TAMPINES MERIDIAN JUNIOR COLLEGE

JC2 PRELIMINARY EXAMINATION

CANDIDATE NAME ( )

CIVICS GROUP

H2 BIOLOGY

9744/01

Paper 1 Multiple Choice Questions

22 September 2023

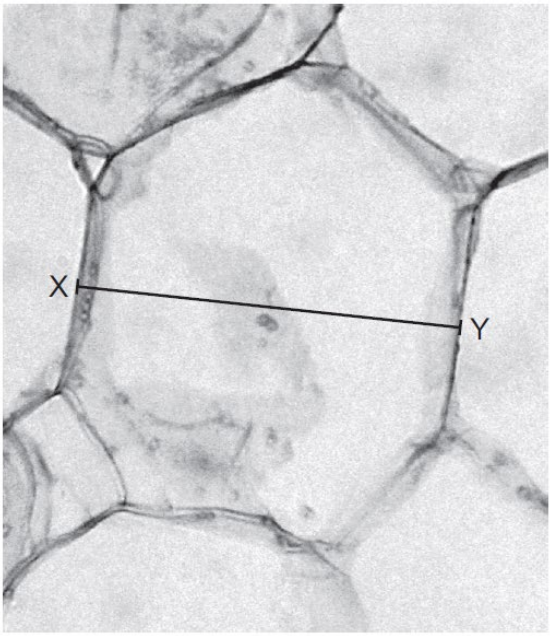
1 hour

Additional material: Multiple Choice Answer Sheet

ANSWERS WITH EXPLANATION

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

QUESTION 1 [Cell, HI-1]
The photomicrograph is of a plant cell. The cell is 25 µm in width from **X** to **Y**.



What is the magnification of the photomicrograph?

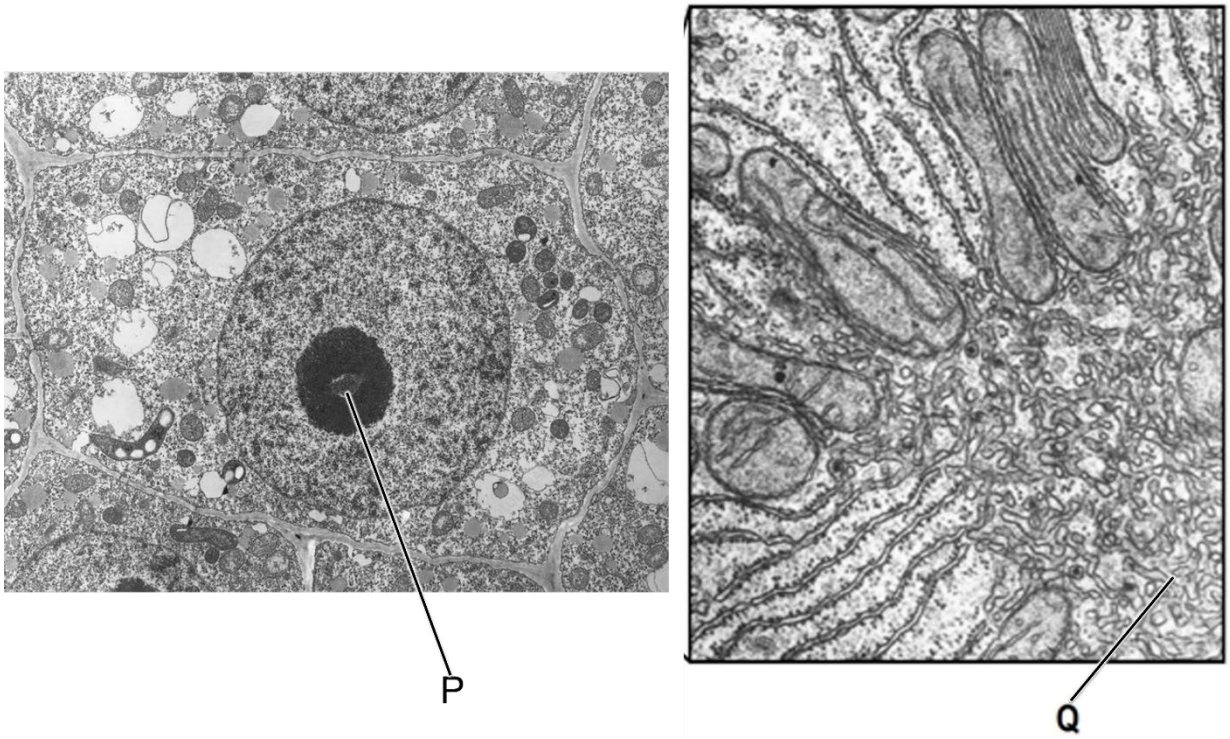
A 2×10^1 **B** 2×10^2 **C** 2×10^3 **D** 2×10^4

Explanation
Length of drawing of cell = 5cm = 50mm = 50 000 µm

Magnification= Length of drawing/actual length
= 50 000 / 25
= 2000
= 2×10^3

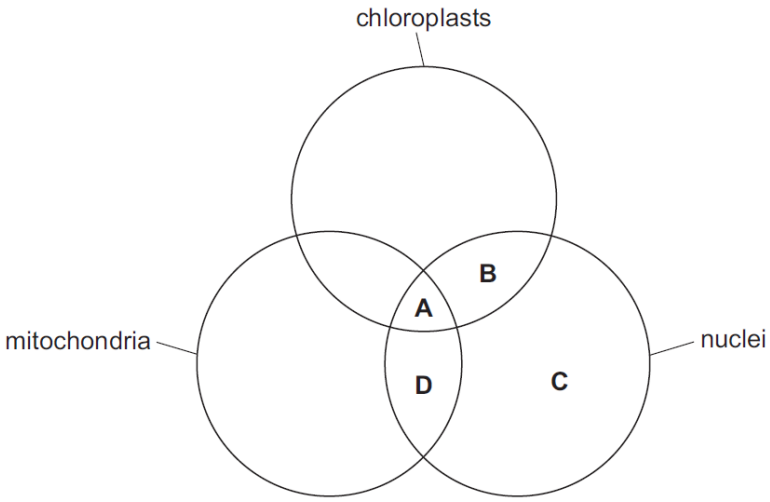
QUESTION 2 [Cell, HI-2]
The diagrams below show the electron micrographs of two organelles **P** and **Q**.

