



H2 Biology

Paper 1 Multiple Choice

9744/01

20 September 2019

60 minutes

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use paper clips, glue or correction fluid.

Write your name, civics group and registration number on the Answer Sheet in the spaces provided.

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

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

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.

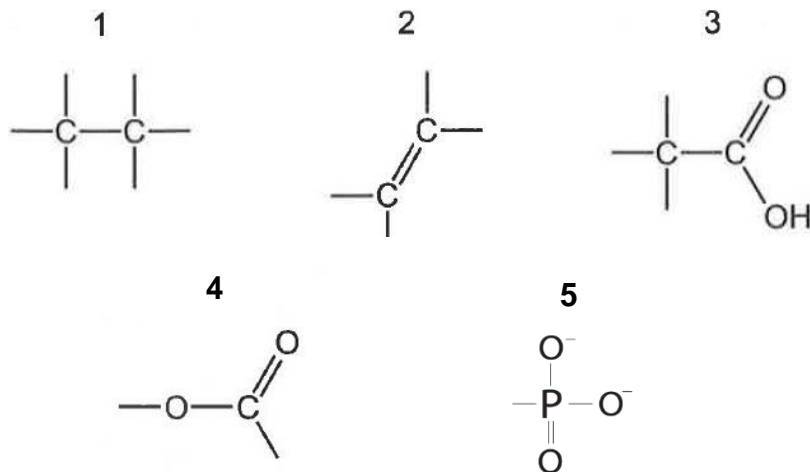
The use of an approved scientific calculator is expected, where appropriate.

ANSWERS

1	B	7	C	13	B	19	D	25	C
2	D	8	C	14	C	20	A	26	C
3	B	9	B	15	D	21	C	27	A
4	B	10	B	16	A	22	C	28	D
5	D	11	A	17	A	23	A	29	B
6	C	12	D	18	C	24	B	30	D

This document consists of **17** printed pages and **1** blank page.

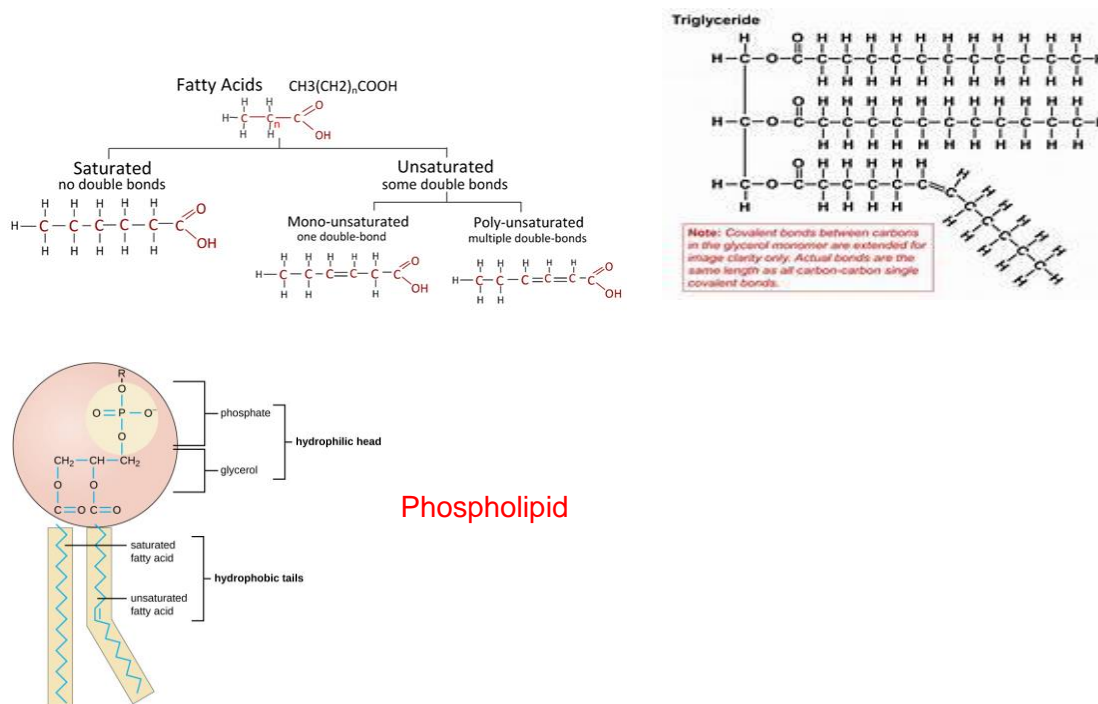
1 Five types of structures found in biomolecules are shown.



Which row correctly matches the biomolecules to the structures which are found within them?

	Unsaturated fatty acid	Saturated fatty acid	Phospholipid	Triglyceride
A	2	1	5	3 (incorrect as it is not found in triglyceride)
B	3	1	5	4
C	3	4 (incorrect)	2	5 (incorrect)
D	4	3	1	2

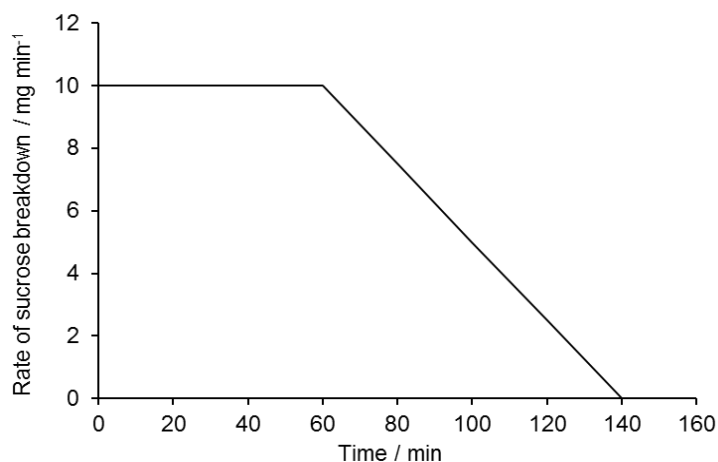
Note the difference between fatty acids vs triglycerides



Both triglyceride and phospholipid have fatty acid components in them. The fatty acids can be saturated or unsaturated.

- 2 The graph shows the results of an investigation using invertase, an enzyme that breaks down sucrose into glucose and fructose.

1 g of sucrose was dissolved in 100 cm³ of water and 2 cm³ of a 1% invertase solution was added.



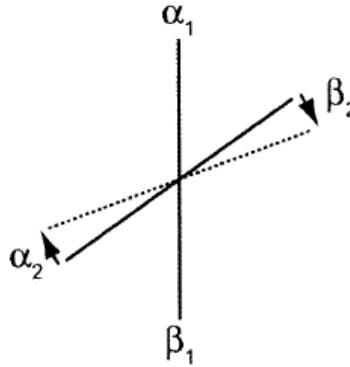
What valid conclusion can be drawn from the graph above?

