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BIOLOGY (964/1)

OVERALL PERFORMANCE

For Semester 1, 2214 candidates sat the examination for this subject and 70.86% of them obtained a full pass.

The percentage of the candidates for each grade is as follows:

Grade	A	A–	B+	B	B–	C+	C	C–	D+	D	F
Percentage	4.29	4.83	8.99	7.45	15.31	15.18	14.81	4.65	2.57	4.88	17.03

CANDIDATES' RESPONSES

SECTION A: *Multiple-Choice*

Answer Keys

Question number	Key	Question number	Key	Question number	Key
1	**C**	6	**D**	11	**A**
2	**D**	7	**B**	12	**C**
3	**A**	8	**C**	13	**B**
4	**A**	9	**A**	14	**A**
5	**C**	10	**D**	15	**B**

General comments

In general, Questions 1, 9, 10, and 14 were in the range of easy questions. More than 70% of the candidates managed to answer them correctly. Meanwhile, Questions 3, 4, 5, 8, 11, 12, 13 and 15 were in the range of moderate questions where 40% to 70% could be answered by the candidates correctly. The easiest question was Question 10, in which 80% of the candidates answered the question correctly. The most difficult question was Question 7, in which only 32% of the candidates answered the question correctly.

SECTION B AND C: *Structure and Essay*

General comments

In general, the questions covered all aspects, which include factual recall, understanding the biological concept, and application of knowledge. The questions widely covered the syllabus of STPM from topic 1 to topic 6. The depths of the questions were in accordance with the syllabus. The questions

were comprehensive and provide appropriate challenges to the candidates. The questions were able to differentiate between the low ability and high ability candidates.

Comments on the individual questions

Question 16

The question was about cellular components in a cell. In part (*a*), only a few candidates were able to answer *P* as *the inner membrane space* or *cristae* where as the rest of candidates answered structure *P* as the *inter membrane space* which was incorrect. The majority of the candidates managed to answer *Q* as *grana*. There were also candidates who gave a general answer, naming *P* and *Q* as *mitochondria* and *chloroplast* respectively, which was not accepted as the answer.

In part (*b*), the majority of the candidates managed to state two common characteristics of mitochondria and chloroplast, which were *the presence of double membrane* and *70S ribosomes*. Some candidates answered *the presence of DNA* which was acceptable as an answer.

In part (*c*), most candidates answered the function of starch granule correctly, as *the storage of starch*. Some gave a general answer such as *for food storage* or *storage of organic substances*, which were not accepted as the answer.

In part (*d*), many candidates gave the general functions of the two organelles instead of giving the importance of cristae and grana. There were candidates who gave an answer such as *to absorb light* for *Q* instead of *to absorb light energy*, which was more precise and accurate.

Question 17

The question was about the transportation of substances across a membrane. In part (*a*), the majority of the candidates answered that *both processes involve facilitated diffusion* and *does not require energy or passive transport*.

In part (*b*), the candidates were able to identify the type of transport proteins, which were the *pore or channel protein* for process *X*, and the *carrier protein* for process *Y*.

In part (*c*), only a few candidates managed to score marks. The majority of the candidates answered the *big molecule* could be transported by process *X*. Only a few candidates answered *polar or charged or hydrophilic molecule*. Some candidates wrote *ions* which was not accepted as the answer.

In part (*d*), most candidates were able to state that process *Y* was involved in the transport of glucose. Hence, the candidates were able to explain the process of the transportion of glucose by the binding of glucose to the carrier protein and led to the alteration or changes in the protein conformation, which allow glucose to be released to the other side of the membrane.

Question 18

In part (*a*), the question was about anaerobic respiration which produce lactic acid when vigorous exercise was practised. The candidates did well in explaining the processes which occured in the absence of oxygen or in anaerobic condition whereby glucose undergoes glycolysis to produce pyruvate. There were candidates who did not use the correct terms in their explanation. Candidates tend to use general terms such as *convert* or *change* instead of *oxidised* or *reduced* in explaining the processes involved.

In part (*b*), the majority of the candidates were able to describe the series of reactions involved in the production of NADH in Krebs cycle satisfactorily, but candidates lost their marks when stating the three compulsory points which were *isocitrate is oxidised to α-ketoglutarate*, *α-ketoglutarate is oxidised to*

succinyl CoA and *malate is oxidised to oxaloacetate*. Candidates lost marks when they wrote *malate is converted to oxaloacetate* instead of *malate is oxidised to oxaloacetate*. Candidates must use scientific terms such as oxidised and reduced in their answer. Some candidates mixed up all the biochemical reactions as well as wrongly spelt the name of substrates.

