EUNOIA JUNIOR COLLEGE
JC1 Promotional Examinations 2022
General Certificate of Education Advanced Level
Higher 2

H2 Biology
Paper 1

9744 / 01

04 October 2022

1 hour

Additional Materials: Optical Mark Sheet

READ THESE INSTRUCTIONS FIRST

You have a total of 1 hour to attempt this paper.

Write your name, civics group and registration number on all the work you hand in.

There are **thirty** 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.

The use of an approved scientific calculator is expected, where appropriate.

Answer **all** questions.

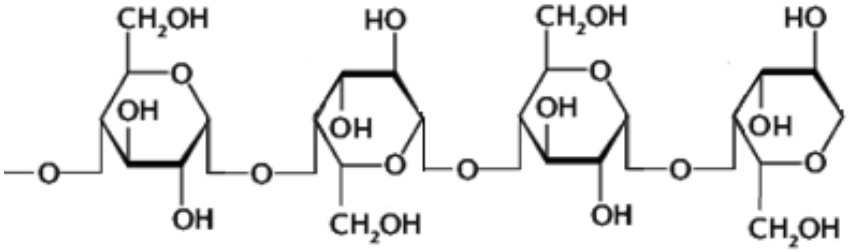
This document consists of **19** printed pages and **1** blank page.

Answer **all** questions on the Optical Mark Sheet provided.

1 Dextrins are a group of carbohydrates with low molecular weight and are produced by hydrolysing starch or glycogen.

Which of the following segments is/are **not** likely to be from a dextrin molecule?

1



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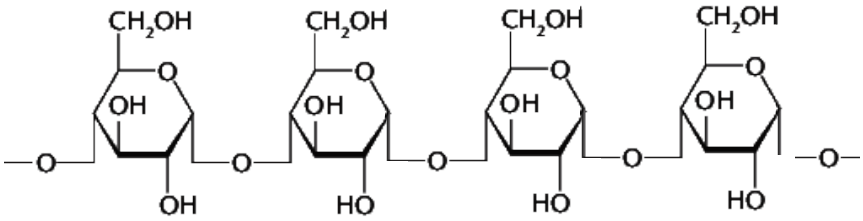

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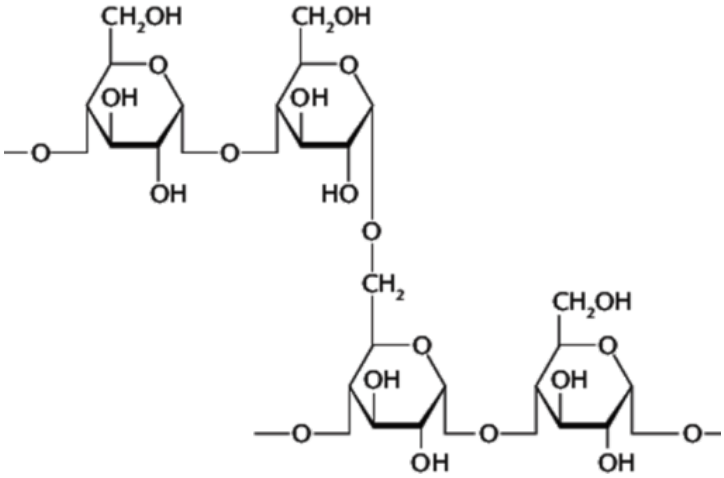

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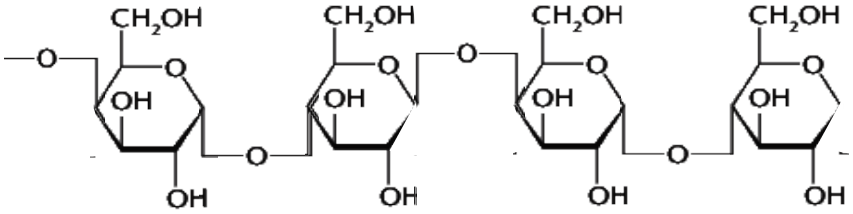


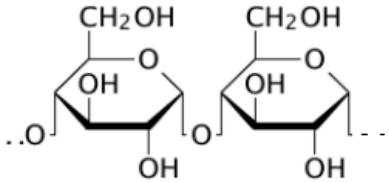
A 1 only

B 1 and 4 only

C 1, 2 and 3 only

D 2, 3 and 4 only

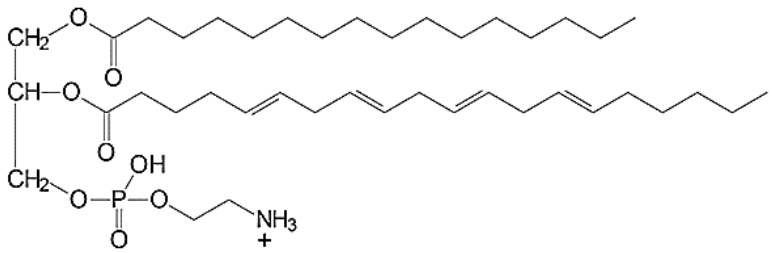
2 The diagram below shows a repeating unit found in a biomolecule.



