

Paper 1 – MCQ

1	A	11	B	21	B	31	D
2	B	12	B	22	C	32	C
3	A	13	B	23	A	33	B
4	D	14	A	24	D	34	D
5	C	15	C	25	A	35	D
6	D	16	C	26	B	36	B
7	B	17	B	27	C	37	B
8	C	18	B	28	A	38	A
9	A	19	A	29	C	39	C
10	D	20	A	30	C	40	D

Paper 2 – Section A (50 marks)

Qn.	Answer	Marks	Comments
1a	- An individual with anemia have a <u>lower red blood cell count</u> than a healthy individual;	1	R: less blood cells (not specific) Generally well done.
1b	- Red blood cells contain <u>haemoglobin</u> that <u>binds reversibly with oxygen</u> - This allows red blood cells to <u>transport oxygen</u> from the lungs to the rest of the body - A lower red blood cell count results in a <u>decrease in oxygen transported to the brain</u>	1 1 1	Poorly done. Many students did not state the function of haemoglobin. Many also did not specify the brain despite the question stating 'light-headness'.

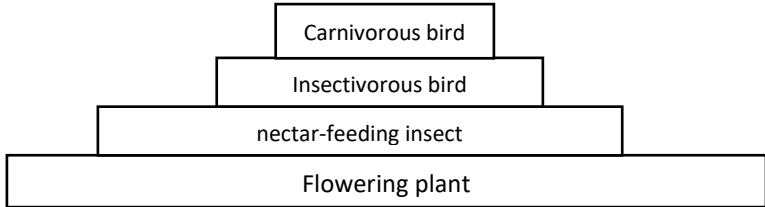
1c	- Tachycardia / faster heart rate / heart failure / heart cells die / heart to be overworked / heart to be strained - to compensate for its reduced ability of blood to carry oxygen	1 1	R: high blood pressure (condition is not specific to the heart) A: weaker contractions as heart muscle tissue does not receive sufficient oxygen
2ai	- A consists of layers of long cylindrical, <u>closely packed</u> cells while B consists of irregularly shaped cells with numerous large <u>intercellular air spaces</u> between them. - A contains <u>more chloroplasts</u> than B. - B contains the <u>transport tissues / xylem and phloem</u> while A does not. - Cells in B are <u>covered with a thin film of moisture</u> while cells in A does not. Any 2	2	R: functional differences (a handful of students did not read the question properly) Poorly done question, while most students can identify the 4 structures, many are not familiar with the structural features.
2aii	- C is made up of <u>dead cells</u> while D is made up of <u>living cells</u>. - C has a <u>continuous lumen / no cross walls</u> while D contains <u>cross-walls / sieve plates</u> between cells. - C contains <u>lignin deposits</u> while D does not. Any 2	2	Some students are not making comparisons but rather simply listing structural features.
2b	The diagram shows two guard cells flanking a central pore (stoma). Each guard cell contains a large central vacuole, several small chloroplasts, and a prominent nucleus. The cells are bounded by a cell wall and a cell membrane. The pore between them is labeled 'stoma'.	3	1 mark for accurate drawing a pair of guard cells and stoma 1 mark for any three correctly labelled structures 1 mark for drawing criterias (solid lines without shading, appropriate size, neat labels) Poorly done. Many are not clear about structures in guard cells, shaded the nucleus, had label lines cutting across excessively and labelled stomata (plural).