Question 19

In part (*a*), the question was about the types of simple epithelial tissues. The candidates were required to describe the structures and characteristics of the cell that composed the tissues. However, only a few candidates managed to describe the cell involved. The candidates could not correspond correctly the tissue structure to its epithelial tissue.

In part (*b*), the question was about the formation and breakdown of maltose. Majority of the candidates were able to answer *the formation of a molecule of maltose was made up from two molecules of α-glucose*. The majority of the candidates managed to obtain marks for the formation of maltose by the bonding of two molecules of glucose by α-1,4-glycosidic bond. However, none of the candidates mentioned the two hydroxyl groups. The candidates were also able to mention that *condensation process involved in the production of maltose* as well as *hydrolysis process involved in the breakdown of maltose which was catalysed by maltase and the process is reversible*.

Question 20

In part (*a*), the question was about the mode of action of a competitive inhibitor in an enzymatic reaction. The candidates were able to mention that *the inhibitor binds to the active site of the enzyme hence prevents the substrate to bind to the enzyme*. However, only a few candidates were able to mention that *due to the prevention of enzyme-substrate binding, no products were formed*. Most candidates were able to mention that *the process can be overcomed by increasing the concentration of the substrate*.

In part (*b*), the question requires the candidates to explain how photosynthesis converted carbon dioxide from the atmosphere into a carbohydrate molecule. The majority of the candidates were able to mention that *carbon dioxide binds to RuBP* but could not gain mark if they did not mention the carbon fixation process. The candidates gained marks for mentioning that *the process of the binding of carbon dioxide and RuBP was catalysed by rubisco*. However, few candidates lost marks due to wrongly spelt the term bisphosphate. Some candidates were able to explain the Calvin cycle precisely as well as able to use the correct scientific terms. There were candidates who answered by writing in a general statement. For example, candidates mentioned that *G3P is converted into carbohydrate* instead of *G3P is converted into sugar or glucose*. Few candidates lost marks due to wrongly spelt the substrate as well as giving a general answer in the conversion of carbon dioxide into carbohydrate. Some candidates explained the light dependent reaction in detail which is not required to answer this question. The candidates must use proper scientific terms in their explanation.

BIOLOGY (964/2)

OVERALL PERFORMANCE

For Semester 2, 2197 candidates sat the examination for this subject and 53.34% of them obtained a full pass.

The percentage of the candidates for each grade is as follows:

Grade	A	A–	B+	B	B–	C+	C	C–	D+	D	F
Percentage	5.92	5.14	10.56	9.10	6.46	8.97	7.19	5.46	6.51	7.19	27.49

CANDIDATES' RESPONSES

SECTION A: *Multiple-Choice*

Answer Keys

Question number	Key	Question number	Key	Question number	Key
1	**D**	6	**C**	11	**A**
2	**D**	7	**B**	12	**D**
3	**B**	8	**A**	13	**C**
4	**B**	9	**A**	14	**B**
5	**A**	10	**C**	15	**A**

General comments

In general, Question 1, 2, 5, 9, 11, 12 and 15 were in the range of easy questions. More than 65% of the candidates managed to answer them correctly. Meanwhile, Question 3, 6, 7, 10, 13 and 14 were in the range of moderate questions where 50% to 65% of the questions could be answered correctly by the candidates. The easiest question was Question 8, in which 83% of the candidates answered the question correctly. The most difficult question was Question 4, in which only 42% of the candidates answered the question correctly.

SECTION B AND C: *Structure and Essay*

General comments

In general, the questions covered all aspects, which included the lower order thinking skills (LOTS) and higher order thinking skills (HOTS). The questions were within the scope of Biology STPM Semester 2 syllabus. Question 16 required the candidates to utilise their analysing skills whereas Question 17

involved factual recall as well as application skills. As for the essay questions, candidates must have good understanding of the questions to enable them to answer it correctly. The questions were able to differentiate between the low ability and high ability candidates.

Comments on the individual questions

Question 16

The question was about gaseous exchange in humans. The candidates were required to answer the questions based on the oxygen dissociation curves given. In part (*a*), most candidates managed to identify the curves *X*, *Y* and *Z* as *myoglobin*, *foetal's haemoglobin* and *mother's haemoglobin* respectively.

