EUNOIA JUNIOR COLLEGE
JC1 Promotional Examinations 2020
General Certificate of Education Advanced Level
Higher 2

H2 Biology

Paper 1 Multiple Choice

9744/01

02 October 2020

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 **21** printed pages and **1** blank page.

BLANK PAGE

1 Both α-amylase and β-amylase can hydrolyse α-1,4-glycosidic bonds, but not α-1,6-glycosidic bonds.

α-amylase acts randomly within polysaccharides and can produce glucose, maltose, trisaccharides and short, branched chains.

β-amylase acts at the ends of polysaccharides to produce maltose molecules.

Which of the following statements about polysaccharide digestion is correct?

A Both α-amylase and β-amylase are needed for the complete digestion of starch to produce only glucose molecules.

B Digestion of amylose by α-amylase will produce branched molecules only.

C Digestion of amylose using β-amylase will yield a higher proportion of disaccharides than digestion using α-amylase.

D Disaccharides can be produced from the digestion of cellulose using β-amylase, but not α-amylase.

2 The table below shows the percentages of carbon, hydrogen and oxygen atoms in molecules X, Y and Z.

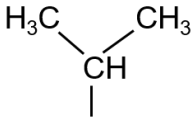
molecule	% carbon	% hydrogen	% oxygen
X	25.0	50.0	25.0
Y	28.5	47.7	23.8
Z	34.6	61.6	3.8

Which row correctly identifies molecules X, Y and Z?

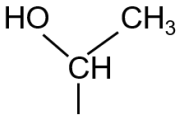
	X	Y	Z
A	monosaccharide	disaccharide	polysaccharide
B	monosaccharide	polysaccharide	triglyceride
C	polysaccharide	triglyceride	monosaccharide
D	triglyceride	monosaccharide	polysaccharide

3 Threonylvaline is a dipeptide formed from two amino acids, valine and threonine. A peptide bond forms between the amino group of valine and carboxyl group of threonine.

The R groups of the two amino acids are shown.



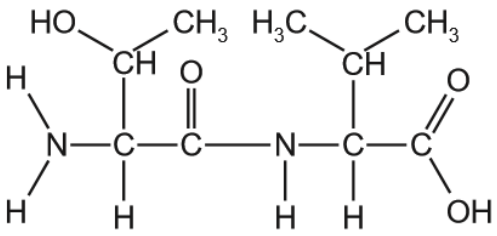
valine



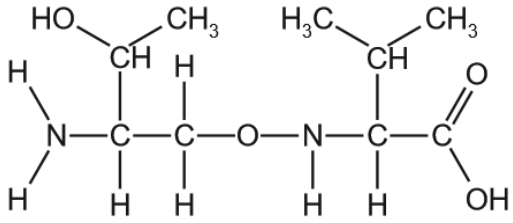
threonine

Which of the following is the molecular structure of threonylvaline?

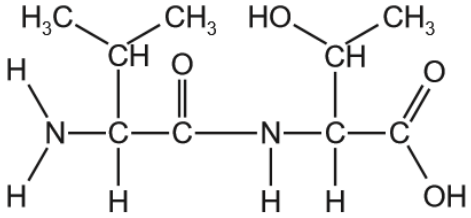
A



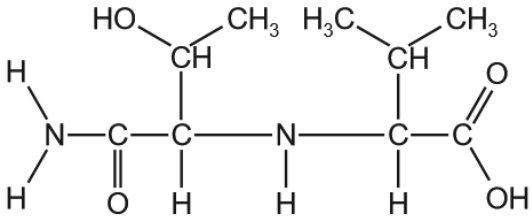
B



C

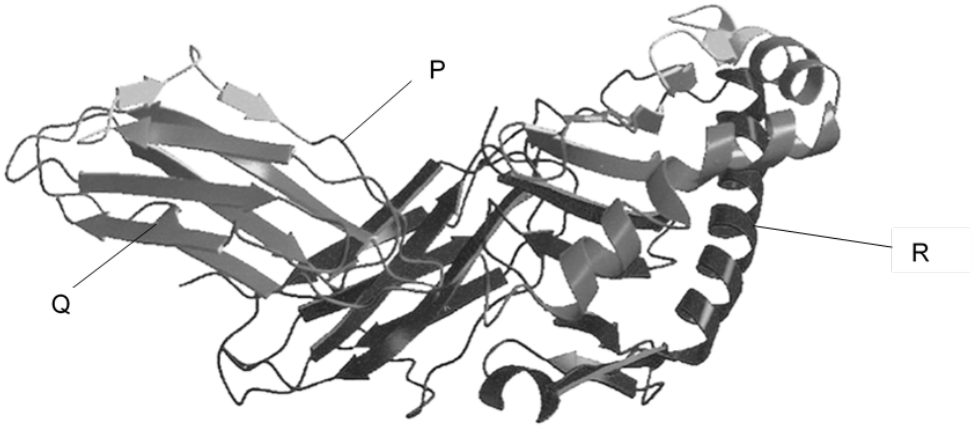


D



4 The diagram shows the structure of HLA-DR1, which is a cell surface membrane receptor.

HLA-DR1 consists of two polypeptides. Parts of the protein are labelled P, Q and R.



