EUNOIA JUNIOR COLLEGE
JC1 Promotional Examinations 2021
General Certificate of Education Advanced Level
Higher 2

H2 Biology

Paper 1 Multiple Choice

9744/01

05 October 2021

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use paper clips, glue or correction tape/fluid.
Write your name, civics group and registration number on the Answer Sheet in the spaces provided.

There are **thirty** Multiple Choice 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 very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

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

1 Raffinose is a trisaccharide which can be degraded by enzymes. The results of two different enzymatic incubations are shown here:

enzyme used	products
sucrase	melibiose and fructose
galactosidase	galactose and sucrose

Which statements are consistent with the results shown above?

1 Raffinose is composed of two different monosaccharides.

2 Melibiose is a dissaccharide.

3 Acid hydrolysis of raffinose would yield glucose.

4 The products of raffinose digestion by sucrase and galactosidase will each yield an orange-red precipitate when heated with Benedict's reagent.

A 1 and 3 only

B 2 and 4 only

C 2, 3 and 4 only

D 1, 2, 3 and 4

2 In triglyceride molecules, where are carbon-carbon double bonds located?

A between fatty acids and glycerol

B within fatty acids and within glycerol

C within fatty acids only

D within glycerol only

3 Which correctly matches the functional and structural features of cellulose, collagen, glycogen and triglyceride?

		function	structure		
			fibrous	molecule held together by hydrogen bonds	branched chains
A	cellulose	support	✓	✓	×
	triglyceride	energy source	×	×	×
B	collagen	strengthening	✓	✓	×
	cellulose	support	✓	×	✓
C	collagen	strengthening	✓	✓	✓
	glycogen	storage	×	×	✓
D	glycogen	storage	×	✓	✓
	triglyceride	energy source	×	✓	×

key: ✓= true ✗= false

4 Which row about the structure of proteins is correct?

	primary structure	tertiary structure	quaternary structure
A	is the number of amino acids present in a protein	is the result of cross bonding between all the amino acids in the primary structure	is the polypeptides that link together to form a protein
B	is the order of amino acids present in a protein encoded by DNA	is the shape formed by folding of a polypeptide and held together by hydrogen bonds	contains two types of polypeptide that interact forming the shape of a protein
C	is the result of translation of an mRNA molecule by a ribosome into a chain of amino acids	is the result of ionic and hydrogen bonds, disulfide bridges and hydrophobic interactions between amino acids	is formed by four polypeptides and an additional reactive group attached to the protein
D	is the sequence of amino acids in a protein coded by an mRNA molecule	is formed as a result of interaction of the side chains of amino acids in the primary structure	is formed by the linking together of more than one polypeptide to form a protein

5 During the development of HIV, the polyprotein is hydrolysed by a HIV protease enzyme, producing several smaller peptides. This viral enzyme is the target of new anti-AIDS drugs.

Which feature is essential for the success of these drugs?

A A complex structure that inhibits many types of viral and non-viral enzymes.

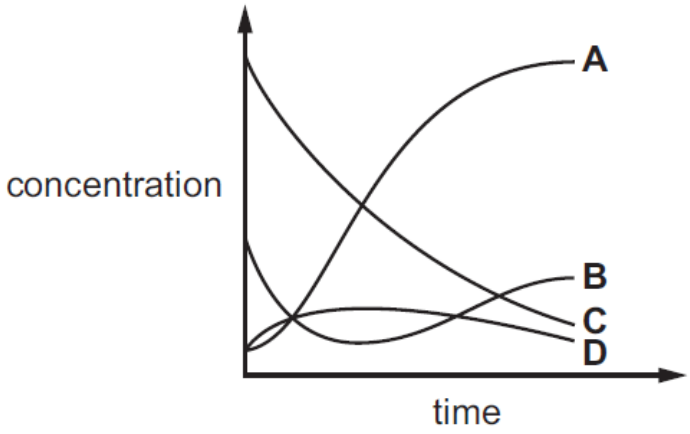
B A molecule containing a heavy metal atom that is a non-competitive inhibitor of enzymes.

C A protein that can act as a competitive inhibitor of protease enzymes.

D A specific structure that inhibits only HIV protease.