In part (*b*), candidates were required to identify, with reason, which curve showed the highest affinity for oxygen. The majority of the candidates were able to identify the curve but they were unable to give the appropriate reason to support their answer. Some candidates mentioned *the curve shifted towards the left* instead of *the curve is at the extreme left*, which was accepted as the correct answer. Only a few candidates answered *myoglobin managed to bind with oxygen at lower partial pressure of oxygen*, which was also accepted as the correct answer.

In part (*c*), candidates were required to give the three factors that caused curve *Z* to shift to the right of the graph given. Most candidates only mentioned the factors such as *pH*, *partial pressure of CO$_2$* and *temperature* without mentioning the condition of the factors. Hence, no marks was awarded to the candidates. The acceptable answers were *low pH*, *high partial pressure of CO$_2$* and *high temperature.*

Question 17

The question was about the mechanism of phytochrome action, their roles in photoperiodism and flowering of a plant. In part (*a*)(i), the majority of candidates answered correctly the photoperiodic group for species *P* and *Q* as *short-day plant* and *long-day plant* respectively. However, for part (*a*)(ii), only a few candidates were able to relate the length of dark period with its effect on the flowering for both types of plants.

In part (*b*), only a few candidates managed to score marks for this part. The majority of the candidates answered the *flash of far-red light cancels the red light* instead of *the flash of far-red light cancels the effect of red light*, which was the acceptable answer.

In part (*c*), although the answer for the question is quite straightforward that is *able to produce flowers at all seasons*; some candidates were unable to answer it correctly. The depth of understanding on an application-based question by the candidates was lacking.

Question 18

In part (*a*), the question was about the transport system in mammals. The candidates were required to describe the control of heart rhythm. Many candidates had good understanding regarding the topic of the question but the way they presented their answers were unsystematic and unsatisfactory. Some candidates mentioned that *heart is myogenic* instead of *the heart muscle is myogenic*. Several candidates wrote *impulse travels along Purkinje fibres* instead of *impulse travels along bundle of His and Purkinje fibres*, which was accepted as the answer. Many candidates failed to mention *the contraction of ventricles started from the apex of the heart*.

In part (*b*), the question was about the sexual reproduction in humans. The candidates were required to state the hormones present in early pregnancy and describe their functions. Most candidates were able to name the hormones correctly but unable to write their correct functions. For example, the

candidates answered *progesterone inhibits the release of FSH* instead of *progesterone inhibits the release of FSH and LH*. Several candidates mentioned that *hCG prevents autolysis of corpus luteum* instead of *hCG prevents the degeneration of corpus luteum*. Some candidates wrongly spelt *human chorionic gonadotropin* as *human choronic gonandotropin*.

Question 19

In part (*a*)(i), the question was about the definition of resting potential. Few candidates managed to answer it correctly. Candidates could only mention that the neuron had a resting potential at -70 mV. When a neuron was not being stimulated, it maintained a resting membrane potential.

In part (*a*)(ii), the question was about how the resting potential was maintained. The candidates should use the correct and specific terms in the explanation such as axon or axoplasm. Few candidates were able to differentiate between membrane and axon. For instance, the candidates answered *the inside of membrane becomes more negative* instead of *the inside of axon become more negative*. Another example of common mistakes made by the candidates in their answer was *the charges inside and outside the axon are maintained by sodium-potassium pump* instead of *the charge inside and outside of the axon is maintained by sodium-potassium pump and leak channels*.

In part (*b*), the question was about the transmission of impulse at the neuromuscular junction. As the question required the candidates to answer the impulse transmission at the neuromuscular junction, hence a complete statement such as *impulse arrive at the synaptic knob of motor neuron* must be mentioned. If the candidates did not mention motor neuron, no mark will be awarded to them. Few candidates mentioned specifically the name of the neurotransmitter, which was the acetylcholine. Spelling errors also occurred whereby *sarcolemma* is wrongly spelt as *sacrolemma*, and *acetylcholine* is wrongly spelt as *acetylchlorine*. Several candidates explained the mechanism of muscle contraction according to the sliding filament hypothesis, which was not required in the question.

Question 20

In part (*a*), the question was about osmoregulation in mammals. The candidates were required to explain the formation of glomerular filtrate. The majority of the candidates knew that the process involved was ultrafiltration. However, some candidates used the wrong terms in their answer. For instance, the candidates answered *the size/lumen of efferent arteriole is smaller than afferent arteriole* instead of *the diameter of efferent arteriole is smaller then afferent arteriole*, which was the correct answer. There were a few candidates that were able to mention that *the filtrate passed through the filtration slits of the podocytes*. Several candidates also explained the process of reabsorption that was not required by the question.