Which of the following shows the correct identities and functions of **P** and **Q**?



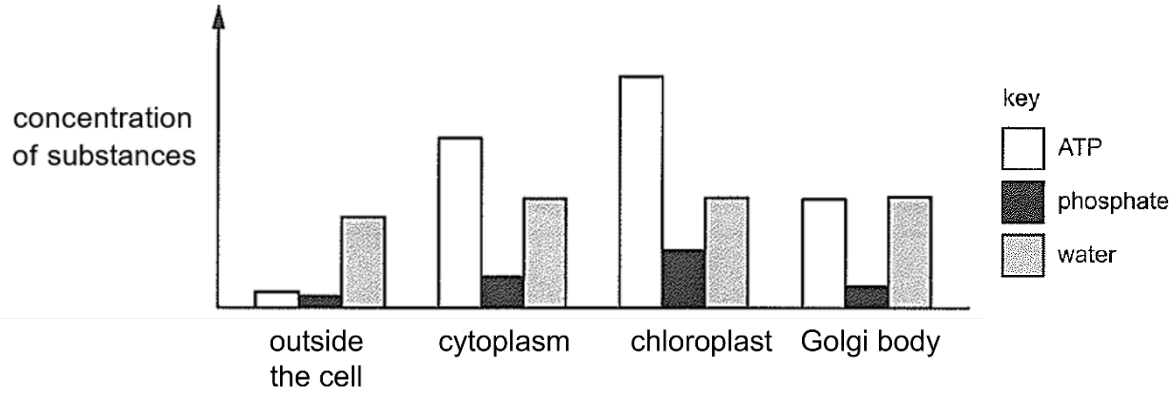
	Identity of **P**	Function of **P**	Identity of **Q**	Function of **Q**
A	Nucleosome	Transcription of rRNA gene	Smooth ER	Transport of proteins
B	Nucleosome	Assembly of ribosomal subunits	Secretory vesicles	Synthesis of lipids
C	Nucleolus	Assembly of ribosomal subunits	Smooth ER	Synthesis of lipids
D	Nucleolus	Transcription of rRNA gene	Secretory vesicles	Transport of proteins

QUESTION 3 [Cell, KU-2]
Which letter identifies the cell structures where semi-conservative replication of DNA occurs? **(A)**



Explanation:
All 3 organelles (chloroplast, mitochondria and nuclei) contain DNA and DNA polymerase which allow DNA replication to occur.

QUESTION 4 [Transport, HI-2]
The chart shows the concentration of some substances outside the cell, in the cytoplasm, in the chloroplast and in the Golgi body of a plant cell.



Which statement about the direction of movement of these substances and the process by which they are moving is correct?

A ATP is leaving the chloroplast by facilitated diffusion, water is leaving the plant cell by osmosis.

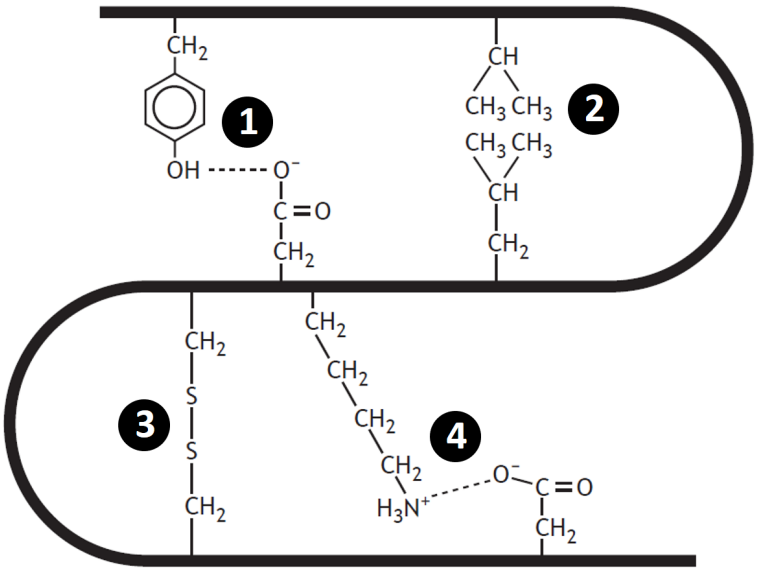
B Phosphate and ATP are entering the chloroplast and Golgi body by active transport.

C Phosphate and ATP are leaving the Golgi body by facilitated diffusion, water is leaving the plant cell by osmosis.

D Phosphate is entering the chloroplast by facilitated diffusion, water is entering the chloroplast by osmosis.

Explanation:
Statement B: Both ATP and phosphate Concentration are lower in Golgi body compared to the cytoplasm, hence they cannot be **entering** GA via active transport.
Statement C: Both ATP and phosphate Concentration are lower in Golgi body compared to the cytoplasm, hence they cannot **leaving** GA via facilitated diffusion.
Statement D: Phosphate concentration is higher in chloroplast compared to cytoplasm, hence it enters the chloroplast via active transport.