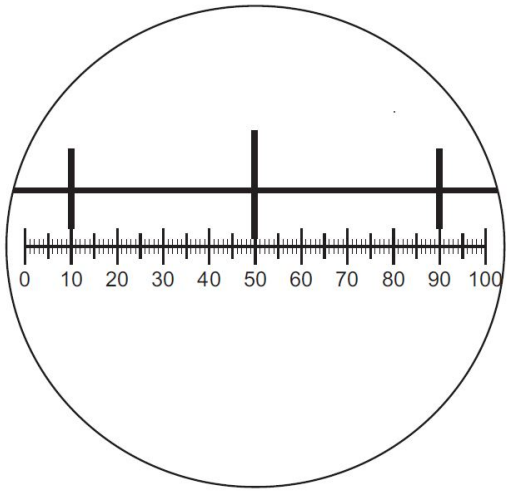
6 The graphs show how the concentration of different components of an enzyme-catalysed reaction (e.g. substrate, active sites) changes with time.

Which graph represents enzymes with empty active sites?

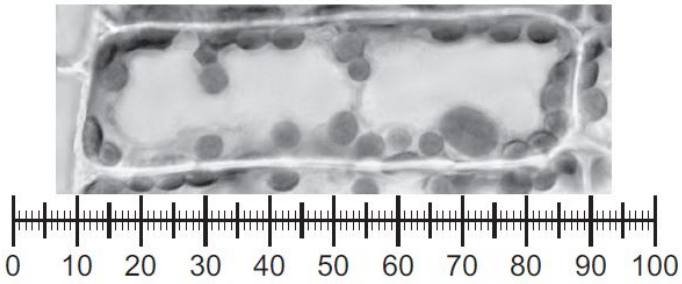


7 The diagram shows a stage micrometer scale viewed through an eyepiece containing a graticule.

Each small division of the stage micrometer scale is 0.1 mm.



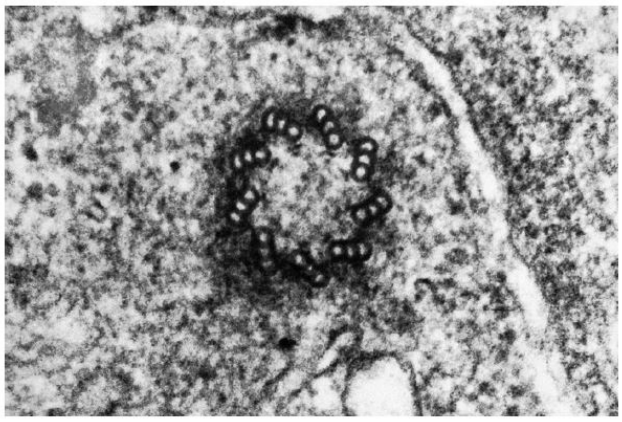
The stage micrometer scale is replaced by a slide of a plant cell.



What is the actual length of the nucleus in the plant cell?

A 8 μm **B** 25 μm **C** 200 μm **D** 0.8 mm

8 The electron micrograph shows a cell structure in a eukaryotic cell.



Which statement(s) about this cell structure is/are correct?

1 ATP is synthesised in this cell structure.

2 The cell structure is made of protein molecules.

3 The cell structure replicates during interphase of the cell cycle.

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

9 Which description of cell surface membrane permeability is correct?

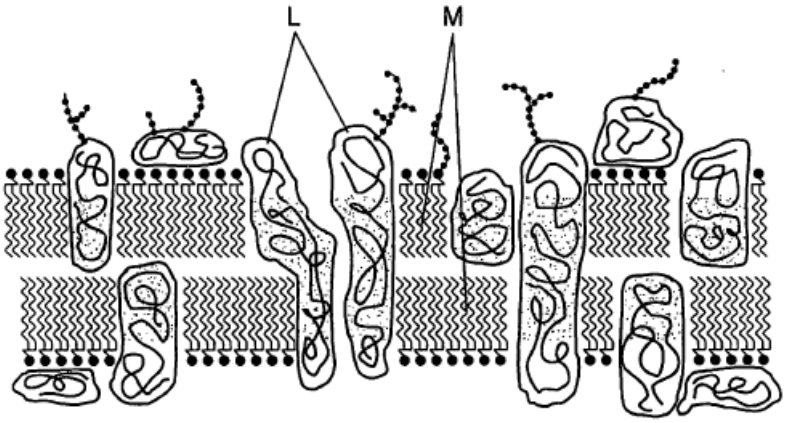
A An increase in the concentration of cholesterol molecules in the cell surface membrane can increase its permeability to hydrophilic substances.