Which of the following biomolecules has the above repeating unit?

	cellulose	glycogen	amylose	collagen
A	X	X	√	X
B	√	X	√	X
C	√	X	X	√
D	X	√	√	X

3 The structure of phosphatidylcholine, a common membrane phospholipid, is shown.



Which combination correctly describes the synthesis and property of one molecule of phosphatidylcholine?

	number of water molecules eliminated during synthesis	property
A	3	amphipathic
B	2	amphipathic
C	3	hydrophobic
D	2	hydrophobic

4 A peptide section of an insulin molecule was hydrolysed by two proteases, trypsin and chymotrypsin.

- Trypsin breaks the peptide bonds at the carboxyl terminals of lysine (lys) and arginine (arg).
- Chymotrypsin breaks the peptide bonds at the carboxyl terminals of phenylalanine (phe), tryptophan (trp) and tyrosine (tyr).

The hydrolysis was performed separately using:
1 both enzymes, or
2 trypsin only, or
3 chymotrypsin only.

The sequence of amino acid residues in the peptide is shown below:

amino terminal	tyr-leu-val-cys-gly-glu-arg-gly-phe-phe-tyr-thr-pro-lys-ala	carboxyl terminal

Which statement concerning the products of hydrolysis is correct?

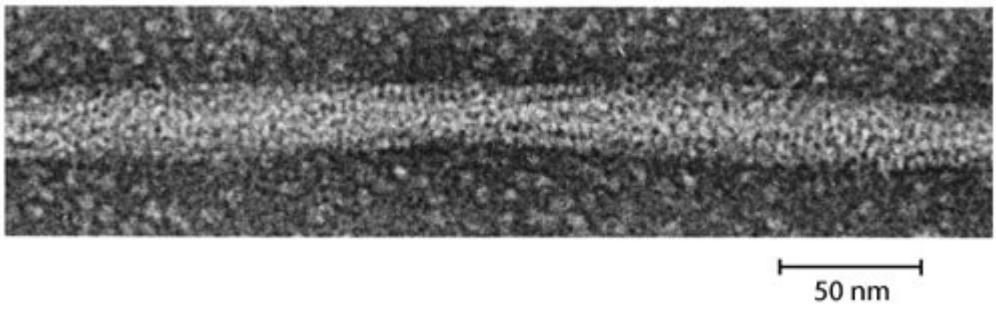
A Fewer than half of the fragments from hydrolysis 1 are single amino acids.

B Hydrolysis 2 yields one fewer fragment than hydrolysis 3

C Hydrolysis 2 yields one more dipeptide than hydrolysis 3

D With hydrolysis 1, all fragments formed are seven or fewer amino acid residues long.

5 An electron micrograph of a stained fibre of deoxyhaemoglobin S (HbS) is shown below.



Which of the following statements is true?

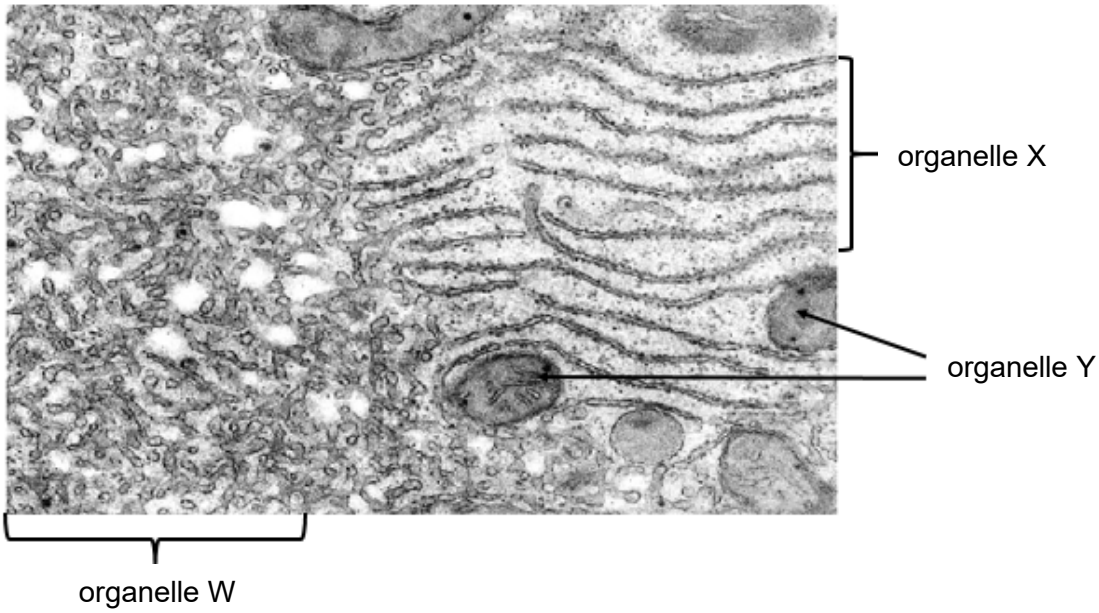
A Mutation in the mature red blood cell results in the production of HbS which precipitates out as long rigid fibres under low oxygen concentration.