Which of the following statements about HLA-DR1 is **not** true?

A In the formation of structure P, peptide bonds are formed between adjacent amino acids via condensation reactions.

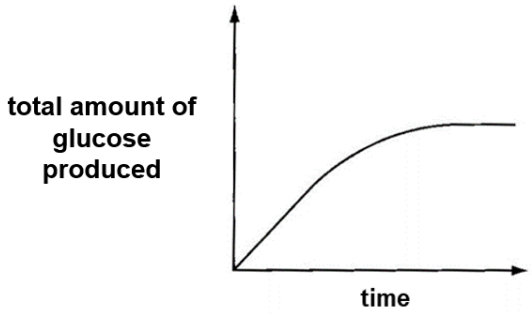
B Q is important for the folding of the polypeptide into a specific 3D conformation.

C Structure R is formed by hydrogen bonding between R groups.

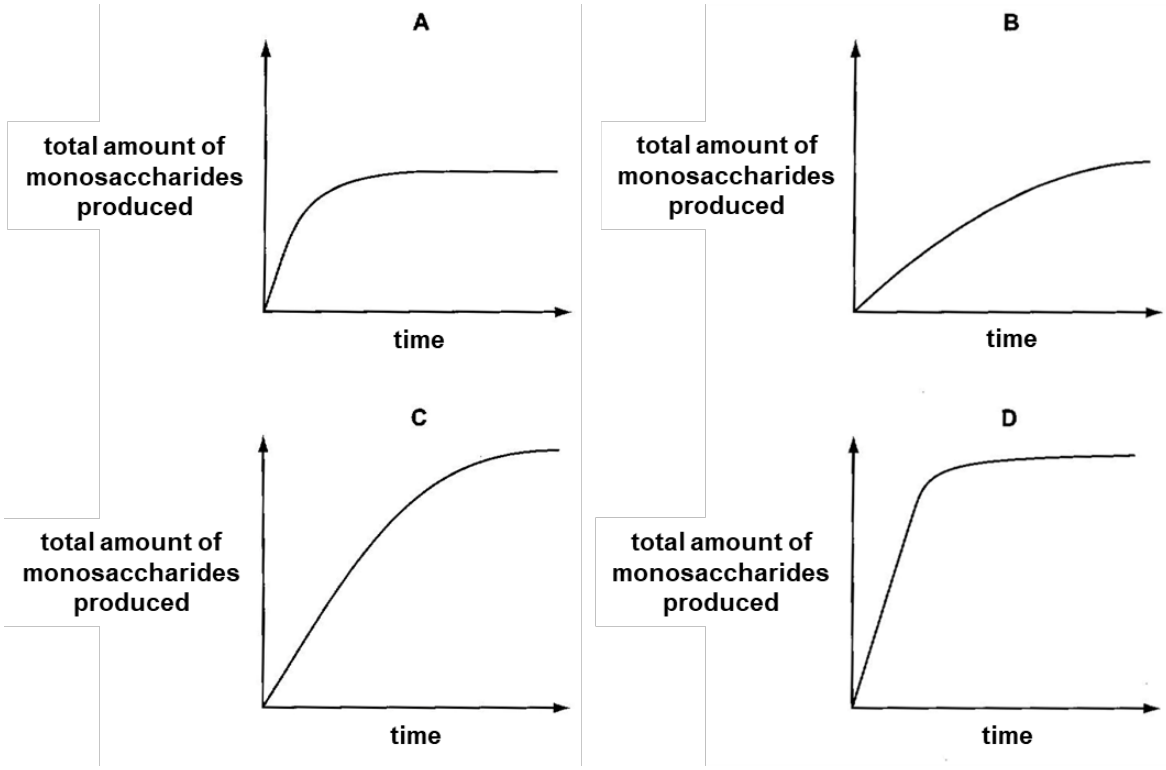
D Structures P, Q and R play a role in the formation of the quaternary structure of HLA-DR1.