B Cell surface membrane permeability to large hydrophilic molecules is high and can be increased by membrane transport proteins involved in facilitated diffusion.

C The permeability of the cell surface membrane to ions increases as the proportion of saturated fatty acid chains in the phospholipids increases.

D Without the presence of carrier and channel membrane proteins, the cell surface membrane has a low permeability to large polar molecules.

10 The diagram below shows part of the cell surface membrane of an animal cell.



Which statement(s) correctly describe(s) the movement of molecule(s) across this membrane?

1 Oxygen diffuses through molecules M.

2 Water may move through L via osmosis.

3 L has hydrophilic R groups that may allow facilitated transport of water.

4 Water may pass through M via osmosis.

A 4 only

B 1 and 3 only

C 1, 2 and 3 only

D All of the above

11 When living pancreatic cells were placed in a solution of a red stain called neutral red, the cytoplasm became red. The cells were then removed from the solution of neutral red.

The red stain in the cytoplasm moved into vesicles, which were exported from the cell, eventually leaving the cell colourless.

In another experiment, a respiratory inhibitor was placed into the solution and the cell remained colourless.

Which transport mechanism(s) could explain how the red stain entered and left the cells?

A active transport

B osmosis and exocytosis

C facilitated diffusion and endocytosis

D active transport and exocytosis

12 The following statements describe various nucleic acids in eukaryotes.

1 a polynucleotide of variable length formed by a process which involves complementary base pairing

2 a small polynucleotide with a specific three-dimensional shape

3 a large polynucleotide with a specific shape associated with proteins

4 a large polynucleotide with supercoiled sections associated with proteins

Which row correctly matches the description to the function of the nucleic acid?

	carrier of specific amino acids	catalyst of protein synthesis	carrier of coded information	long-term storage of coded information
A	2	4	3	1
B	3	2	4	1
C	2	3	1	4
D	1	3	2	4

13 Which statement(s) about DNA polymerases and RNA polymerases is/are correct?

1 They read the DNA template in the 3’ to 5’ direction.

2 They catalyse the formation of hydrogen bonds between complementary base pairs.

3 They read the terminator sequence and stop adding nucleotides to nucleic acid chains.

4 They bind to the same specific sequences to start their processes.

A 1 and 3

B 2 and 3

C 1 only

D 4 only

14 The following steps describe a method to study the structure and localisation of protein kinase c in yeast cells.

- tRNAs with anticodon AAG were isolated and chemically modified to carry their specific fluorescent amino acids.
- During translation, chemically modified amino-acyl tRNAs bind to the large ribosomal subunit.
- Fluorescent amino acids are incorporated into the elongating polypeptide chain.
- After translation, the polypeptide chain folds into its native conformation and the positions of the fluorescent amino acids can be detected and studied.

Which of the following describes a condition which will allow the above method to be carried out?

A Amino-acyl tRNA synthetase is specific to the fluorescent amino acid and chemically modified tRNA in order to form modified amino-acyl tRNA.

B Peptidyl transferase is specific to the fluorescent amino acid and the elongating polypeptide chain in order to catalyse the formation of a peptide bond.

C The ribosome is specific to the mRNA sequence in order to synthesise protein kinase c.

D Chemically modified amino-acyl tRNA is specific to the P site of a large ribosomal subunit in order to add the fluorescent amino acid to the elongating polypeptide chain.