In part (*b*), the question was about immunity that require the candidates to state the three classes of antibodies and their respective functions. Most candidates were able to name the classes of antibodies correctly but lost their marks in describing the functions of the respective antibodies. Several candidates were unfamiliar with the proper way of writing the name or classes of antibodies. For example, IgG were written as Ig G or IGG, which was not accepted as the correct answer.

BIOLOGY (964/3)

OVERALL PERFORMANCE

For Semester 3, 2187 candidates sat the examination for this subject and 60.77% of them obtained a full pass.

The percentage of the candidates for each grade is as follows:

Grade	A	A–	B+	B	B–	C+	C	C–	D+	D	F
Percentage	9.97	5.67	7.09	6.58	12.44	10.61	8.41	3.38	8.41	2.74	24.69

CANDIDATES' RESPONSES

SECTION A: *Multiple-Choice*

Answer Keys

Question number	Key	Question number	Key	Question number	Key
1	D	6	D	11	B
2	A	7	C	12	C
3	A	8	D	13	C
4	B	9	A	14	B
5	B	10	D	15	A

General comments

In general, Question 1, 5, 10, 11, 12 and 13 were in the range of easy questions. More than 70% of the candidates managed to answer them correctly. Meanwhile, Question 2, 3, 4, 7, 8 and 15 were in the range of moderate questions where 45% to 69% of the candidates could answer them correctly. The easiest question was Question 1, in which 79% of the candidates answered the question correctly. The most difficult question was Question 9, in which only 30% of the candidates answered the question correctly.

SECTION B AND C: *Structure and Essay*

General comments

In general, the questions covered all aspects, which included the lower order thinking skills (LOTS) and higher order thinking skills (HOTS). The questions covered a range of topics in the STPM Semester 3 syllabus, which contained both factual recall questions and application of knowledged. The questions were able to differentiate between the low ability and high ability candidates.

Comments on the individual questions

Question 16

The question was about modes of natural selection, namely disruptive selection and stabilising selection. The candidates were required to interpret two related graphs. In part (*a*), many candidates were able to name the two modes of selection correctly, but some candidates spelt the word *disruptive* wrongly as *distruptive*. This was a very common mistake made by the candidates.

In part (*b*), most candidates were able to describe the two modes of selection correctly, but many candidates used incorrect terms in their answers such as *intermediate phenotypes* written as *intermediate traits/characteristics*, which were incorrect. Many candidates wrongly wrote *P favours extreme phenotypes* instead of *P favours both/two extreme phenotypes*. As for *Q*, the candidates wrote *selection against extreme phenotypes* instead of *selection against both/two extreme phenotypes*.

In part (*c*), most candidates were able to answer correctly the effect of selection in *P*. However, many candidates did not mention how different gene pool is formed in their answers.

Question 17

The question was about the recombinant DNA technology, specifically in the production of transgenic plant. In part (*a*), many candidates were only able to name molecule *P* as plasmid but they could not name the bacterium *Q* and process *T* correctly.

In part (*b*), most of the candidates were not able to describe step *S* and step *R* precisely as the terms used by them are incorrect. For instance, in step *R*, many candidates wrote *bacteria is inserted into plant cell*. The correct term should be *bacteria is transformed or infected the plant cell*. As for step *S*, *the medium containing herbicide is used for screening of the recombinant plant* instead of *medium containing antibiotic*, which was wrong in concept and not accepted as the correct answer.

In part (*c*), most candidates mentioned that *the gene of interest is incorporated into plant*, which was incorrect. The correct answer was *the gene of interest is incorporated into DNA of plant*. Candidates should use appropriate and specific terms in their answer.

In part (*d*), the question was about the advantage of the transgenic plant, which was referred to herbicide resistant plant. Some candidates answered correctly about the transgenic plants becoming resistant to herbicide, but many candidates provided other advantages of transgenic plants such as increase high yield of crop, resistance to diseases and insecticide, which were not accepted as the correct answer.

Question 18

In part (*a*)(i), the question was about the definition of taxonomy. Many candidates were not able to define taxonomy by using the correct term which was taxonomy is *a scientific study of classification*. Many candidates only wrote *taxonomy is a classification of the organisms*. Some candidates did not mention about the purpose of the classification.

In part (*a*)(ii), the question was about the description of five taxonomic rank/taxa respectively. Most candidates were able to state correctly at least five taxa. However, many candidates could not describe each taxonomic rank correctly. For example, many students mention *phylum consists of a number of classes* without mentioning that all these classes shared similarity among themselves.