B The long HbS molecule is insoluble due to its large molecular size and this results in the sickling of red blood cells.

C The aggregation of HbS molecules, under low oxygen concentration, causes the fibre to be precipitated out of solution, resulting in the sickling of red blood cells.

D Under low oxygen concentration, HbS molecules form a triple helix structure, causing the cell membrane of the red blood cells to be more rigid and hence this results in sickling of red blood cells.

6 The electron micrograph below shows three cell organelles W, X and Y.



Which of the following statements about these organelles is true?

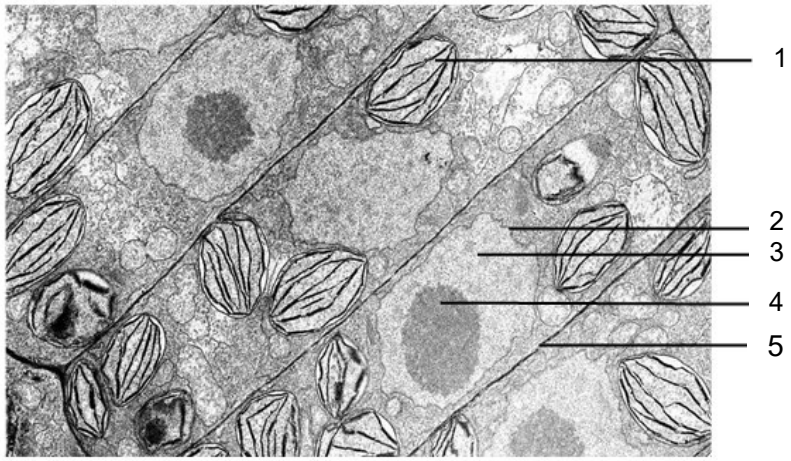
A Only organelle X contains RNA.

B Only organelle W contains carbohydrates and phospholipids.

C Organelle X has 80S ribosomes whereas organelle Y has 70S ribosomes.

D Organelles X and Y have double membrane whereas organelle W has a single membrane.

7 The following electron micrograph shows root cells from the duckweed plant.



Which of the following about structures 1 to 5 is correct?

	contain ribosomal subunits	contain tRNA	contain phospholipids
A	1, 2, 3	3 only	1, 4
B	1, 3, 4	1, 3	2, 5
C	1, 3, 5	1, 2, 4	2, 4, 5
D	2, 4, 5	2, 4, 5	1, 3, 4, 5

8 Which set of factors shown below will result in the cell surface membrane being the **least** fluid?

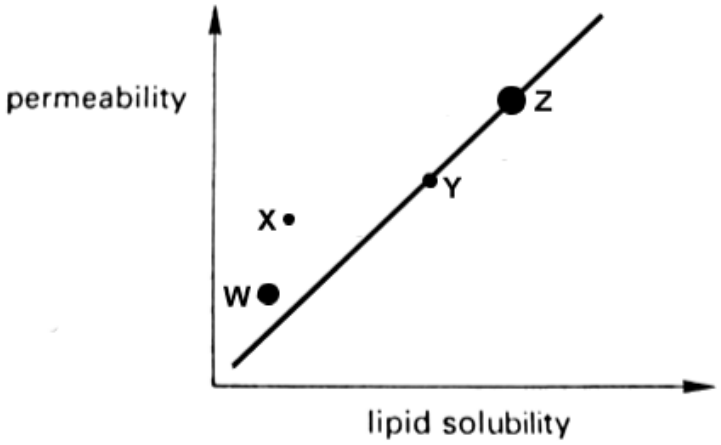
A High proportion of cholesterol and high temperature

B Low proportion of phospholipids with saturated fatty acids and high temperature

C Low proportion of phospholipids with unsaturated fatty acids and low temperature

D High proportion of phospholipids with unsaturated fatty acid and low temperature

9 The diagram shows the relationship between the size, lipid solubility and ability of molecules to cross the mammalian cell surface membrane. The diameter of the black circles in the diagram is proportional to the size of the molecules.



Which of the following could molecules W to Z represent?

	W	X	Y	Z
A	glucose	water	carbon dioxide	cholesterol
B	glucose	methane	carbon dioxide	calcium chloride
C	calcium chloride	methane	cholesterol	glucose
D	calcium chloride	water	glucose	cholesterol

10 Serine proteases, such as chymotrypsin and trypsin, are enzymes that cleave peptide bonds in proteins. Three specific amino acids (Asp, His, Ser) arranged in a special alignment, are found conserved in all serine proteases. This conserved alignment is often referred to as "the catalytic triad". At the active site, scientists also found a variable region between different members in this class of enzymes.

Which feature allows different serine proteases to bind to different substrates?