2c	- A moist environment has <u>higher humidity</u>; - which means <u>higher accumulation of water vapour outside the stomata</u>; - This makes the <u>water vapour concentration gradient</u> between the leaf and the atmosphere <u>less steep / more gentle</u>; - This results in a <u>lower rate of transpiration</u>; Any 2 for 1m	2	A significant number of students were confused between water potential and concentration gradient.
3a	- Structure C is the <u>diaphragm</u>, - which <u>contracts and flattens</u> down - Structure A is the <u>intercostal muscles</u> - <u>external intercostal muscles contract</u>, while the <u>internal intercostal muscles relax</u> - Structure B is the <u>ribs</u>, - which <u>raises upwards and outwards</u> - This causes the <u>thoracic volume to increase</u>. - Atmospheric pressure is now <u>higher</u> than pressure in the lungs, air is inhaled. Any 2 for 1m	4	Most students were familiar with the process of inhalation but majority of students were not able to identify A and B correctly.
3b	- Carbonic anhydrase <u>catalyses</u> the reaction between <u>carbon dioxide and water</u> to form <u>carbonic acid</u> - which is then <u>converted into hydrogencarbonate ions</u>, allowing carbon dioxide to be <u>transported in blood plasma</u>. - With lower levels of carbonic anhydrase, <u>less carbon dioxide is excreted/exhaled</u> at the lungs / <u>slower rate of gaseous exchange</u>. - This could result in an <u>increase</u> in blood <u>acidity</u> / the <u>accumulation</u> of carbon dioxide can be <u>toxic</u> to the individual / <u>rapid breathing</u> to expel carbon dioxide Any 3, each 1m	3	Poorly done question. Many students skipped this question. Some were unsure which reaction was catalysed by carbonic anhydrase. Some students associated it to carbon monoxide and carboxyhemoglobin. A: catalyzes conversion of carbon dioxide to carbonic acid A: lower efficiency of removal of carbon dioxide from body

3c	- sticky mucus <u>paralyses cilia</u> / <u>reduces the sweeping action of cilia</u>; - mucus and dust particles cannot be removed, air passages become <u>blocked</u>; - breathing becomes difficult / laboured; - resulting in persistent <u>coughing to clear air passages</u>; - this increases <u>risk of infection / inflammation</u> of the airways / may lead to <u>emphysema</u> Any 2 for 1m	2	Generally well done.
4a	A – Graafian follicle B – Corpus luteum	1 1	A number of students skipped this question. Many had spelling errors (max 1m)
4bi	- During the fertile periods from <u>day 11 to 16</u>. - <u>Sperms</u> can live for approximately <u>three/four days</u> in the female reproductive system - An <u>egg</u> can survive up to about <u>one/two days after its release</u> from an ovary.	1 1 1	A: +/- 1 day for fertile period Explanation must match suggested fertile period. Generally well done.
4bii	- The method <u>assumes</u> that the woman's <u>menstrual cycle</u> is highly <u>regular</u> / <u>follows a 28-day cycle</u> / <u>ovulation always occurs on day 14th</u> - However, there are various factors such as emotional stress, illness and malnutrition which may affect the menstrual cycle.	1 1	Generally well done.
5a	- Order of bases in DNA determines <u>order of bases in mRNA</u> formed during <u>transcription</u>. - This in turn determines <u>order of amino acids in protein</u> formed during <u>translation</u>. - Hence, an individual with a mutation in the gene produces aspartoacylase enzymes that are of the wrong 3D conformation / with an altered active site / non- functional.	1 1 1	Poorly done, most students are not familiar with processes of transcription and translation.
5b	- Myelin sheath <u>insulates the axon</u>, - allowing nerve impulses to <u>jump from node to node</u>. - Malformation of myelin sheath will thus <u>slow down the transmission of impulses</u> along the nerve fibre, - resulting in the individual having a <u>slower reaction time</u>. Any 2 for 1m	2	Many were incorrect about what was being insulated, some stated "neurone", "dendron", "node of ranvier".
5ci	- The disease is only expressed in <u>homozygous recessive</u> condition / The individual is diseased only if he inherit <u>two recessive alleles</u> for the gene.	1	Many students are unclear about what this term meant.