15 Below are descriptions of different gene mutations.

1 deletion toward the end of the coding sequence

2 insertion in the middle of coding sequence

3 substitution close to the beginning of the coding sequence

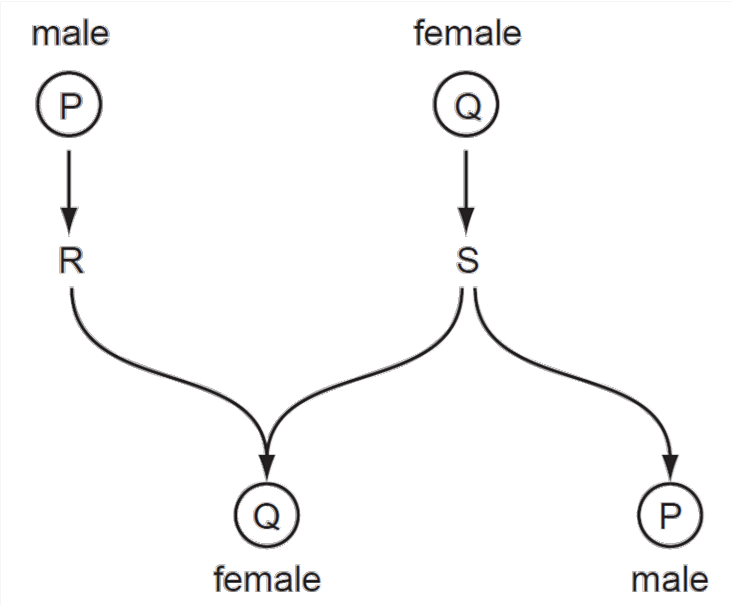
Which row correctly identifies the possible effects of these mutations on the synthesis of polypeptides?

	premature ending of a polypeptide	a non-functional polypeptide	a polypeptide with unchanged function	a polypeptide with a different function
A	1, 2, 3	1, 2, 3	1, 2, 3	1, 2, 3
B	1, 2, 3	2 only	1, 3 only	1, 2 only
C	1, 3 only	1, 2, 3	3 only	1, 2, 3
D	2, 3 only	2, 3 only	1, 2, 3	2, 3 only

16 What are the conditions in a human cell just before the cell enters prophase?

	number of chromatids	number of molecules of DNA in nucleus	spindle present	nuclear envelope present
A	46	46	yes	no
B	92	46	no	yes
C	46	92	yes	yes
D	92	92	no	yes

17 Sex determination in some insects, such as bees and wasps, is not controlled by sex chromosomes, but by ploidy level. Males are haploid, while females are diploid.

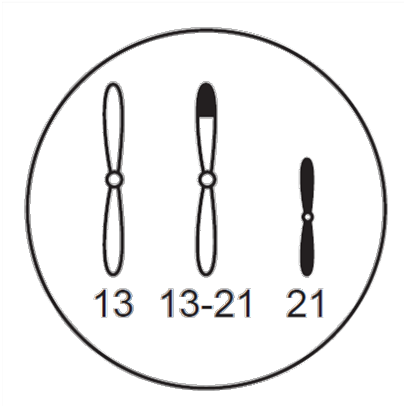


Which row correctly describes P, Q, R and S?

	P	**Q**	**R**	**S**
A	n	n	mitosis	mitosis
B	n	2n	mitosis	meiosis
C	2n	n	meiosis	meiosis
D	2n	2n	meiosis	mitosis

18 Down's syndrome can be caused by a trisomy of chromosome 21, but can also result from translocation of chromosome 21 onto chromosome 13, forming a single chromosome 13-21.