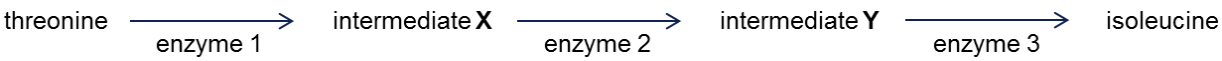
A Presence of a specific cofactor required for catalysis

B Specific spatial arrangement of Asp, His, and Ser at the active site

C Different R-group properties of amino acids in the catalytic triad

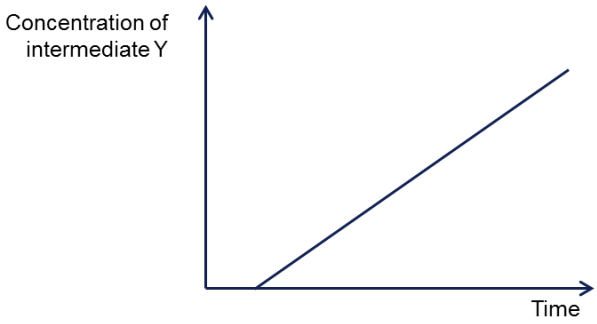
D Different R-group properties of amino acids lining the variable region

11 In the production of isoleucine from threonine, the end product acts as an inhibitor of the first enzyme of the pathway. The pathway is shown below.

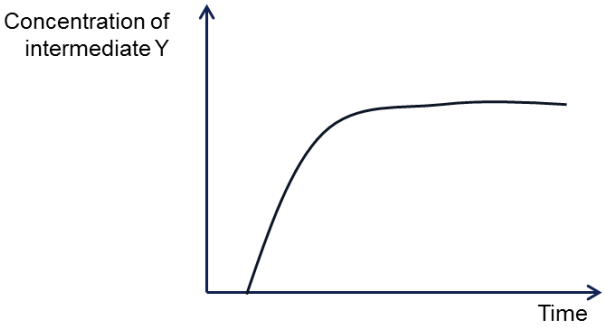


Which of the following graphs shows the concentration of intermediate **Y** when threonine is supplied in excess?

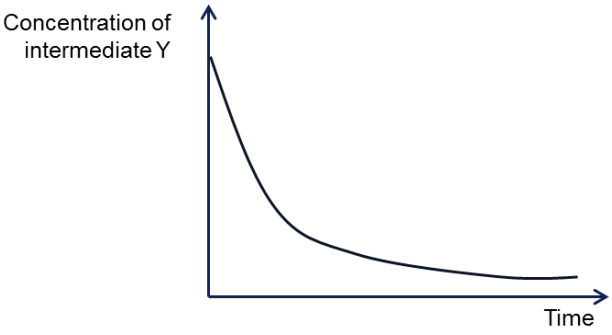
A



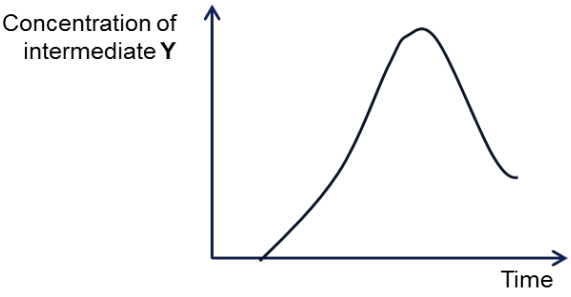
B



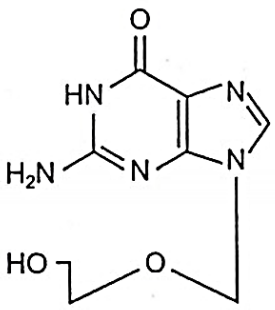
C



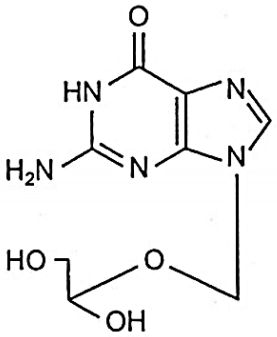
D



12 The structures of some drugs that are analogues of viral nucleotides are shown below. They interfere with viral nucleic acid synthesis so that incomplete polynucleotides are formed.



acyclovir



gancyclovir

Which statement explains how these drugs interfere with viral nucleic acid synthesis?

A They are competitive inhibitors of DNA or RNA polymerase enzymes.

B They bind irreversibly to the active site of the viral DNA or RNA polymerase.

C They bind irreversibly to the active site of the host cell DNA or RNA polymerases.

D They replace nucleotides so inactive nucleic acids are synthesised instead of active ones.

13 Four nucleotides, **A**, **B**, **C** and **D**, each consist of a phosphate group, a nitrogenous base, and a pentose sugar. Characteristics of the base and sugar components before they are joined to form each nucleotide are shown in the table.

Which nucleotide could pair with an adenine base during DNA replication?

	ring structure of nitrogenous base	ratio of carbon to oxygen atoms in pentose sugar
A	single	1:1
B	single	5:4
C	double	1:1
D	double	5:4

14 Some of the events that occur during transcription are listed below.

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

Before the mRNA molecule leaves the nucleus, which events occur twice during transcription?