QUESTION 5 [BioMol, HI-2]
The diagram shows some interactions between amino acid R-groups in a polypeptide chain.



Which row correctly describes the nature of the interactions?

	can be disrupted by extreme pH	can be disrupted by high temperatures	located within the core of a globular protein	located within the transmembrane domain of a receptor protein
A	1, 3, 4	1, 2, 3, 4	2	1, 2, 4
B	2, 4	3	1, 4	2, 3
C	3	1, 4	2, 3	1, 2, 3, 4
D	1, 4	1, 4	2, 3	2

Explanation
1. Hydrogen bond
2. Hydrophobic interaction
3. Disulfide bond
4. Ionic bond

- Extreme pH and high temperature disrupt both hydrogen bond and ionic bond which are weak bonds.
- Globular protein has hydrophilic amino acids on the outside and hydrophobic amino acids within the core, hence both hydrophobic interactions and disulfide bonds are found within the core.
  Transmembrane domain of the receptor protein interacts with the hydrophobic fatty acid chain of the phospholipid bilayer, hence the hydrophobic amino acids are found at the transmembrane

QUESTION 6 [BioMol, KU-2]
How many of the following statements correctly describe red blood cells?

- At high altitude, humans have increased number of red blood cells to compensate for low percentage saturation of oxygen.
- At high altitude, humans have increased number of red blood cells to increase the number of mitochondria in the blood for ATP production.
- The shape of haemoglobin in red blood cells changes when oxygen is released from it.
- Haemoglobin in red blood cells is insoluble in water because hydrophobic R groups are arranged around the outside of the molecule.

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

Explanation
Statement 1 & 3 are correct.
Statement 2: Red blood cell do not have organelles such as mitochondria.
Statement 4: Haemoglobin is a globular protein which is soluble in water with hydrophilic R groups arranged on the outside of the molecule.

QUESTION 7 [BioMol, KU-1]
Collagen is a fibrous protein found in mammalian tendons.

Which feature contributes to the great tensile strength of collagen?

A A secondary structure with many hydrogen bonds firmly holding the α-helices.
B A regularly folded tertiary structure held together with hydrogen bonds and ionic bonds.
C A primary sequence with covalent bonds linking a variable sequence of amino acids.
D A quaternary structure of triple helix held together by hydrogen bonds between the three polypeptides.

Explanation
Option A: Each collagen polypeptide chain consists of about 1000 amino acid residues and is in the shape of a loosely wound left-handed helix (NOT an α-helix).

Option B: It is a fibrous protein with a quaternary structure. It has no tertiary structure. Three polypeptide chains are wound around each other to give a triple helix known as tropocollagen.

Option C: This statement is factually correct but it does not contribute to its great tensile strength. Sequence of amino acids is usually a repeat of:
- Glycine – Proline – X, or
- Glycine – X – Hydroxyproline [where X is any other amino acids except glycine]

Option D: The three polypeptide chains in the triple helix are linked together by **hydrogen bonds** formed between **peptide N-H groups** of glycine and **peptide C=O groups** of other amino acids on the other chains.

QUESTION 8 [Enzymes KU-2]

The lock-and-key hypothesis and induced-fit hypothesis explain how an enzyme interacts with a substrate.

Which of the following statements are true of both hypotheses?

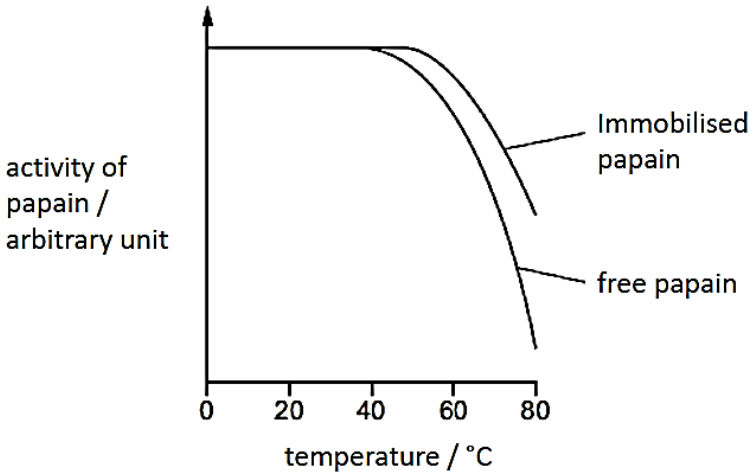
1 An increase in substrate concentration will not increase the rate of formation of enzyme-substrate complexes.
2 Covalent bonds hold the substrate at the active site of the enzyme.
3 An enzyme undergoes a conformational change as it forms enzyme-substrate complexes.
4 An increase in enzyme concentration may increase the number of enzyme-substrate complexes.

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

Explanation
1 – False. High substrate concentration may increase the rate of formation of E-S complexes when substrate concentration is limiting.
2 – False. Weak hydrogen and ionic bonds hold the substrate at the active site.
3 – True for induced-fit hypothesis, but false for lock-and-key hypothesis (i.e. no conformational change).
4 – True. Increase in enzyme concentration leads to increased frequency of effective collision between enzymes and substrates.

QUESTION 9 [Enzymes, HI-2]

The graph compares the effect of temperature on the activity of the protease enzyme, papain, when free in solution and when immobilised in alginate beads.



Which statement about the effect of immobilisation of papain is correct?

A It increases the stability of papain at higher temperatures.