5 Lactose is a disaccharide present in milk.

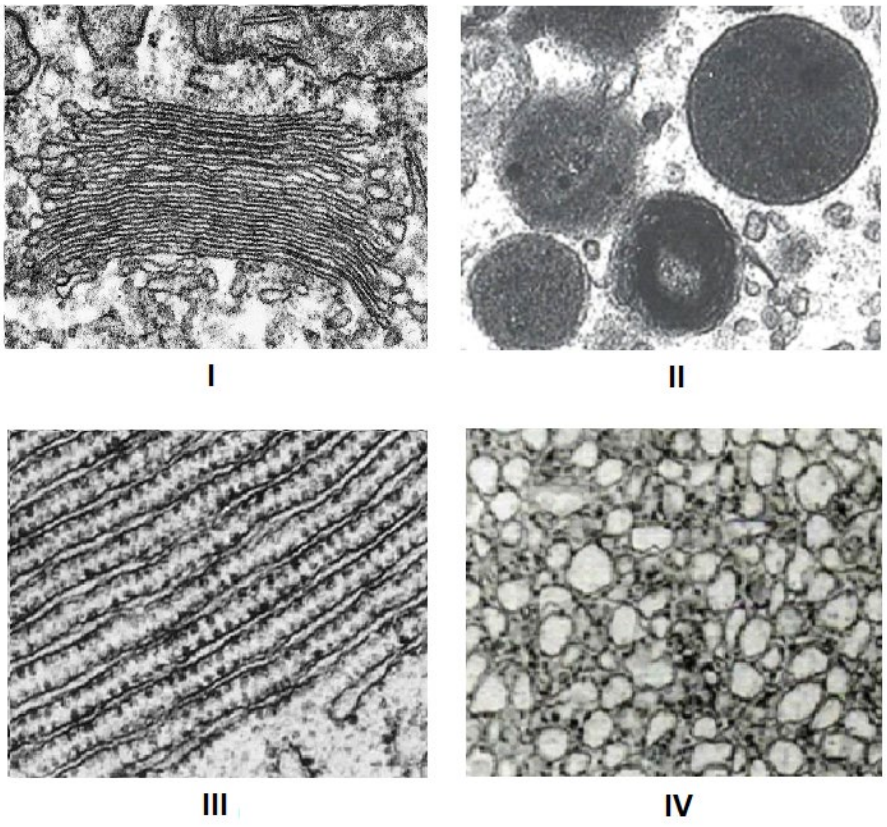
5 cm^3 of 1% β-galactosidase solution was added to 10 cm^3 of milk. The graph shows the total amount of glucose produced over ten minutes.



Which of the following graphs would be obtained when 5 cm^3 of a 2% β-galactosidase solution is added to 5 cm^3 of milk?



6 The diagram shows electron micrographs of four organelles under different magnifications.

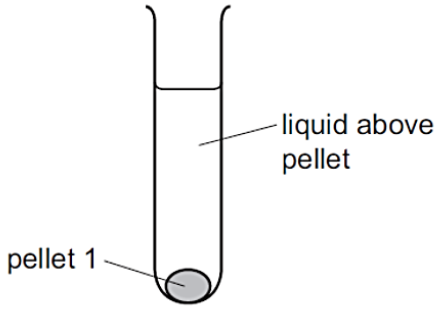


Which row correctly identifies the functions of these organelles?

	I	II	III	IV
A	attachment of carbohydrate group to protein	folding of secretory proteins	compartmentalises hydrolytic enzymes to prevent autolysis	increases surface area for synthesis of carbohydrates
B	folding of secretory proteins	increases surface area for synthesis of carbohydrates	attachment of carbohydrate group to protein	synthesis of lysosomes
C	synthesis of lysosomes	compartmentalises hydrolytic enzymes to prevent autolysis	folding of secretory proteins	increases surface area for synthesis of carbohydrates
D	folding of secretory proteins	compartmentalises hydrolytic enzymes to prevent autolysis	synthesis of lysosomes	attachment of carbohydrate group to protein

7 Differential centrifugation is carried out to separate cell structures in animal cells.

A sample of cells was lysed to release the cell structures before the extract was filtered into a centrifuge tube and spun in a centrifuge. The diagram below shows the centrifuge tube after the first round of centrifugation.



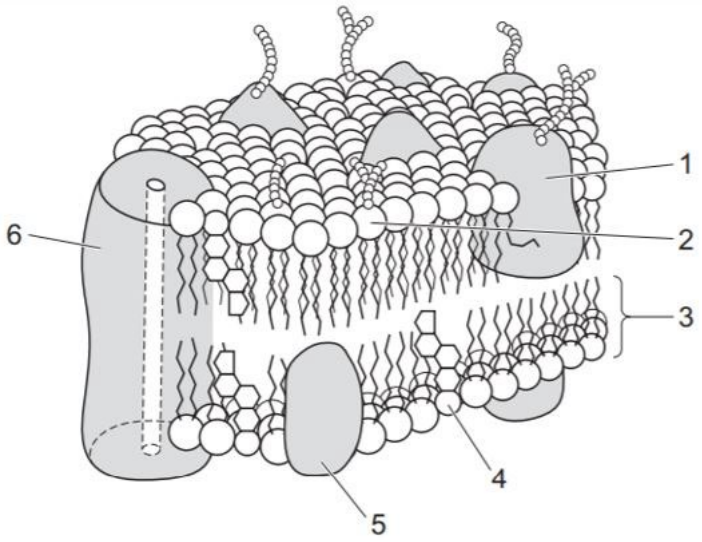
The liquid above pellet 1 was poured into a clean centrifuge tube and spun in the centrifuge at a higher speed to obtain pellet 2.

This procedure was repeated two more times to obtain pellet 3 and pellet 4.

