendranthema*, is a valid example of how the environment may affect the phenotype?
- A Anthocyanins and anthoxanthins are vacuolar pigments, whereas xanthophylls and carotenes are pigments found in membrane-bound organelles known as plastids. These, together with molecules known as co-pigments, are responsible for the variation observed in petal colour in *Dendranthema*.
 - B Identical genetic crosses performed between varieties of *Dendranthema* result in a greater proportion of offspring plants with plastids exhibiting a yellow colour when grown in a field and a greater proportion of offspring plants with colourless plastids when grown in a glass house.
 - C The seeds of a cross between *Dendranthema weyrichii* and *Dendranthema grandiflora* produce plants that are far more frost-tolerant and exhibit an extended flowering season compared with both parent plants.
 - D The seeds of a cross between *Dendranthema weyrichii* (height varying between 12.5 – 15.0 cm) and *Dendranthema grandiflora* (height varying between 8.0 – 25.0 cm) produce plants, when grown in natural day length, of a height varying between 55.0 – 71.0 cm.

23. Rubisco is the carbon dioxide-fixing enzyme. One rubisco molecule has eight active sites where carbon dioxide fixation occurs, with each active site catalysing only three reduction reactions per second.

The enzyme also catalyses, at the same active sites, the addition of oxygen to rubisco biphosphate (RuBP). This reaction is favoured when oxygen concentrations in the leaf are high and carbon dioxide concentrations are low.



Which of the facts is paired with a correct explanation?

	Fact	Explanation
A	On very hot, dry days stomata close to prevent water loss.	This reduces the availability of oxygen, increasing the production of 3-phosphoglycerate.
B	Plants synthesise large volumes of rubisco.	This may be an adaptive response to compensate for low concentrations of oxygen.
C	Processing 2-phosphoglycolate will eventually release carbon dioxide.	This will increase the rate of reduction and increase the rate of RuBP regeneration, increasing the rate of photosynthesis.
D	Rubisco is an inefficient photosynthetic enzyme.	This is because the rate of carbon dioxide reduction can be decreased by the competitive binding of oxygen molecules to the active site.

24. The table below shows reactions occurring in a plant cell, and their respective locations.

	Reaction	Location in a cell
1.	ribulose biphosphate + CO ₂ → glycerate-3-phosphate	Stroma
2.	glucose + ATP → glucose-6-phosphate + ADP	Matrix
3.	oxygen + 4H ⁺ + 4e ⁻ → 2 H ₂ O	Stroma
4.	oxaloacetate + acetyl-CoA → citrate	Matrix

Which of the following is / are **incorrectly** matched?

- A 2 only
- B 4 only
- C 2 and 3 only
- D 1, 2 and 3
25. Which of the following statement(s) about membranes is correct?
1. All intracellular membranes in a eukaryotic cell have the same type of lipids and proteins.
 2. The outer and inner membranes of mitochondria have the same type of transport proteins.
 3. Carbohydrates form part of glycoproteins or glycolipids in the membranes.
 4. All plant cell membranes have cholesterol.
- A 1 only
- B 3 only
- C 3 and 4 only
- D 1, 3 and 4

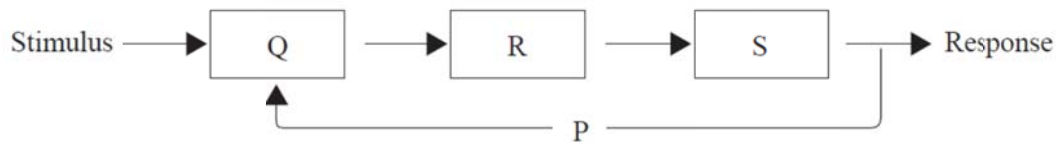
26. In an experiment on osmosis in plant cells, the solute potential (Ψ_s), pressure potential (Ψ_p) and water potential (Ψ_w) of the cell were recorded in the table below.