- A Between 0 and 60 min, the concentration of the substrate remains constant.
- B After 60 min, the concentration of enzymes becomes the limiting factor.
- C At 140 min, some of the enzyme molecules are denatured.
- D Between 60 and 140 min, the concentration of the substrate is the limiting factor.**

Comment: It is limiting as it affected the rate of reaction (sucrose breakdown). Before 60min, substrate wasn't as it was still high in concentration

- 3 A molecule of haemoglobin is made up of two α polypeptide subunits (α_1 and α_2) and two β polypeptide subunits (β_1 and β_2).

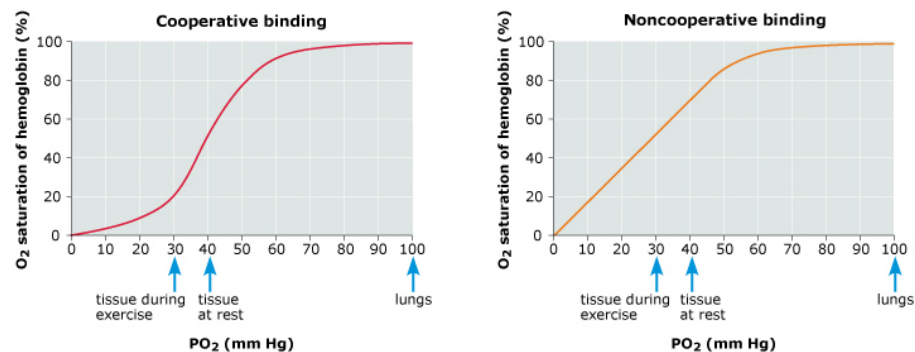
The relative positions of these subunits change when a deoxygenated haemoglobin molecule takes up oxygen. The axis joining the α_2 and β_2 subunits rotates by about 15° in relation to the axis joining the α_1 and β_1 subunits, as shown in the diagram.



Which statements about this rotation are correct?

- 1 The points of contact between the four subunits are altered. **True – as seen by diagram (or by logical thinking?)**
- 2 The rotation resulting from adding one oxygen molecule to one of the subunits makes it easier to add oxygen to the other subunits. **True – due to cooperative binding**
Refer to Protein notes (haemoglobin). For the graphs below, don't need to know the content but good to have an idea of the shape of the graph.

- The x-axis shows the **partial pressure of oxygen (PO₂)**. This is a measure of the amount of oxygen present in a tissue. The blue arrows on the x-axis show the partial pressure of oxygen in various tissues of the body.
- The y-axis shows the **oxygen saturation of hemoglobin (O₂ saturation)**. This is the percentage of oxygen-binding sites on hemoglobin molecules that are actually bound to oxygen.



- 3 The rotation makes different amino acids available for binding oxygen.
False – Recall oxygen binds to Fe²⁺ of the porphyrin ring of the heme group?
- 4 The rotation alters the quaternary structure of the molecule.
True – it affects the interaction between the subunits

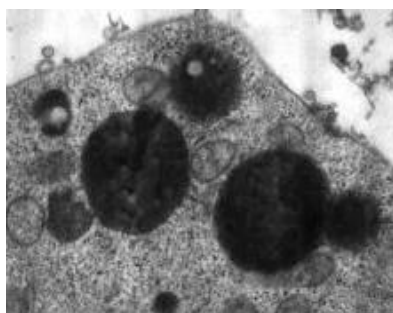
Comment: This question is from TYS 2014 Paper 1. For this kind of question (where the “axis joining” is new to us), go for the “elimination” approach. Hopefully, you managed to identify that statement 2 must be True while statement 3 must be false. By just eliminating statement 3 from the available options, you are only left with Option B.

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

D 2, 3 and 4 only

- 4 In a metabolically active cell, the endomembrane system is an important pathway in the synthesis and processing of molecules like proteins. Figures I, II, III and IV show some of the components of the endomembrane system.

(I)



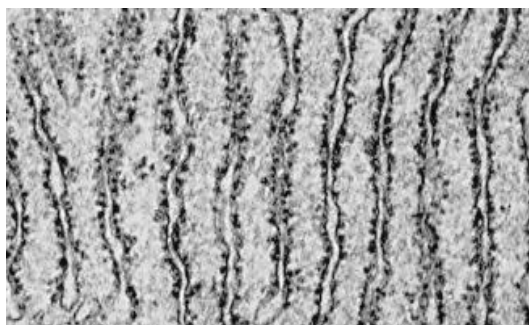
Lysosome

(II)



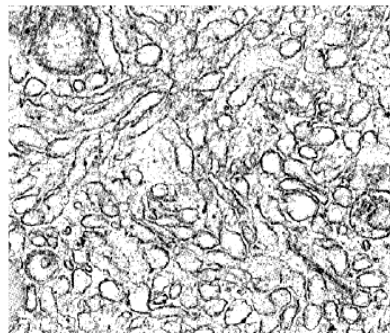
Golgi apparatus

(III)



Rough endoplasmic reticulum

(IV)



Smooth endoplasmic reticulum

Comment: You should be able to identify drawings and electron micrographs (as shown above) so good to look through this question again before the A level exam

The following are processes that occur in a metabolically active cell.

- modification of carbohydrates on protein (occurs inside Golgi apparatus; note uppercase "G" for Golgi apparatus)
- folding of protein into its 3 dimensional conformation (occurs inside rough ER)
- synthesis of steroids (Role of smooth ER)
- storage of synthesized proteins (Hydrolytic enzymes are the synthesized proteins; recall that lysosome is responsible for digestion of substances within the cell)

In which the figures I, II, III, IV do the above processes take place?

	I	II	III	IV
A	d	a	c	b
B	d	a	b	c
C	c	a	b	d
D	d	c	b	a

- 5 Ribosomes are described in terms of the sedimentation rates measured in Svedberg units (S). A higher value of S indicates a higher rate of sedimentation.

Ribosome subunits have sedimentation rates of approximately 60S, 50S, 40S and 30S.

The sedimentation rate of an intact ribosome in a cell is about 10% less than the total of the sedimentation rates of its subunits.

Which subunits make up a prokaryotic ribosome?

	60S	50S	40S	30S
A	√	x	√	x
B	x	x	√	√
C	x	√	√	x
D	x	√	x	√

Key

√ = subunit present

x = subunit not present

Comment: Refer to Cell Organelle lecture notes p15 (under ribosomes)

Eukaryotic ribosomes = 80S consisting of 2 subunits which are 60S large subunit + 40S small subunit

Prokaryotic ribosomes = 70S consisting of 2 subunits which are 50S large subunit + 30S small subunit

- 6 A certain cell surface membrane is made entirely of phospholipids and is 6 nm thick. A volume of 1 mm³ of this membrane was homogenised and dropped onto the surface of water in a large tray. The phospholipids spread out to form a continuous thin film with half of the thickness of the cell surface membrane.

What is the expected surface area of this film?

- A** 167 000 mm² because the phospholipids formed a single layer
- B** 167 000 mm² because the phospholipids formed a double layer
- C** 334 000 mm² because the phospholipids formed a single layer
- D** 334 000 mm² because the phospholipids form a double layer

Comment: Since the answers are given in mm², then convert units to mm first.