B It alters the shape of papain's active site at 40°C.

C It decreases the activity of papain at 45°C.

D It reduces the number of collisions of papain with the substrate.

Explanation
Statement B – at 40°C, papain activity is still at it's highest for immobilised papain. Hence no change in the shape of active site.
Statement C – at 45°C, papain activity is still at it's highest for immobilised papain.
Statement D – immobilised papain reach the same highest activity as free papain→ no change in the number of effective collision between papain and substrate.

QUESTION 10 [Transformation of Energy 1/3, HI-2]

Rotenone and antimycin are two metabolic poisons which affect cellular respiration. The effects of rotenone and antimycin on aerobic respiration are summarised in the table.

	Ability to use glucose	Ability to use oxygen	ATP yield
Rotenone	Yes	No	Decreases
Antimycin	Yes	Yes	Decreases

Which of the following correctly identifies the specific functions of these two metabolic poisons?

	Rotenone	Antimycin
A	Electron transport inhibitor	Inhibits ATP synthase
B	Inhibits ATP synthase	Electron transport inhibitor
C	Dissipate proton gradient	Inhibits ATP synthase
D	Inhibits ATP synthase	Dissipate proton gradient

Explanation

Ability to use glucose:

Both rotenone and antimycin have the ability to use glucose. Thus the glycolysis, Link reaction and Krebs cycle can still proceed.

Ability to use oxygen:

Rotenone cannot use oxygen which is the final electron acceptor in Oxidative Phosphorylation(OP). Hence, OP can proceed. Electrons can pass down the electron transport chain in the inner mitochondrial membrane and energy released is used to pump protons into the inter-membrane space creating a proton gradient. Protons can diffuse down the proton gradient through the ATP synthase. Thus, since there is a decrease in ATP yield, it is an inhibitor of the electron transport chain.

However, antimycin has the ability to use oxygen. Since it still results in a decrease in ATP yield, it is an inhibitor of ATP synthase instead.

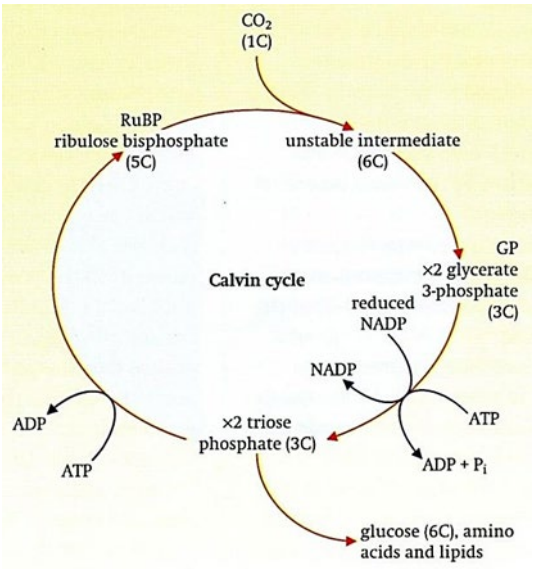
QUESTION 11 [Transformation of Energy 2/3, KU-3]
In an experiment, chloroplast extracts were first treated with a chemical that binds with the electron that was accepted by the electron acceptor in Photosystem **I**. The extracts were then treated with 2 hours of light and were provided with ample carbon dioxide and water.

Which of the following correctly shows the products that were formed after the experiment?

	O_2	ATP	Reduced NADP	Glucose
A	+	+	-	-
B	-	+	+	+
C	+	-	-	-
D	-	-	+	-

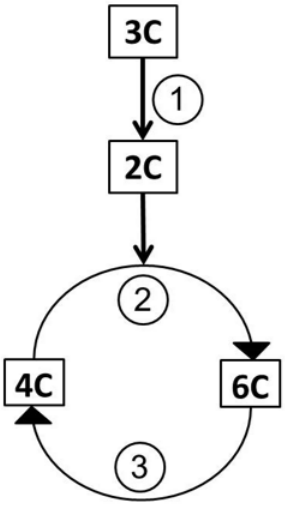
Explanation
If the chemical binds with electron acceptor in photosystem I,

- Since chemical binds with electron that was accepted by electron acceptor in photosystem I, photolysis of water can still take place in the thylakoid space. Hence, oxygen can still be given off.
- Proton gradient can still form and protons can still diffuse down ATP synthase to activate it to produce ATP.
- Since electrons released from photosystem 1 flow down the electron transport chain from Photosystem I, and then **com**bine with NADP+ and H+ from the stroma to form NADPH, Chemical binds with the electrons and prevents it from combining with NADP. Hence, NADP cannot be reduced hence no reduced NADP.
- Without, reduced NADP, Calvin cycle cannot take place as reduced NADP is needed in PGA/GP reduction. Thus, no glucose produced.



QUESTION 12 [Transformation of Energy 3/3, HI-3]

The diagram shows a few stages of respiration and number of carbon atoms in the compounds involved.