Condition of plant cell	Potential / kPa		
	Ψ_s	Ψ_p	Ψ_w
Plasmolysed	-1000	P	Q
Fully turgid	-600	R	S

Which of the following correctly represents the value of **P**, **Q**, **R** and **S**?

	P	Q	R	S
A	+1000	-2000	+600	0
B	-1000	-2000	0	-600
C	0	-1000	-600	-1200
D	0	-1000	+600	0

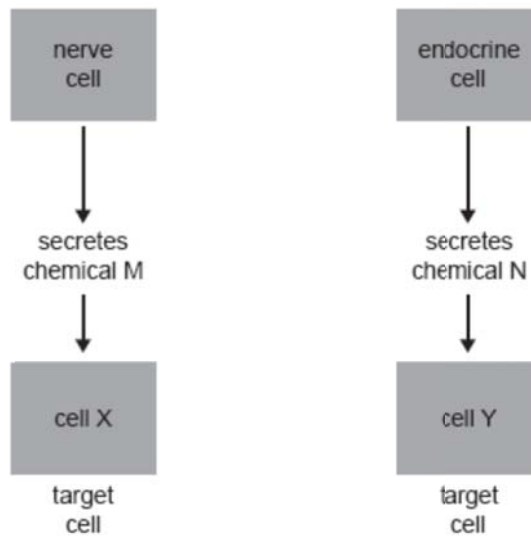
27. The diagram below illustrates the main features of homeostasis.



What are **P**, **Q**, **R** and **S**?

	P	Q	R	S
A	Feedback	Receptor / Detector	Controller / Integrator	Effector
B	Receptor / Detector	Controller / Integrator	Feedback	Effector
C	Feedback	Receptor / Detector	Effector	Controller / Integrator
D	Effector	Receptor / Detector	Feedback	Controller / Integrator

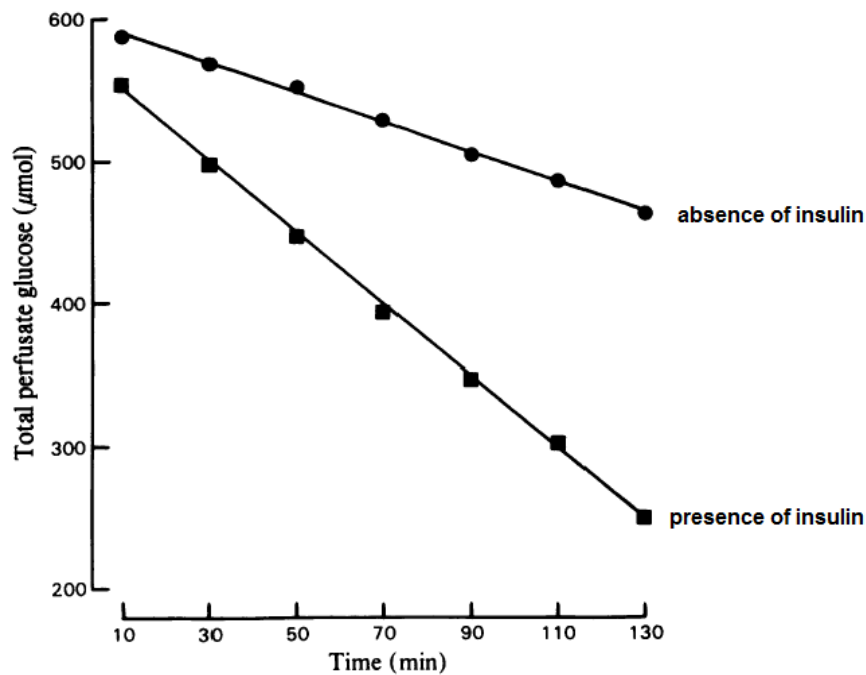
28. The diagram shows how a nerve cell and an endocrine cell interact with cell X and cell Y respectively.



Which of the following is true of both interactions?

- A Diffusion is involved in the movement of chemicals M and N to their respective target cells.
- B Chemical M is secreted faster than chemical N.
- C When both cells X and Y are stimulated, phosphorylation cascades must be initiated.
- D Both chemicals M and N must bind to cell-surface receptors on cell X and Y respectively.