Working:

1mm = 1000 μm = 1000 x 1000 nm

In other words, 1 nm = 1 x 10⁻⁶ mm

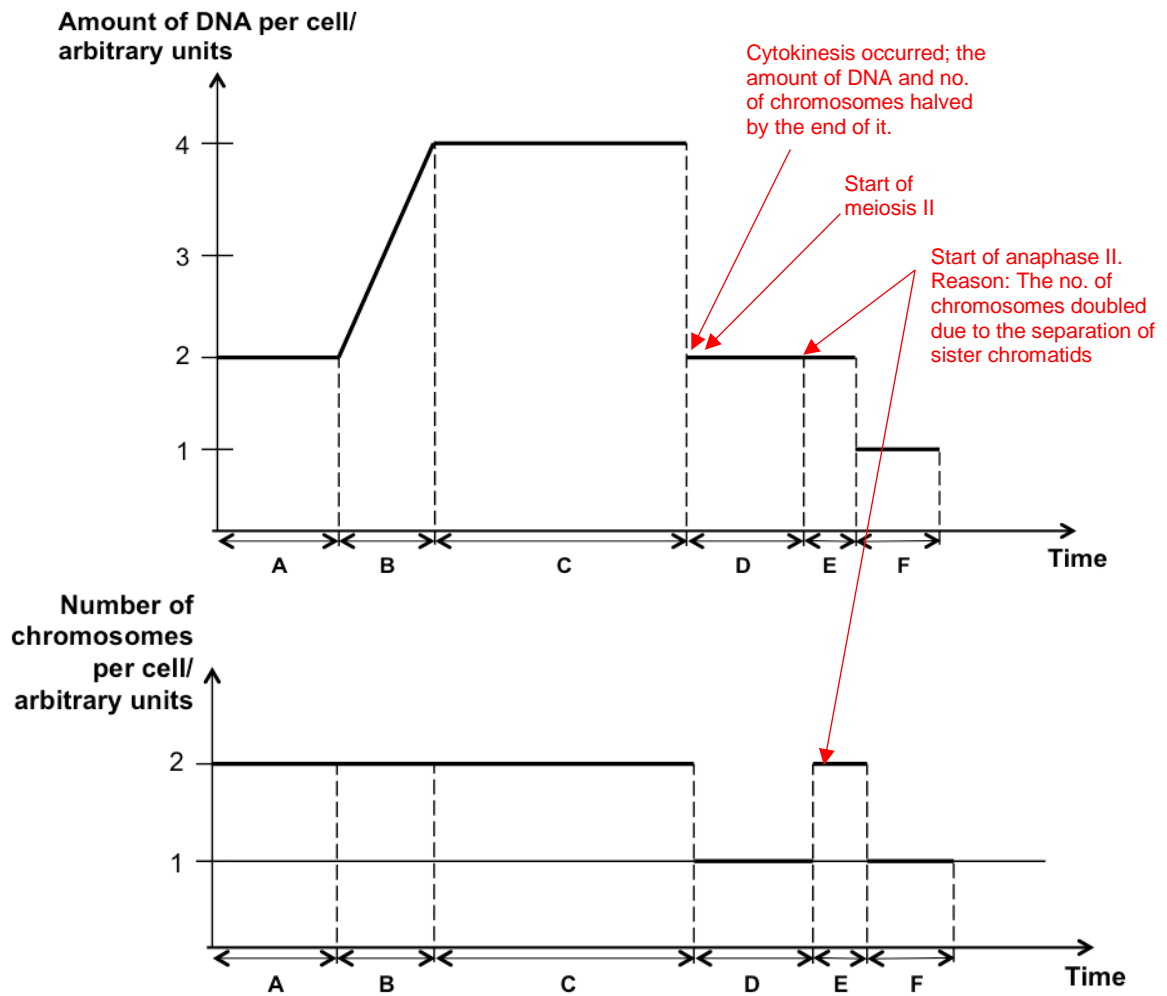
3nm which is half of the thickness of cell surface membrane is 3 x 10⁻⁶ mm

You are trying to find surface area (SA)

Volume = SA x height

SA = Volume / height = 1mm³ / 3 x 10⁻⁶ mm = 333333.333 mm² (closest match to option C)

- 7 The figures below show how the amount of DNA and number of chromosomes vary in a cell of a newly discovered plant species, *Eunoia ignium* during meiosis.

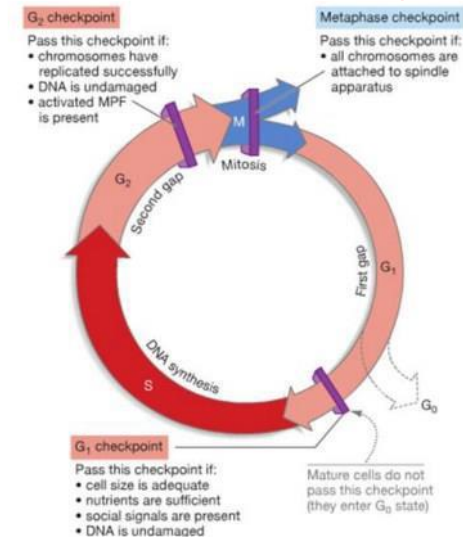


Which statement is **false**?

- A Phase A and B correspond to G1 and S phase of interphase respectively.
- B In phase C, the cell is undergoing prophase, metaphase, anaphase and telophase of meiosis I only.
- C** In phase E, the cell is undergoing telophase II only.
phase
Comment: Refer to the annotations on the above graphs
- D In both phases D and F, the cell has completed cytokinesis.
- 8 The protein p53 is produced in a cell in response to DNA damage. This protein stops the cell cycle for a short time just before the DNA is replicated, so that the DNA can be repaired.
At which phase of the cell cycle will this stop occur?

- A S
- B M
- C** G1
- D G2

Refer to Cancer lecture notes p3

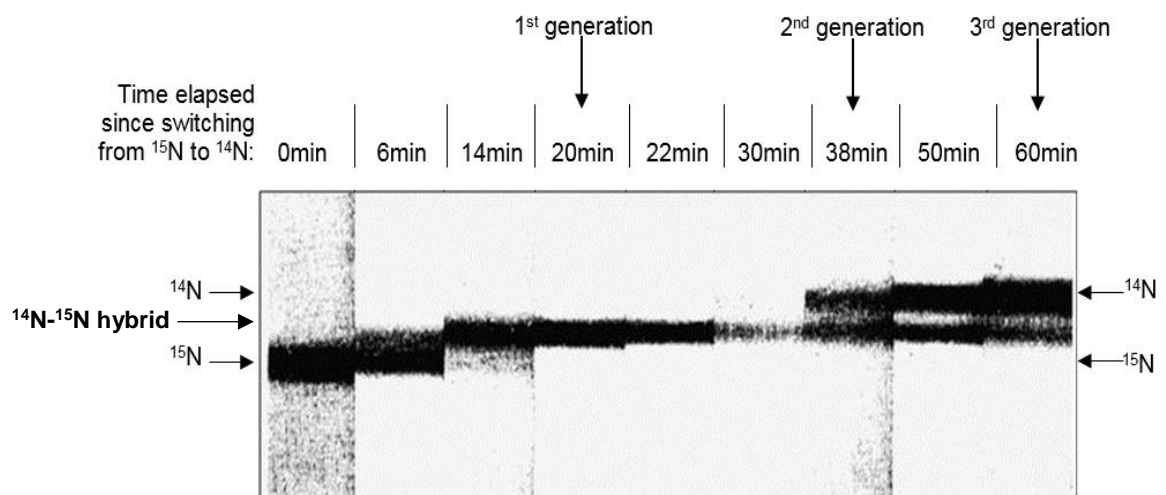


- 9 In an investigation to study the mode of DNA replication, *Escherichia coli* (*E. coli*) cells were grown in a nutrient medium containing heavy isotope of nitrogen (¹⁵N) for an extended period of time until all the DNA was labelled.