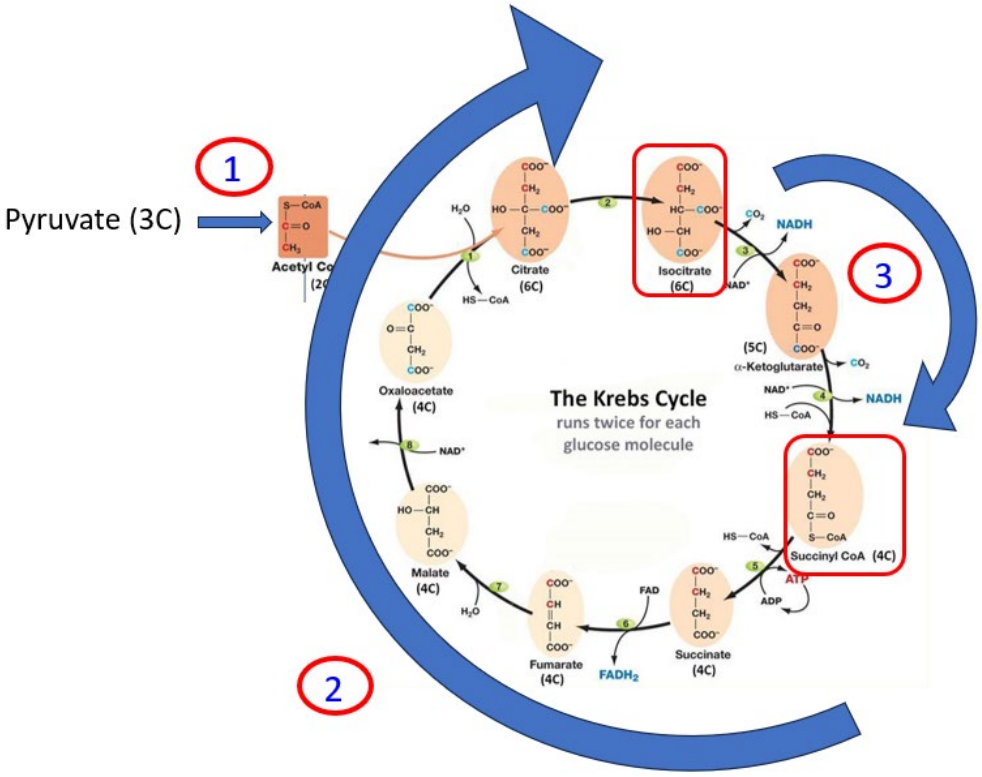


Which reactions occur at Stages 1-3?

	Stage 1	Stage 2	Stage 3
A	CO_2 production and oxidation of coenzyme	ATP hydrolysis	Oxidative decarboxylation and oxidative phosphorylation
B	Oxidative decarboxylation and oxidation of coenzyme	Substrate-level phosphorylation	CO_2 production and oxidative phosphorylation
C	CO_2 production and reduction of coenzyme	ATP hydrolysis	Oxidative decarboxylation and dehydrogenation
D	Oxidative decarboxylation and reduction of coenzyme	Substrate-level phosphorylation	CO_2 production and dehydrogenation

Explanation

Stage 1: Link Reaction, Stage 2 & 3: Krebs cycle



QUESTION 13 [Cell Cycle, HI-3]

A child with Down syndrome has the genotype P^1 P^2 P^3 for a gene on chromosome 21 that has four different alleles — allele P^1, allele P^2, allele P^3, allele P^4. The child's mother has the genotype P^1 P^2 and the father has the genotype P^3 P^4.

In which parent did chromosomes fail to separate, and did this event occur in the first or second meiotic division?

A Mother; Meiosis I

B Mother; Meiosis II

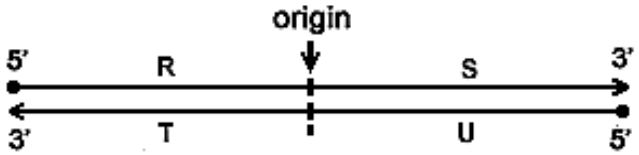
C Father; Meiosis I

D Father; Meiosis II

Explanation

- Since child has $P^1P^2P^3$, and that his mother has P^1 and P^2, nondisjunction must have occurred in the mother.
- Meiosis I separates homologous chromosomes, and would have separated P^1 and P^2 during normal formation of ovum in the mother.
- Since child has both P^1 and P^2, nondisjunction must have occurred during meiosis I, where the pair of homologous chromosome 21 fail to separate, pulling the pair of HC (each containing P^1 and P^2 respectively) to one pole.
- If nondisjunction occurs during meiosis II, the ovum would contain either P^1P^1 or P^2P^2, and the child would have the genotype $P^1P^1P^3$ or $P^2P^2P^3$.

QUESTION 14 [DNA Rep & Gene Exp 1/2, HI-1]
DNA synthesis is initiated at the indicated origin of replication as shown in figure below.



Which segments of single-stranded DNA are templates for the synthesis of Okazaki fragments?

A R and U

B S and U

C R and T

D S and T

Explanation
Lagging strands are synthesised away from the replication fork, from 5' to 3'.

QUESTION 15 [DNA Rep & Gene Exp 2/2, KU-2]
Which statement about the transcription and translation of a gene is correct?

A The non-transcribed strand of DNA has a base sequence that is **identical** to the mRNA produced in transcription.

B The template strand of DNA has a base sequence that is **identical** to the mRNA produced in transcription.

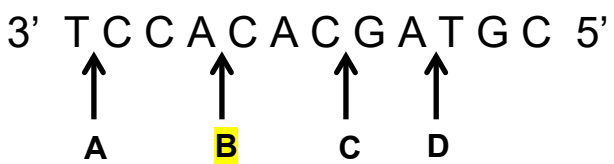
C The non-transcribed strand of DNA has a base sequence that is complementary to the tRNA molecules required in translation.

D The template strand of DNA has a base sequence that is **complementary** to the tRNA molecules required in translation.

Explanation
- Statement A- the non-transcribed strand of DNA (i.e. non-template strand) has a base sequence that is similar to mRNA as DNA use Thymine whereas mRNA use Uracil.
- Statement B - the template strand of DNA has a base sequence that is complementary to mRNA.
- Statement D - the template DNA has a similar base sequence to tRNA as both template DNA and tRNA are complementary to the mRNA.