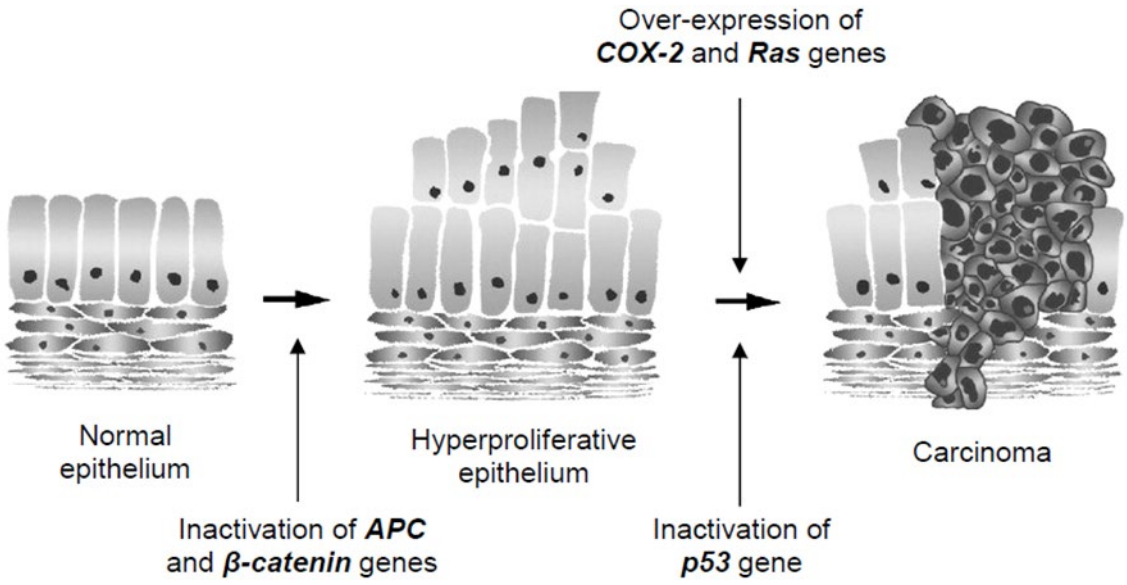
The diagram shows chromosomes 13 and 21 in the nucleus of a diploid (2n) testis cell from a phenotypically normal male carrier of a 13-21 translocation. This cell has a chromosome number of 45.



Which is not a likely outcome of fertilisation of normal oocytes by sperm from this male?

	chromosomes in sperm	embryo
A	13 and 21	2n = 46 normal phenotype
B	13-21	2n = 45 normal phenotype
C	13-21 and 21	2n = 46 Down's syndrome
D	13-21 and 21	2n = 47 Down's syndrome

19 The diagram below illustrates the development of colorectal cancer.



Which of these statements can be inferred from this multistep model of carcinogenesis?

1 Cells whose *APC* and *β-catenin* genes are inactivated have lost contact inhibition.

2 *APC* and *β-catenin* genes are most likely tumour suppressor genes.

3 High levels of *Ras* protein are produced only when both copies of *Ras* gene are mutated.

4 Two copies of normal *p53* alleles must be present to inhibit cell division.

5 Gain-of-function mutation in *COX-2* gene is one of the pre-requisites for the formation of carcinoma.

A 1, 2 and 3

B 1, 2 and 5

C 2, 3 and 4

D 2, 3 and 5

20 Cancer cells may divide by far more divisions than other cells found in humans.

Which statements about cancer cells are correct?

1 They are able to synthesise the enzyme telomerase.
2 They have a mutation in the telomeres so DNA is not hydrolysed.
3 They have DNA polymerase so they can replicate their DNA without telomere loss.
4 They increase the number of copies of repeated DNA sequences in the telomeres.

A 1, 2 and 4

B 1 and 4

C 2 and 3

D 3 and 4

21 The protein retinoblastoma, RB, is a tumour suppressor protein encoded by a single gene on chromosome 13 of the human genome.

On which of the following would mutation most likely result in retinoblastoma cancer?

A One *RB* gene on each chromosome 13.

B One *RB* gene on one chromosome 13.

C Two *RB* genes on each chromosome 13.

D One *RB* gene on one chromosome 13 and the other *RB* gene, by translocation, on one chromosome 6.

22 Which statement correctly describes a role of histone proteins?

A All eukaryotic genes are transcribed continuously because they are not packaged by histones.

B DNA must be selectively released from its histone packaging before transcription can occur in bacteria.

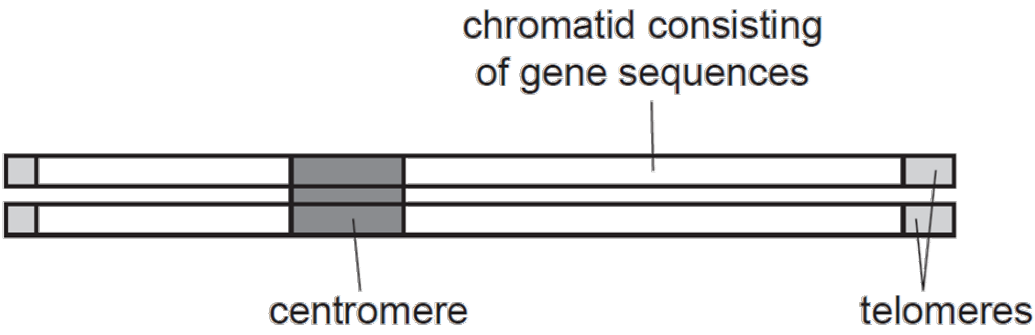
C Histones package prokaryote chromatin into the nucleosomes that form the bulk of the chromosome.