A 1 and 2 only

B 1, 2 and 3

C 1, 3 and 4

D 2, 3 and 4

15 Two students were discussing the involvement of DNA and RNA in transcription and translation.

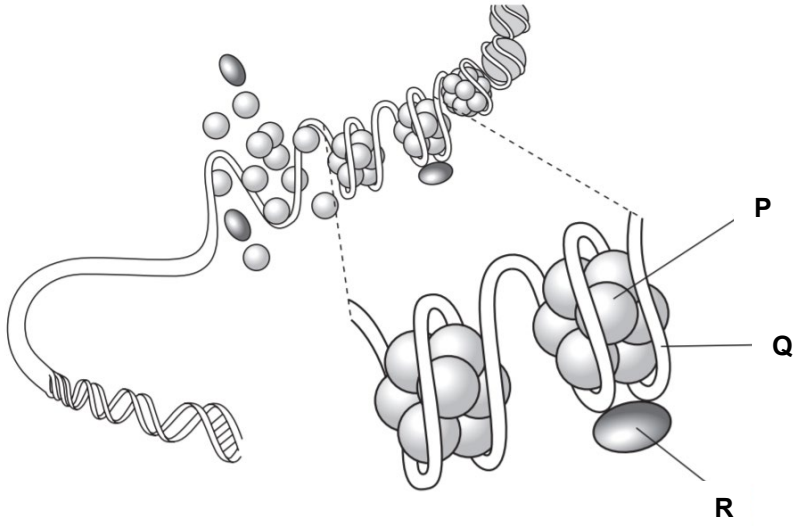
- Student 1 always gave correct facts.
- Student 2 gave further information about each fact, which was sometimes correct.

	correct facts given by student 1	further information given by student 2
1	RNA polymerase catalyses the formation of the mRNA from the template DNA strand.	A thymine ribonucleotide will pair with an adenine deoxyribonucleotide.
2	Three types of RNA are required for the process of translation: mRNA, tRNA, rRNA.	Only rRNA has enzymatic activity to catalyse the formation of peptide bonds.
3	A length of mRNA is 747 nucleotides long, including stop and start codons.	This mRNA can produce a polypeptide that is 249 amino acids long.
4	Adjacent mRNA codons of AAU and CUG bind to complementary tRNA anticodons.	There is a total of 14 hydrogen bonds formed between the six base pairs.

Which further information, given by student 2, is correct?

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

16 The diagram shows part of the organisation of a DNA molecule and the associated histones.



Which statement about the features labelled **P**, **Q** and **R** during the regulation of gene expression is correct?

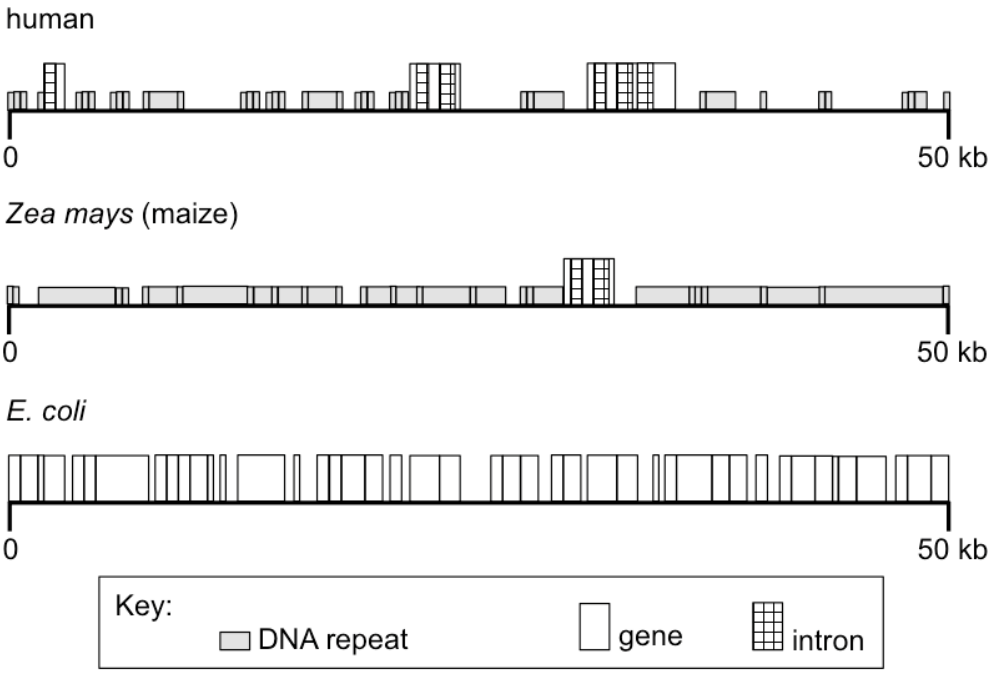
A The DNA strand **Q** wraps around histone **P** to form small clusters that are held in place by histone **R**.