QUESTION 16 [Mutation & Conseq 1/2, HI-1]
The diagram shows a template strand of DNA which codes for four amino acids.

Where would a mutation, introducing a thymine nucleotide, result in the premature termination of translation?



Explanation
- Insertion of T at 'B' will result in the triplets being read as TCC ATC ACG ATG, which when transcribed, will result in the codons AGG **UAG** → stop codon.

QUESTION 17 [Mutation & Conseq 2/2, HI-2]
Sickle cell anaemia is caused by a mutation in an allele of the gene that codes for the β-globin polypeptide of haemoglobin.

The diagram shows the sequence of bases in a small section of the template strand of DNA for both the Hb^A (normal) and Hb^S (sickle cell) β-globin alleles.

Hb^A CTGACTCCTGAGGAGAAGTCT
Hb^S CTGACTCCTGTGGAGAAGTCT

How will the mutation in the allele result in the production of an altered version of the β-globin polypeptide?

A All the amino acids coded for after the mutation will differ from those in the Hb^A protein.

B mRNA transcribed from the Hb^S allele will contain the codon CAC instead of the codon CTC.

C A tRNA molecule with the anticodon GUG will hydrogen bond to the altered codon on mRNA.

D The ribosome will be unable to continue translation of the Hb^S mRNA after the altered codon.

Explanation
- Single nucleotide substitution from A-T at non-template strand, causing mRNA to change from CUC to CAC.
- Statement A - single nucleotide substitution is not a frameshift mutation, hence only 1 amino acid is changed.
- Statement B -mRNA does not have thymine and the codon change from CUC to CAC.
- Statement D -the single nucleotide substitution does not cause pre-mature stop codon.

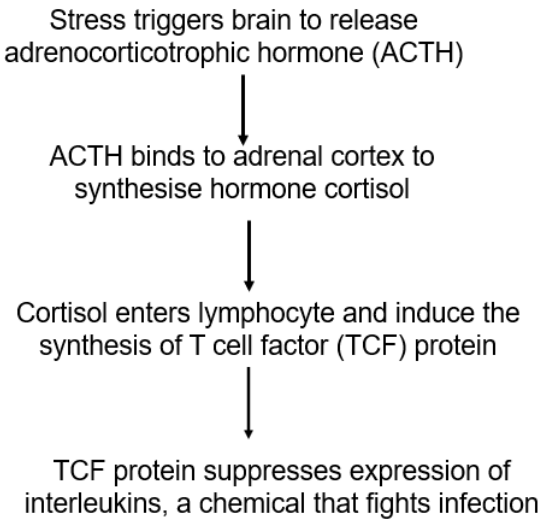
QUESTION 18 [Molecular Techniques, KU-2]
Which of the following correctly describes an advantage and limitation of the Polymerase Chain Reaction (PCR)?

	Advantage	Limitation
A	Highly accurate due to proof-reading function of *Taq* DNA polymerase	The extent of amplification is limited by the denaturation of polymerase
B	Able to produce 20^2 copies of the target DNA after 20 cycles	Cannot amplify unknown sequences as primers cannot be made
C	Works on DNA from various species and sources	More time consuming than traditional methods of using bacteria to amplify DNA sequences
D	Only requires a minute amount of template for amplification	Only able to amplify a small fragment of DNA

Explanation
- Option A – Taq D Polymerase is a DNA polymerase hence, it has proof-reading mechanism. After several cycles, enzymes may get denatured even though primers and nucleotides are added in excess and are still available, PCR cannot continue.
- Option B – It is able to produce 2^{20} copies of target DNA.
- Option C – PCR is relatively faster thantraditional methods of using bacteria as it takes only several hours.

QUESTION 19 [OCGE & SC 1/2, HI-2]

When a person undergoes a stressful experience, their immune system can be suppressed and they become more susceptible to infection. Some of the elements involved in this chain of events are shown in the diagram below.



Which combination correctly shows the genes that have transcription-enhancing factors bound to their control elements during the above sequence of events?

	Gene for ACTH	Gene for TCF	Gene for interleukin
A	✓	×	×
B	×	✓	✓
C	✓	✓	×
D	×	×	✓

Explanation

- Transcription-enhancing factors only increase transcription of a gene.
- Since, stress triggers the brain to release ACTH, there must be increased transcription of ACTH genes.
- Cortisol also induces synthesis of T cell factor (TCF) hence, there must be increased transcription of TCF genes.
- Since TCF suppresses interleukin, interleukins will not be expressed hence, it will not involve any transcription enhancing factors.

QUESTION 20 [OCGE & SC 2/2, KU-1]
What are some similarities between all cancer cells and all stem cells?

A They replicate indefinitely, lack cell-cell adhesion and are able to move from one location in the body to another.

B They lack contact inhibition, are non-differentiated and are regulated by molecular signals.

C They are able to move from one location to another, are regulated by molecular signals and can be found in various parts of the body.

D They replicate indefinitely and are non-differentiated.

Explanation
- Both can replicate indefinitely and are non-differentiated.
- Cancer cells are a result of accumulated mutation hence, they no longer respond to signals that control cellular growth and death.
- Cancer cells can only move at a later stage during metastasis.

QUESTION 21 [Viruses, KU-1]
Which of the following is **not** found in all viruses?