Which row correctly indicates the order in which the cell structures were collected?

	pellet 1	**pellet 2**	**pellet 3**	**pellet 4**
A	nucleus	mitochondria	lysosomes	ribosomes
B	nucleus	lysosomes	mitochondria	ribosomes
C	ribosomes	lysosomes	mitochondria	nucleus
D	ribosomes	mitochondria	lysosomes	nucleus

8 The diagram shows the constituent biomolecules in a cell membrane.

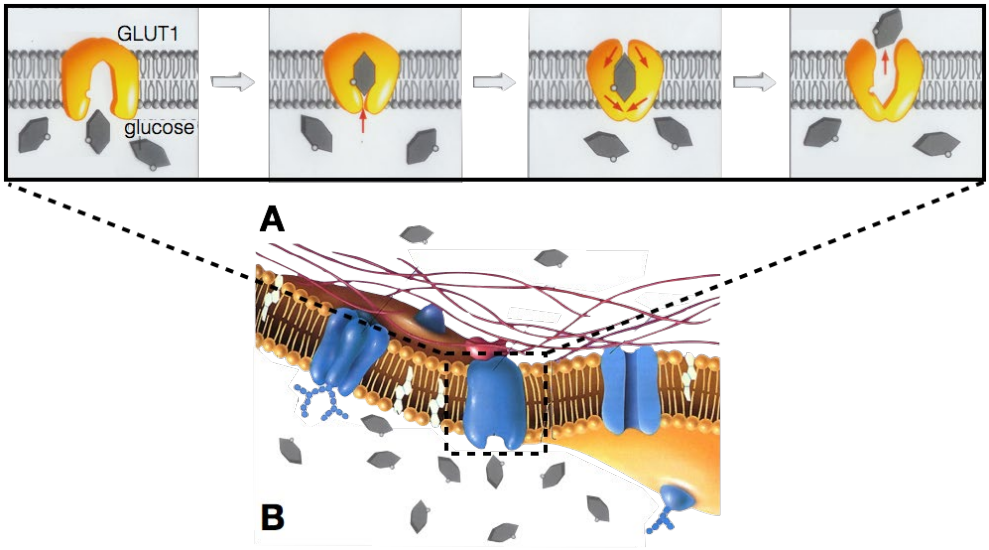


Which row correctly identifies the functions of two of the labelled molecules?

	molecule	function	molecule	function
A	1	allows tissue formation	4	regulates the fluidity of the membrane
B	2	acts as an receptor	5	active transport
C	3	facilitated diffusion	4	regulates the fluidity of the membrane
D	6	bulk transport	5	acts as an enzyme

9 Glucose Transporter (GLUT-1) is a carrier protein in the cell surface membrane of cells throughout the body.

The diagram below illustrates its mechanism in transporting glucose.



The following statements were made.

1 As glucose is a polar molecule, it cannot diffuse directly across the cell surface membrane.

2 There is a net movement of glucose molecules from **A** to **B** through the hydrophilic pore of GLUT-1.

3 GLUT-1 pumps glucose across the membrane via active transport.

4 GLUT-1 undergoes conformational changes upon binding of glucose at its binding site.

Which of the following statements are **incorrect**?

A 1 and 4

B 1 and 3

C 2 and 4

D 2 and 3

10 A DNA molecule comprising 19-base pair was analysed to determine the number of nucleotide bases in each of the two strands. An incomplete set of data is shown in the table below.

	number of nucleotide bases			
	A	C	G	T
strand 1				4
strand 2		7		5

How many hydrogen bonds are present in this DNA molecule?

A 38 **B** 48 **C** 39 **D** 57

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

strain	**characteristics**	**possible reason**
1	Okazaki fragments accumulate and daughter strand is incomplete.	DNA ligase activity is missing.
2	Supercoils remain at the flanks of the replication bubbles.	DNA helicase has low levels of activity.
3	DNA synthesis is very slow.	DNA polymerase has low affinity for binding to DNA.
4	Replication is not initiated.	A segment at origin of replication is deleted.