29. The figure below shows the time course of glucose uptake by the working rat heart in the absence and presence of insulin. The lower the amount of total perfusate glucose, the greater is the uptake of glucose by the rat heart.



From the given data, which of the following statements can be concluded to be correct?

1. Cells in the rat's heart have receptors for insulin.
 2. There is increased uptake of glucose by the rat's heart in the presence of insulin.
 3. Release of insulin is stimulated by increase in blood glucose level.
 4. The rat is given a carbohydrate-rich meal prior to the experiment.
- A 1 and 2 only
B 1 and 4 only
C 2 and 3 only
D 3 and 4 only
30. Which process triggers the uptake of Ca^{2+} ions in synaptic transmission?
- A The influx of Na^+ ions
B The release of neurotransmitters
C The depolarisation of the post-synaptic membrane
D The arrival of nerve impulse in the pre-synaptic neuron

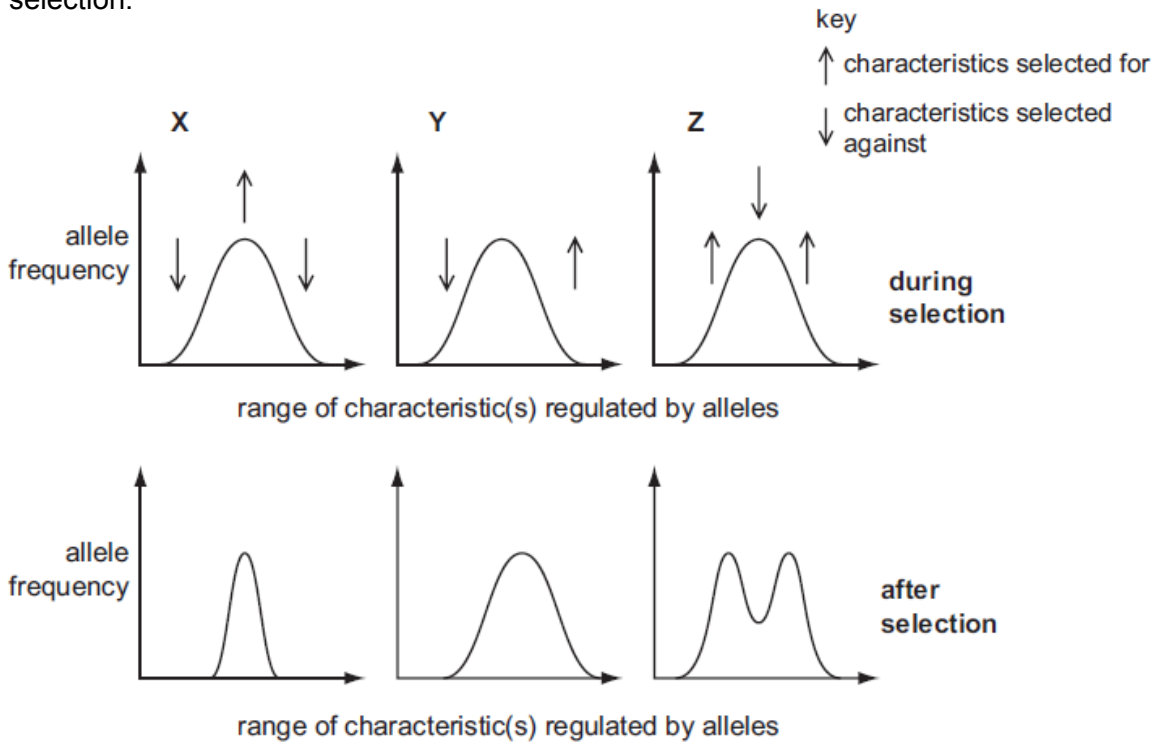
31. Organisms are classified using taxons. The scientific names of three species of Hawaiian honeycreeper are below.