B The DNA strand **Q** is exposed when histone **R** dissociates from the cluster, allowing the associated histones **P** to be released.

C The DNA molecule **Q** wraps around histone **P** and histone **R** holds the cluster in place so that **Q** can fit inside the nucleus.

D The DNA molecule **Q** and associated histone **P** move closer together as a result of **R** acetylating the tails of histone **P**.

17 The diagram shows 50 kb segments of the human, *Zea mays* and *E. coli* genomes.



Which one of the following statements is a valid conclusion from the above results?

A More complex organisms have higher density of DNA repeats.

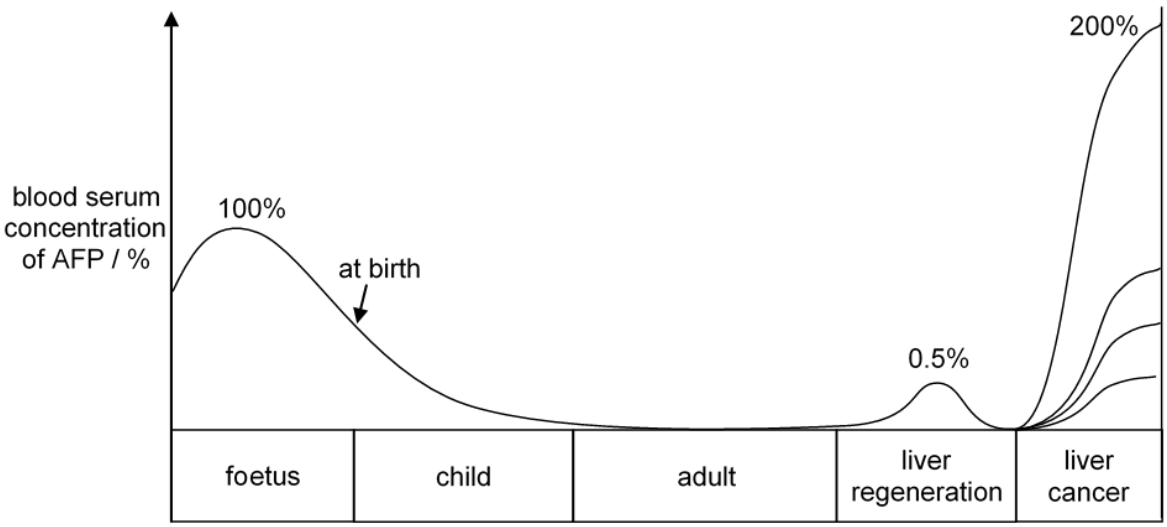
B Organisms with smaller chromosome number have higher gene density.

C *Zea mays* has a higher density of DNA repeats as compared to humans and *E. coli*.

D The presence of introns allows alternative splicing to occur in eukaryotes and allows them to synthesise the same number of proteins as prokaryotes.

18 α-fetoprotein (AFP) in blood serum is commonly used as a biomarker for the detection of liver cancer. The *AFP* gene is expressed only in the human foetus but not in a healthy adult.

The graph (not drawn to scale) shows the blood serum levels of AFP at various stages of life.



Which of the following statements are correct?

1 The *AFP* gene is found in euchromatin regions of the nucleus of a foetal cell.

2 During early foetal development, deacetylation of lysine residues of histones could have occurred at the *AFP* gene promoter.

3 Upon birth, DNA methylation of the *AFP* gene may have occurred to silence gene expression.

4 It may be difficult to distinguish early-stage liver cancer from liver tissue regeneration.

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

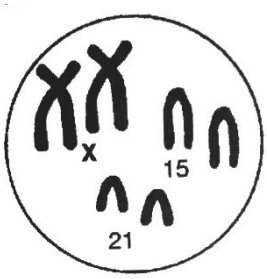
19 A cell, in the midst of actively dividing cells in a lilium root tip, was found to be arrested in its cell cycle with an intact nucleus.

Which of the following is/are the likely cause(s)?

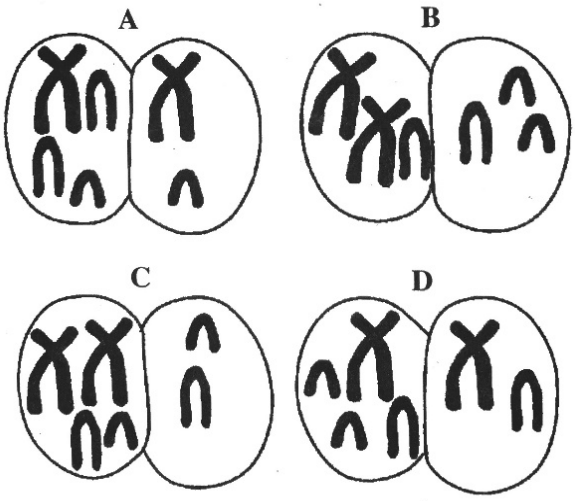
1 Damaged DNA or incomplete replication of DNA.
2 Homologous chromosomes are unable to pair up.
3 Incomplete formation of the mitotic spindle resulting in some chromosomes not attached to fibres.
4 Centrioles fail to replicate.