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

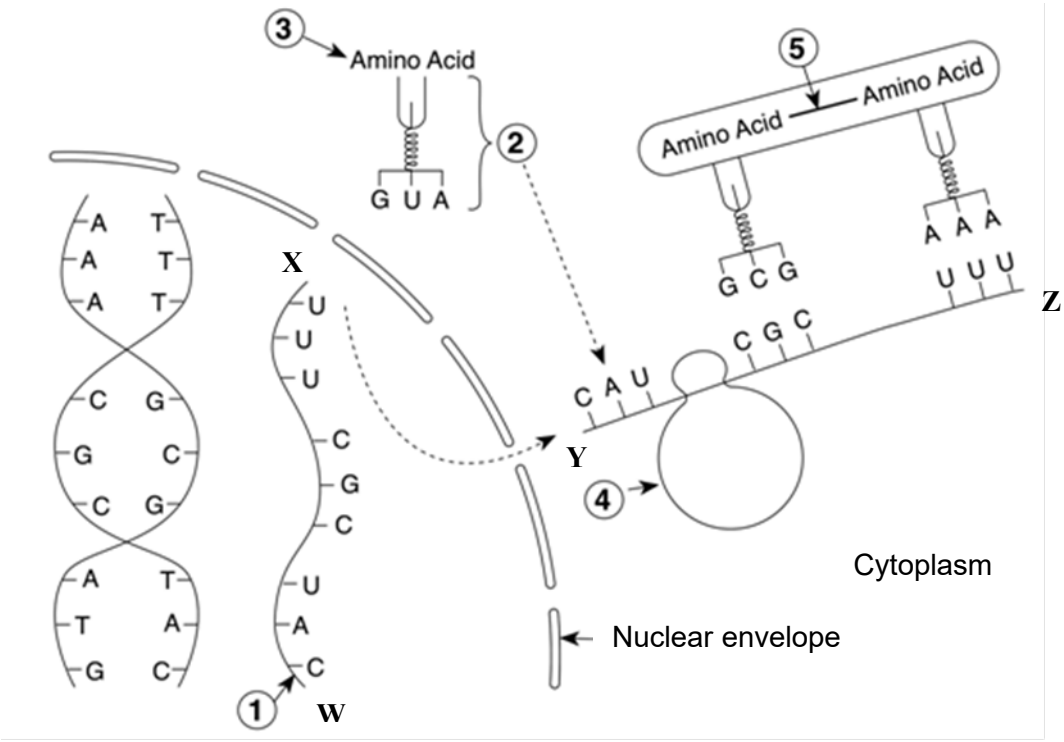
A 2 and 3

B 1 and 4

C 1, 3 and 4

D All of the above

12 The diagram shows biochemical reactions involved in protein synthesis.



Which of the following options is correct?

	entire molecule transcribed from DNA	5' end of molecule	enzyme involved in catalysing bond 5
A	1 and 2	**Z**	peptidyl transferase
B	1 and 2	**Y**	aminoacyl tRNA synthetase
C	1, 2 and 3	**X**	aminoacyl tRNA synthetase
D	1, 2 and 4	**W**	peptidyl transferase

13 The 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.

U	**A**	**U**	**A**	**A**	**G**	**A**	**G**	**G**	**C**	**C**	**U**	**U**	**G**	**G**
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

With reference to the information provided, which of the following predictions is **false**?

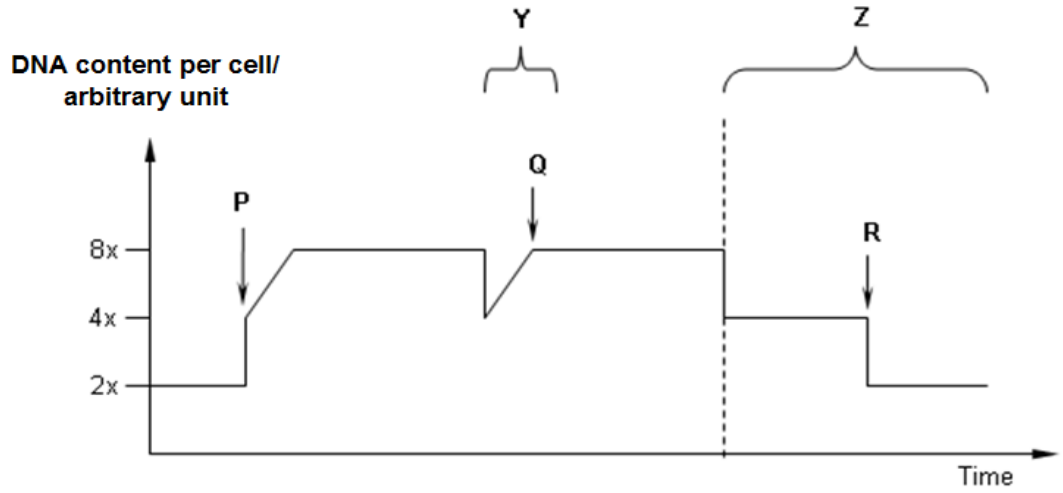
A Insertion of a nucleotide between positions 3 and 4 is expected to cause a greater change in the amino acid sequence than an insertion between positions 12 and 13.

B Deletion of a nucleotide at position 5 would only result in a change of the second amino acid in the chain.

C Substitution of a different nucleotide at position 12 would not change the amino acid chain.

D Substitution of a different nucleotide at position 13 would lead to a change of one amino acid.

14 The graph represents the changes in the DNA content within a cell.



Which row correctly identifies the events occurring at **P**, **Q**, and **R**, and the stage where meiosis is occurring?

	P	Q	R	meiosis occurring
A	S phase	fertilisation	cytokinesis	Y
B	fertilisation	interphase	cytokinesis	Z
C	S phase	prophase	telophase	Y
D	fertilisation	metaphase	telophase	Z

15 No crossing over occurs during meiosis in male fruit flies (*Drosophila melanogaster*).

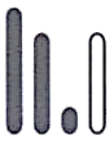
The diagram below shows the four pairs of homologous chromosomes present in a testis cell of a male fruit fly.

Assuming meiosis occurs normally, which set of chromosomes in the nucleus of a gamete shows the genetic variation resulting from independent assortment?