These *E. coli* cells were then transferred to a nutrient medium containing only light isotope of nitrogen (¹⁴N) and were allowed to multiply over three generations. The DNA of the *E. coli* cells was then harvested at nine different time intervals.

Subsequently, density gradient centrifugation of these *E. coli* DNA using caesium chloride was performed.

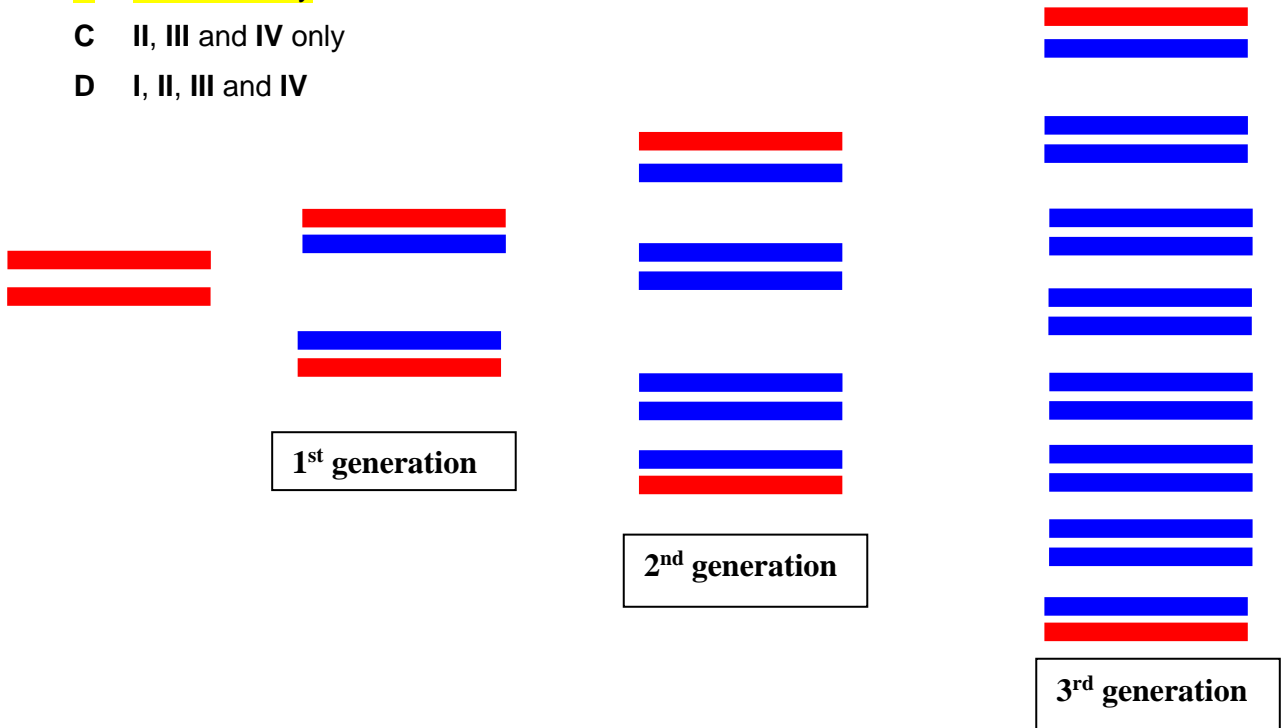
The diagram shows the results obtained.



Which statements are consistent with the results observed?

- I At 20 min, the entire DNA of *E. coli* exists as hybrid with 100% ¹⁵N DNA.
- II At 20 min, DNA of *E. coli* is 50% ¹⁴N-¹⁵N hybrid and 50% ¹⁵N DNA.
- III At 38 min, there are two bands consisting of 50% ¹⁴N-¹⁵N hybrid DNA and 50% light DNA.
- IV At 60 min, there is 25% ¹⁴N-¹⁵N hybrid DNA and 75% light DNA.

- A I and II only
B III and IV only
 C II, III and IV only
 D I, II, III and IV



- 10 Researchers from the Eunoia Genome Institute conducted studies on a newly discovered microorganism living next to an undersea vent spewing geothermally heated water. This organism was found to have 50 different types of amino acids, many new to science. Its DNA was also found to contain only 2 types of nitrogen bases.

What is the minimum number of bases per codon that could code for proteins in this organism?

- A 4 **B 6** C 8 D 16

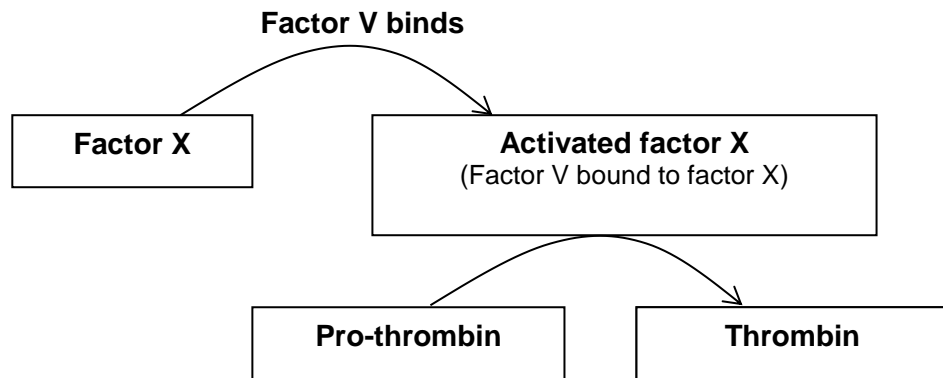
Comment: Remember $4^3 = 64$ combination where there are 4 bases, 3 bases per combination (codon) which is more than sufficient for 20 amino acids

For this question (follow the above):

$$2^n = 50$$

$$n = 6$$

- 11 Multiple proteins are involved in the process of blood clotting. The diagram below shows how factor V functions as a co-factor in blood clotting.



Thrombin goes on to cleave fibrinogen to form fibrin, which helps in blood clot formation. Another protein that is involved in blood clotting is activated protein C (aPC), a natural anticoagulant that acts to limit the extent of clotting by degrading factor V.

Comment

Fibrin: Promote clotting

Factor V: Promote clotting

aPC: Limit clotting

Mutant Factor V (factor V Leiden) is basically Factor V that cannot be degraded → promote clotting. In this situation, the type of mutation must be dominant, and gain-of-function because the mutant protein is not degraded and continues to exert its activity when it is supposed to be degraded.