D The organisation of DNA by histones in eukaryotes allows some gene control sequences to be thousands of base pairs away from the gene concerned.

23 In order to replicate, the ends of a eukaryotic chromosome contain a special sequence of DNA called a telomere. Human telomeres consist of repeating TTAGGG sequences which extend from the ends of the chromosomal DNA.

When cells undergo mitotic division, some of these repeating sequences are lost. This results in a shortening of the telomeric DNA.

The diagram shows a eukaryotic chromosome.



What is a consequence of the loss of repeating DNA sequences from the telomeres?

A The cell will begin the synthesis of different proteins.

B The cell will begin to differentiate as a result of the altered DNA.

C The number of mitotic divisions the cell can make will be limited.

D The production of mRNA will be reduced.

24 The table shows a comparison between the genomes of a prokaryote and a eukaryote.

Feature	Prokaryote	Eukaryote
Genome length (base pairs)	4 640 000	12 068 000
Number of proteins	4 300	6 200
Proteins with roles in metabolism	650	650
Proteins with roles in energy release	240	175
Proteins with roles in protein synthesis	410	750

Which feature of eukaryotes accounts for the differences in the number of proteins with roles in protein synthesis?

A The DNA of eukaryote has histones.

B The DNA of eukaryote has introns.

C The DNA of eukaryote has more base pairs.

D The DNA of eukaryote has less base pairs.

25 Hepatitis C virus (HCV) can only replicate by injecting its genome into human cells upon infection. HCV is a positive–sense RNA virus, i.e. its genomic material is RNA that can be used for translation immediately.

Which of the following are most likely **not** needed for HCV replication?

1 DNA–dependent RNA polymerase

2 Reverse transcriptase

3 Ribosomes

4 RNA–dependent RNA polymerase

A 1 and 2

B 1 and 3

C 1, 2 and 4

D 1, 3 and 4

26 Which of the following are valid comparisons between the replication cycles of lambda phage and HIV?

1 Both replication cycles involve uncoating to release viral genome into the cytoplasm.

2 The protein involved in receptor binding for HIV is attached with short carbohydrate chains but not lambda phage.

3 The synthesis of viral proteins in both viruses involves transcription of viral DNA and translation.

4 Both involve the insertion of viral DNA into host genome and may cause insertional mutagenesis leading to uncontrolled cell division.