A

B

C



D

16 Patau's syndrome is a common autosomal disorder caused by a chromosomal aberration.

- Approximately 80% of infants with Patau's syndrome has a full trisomy of chromosome 13 in all cells.
- The extra chromosome 13 is most often of maternal origin.
- In more than 50% of individuals diagnosed with the syndrome, two of the three chromosomes 13 present are found to be nearly genetically identical.
- The risk of having babies with Patau's syndrome increases with the mother's age.

What can be concluded about chromosome 13 from this information?

A Non-disjunction occurs more frequently during meiosis I than in meiosis II.

B Non-disjunction occurs most commonly in mitosis of developing female foetuses.

C Non-disjunction commonly occurs during gamete formation in females.

D Two of the three chromosomes 13 are nearly genetically identical due to crossing over between non-sister chromatids of homologous chromosomes.

17 Gene mutations in the *BRCA* genes are responsible for the majority of hereditary breast cancer in humans.

The proteins produced by the *BRCA* genes migrate to the nucleus, where they activate the expression of other genes, such as *p53* and the DNA repair gene, *RAD51*.

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

	gene		
	BRCA	*p53*	*RAD51*
A	✓	✓	✓
B	✓	✓	×
C	✓	×	✓
D	×	×	×

key

✓ = gene produces normal protein

× = gene produces abnormal or no protein

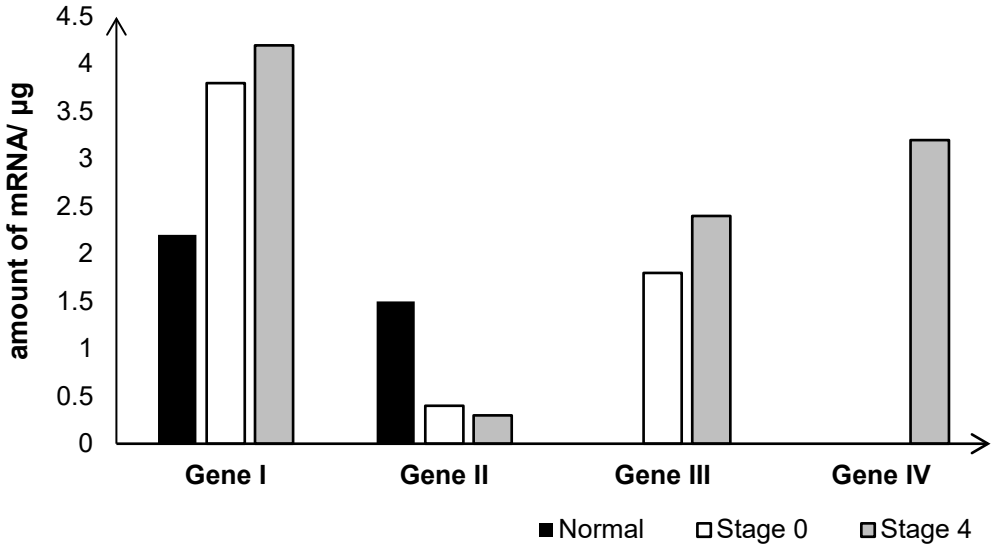
18 When a patient is diagnosed with cancer, the diagnosis will include the stage of the cancer. There are typically five stages, characterised as follows:

stage	description
0	Small localised tumour mass which has not spread to nearby tissues.
1	Small localised tumour mass that has not grown deeply into nearby tissues. It has not spread to the lymph nodes or other parts of the body.
2 and 3	Larger tumour mass which has grown more deeply into nearby tissues. It may has also spread to lymph nodes but not to other parts of the body.
4	Cancer has spread to other organs or parts of the body.

The expression of four genes, **I** to **IV**, was studied in three different individuals:

- Normal (not suffering from cancer)
- Stage 0 cancer
- Stage 4 cancer

All four genes have been implicated in cancer development. The amount of mRNA transcribed from each gene in a somatic cell was quantified, and the results are shown below.

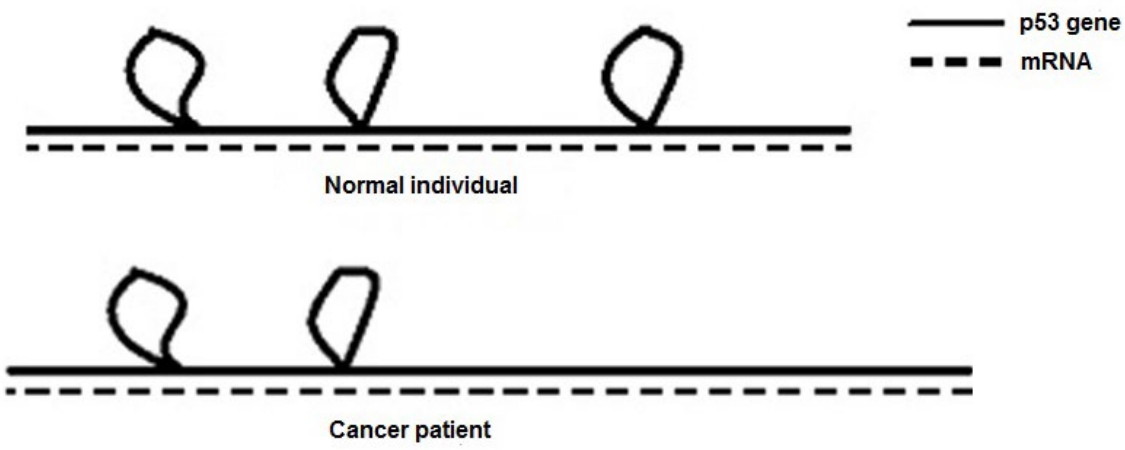


Which of the following correctly identifies genes **I** to **IV**?