This is similar to the Ras gene mutation.

The mutation in the Ras gene from a proto-oncogene to oncogene gives rise to hyperactive Ras protein which continuously activate the cell signalling pathway leading to cell division.

A mutation in factor V protein results in a variant protein called factor V Leiden. The Leiden variant of the protein is resistant to degradation by aPC.

Which option shows the mode of inheritance of the Leiden allele, the type of mutation and its subsequent effect on blood clotting?

	Mode of inheritance	Type of mutation	Result on blood clotting
A	Dominant	Gain-of-function	Blood clots more easily
B	Dominant	Loss-of-function	Blood clots less easily
C	Recessive	Gain-of-function	Blood clots less easily
D	Recessive	Loss-of-function	Blood clots more easily

- 12 In a female calf liver and ovary, about 12,000 genes are expressed. However, an additional 4,000 genes are expressed only in the liver while an additional 3,000 genes are expressed only in the ovary. Which of the following statement(s) is/are **true**?

- The additional genes are subjected to different methylation control in different cell type.
True – some genes are switched off
- The additional genes are found only in the specific cell type.
False – every cell contains the same no. of genes
- Different cell types contain different sets of specific transcription factors.

True – while the no. of genes is the same in different cell type, specific TFs are different. As specific TF (acting as activator or repressor) controls the expression of genes, certain cells will have tissue specific structures no found in other cells.

- 4 A common set of genes are expressed for the normal functions in liver and ovary.
True – refer to 1st sentence

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

- 13 How do retroviruses such as HIV increase the occurrence of cancer?

- A Viral DNA may insert into telomerase gene resulting in telomeres that are resistant to degradation by nuclease.
B Viral DNA may contain oncogenes that cause cancer when integrated into the host cell genome.
C Viral RNA may insert into tumour-suppressor genes and cause uncontrolled cell division.
D Viral RNA may be proto-oncogenes that cause cancer when integrated into the host cell genome.

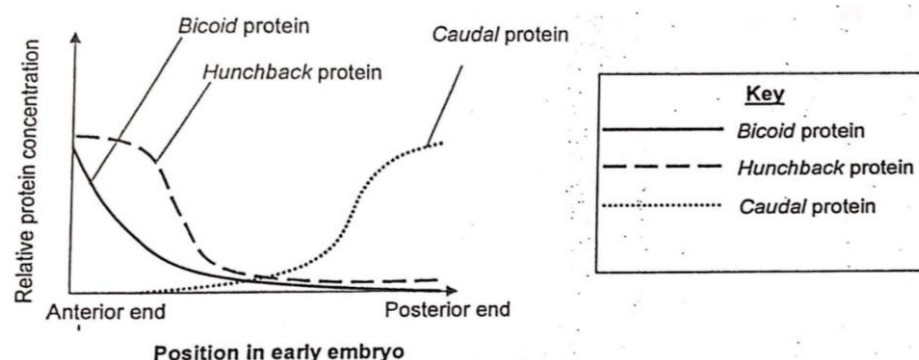
Comment:

HIV RNA is reverse transcribed to DNA which is then integrated into the host cell's genome by integrase.

- 14 In *Drosophila*, three of the genes involved in the embryological development are named *bicoid*, *caudal* and *hunchback*. *Bicoid* protein affects the expression of *caudal* and *hunchback* genes.
Bicoid protein = specific TF (a gene regulatory)
Bicoid gene = regulatory gene

To determine the effect of *bicoid* protein on the other two genes, the levels of *bicoid*, *caudal* and *hunchback* proteins in a developing *Drosophila* embryo were determined. The results are shown in the diagram below.

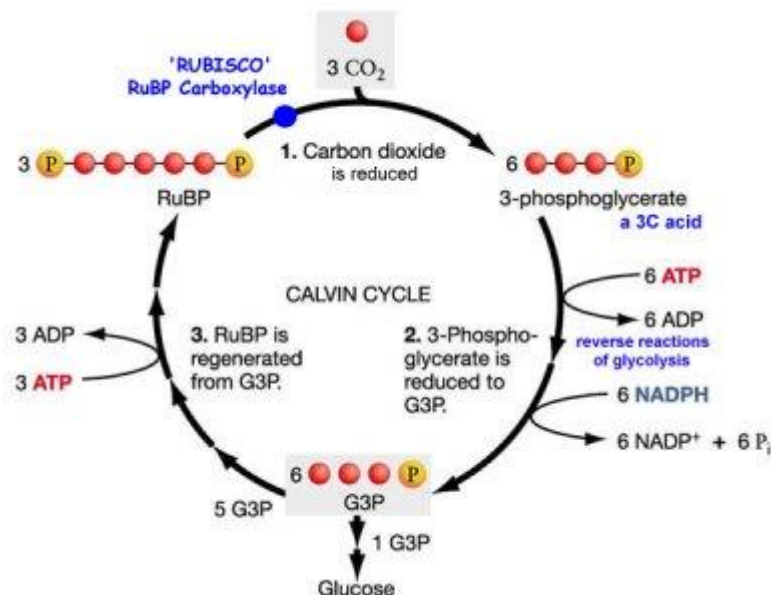
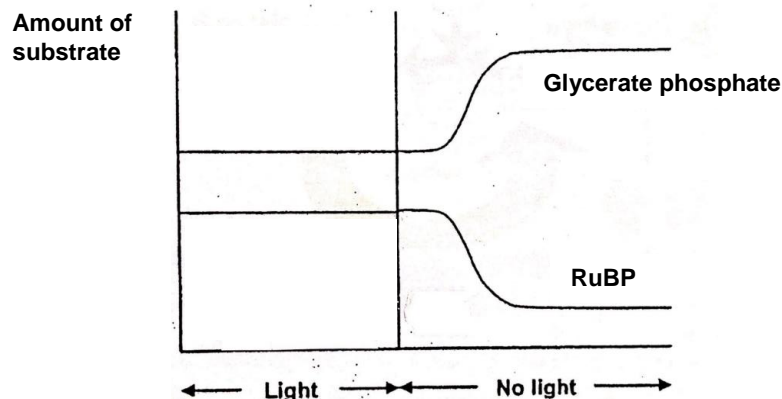
From the graph, Bicoid protein level corresponds to Hunchback protein level but is inversely related to Caudal protein. Hence, Bicoid protein promotes expression of Hunchback gene but repress expression of Caudal gene. The mechanism is unknown but can be derived from the options.



Which of the following statements best describe the possible mechanisms by which the *bicoid* protein might affect the expression of the *hunchback* and *caudal* genes?