- Short-billed Honeycreeper, *Cyanerpes nitidus*
- Shining Honeycreeper, *Cyanerpes lucidus*
- Purple Honeycreeper, *Cyanerpes caeruleus*
- Red-legged Honeycreeper, *Cyanerpes cyaneus*

What is the highest taxon that these honeycreepers have in common?

- A genus
- B order
- C family
- D class

32. The graphs represent the frequency of alleles in species, X, Y and Z during the after selection.



In which species does evolution take place?

- A X only
- B Y only
- C Y and Z
- D None of X, Y nor Z

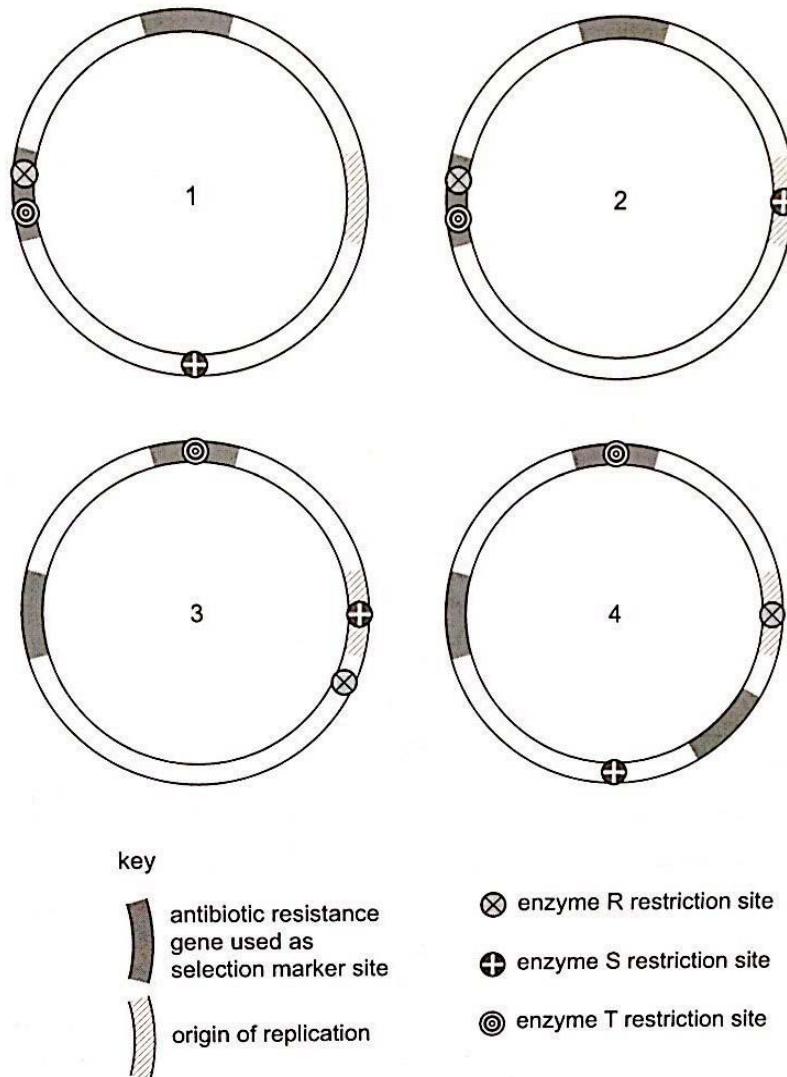
33. The following statements relate to molecular phylogenetics.

1. Lines of descent from a common ancestor to present-day organisms have undergone similar, fixed rates of DNA mutation.
2. Organisms with similar base sequences in their DNA are closely related to each other.
3. The number of differences in the base sequences of DNA of different organisms can be used to construct evolutionary trees.
4. The proportional rate of fixation of mutations in one gene relative to the rate of fixation of mutations in other genes stays the same in any given line of descent.

Which statements, when taken together, suggest the existence of a 'molecular clock' that enables scientists to estimate the time at which one species might have diverged from another?