	Gene I	**Gene II**	**Gene III**	**Gene IV**
A	tumour suppressor gene	proto-oncogene	gene coding for telomerase	gene involved in metastasis
B	tumour suppressor gene	proto-oncogene	gene involved in metastasis	gene coding for telomerase
C	proto-oncogene	tumour suppressor gene	gene coding for telomerase	gene involved in metastasis
D	proto-oncogene	tumour suppressor gene	gene involved in metastasis	gene coding for telomerase

19 mRNA was isolated from a normal individual and a patient suffering from cancer.

The mRNA was allowed to hybridise (form base pairs) with the *p53* DNA gene sequence. The figure below shows a schematic diagram of the hybridisation process under an electron microscope.



Which of the following statements best explains why the patient is suffering from cancer?

A A point mutation occurred in an intron leading to the failure of spliceosome to recognise the splice site, resulting in a longer dysfunctional protein being produced.

B A point mutation occurred in an intron leading to the failure of spliceosome to recognise the splice site, resulting in a longer hyperactive protein being produced.

C A point mutation occurred in an intron leading to excision of the wrong intron, resulting in a longer degradation-resistant protein being produced.

D Gene amplification occurred leading to the multiple copies of a trinucleotide repeat in an intron, hence causing splice site to be misread due to frameshift mutation, resulting in a longer dysfunctional protein being produced.

20 Which of the following is a feature of prokaryotic gene expression?

A Monocistronic mRNA, rather than polycistronic mRNA, is produced.

B RNA synthesis and protein synthesis occur simultaneously.

C Many genes are interrupted by non-coding sequences.

D mRNA is often extensively modified before translation.

21 Which best describes the correct order of elements in the control of gene expression (from earliest to latest)?

A polyribosome, promoter, spliceosome, primary transcript

B spliceosome, promoter, primary transcript, polyribosome

C promoter, primary transcript, spliceosome, polyribosome

D primary transcript, spliceosome, promoter, polyribosome

22 Which of the following statements about the eukaryotic genome is **false**?

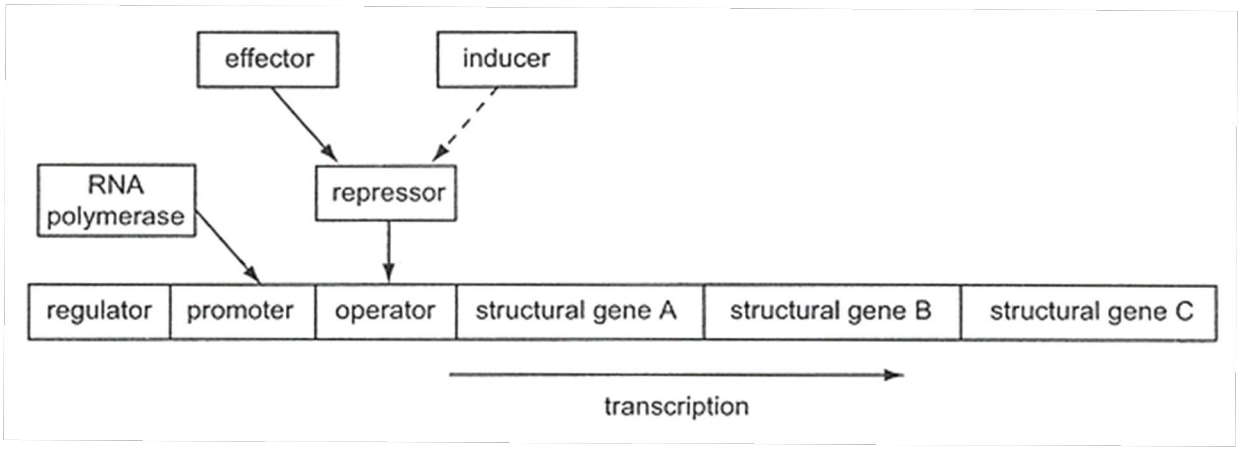
A More than 2 copies of a gene can be found in some cell types during development.

B Different quantities of DNA can be found in different cells of an organism.

C Mutations in non-coding regions can have an effect on the phenotype of an organism.

D In cancer cells, telomeres do not shorten as the end replication problem does not occur.

23 The diagram shows some molecules involved in controlling transcription in bacteria.



The following statements describe the functions of some of the components of the operon.