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

20 The diagram shows three of the 23 pairs of chromosomes found in a human cell.



Which diagram shows an example of non-disjunction in the formation of an egg, that could lead to the formation of a Down's syndrome zygote?



21 Fig. 21.1 shows the entire set of homologous chromosomes in a diploid sex cell of an organism, before it undergoes a type of cell division that leads to the amount of DNA per cell shown at P in Fig. 21.2. In Fig. 21.2, a second type of cell division begins after X.

Fig. 21.1

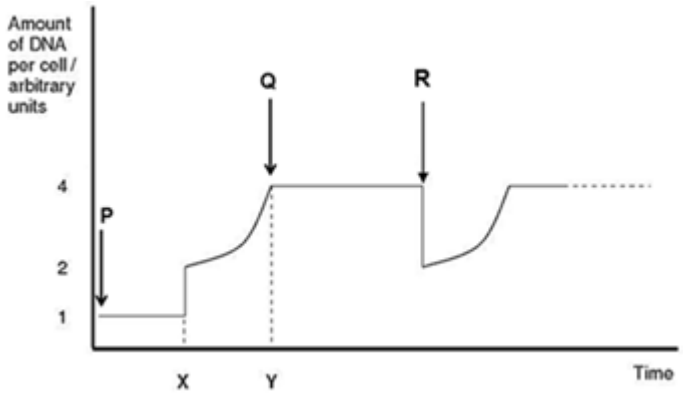


Fig. 21.2

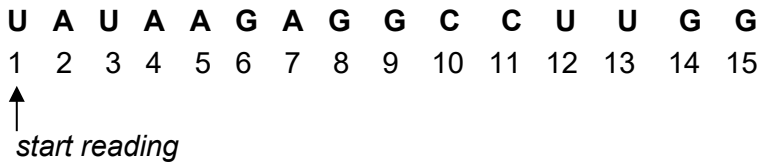
Which of the following is the correct combination of outcomes within a cell in this organism at **P**, **Q** and **R**?

	At **P**	At **Q**	At **R**
A		Diploid set of homologous chromosomes, each chromosome is composed of identical sister chromatids.	Diploid set of homologous chromosomes, each chromosome is a single DNA molecule.
B		Diploid set of homologous chromosomes, each chromosome is composed of identical sister chromatids.	Haploid set of chromosomes, each chromosome is a single DNA molecule.
C		Diploid set of homologous chromosomes, each chromosome is a single DNA molecule.	Haploid set of chromosomes, each chromosome is a single DNA molecule.
D		Tetraploid sets of homologous chromosomes, each chromosome a single DNA molecule.	Diploid set of homologous chromosomes, each chromosome isa single DNA molecule.

22 The following table shows the mRNA codons for six different amino acids.

mRNA codons	amino acid
AAA AAG	lysine
AGA AGG CGG	arginine
GGU GGA GGC GGG	glycine
CCU CCA CCC CCG	proline
UGG	tryptophan
UAU UAC	tyrosine

The base sequence of mRNA coding for part of a polypeptide is shown below.



From the information provided, which of the predictions stated below is **false**?

A The insertion of a nucleotide between positions 3 and 4 is expected to result in a greater change in the amino acid sequence than an insertion between positions 12 and 13.

B The deletion of a nucleotide at position 5 would result only in an alteration of the second amino acid in the chain.

C The substitution of a different nucleotide at position 12 would produce no alteration in the amino acid chain.

D The substitution of a different nucleotide at position 13 would result in the alteration of one amino acid.

23 Mutations in either *BRCA1* or *BRCA2* genes are responsible for the majority of hereditary breast cancer in humans.

The proteins produced by the two genes migrate to the nucleus where they interact with other proteins, such as those produced by the tumour suppressor gene, *p53* and the DNA repair gene, *RAD51*.

Which of the following combination of gene activity is most likely to result in breast cancer?

	gene		
	BRCA1 or *BRCA2*	*p53*	*RAD51*
A	encoding normal protein	encoding normal protein	encoding abnormal protein or no protein
B	encoding normal protein	encoding abnormal protein or no protein	encoding normal protein
C	encoding abnormal protein or no protein	encoding abnormal protein or no protein	encoding normal protein
D	encoding abnormal protein or no protein	encoding abnormal protein or no protein	encoding abnormal protein or no protein

24 Melanoma is a form of skin cancer that begins in cells called melanocytes that control pigment production in the skin.

Which of the following correctly compares a cancerous and a normal melanocyte?

	similarity	difference
A	both cells arise from pre-existing cells	the cell cycle of cancerous melanocytes is arrested at either the S phase or M phase
B	some genes are switched off in both cells	cancerous melanocytes continue to divide even when they are tightly packed
C	both cells contain well-defined nuclei	cancerous melanocytes are always in the M phase of the cell cycle
D	active telomerase is present in both cells	more gene mutations are evident in cancerous melanocytes

25 Which of the following statement(s) about the *trp* operon is/are true?

1 A loss-of-function mutation of the operator will lead to the constitutive production of tryptophan.

2 There is one start and one stop codon in the mRNA coded by the *trp* operon.

3 The repressor is inactive in the presence of excess tryptophan.

4 The mRNA codes for 3 polypeptides involved in the synthesis of tryptophan.

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

26 Which of the following statement(s) is/are true?

1 A mutation in the regulatory protein of a repressible operon can result in continuous transcription of the structural genes.