A Nucleic acid

B Capsid

C Viral membrane

D Proteins complementary to host cell receptor

Explanation
- They contain nucleic acid, which can be either DNA or RNA.
- The nucleic acid is protected by a protein coat called the capsid. Therefore, options A), B), and D) are all typical components of a virus.
- However, not all viruses possess a viral membrane. Protein coat of the virus, along with any additional envelope, provides protection.

QUESTION 22 [OCGE in Prok 1/3, KU-2]
In *E. coli* bacteria, regulation of gene expression involving the catabolite activator protein (CAP) is a type of positive regulation because

A cAMP-CAP helps RNA polymerase to initiate transcription.

B CAP increases the production of cAMP.

C glucose binds to CAP and activates it.

D glucose stimulates the production of cAMP.

Explanation
- Definition of positive control: The **rate of transcription** of structural genes is **increased** in the presence of an active **activator.** The activator is encoded by a **regulatory gene**.
- Option B: Incorrect - cAMP is synthesised from ATP by enzyme adenylyl cyclase in the plasma membrane.
- Option C: Incorrect - Active CAP is formed when CAP is complexed with cAMP not glucose.
- Option D: Incorrect - Adenylyl cyclase (which synthesizes cAMP from ATP) activity is **inhibited** by the presence of glucose**.**

QUESTION 23 [OCGE in Prok 2/3, HI-2]
A gene is found in the plasmid of a bacterial cell.

A student made the following statements regarding the transfer of this gene to a recipient bacterial cell.

1 Transformation occurs when gene is taken up by proteins present on the cell surface membrane of the recipient cell of a closely-related species.

2 Transfer by conjugation occurs only if the plasmid is the F factor.

3 Generalised transduction occurs when gene is accidentally packaged into newly assembled temperate phages which then infect the recipient cell.

Which statements are **not** correct?

A 1 and 2 only

B 1 and 3 only

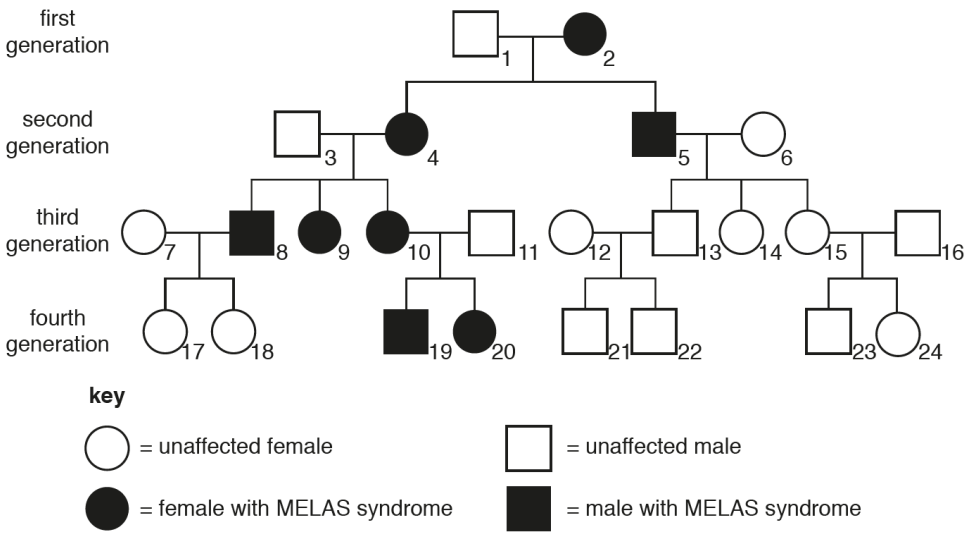
C 2 and 3 only

D 1, 2 and 3

Explanation

- Statement 1 is incorrect because transformation is the incorporation of naked DNA (fragments of DNA) from the environment into the recipient cells to alter the bacterial genotype.
- Statement 2 is correct because only if the gene is found on the F (fertility) plasmid/factor. The presence of the F factor allows the unidirectional transfer of genetic material from a donor bacterial cell to a recipient bacterial cell via a sex pilus.
- Statement 3 is incorrect as only virulent phage can carry out generalized transduction. Specialized transduction can only occur with temperate bacteriophage, since it involves the lysogenic cycle of replication.

QUESTION 24 [Inheritance, HI-3]
The pedigree shows four generations of a family where several individuals are affected by MELAS syndrome, a progressive neurodegenerative disorder.



Which statement describes how the mutant allele is inherited?

A The mutant allele is carried on the mitochondrial DNA, which is inherited only through the maternal line since sperms do not contribute mitochondria to the zygote.

B The mutant allele is carried on the Y-chromosome.

C The mutant allele is dominant and is carried on the X-chromosome.

D The mutant allele is recessive and is carried on the X-chromosome.

Explanation
Statement B – mutant allele on the Y chromosome will only affect males. The pedigree shows affected females too.
Statement C – if it is X-linked dominant, III-8 (X^AY) would have passed the dominant alleles to his two daughters.
Statement D – if it is X-linked recessive, II-3 must be affected (X^aY) to pass the allele to his daughters (X^aX^a).

QUESTION 25 [Inheritance 2/2, HI-1]
A pure-breeding black fowl is crossed with a pure-breeding white fowl. All the progeny are blue. Sibling cross is carried out and there are black, white as well as blue progeny.

Which statement most likely explains the above crosses?

A It is a monohybrid cross involving three different alleles.

B It is a monohybrid cross involving two alleles that exhibit incomplete dominance.

C It is a dihybrid cross involving two alleles that exhibit incomplete dominance at each gene locus.

D It is a dihybrid cross involving three different alleles at each gene locus.