1 RNA polymerase must bind to the promoter to start transcription of the structural genes.
2 The regulator codes for a repressor.
3 The polypeptide synthesised from the structural gene A acts as an effector.
4 The effector binds the repressor to the operator to block transcription.
5 The inducer prevents the repressor binding.

Which molecule acts as an end product repressor?

A effector

B inducer

C RNA polymerase

D regulator

24 X-gal is a compound that turns from colourless to blue when cleaved by the enzyme beta-galactosidase. This enzyme is coded for by the *lacZ* structural gene, which is part of the *lac* operon in *E.coli*.

E.coli cells are cultured in a medium containing X-gal but deficient in lactose and glucose. Which of the following mutations would result in the formation of blue colonies?

I	A gain-of-function mutation in the gene coding for the catabolite activator protein.
II	A loss-of-function mutation in promoter region of the *lacI* regulatory gene.
III	A loss-of-function mutation which affects the DNA binding site of the Lac repressor
IV	A mutation which leads to the loss of the repressor binding site at the operator.
V	A mutation which leads to the loss of the cAMP binding sites of catabolite activator protein.

A **II** and **III** only

B **I** and **V** only

C **II, III** and **IV** only

D **I**, **II**, **III** and **IV** only

25 Which of the following options shows the most plausible effect of a mutation in the *trpR* gene?

	part of Trp repressor affected by mutation	type of mutation	state of *trp* operon in the presence of tryptophan
A	DNA binding site	gain in function	transcribed
B	DNA binding site	loss of function	not transcribed
C	tryptophan binding site	loss of function	transcribed
D	tryptophan binding site	loss of function	not transcribed

26 Which of the following prevents the lambda prophage from undergoing the lytic cycle?

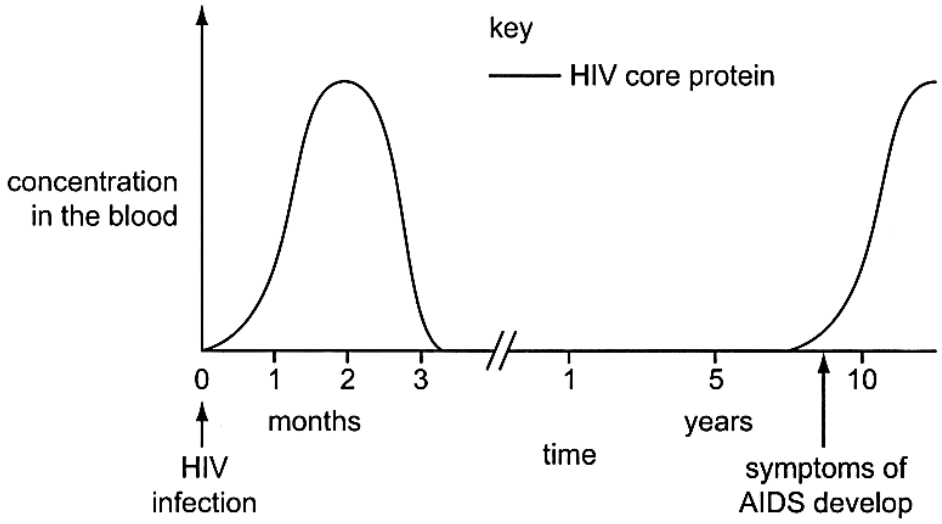
A repressor proteins coded by the prophage's lytic genetic program

B repressor proteins coded by the prophage's lysogenic genetic program

C repressor proteins coded by the host cell's lytic genetic program

D repressor proteins coded by the host cell's lysogenic genetic program

27 The graph shows the changes in the core protein (capsid) concentration of the human immunodeficiency virus (HIV) in the bloodstream after HIV infection. The protein is detected using antibodies.



Which of the following explains the apparent absence of the protein between 3 months and 7 years?

A The core protein attaches to a CD4 receptor so it is not found in the bloodstream.

B The lipid bilayer envelope masks the core protein.

C The patients' own antibodies destroyed the core protein.

D The virus enters the latent phase.

28 Which of the following statements on viral structure are true?

I HIV structure contains a type of RNA-dependent DNA polymerase within the conical capsid.
II The influenza viral genome consists of 8 non-identical segments of negative sense single stranded RNA.
III The binding site of glycoprotein gp41 is complementary in shape and charge to CD4 receptors of T-lymphocytes.
IV Both the lambda phage and the T4 phage have tail fibres.

A I and III only

B II and IV only

C I, II and IV only

D II, III and IV only

29 Some photosynthetic organisms containing chloroplasts that lack photosystem II (PS II) are able to survive.

Which of the following methods would be the best way to detect the lack of PS II in these organisms?

A test for carbon fixation in the dark

B determine the production of starch

C test for liberation of oxygen in the light

D determine if they have thylakoids in the chloroplasts

30 Which of the following processes could still occur in a chloroplast in the presence of an inhibitor that prevents H^+ ions from passing through ATP synthase complexes?

1 sugar synthesis
2 photolysis of water
3 transfer of electrons down the electron transport chain
4 oxidation of NADPH

A 1 and 2

B 1 and 4

C 2 and 3

D 3 and 4

– End of Paper –