5cii	<table><tr><td></td><td colspan="2">Mother</td><td colspan="2">Father</td></tr><tr><td>phenotype of parents</td><td colspan="2">normal</td><td colspan="2">normal</td></tr><tr><td>genotype of parents</td><td colspan="2">Nn</td><td colspan="2">Nn</td></tr><tr><td>gametes</td><td>N</td><td>n</td><td>N</td><td>n</td></tr><tr><td>genotype of offspring</td><td>NN</td><td>Nn</td><td>Nn</td><td>nn</td></tr><tr><td>phenotype of offspring</td><td>normal</td><td>normal</td><td>normal</td><td>diseased</td></tr></table>		Mother		Father		phenotype of parents	normal		normal		genotype of parents	Nn		Nn		gametes	N	n	N	n	genotype of offspring	NN	Nn	Nn	nn	phenotype of offspring	normal	normal	normal	diseased	- 1 1 1 1	Generally well done. Rejected phenotypes: “infected” - as this disease is inherited and not due to infection “do not” - as it is simply not a phenotype.
	Mother		Father																														
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phenotype of offspring	normal	normal	normal	diseased																													
6a	- Q → P → S → R	1	Generally well done.																														
6b	- 4	1	A handful did not read the question properly - “this cell”																														
6c	- Stage <u>S</u> , - During anaphase, centromere splits and the <u>spindle fibres shorten</u> , <u>pulling sister chromatids apart to opposite poles of the cell</u> .	1 1	Generally well done.																														
6d	Similarities • Disintegration of nuclear envelope and nucleolus • Chromatin thread condense, coil and shorten into chromosomes • Both are forms of nuclear division Differences<table><tr><th>Mitosis</th><th>Meiosis</th></tr><tr><td>One nuclear division</td><td>Two nuclear divisions</td></tr><tr><td>Daughter cells have equal number of chromosomes as parent cell.</td><td>Daughter cells have half the number of chromosomes as parent cell.</td></tr><tr><td>Daughter cells are genetically identical to parent cell.</td><td>Daughter cells are not genetically identical to parent cell.</td></tr><tr><td>No crossing over of homologous chromosomes</td><td>Crossing over of homologous chromosomes occur.</td></tr><tr><td>No independent assortment of chromosomes</td><td>Independent assortment of chromosomes occur.</td></tr><tr><td>Takes place in normal body cells (somatic cells)</td><td>Takes place in gonads/sex organs.</td></tr></table>	Mitosis	Meiosis	One nuclear division	Two nuclear divisions	Daughter cells have equal number of chromosomes as parent cell.	Daughter cells have half the number of chromosomes as parent cell.	Daughter cells are genetically identical to parent cell.	Daughter cells are not genetically identical to parent cell.	No crossing over of homologous chromosomes	Crossing over of homologous chromosomes occur.	No independent assortment of chromosomes	Independent assortment of chromosomes occur.	Takes place in normal body cells (somatic cells)	Takes place in gonads/sex organs.	5	At least 1 contrasting point required. Students need to understand the difference between ‘nuclear’ and ‘cell division’ and that interphase and cytokinesis is not a part of mitosis and meiosis but the processes that occur before and after them. Question was marked leniently, some of the points given by students were very superficial. R: meiosis occurs in sex cells / gametes – meiosis produces them.																
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Section B

7a	S: no odd scales, graph takes up at least 1/2 of space A: Axes properly labelled with units and graphs labelled correctly P: points accurately plotted L: smooth curved line through most plotted points, not extrapolated at either end.	4	Continuous data should be drawn using line graphs instead of a bar graphs. Max 2 marks will be awarded for S and A if done properly. Some students flipped the axis, again only max 2 marks awarded for S and P if done properly.
7b	- Both diets had the same level of effectiveness for the <u>first 4 weeks</u> where there was the <u>same average percentage decrease in BMI</u> - <u>At the end of 16 weeks</u>, average percentage decrease in BMI resulted by the ketogenic diet is <u>more than doubled</u> that resulted by the Atkin's diet, indicating that the ketogenic diet was more effective.	1 1	Most students did not pick up on the comparative effectiveness in the early weeks and only compared data of 16th week. Some did not quote any data.
7c	- <u>Large amounts of amino acids</u> are produced after digestion. Excess amino acids undergo <u>deamination</u> in the liver. - <u>Increase concentration of urea formed</u> during deamination may result in kidney failure / formation of kidney stones / can be toxic	1 1	Note that 'side effects' refer to negative effects. Max 1m given for students who only wrote benefits of protein diet.
7d	- Ketogenic diet reduces carbohydrate intake, and so with <u>lesser carbohydrates digested/absorbed</u>, this results in <u>lower blood glucose level</u> - This will be beneficial for individuals with type II diabetes where <u>cells are resistant to the effects of insulin</u>.	1 1	Generally well done
8a	 1m for correct overall shape of pyramid 1m for complete food chain with at least four trophic level	2	Generally well done, a handful of students wrote an incomplete food chain.