	Effect on <i>hunchback</i> gene	Effect on <i>caudal</i> gene
A	<i>Bicoid</i> protein binds to <i>hunchback</i> gene enhancer sequence and increases transcription of <i>hunchback</i> gene.	<i>Bicoid</i> protein binds to <i>caudal</i> gene enhancer sequence and increases the transcription of <i>caudal</i> gene.
B	<i>Bicoid</i> protein binds to <i>hunchback</i> gene silencer sequence and decreases transcription of <i>hunchback</i> gene.	<i>Bicoid</i> protein binds to <i>caudal</i> gene enhancer sequence and increases transcription of <i>caudal</i> gene.
C	<i>Bicoid</i> protein binds to <i>hunchback</i> gene enhancer sequence and increases transcription of <i>hunchback</i> gene.	<i>Bicoid</i> protein binds to <i>caudal</i> mRNA and prevents translation of <i>caudal</i> mRNA.
D	<i>Bicoid</i> protein binds to <i>hunchback</i> mRNA and prevents translation of <i>hunchback</i> mRNA.	<i>Bicoid</i> protein binds to <i>caudal</i> gene silencer sequence and decreases transcription of <i>caudal</i> gene.

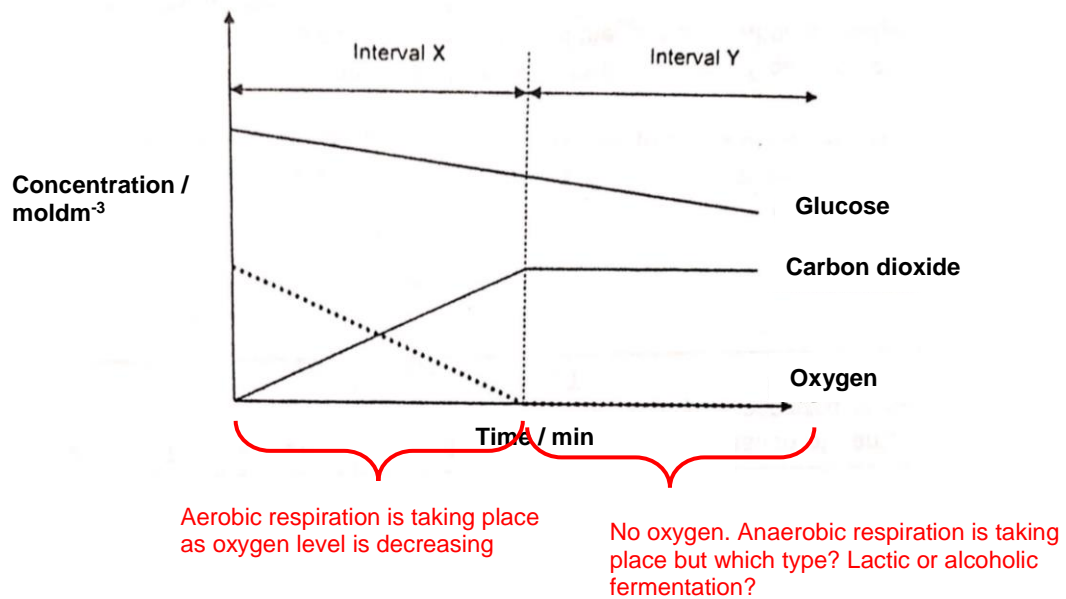
- 15 The graph below shows the change in the concentration of RuBP and PGA in the presence of light and when the light is switched off.



Which statement(s) is/are **true**?

- 1 In the dark, the amount of glycerate phosphate increased initially due to the lack of reduced NADP.
 - 2 In the dark, the amount of glycerate phosphate increased initially as more RuBP is converted to glycerate phosphate.
 - 3 In the dark, the amount of RuBP decreased initially as it reacted with carbon dioxide.
 - 4 In the light, the concentration of RuBP and glycerate phosphate were constant as RuBP that was used to form glycerate phosphate was regenerated.
- A** 1 and 2 only
- B** 1, 3 and 4 only
- C** 2, 3 and 4 only
- D** 1, 2, 3 and 4

- 16 In an experiment, metabolically active cells were introduced to a sealed container of nutrient solution. The graph of the levels of glucose, carbon dioxide and oxygen were then analyzed over time.

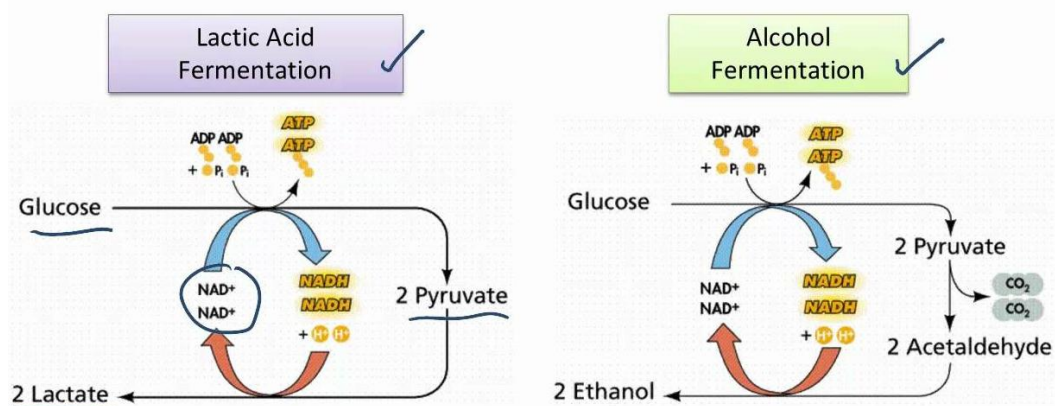


Which of the following can be concluded from the graph?

	Process happening at interval X	Process happening at interval Y
A	Aerobic respiration	Lactic acid fermentation
B	Aerobic respiration	Alcoholic fermentation
C	Lactic acid fermentation	Aerobic respiration
D	Alcoholic fermentation	Aerobic respiration

Comment: Refer to the image below

What are the two types of anaerobic respiration?



17 Which of the following statement(s) will lead to an **increased production of glycogen** in the liver cells of a healthy human?
Comment: Not glucagon

- 1 Reduction in cyclic AMP production (this 2nd messenger is involved glucagon mediated cell signaling → less glycogen breakdown to release glucose but it does not mean increased production of glycogen)
- 2 A high glucose content in the diet (will result in greater release of insulin → more glycogen)
- 3 Activation of receptor tyrosine kinases by glucagon (will result in the decreased production of glycogen)
- 4 Activation of phosphatases (remove phosphate group from substrate; works opposite to kinase)

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

18 Many signal transduction pathways use second messengers to

- A** transport a signal through the plasma membrane.
- B** bind to an intracellular receptor to form a complex.
- C** **relay a signal throughout the cytoplasm.**
An example of a second messenger is cyclic AMP (stated in syllabus).
Note it is termed as “second” messenger and NOT “secondary” messenger.
- D** amplify the message by phosphorylating proteins.

- 19 In *E. coli*, the production of enzymes for tryptophan synthesis is carefully controlled according to the organism's needs. The *trp* operon encodes five enzymes involved in the synthesis of tryptophan. One of the enzymes is **tryptophan synthetase**.