Explanation

Parental genotypes: BB x bb
↓
F1 genotype: Bb

Sibling cross: Bb x Bb
↓
F_2 genotypes: BB, Bb, Bb, bb

Ratio: 1Black, 2Blue, 1White

QUESTION 26 [Evolution 1/2, HI-3]
Granitic Island and Coralline Island of Seychelles are home to seven and three endemic species of lizards respectively.

The lizards could be differentiated by their different body colouration. It was found that lizards with similar body colouration mate with one another more frequently than would be expected under a random mating pattern.

Which of these statements could apply to these lizards?

1 Different species between Granitic Island and Coralline arose by allopatric speciation due to the presence of a geographical barrier between them.

2 The seven species of lizards within Granitic Island arose by sympatric speciation due to reproductive isolation.

3 Adaptive radiation has taken place due to the many available ecological niches found on the islands.

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

Explanation
- Since they are islands and are separated by body of water, there is geographical isolation hence the different species arose. This is known as allopatric speciation.
- Since the different species arose within the same island, there is no geographical isolation therefore it is sympatric speciation.
- Having many available ecological niches will result in different selection pressures present at the different niches hence, different alleles will be selected for and against. This allows adaptive radiation to take place.

QUESTION 27 [Evolution 2/2, KU-2]
Harmful alleles can lead to various disorders, diseases, or reduced overall fitness of an organism. They are usually recessive and remain in populations globally despite natural selection.

Which statements are true?

1 Harmful traits may be maintained by the same mutation that keeps arising in the population.

2 The harmful effects may only be expressed later in the life of the organism, after reproduction has occurred.

3 Harmful alleles continue to exist due to diploidy.

4 Genetic drift can select for harmful alleles.

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

Explanation
1. Mutation is random.
2. Since its onset is much later, organism would have passed on the genes to the next generation.
3. Diploid organisms may still carry the recessive allele and be a carrier without itself being affected.
4. Genetic drift is the gain or loss of alleles and is due to random chance.

QUESTION 28 [Immunity 1/2, KU-1]

The innate immune system involves phagocytes while the adaptive immune system involves……1…… . Humoral immunity is mediated by antibodies from ……2…… and is involved in the elimination of……3…… . Cell-mediated immunity is mediated by ……4…… and is involved in the elimination of ……5…….

Which words correctly complete gaps 1–5?

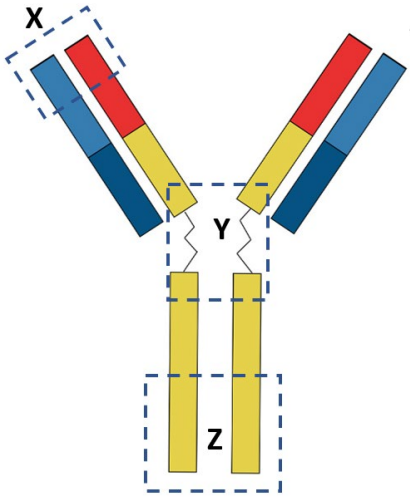
	1	2	3	4	5
A	lymphocytes	naïve B lymphocytes	intracellular pathogens	mature cytotoxic T cell	extracellular pathogens
B	specific circulating glycoproteins	plasma cells	intracellular pathogens	macrophages	extracellular pathogens
C	intact skin and mucosal layers	activated B lymphocytes	extracellular pathogens	antibodies	intracellular pathogens
D	lymphocytes	plasma cells	extracellular pathogens	mature cytotoxic T cell	intracellular pathogens

Explanation

- Only plasma cells produce antibodies.
- Mature cytotoxic Tcell is part of the cell-mediated immunity.

QUESTION 29 [Immunity, KU-2]

The diagram shows an antibody molecule.



Which statements on formation of antibody diversity are true?

1 The presence of multiple variable gene segments allows variation in region **X**.

2 Random arrangement of VDJ segments at the light chain locus by recombinase.

3 Region **Y** is the disulfide bridges that gives the flexibility for the antibody molecule to bind around different antigens.

4 Affinity maturation through the process of somatic hypermutation in the production of mature naïve B and T cells.

5 Class switching to other classes in region **Z** occurs to further diversify antibodies of the same specificity.

A 2 and 4 only **B** 2, 3 and 4 **C** 1 and 5 only **D** 1, 2, 3 and 5

Explanation
Statement 1 [True] - Region X is the antigen binding site which has a complementary shape that binds to specific epitopes upon somatic recombination.
Statement 2 [False] - Random arrangement of VDJ segments at the ~~light~~ heavy chain locus by recombinase
Statement 3 [False] - It is the hinge region that gives flexibility for an antibody molecule to bind around the antigen not the disulfide bridges. Disulfide bridges simple link the 2 identical heavy chains and 2 identical light chains together.
Statement 4 [False] - Affinity maturation and class switching will result differentiation into antibody-secreting plasma cells and memory cells.
Statement 5 [True] – Region X (Antigen binding site) remains constant as class switching in Region Z (Fc region) changes the heavy chain constant region but retains its specificity for the antigen.

QUESTION 30 [Climate Change, KU-2]
Which of the following describes a positive feedback loop concerning climate change?

A Rising sea temperatures will cause increased growth of photosynthetic algae.

B Increased atmospheric temperature result in melting of sea ice which decreases the amount of sunlight reflected back into space.

C Earlier migration of birds from southern winter habitats to northern breeding habitats.

D Increase in atmospheric temperature causes many species to move towards increased altitudes to stay within their optimum temperature range.

Explanation
Definition of positive feedback: feedback that tends to magnify a process or increase its output. Options A, C and D will not cause a magnification or increase in output.

☺ End of Paper 1 ☺