8b	- Energy is <u>lost</u> as heat to the environment, <u>through respiration</u> and in <u>uneaten parts of dead bodies / faeces / excretory products</u>. - As such, about 90% of the energy is lost at each trophic level.	1 1	Generally well done
8c	- DDT <u>cannot be excreted</u> and thus <u>bioaccumulates</u> in the bodies of organisms <u>over time</u>. - As such DDT is passed along the food chain, <u>increasing in concentration</u> in the bodies of organisms <u>along the trophic levels</u>, - This process is known as <u>bioamplification / biomagnification</u> and - results in high levels accumulated in bodies of dolphins and sharks at the <u>top of the food chain</u>. Any 3, each 1m	1 1 1	Students are confused between terms bioaccumulation and bioamplification. Many describe food chain at length but are missing the keywords important in this very standard question.
8d	- For scientific research, as studies on wildlife give us insight on human beings. - Maintenance of a balanced ecosystem - Maintenance of biodiversity –preventing the extinction of animal and plant species, and maintaining a large gene pool. - For economic purpose – Forests are a source of raw materials for industries. - Preservation of natural scenery and wildlife for appreciation Any 3, each 1m (accept any other relevant points)	3	Generally well done. A number of students describe at length about a single benefit of conservation of forest, rather than discussing the various benefits.
E9a	- As blood passes from the renal artery into the glomerulus, <u>small molecules are forced out of the glomerular blood capillaries into the bowman's capsule</u> - by the <u>high hydrostatic blood pressure</u> - This process is known as <u>ultrafiltration</u>. - As the filtrate passes through the tubule, <u>useful substances</u> such as water, glucose and amino acids <u>get selectively reabsorbed</u> back into the bloodstream - <u>Excess water</u> and metabolic waste products such as <u>urea pass out of the collecting duct</u> as urine.	1 1 1 1 1	Many missed out on the last point which is key, as it mentions the components that form urine.
E9b	- When <u>water potential of blood decreases below norm</u>, the <u>hypothalamus is stimulated</u>. - <u>Increase antidiuretic hormone (ADH) secretion</u> by pituitary gland - <u>Causes cells in the walls of the collecting ducts to become more permeable to water</u> - This <u>increases reabsorption of water</u> into the bloodstream. - <u>Less urine</u> is produced / urine is <u>more concentrated</u>. - Water potential increases back to norm	1 1 1 1 1	Generally well done. A handful mixed up hypothalamus and pituitary gland.

O9a	- Is a <u>protein</u> therefore its activity is <u>affected by pH and temperature</u> - Functions as a <u>biological catalyst</u> - Speeds up chemical reactions by <u>lowering activation energy</u> - Is <u>specific</u> in action due to its <u>3-dimensional shape</u> - <u>Remains chemically unchanged</u> at the end of the reaction	1 1 1 1 1	Small handful of students wrongly stated that enzymes denature at low temperature and that enzymes only catalyze breaking down of substrates.
O9b	Production: - Enzymes are protein in nature. <u>Ribosomes</u> are involved in <u>synthesizing</u> proteins. - <u>Rough endoplasmic reticulum</u> then <u>transports proteins</u> made by ribosomes <u>to the Golgi Apparatus</u>. - <u>Golgi Apparatus</u> then <u>chemically modifies</u> the substances made by the ER. It also <u>stores</u> and <u>packages</u> substances into vesicles for secretion out of the cell. Secretion: - <u>Secretory vesicles</u> then <u>pinched off from the Golgi apparatus</u> and move to the cell surface membrane - Secretory vesicles then <u>fuse with the cell surface membrane</u>, secreting the enzymes outside of the cell.	1 1 1 1 1	Poorly done. Many are not familiar with role of Golgi apparatus. Students are not familiar with the term secretory vesicles as well. A: transcription & translation process (1m for each process described in detail)