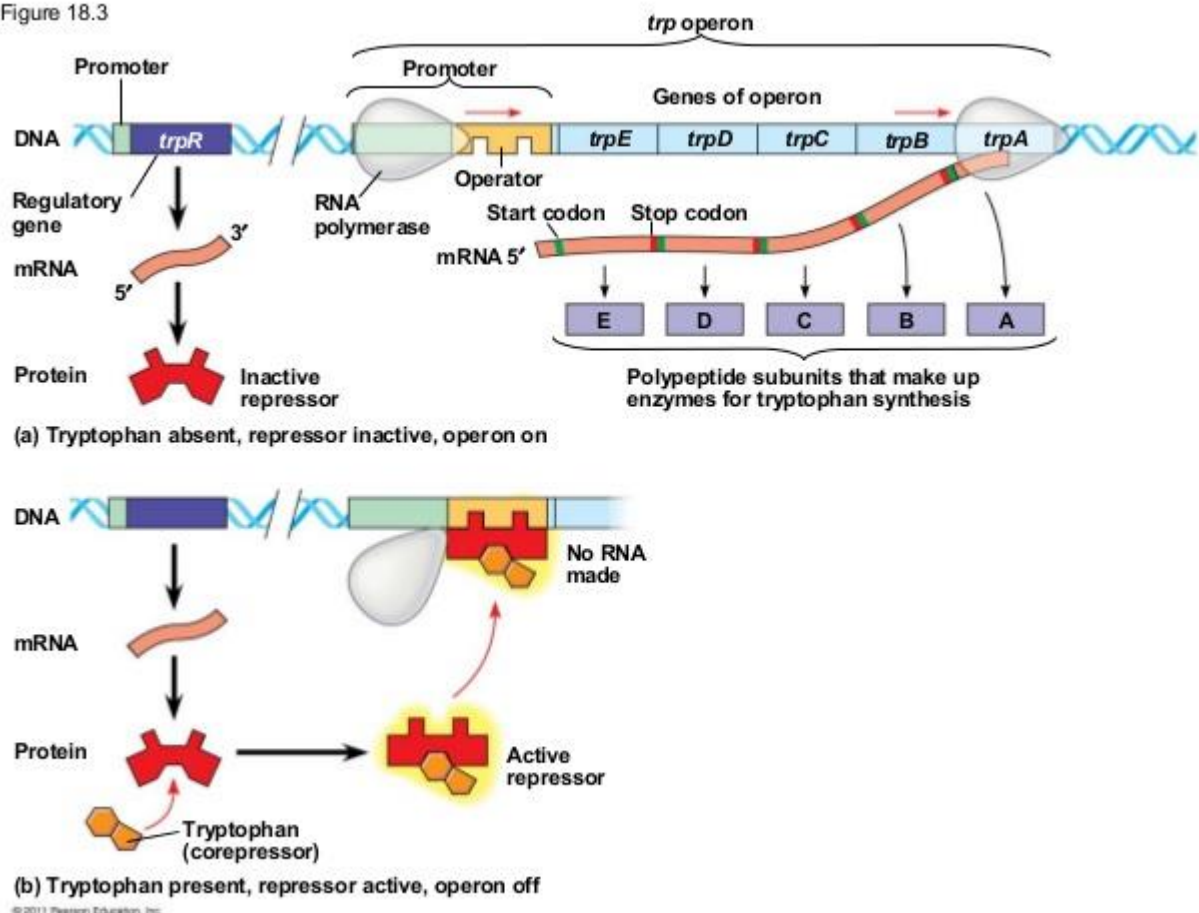
Which of the following shows the **possible control in the synthesis of tryptophan synthetase** under different conditions? **Comment: Trp operon = repressible system (usu "ON" but can be turned OFF)**

Key: Presence (✓) or absence (X) of tryptophan synthetase.

	Condition	Presence of tryptophan	Absence of tryptophan
A	A mutation that makes the <i>trp</i> repressor exists in an active conformation.	✓	X
B	A mutation that makes the <i>trp</i> repressor non-functional.	X	✓
C	A mutation that makes the <i>trp</i> operator incapable of binding to the <i>trp</i> repressor.	X	X
D	A mutation that swap the positions of the <i>trp</i> operator and promoter.	✓	✓

Comment: Tryptophan serves as a co-repressor; binds to the inactive repressor.... Refer to STQ 8 Prelim Paper 2 Answer. Notice that we tested you on the lac operon in the MYE? So, you need to know both the lac operon (inducible system) and the trp operon (repressible system) as stated in syllabus.

Figure 18.3



- 20 Which of the following statements correctly distinguish between the mode of reproduction of the influenza virus and HIV?
- 1 During **attachment**, influenza virus makes use of the **neuraminidase** while HIV makes use of gp120 to bind to their respective target cells. **Incorrect**
 - 2 **Influenza enters via endocytosis** while **HIV enters via fusion** of its lipid envelope with the cell surface membrane. **True**
 - 3 During uncoating of the influenza virus, its **DNA** dependent RNA polymerase is released while for the HIV, its reverse transcriptase is released into the cytosol. **Incorrect; should be RNA dependent RNA polymerase**
 - 4 For influenza virus, RNA is used as a template for the synthesis of more viral RNA and proteins, while for HIV, its **RNA** is integrated into the host chromosome. **Incorrect; should be DNA**
- A** 2 only
- B** 3 and 4 only
- C** 2, 3 and 4 only
- D** 1, 2, 3 and 4
- 21 A population of cats contains individuals with shortened tails known as Manx cats and individuals with normal tails known as non-Manx cats. Mating of two non-Manx cats always produced non-Manx cats. Mating of two **heterozygous Manx cats** always produced a mixture of Manx cats and non-Manx cats, where the number of Manx cats is usually **twice that of non-Manx cats**.

Which hypothesis is consistent with these observations?

- A** The genes for shortened tails and normal tails are linked on the same chromosome.
- B** The genes for shortened tails and normal tails are sex-linked.
- C** The allele for shortened tails is dominant over the allele for normal tails and the homozygous dominant genotype results in death.

Explanation

Heterozygous Manx cat tells us that Manx cat with shortened tail must be dominant over Non-Manx cat with normal tail

Let's assume the allele for shortened tail is T; normal tail is t

In the normal situation, it should be 3 Manx : 1 non-Manx but the question stated 2:1 instead. If you refer to the genotype ratio, it would be

1TT: 2Tt: 1tt

1TT → lethal → death hence 2:1 ratio

- D** The allele for shortened tails is dominant over the allele for normal tails and the homozygous recessive genotype results in death.