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

34. The diagram shows four plasmids.

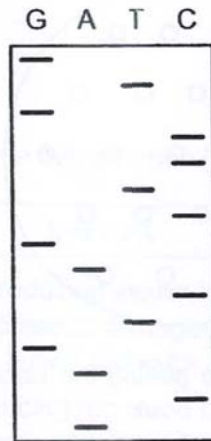


Which plasmids would be suitable to use for genetic engineering using restriction enzyme S?

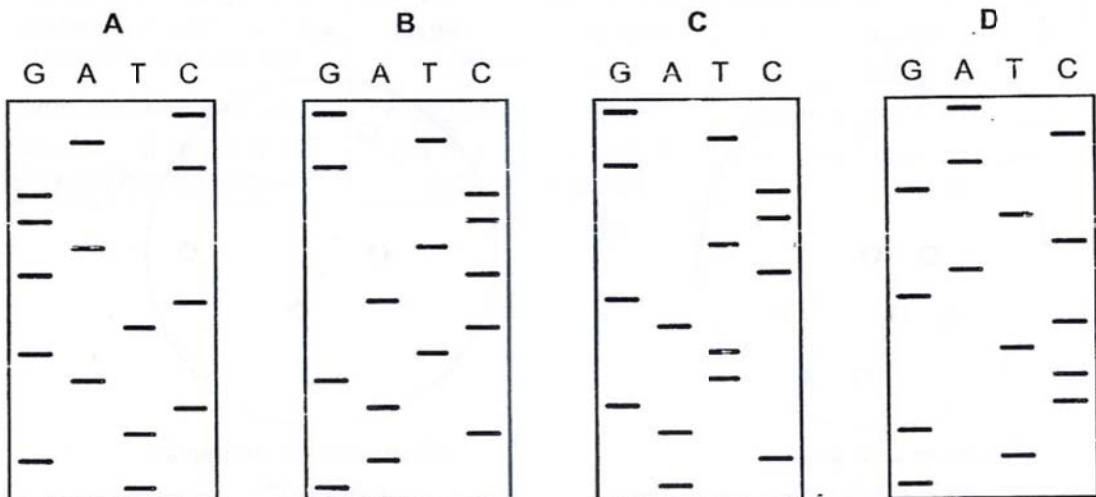
- A 1 and 4 only
- B 2 and 3 only
- C 1, 2 and 4
- D 1, 3 and 4

35. In people with a mutant allele, a protein contains just one different amino acid in its primary structure. To identify the presence of this mutant allele, DNA nucleotide sequences were compared using electrophoresis.

The electrophoresis results from the DNA of a normal allele of a gene are shown below.



Which diagram represents the DNA sequence for the mutant allele of this gene?



36. Which of the following is **not** necessary for Polymerase Chain Reaction to occur?

1. dATP
2. RNA primers
3. DNA fragment
4. Ribonucleotides

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

37. In parallel with the Human Genome Project, the DNA of a set of model organisms (such as bacteria, roundworms, fruitflies, mice and chimpanzees) are being studied.

Which technique might be most useful in using the information from model organisms to provide critical clues about the structure and function of human genes?

- A Sequencing
 B DNA fingerprinting
 C Comparing molecular homology
 D Finding the regions of repetitive sequences

38. A key feature of most multicellular organisms is the ability to differentiate and produce specialised cells.

Which row best describes the ability of zygotic cells to differentiate?

	totipotent	pluripotent	multipotent
A	✓	✓	✓
B	✓	✗	✓
C	✓	✗	✗
D	✗	✓	✓

Key
 ✓ = ability
 ✗ = no ability

- 39.** It is possible to introduce an allele for a functioning CFTR protein into lung epithelial cells of patients suffering from the genetically inherited condition cystic fibrosis.

Why this strategy can never provide a permanent cure for the patient?

- A** epithelial cells are continually dying and being replaced
- B** the DNA molecule that makes up the functioning allele is very unstable
- C** the methods of inserting the allele have low success rate
- D** this is only somatic and not germ line therapy

- 40.** 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.