2 During generalised transduction, the prophage may be improperly excised to include the adjacent segment of bacterial DNA during an induction event.

3 A mutation in the regulatory gene that results in the permanent repression of the *lac* operon could be due to the inability of the repressor to bind to the inducer.

4 The F factor on the F plasmid codes for proteins necessary for the formation of sex pili and subsequent cytoplasmic mating bridge, allowing for conjugation to occur between bacteria.

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

27 Which of the following statement(s) describing bacterial conjugation is/are true?

1 The F plasmids made of single-stranded DNA.

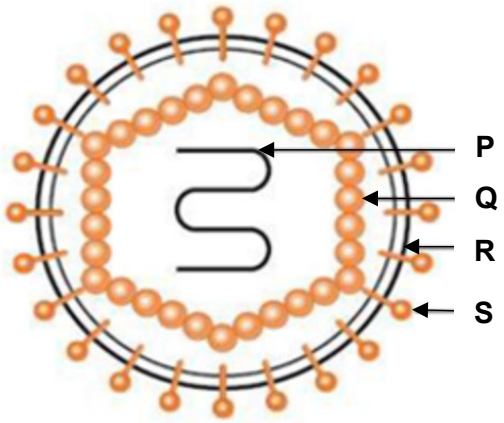
2 When an F^+ donor gives its F plasmid to an F^- recipient, both become F^-.

3 When an F^+ donor gives its F plasmid to an F^- recipient, the donor becomes F^-.

4 When F^+ cells are mixed with F^- cells, eventually all the cells will become F^+.

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

28 The diagram shows the structure of a virus which enters host cells by the process of fusion.



Which of the following statements are true?

1 **P** determines the structure of **Q** and **S**.

2 **Q** assists viral entry into the host cell.

3 **R** and **S** are required for the entry of the virus into the host cell.

4 **Q** and **R** are made of the same components.

A 1 and 2

B 1 and 3

C 2 and 3

D 2 and 4

29 Which of the following statement(s) regarding viruses is/are **incorrect**?

1 When viruses undergo antigenic drift, two different viruses infect a single host cell and recombine to form a new viral subtype.

2 The DNA-dependent RNA polymerases that are required for the replication of influenza viral genome in the host cell are of viral origin.

3 For the influenza virus to enter the host cell, haemagglutinin on the host cell membrane binds to a sialic acid receptor of the viral envelope.

4 The enzyme integrase is involved in the integration of viral DNA into the host cell genome in both the T4 phage and Human Immunodeficiency Virus (HIV) life cycles.

A 1 only

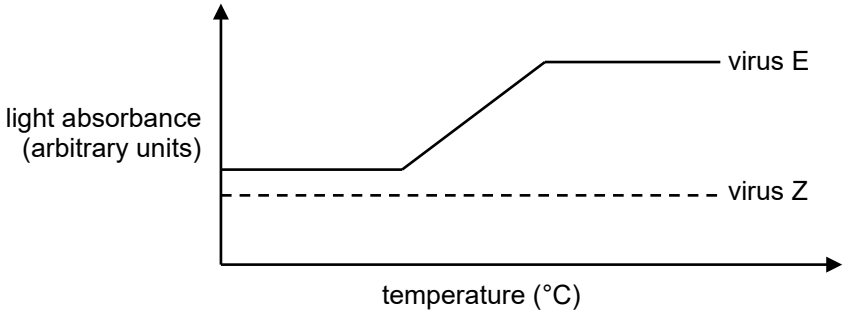
B 1, 2 and 3

C 2, 3 and 4

D 1, 2, 3 and 4

30 Two new viruses E and Z, which infect eukaryotic cells, have been identified.

In one experiment, the nucleic acid from each virus is isolated and analysed over a range of temperatures. The light absorbance of nucleic acids increases when denaturation occurs. The behaviour of the nucleic acid from each virus is shown in the graph.



In a second experiment, it is found that treatment with reverse transcriptase inhibitors or with inhibitors of DNA synthesis blocks the ability of virus Z to replicate.

In contrast, reverse transcriptase inhibitors have no effect on the ability of virus E to replicate, but DNA synthesis inhibitors blocks replication of virus E.

Which of the following conclusions can be drawn from the results of both experiments?

A The genome of virus E is single-stranded RNA and that of virus Z is double-stranded DNA.

B The genome of virus E is double-stranded DNA and that of virus Z is single-stranded RNA.

C The genome of virus E is double-stranded RNA and that of virus Z is single-stranded DNA.

D The genome of virus E is double-stranded DNA and that of virus Z is double-stranded RNA.

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