5 The replication cycle of HIV involves enzymes not coded by the host genome but not lambda phage.

A 1 and 4

B 2 and 3

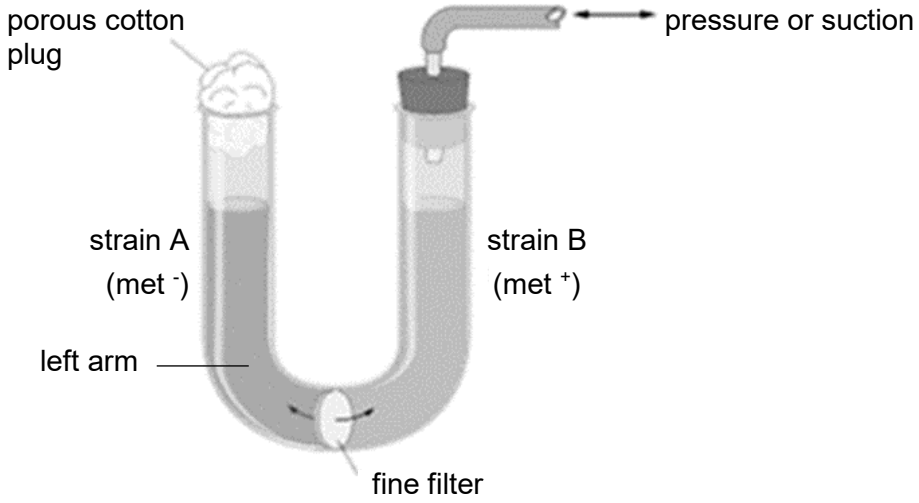
C 2, 4 and 5

D 1, 3 and 5

27 Which row correctly describes antigenic drift and antigenic shift?

	antigenic drift	antigenic shift
A	achieved by reassortment of gene segments	achieved by accumulation of mutations
B	new viral strain may infect hosts of the same species	new viral subtype may infect hosts in a different species
C	occurs less frequently	occurs more frequently
D	results in major antigenic change	results in minor antigenic change

28 To investigate gene transfer by transduction between bacteria, two strains of the same bacterial species were each placed in different arms of a U-tube with a filter separating them.



met $^{+}$ is a wild-type gene that codes for the bacteria's normal ability to synthesise the essential amino acid, methionine.
met $^{-}$ indicates that the *met* $^{+}$ gene has been mutated.

Bacteria with normal wild-type genes can synthesise all the essential amino acids even if grown on a minimal medium (with no essential amino acids).

Liquid may be transferred between the arms of the tube by the application of pressure or suction, but particles that are larger than the filter pore size would not be able to pass through the fine filter.

type of particle	size
bacteria	1 – 10μm
bacteriophages	0.025 – 0.2μm

After several hours of incubation, bacterial cells from the left arm of the tube are grown in a separate minimal medium.

Which pair of experimental results best shows that transduction was most likely the process responsible for gene transfer between strains A and B?

	filter pore size	growth of colonies on minimal medium
A	5μm	yes
	0.1μm	yes
B	5μm	no
	0.1μm	no
C	0.45μm	yes
	0.02μm	yes
D	0.45μm	yes
	0.02μm	no

29 In the gene regulation of the *lac* operon, which event takes place in the absence of lactose?

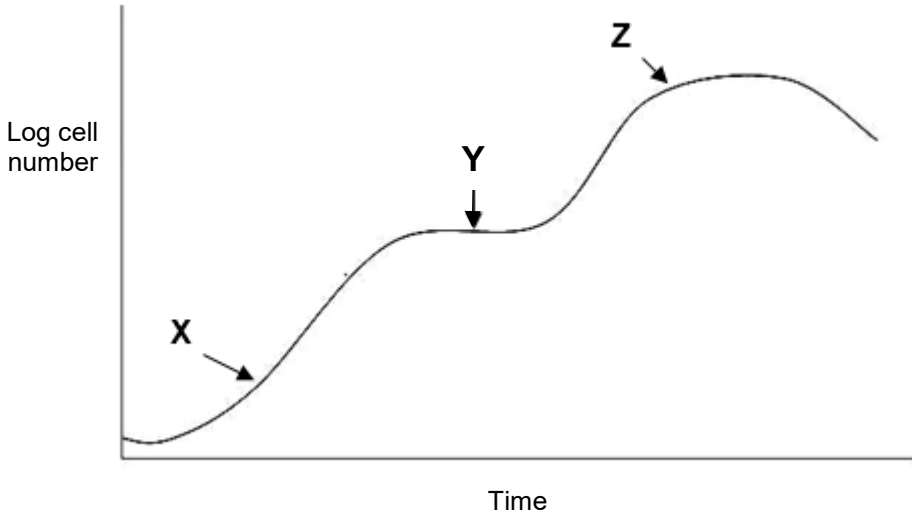
A Regulator protein prevents binding of RNA polymerase so no mRNA is produced.

B Regulator protein binds to lactose.

C Regulator protein binds to DNA polymerase.

D Regulator protein binds to mRNA.

30 *E. coli* bacteria are grown in a culture of nutrients, which includes glucose and lactose as the main source of carbon-based nutrient. The following growth curve is obtained.



Which row is correct?

	CAP activated	high amounts of *lac* polycistronic mRNA	repressor inactivated
A	X only	X and Y only	Y and Z only
B	Y only	X and Y only	X, Y and Z
C	Y and Z only	Z only	Y and Z only
D	Y and Z only	Y and Z only	X, Y and Z

– End of Paper –