- 22 In lentils, the seed coat pattern is determined by a gene with 3 alleles, C^M , C^S and C^C , whose phenotypes are marbled, spotted and clear respectively. Four crosses were repeated many times. The crosses and the outcomes of these crosses are shown in the table below.

cross	parents	offspring phenotype and ratio
1	marbled x marbled	3 marbled : 1 clear Comment: C^M is dominant over C^C
2	spotted x clear $C^S C^S \times C^C C^C$	all spotted
3	marbled x marbled	3 marbled : 1 spotted Comment: C^M is dominant over C^S
4	clear x clear $C^C C^C \times C^C C^C$	all clear

From the data, it is possible to conclude that,

- A spotted is recessive to clear. **Incorrect as observed in cross 2, spotted x clear results in all spotted offspring**
- B all of the clear offspring are heterozygous. **Incorrect as Cross 1 shows that clear allele is recessive to marbled. Cross 2 shows that clear allele is recessive to spotted. The only way clear phenotype is observed is when it is homozygous.**
- C two thirds of the marbled offspring in cross 3 are heterozygous. **This is correct. The genotypic ratio for cross 3 is 1 $C^M C^M$: 2 $C^M C^S$: 1 $C^S C^S$, thus 2/3 of the marbled offspring are heterozygous.**
- D the marbled parents in cross 1 have the same genotype as the marbled parents in cross 3. **This is incorrect. The parents in cross 1 are $C^M C^C$ whereas the parents in cross 3 are $C^M C^S$**
- 23 Calculation of chi-square on the results of a **monohybrid cross** give a chi-squared value of **5.88**.

Using the table below decide which is correct. Part of the table of chi-square values is shown:

degrees of freedom	p = 0.5	P = 0.1	P = 0.05	P = 0.01	P = 0.001
1	0.46	2.71	3.84	6.64	10.83
2	1.39	4.6	5.99	9.21	13.82
3	2.37	6.25	7.82	11.34	16.27
4	3.36	7.78	9.49	13.28	18.46
5	4.35	9.24	11.07	15.09	20.52

What is the probability that chance produced the difference between the observed and expected result?

- A **between 0.01 and 0.05**
- B between 0.05 and 0.1
- C between 0.5 and 0.1
- D more than 0.5

- 24 Induced pluripotent stem cells are stem cells that can be generated directly from adult stem cells under the influence of molecular signals.

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

- I An induced pluripotent stem cell can become any cell of the developed organism, but cannot produce trophoblast and placenta to support organismal development, whereas a totipotent stem cell can produce a whole organism including extraembryonic tissue. **True**
- II A totipotent stem cell and induced pluripotent stem cell can give rise to any cell. **False**
- III An induced pluripotent stem cell can give rise to a single cell lineage whereas a totipotent stem cell can give rise to multiple, but limited number of cell lineages. **False**
- IV A totipotent stem cell can become any cell of a developed organism, but cannot produce trophoblast and placenta to support organismal development, whereas an induced pluripotent stem cell can produce a whole organism including extraembryonic tissue. **False**

V Induced pluripotent stem cells have the same developmental potential as embryonic stem cells. **True**

A I only

B I & V only

C II, III & IV only

D III, IV & V only

- 25 At the start of the polymerase chain reaction (PCR), single stranded primers are added to the denatured DNA and the mixture cooled to 60°C.

What explains why the denatured DNA strands anneal with primers and not each other?

Note: This means single-stranded DNA after the H bonds between both strands are broken by heat

A The primers are shorter and anneal more easily.

B The primers anneal only to the 3' end of the denatured DNA.

C The primer concentration exceeds the denatured DNA concentration.

Comment: Hence, higher chance that primer will bind to the denatured DNA instead of denatured DNA strands binding to each other

D The temperature prevents the denatured DNA from annealing together.

- 26 Which of the following is not biogeographical evidence supporting the descent from a common ancestor?

A *Mesosaur cynognathus* fossils have been found in both the continents of Africa and South America.

Comment: Both Africa and South America continents used to be linked together; supports the idea that the common ancestor originated from there before the continents drifted apart

B Diverse early horse fossils have been found only in the continent of North America.

Comment: Supports the idea that modern species of horse originated from N America but had spread throughout N America and the rest of the world

C The red fox, *Vulpes vulpes* is found in mainland Asia and Australia.

Comment: This does not support the idea of descent from a common ancestor

- D** Galapagos finches resemble the finches in Ecuador, South America
 Comment: As Galapagos islands are near to Ecuador, it is highly likely that the finches resemble each other since they are derived from a common ancestor

27 Which of the following statements about natural selection is **false**?

- A** Natural selection will result in a population acquiring new alleles that will confer advantageous phenotypes that will be selected for.
 Comment: Natural selection does not result in mutation (source of new alleles). Natural selection operates because there was pre-existing genetic variation. Mutation was one of the way in generating genetic variation.
- Other ways include: Crossing over and independent assortment between homologous pairs during meiosis.
- B** Natural selection occurs even when the environmental conditions remain unchanged.
 Comment: As long as there is hereditary variation and selective pressure.
 Recall the 4 guiding questions that govern evolution by natural selection (refer to my summary notes)
- C** Natural selection works to eliminate the unfit from the population through selection pressure, leaving the fit to reproduce.
 Comment: Presence of heritable variations – individuals who are more adapted (i.e. fit individuals) would be selected for over those who are less adapted (i.e. unfit individuals) to the environment
- D** Natural selection works when the population is under a constant struggle for survival.
 Comment: This means that is presence of selective pressure (e.g. predator, limited food, etc)

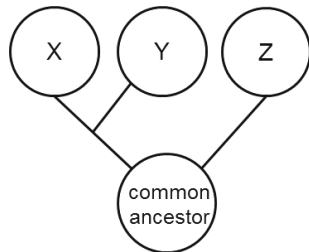
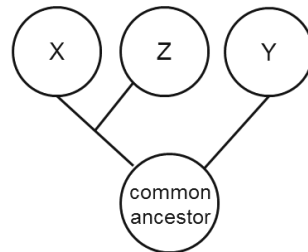
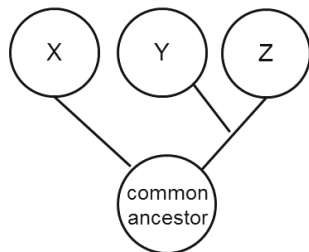
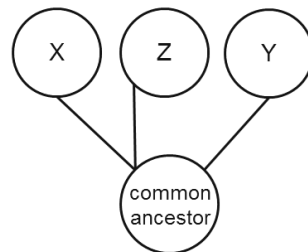
28 Which statement about the adaptive immune response is **incorrect**?

- A** Naïve T-cells can differentiate into T helper cells, cytotoxic T cells or memory T cells upon activation.
- B** An activated B-cell can produce different classes of antibodies at any one time to target specific foreign antigens.
- C** Somatic hypermutation occurs more frequently at certain regions of the genome than at others.
- D** One time vaccination allows for an individual to be immunised against the virus subtype for a lifetime.

- 29 Cytochrome c is a protein found in most organisms. The amino acid sequence of this protein varies between different species and can be used to determine evolutionary relationships. The table shows the numbers of differences in the amino acid sequences of cytochrome c between three species (X, Y, and Z).

	species Y	species Z
species X	8	2 Comment: X and Z are closely related so common ancestor must be the most recent (Option B)
species Y	0	9

Which diagram best represents the evolutionary relationships between species X, Y and Z?

**A****B****C****D****B**

- 30 Which of the following is **not** an effect of global warming?
- A** Increasing sea level rise leading to flooding of low-lying countries.
 - B** Deterioration of coral reefs due to coral bleaching events.
 - C** Disruption of symbiotic relationships between host plants and pollinators.
 - D** Decrease in the amount of radiation from the sun reaching the earth's surface.

- END OF PAPER -