Furthermore, many candidates wrote the examples of each taxonomic rank such as *Kingdom has five phyla; phylum Bryophyta, Filicinophyta, Coniferophyta and Angiospermophyta*, which was not accepted as the correct answer. The candidates should answer *Kingdom is the highest rank in taxonomic hierarchy* or *it is a level above phylum level*. For all other seven taxa, the level of each taxon must

be mentioned in the answers. Some inapropriate words such as the first level, the last level, the next level, the level after or before on a certain level of taxon were used by many candidates and all these were not accepted.

In part (*b*), the question was about the biological concept of species. Most of the candidates were able to mention that *the species is a group of organisms that can interbreed with each other to produce offspring*. Only a few candidates answered correctly that a *species is a group of organisms that are reproductively isolated with other group of organisms*.

Question 19

In part (*a*), the question was about three types of survivorship curves, namely Type I, Type II and Type III. Few candidates answered these three types of curves as *Type 1*, *Type 2 and Type 3*, which were not accepted as the answer. Almost all the candidates sketched the graphs of these three survivorship curves which were not requested by the question. Many candidates were able to describe correctly each type of curve by giving the relevant points. For example, in survivorship curve Type I, survival rate is high in the early part of life cycle whereas in survivorship curve Type III, mortality is high in the early part of life cycle. However, in survivorship Type II, survival rate and mortality are constant throughout the lifespan, but many candidates wrote *survival rate/mortality are always equal or the same*, which was wrong. In this part of the question, most candidates mentioned the survival strategies used by the organisms which were not requested by the questions.

In part (*b*), the question was about survival strategies used by an ant and a tiger. Majority of candidates were able to differentiate the survival strategies between ant and tiger. Many candidates also wrote *k-strategies* instead of *K-strategies*. The alphabet K must be written in capital letter.

Question 20

In part (*a*), the question was about enzymes used in DNA replication and its function. Most candidates were able to state correctly at least three types of enzymes but unable to state the function of enzymes correctly. For example, *helicase is used to unwind double helix DNA*, but the candidates only mentioned that *helicase cut the hydrogen bonds in DNA molecules*. Some candidates mentioned *DNA polymerase III is used to synthesise DNA strand* only. The candidates should write *DNA polymerase III is used to synthesise new DNA strand from RNA primer*. On the other hand, some candidates mentioned that *the function of DNA polymerase I is to remove RNA primer only*, which is an incomplete answer. The function of DNA polymerase I is actually to remove RNA primer and replace with DNA nucleotides. A few candidates mention *RNA primer was replaced with nucleosides* which is not accepted as the answer. The term *Okazaki fragment* was wrongly written as *okazaki fragment* by many candidates. The alphabet O must be written in capital letter as it is a scientific term. Some candidates explained about the DNA replication mechanisms that involved all those enzymes which was not accepted.

In part (*b*), the question was about mutation that causes sickle cell anaemia and its consequences. Many candidates were able to state that sickle cell anaemia were caused by gene mutation and resulted in red blood cells changing in shape. However, some terms used by the candidates were incorrect. For example, a majority of the candidates wrote the disease was caused by *substitution mutation* instead of *base substitution* or *gene mutation*, which were the correct answers. Meanwhile, the candidates wrongly spelt *Glutamic acid* as *Glutamate* and *Glutamine*. Besides, many candidates mentioned the mutation causes insufficient oxygen transported to the cells, which was an incorrect concept. The correct answer was *the mutation causes reduction of amount of oxygen to be transported to the cells*. Only a few candidates mentioned that the mutation or sickle cells anaemia is inheritable and the phenotype was seen in homozygous condition.

PAPER 964/5 (*Written Practical Test*)

Question 1

The question was about osmosis in plant tissues (potato). Most candidates understood the concept of osmosis very well. Some candidates did not provide accurate answer, such as for question (*d*)(i). For part (*d*)(i), the candidates should state that the potato strip would be back to the original size or condition. However, some candidates answered the potato strip becomes turgid/longer.

For part (*d*)(ii), none of the candidates obtain full marks for this question. The question require the candidates to apply their knowledge on the concept of osmosis as the candidates were required to predict the observation of the potato strip if it were transferred to one solution to another solution with different concentration.

Question 2

The question was about the anatomy of an animal, specifically the liver and the kidney. For part (*a*)(i) and (*b*)(i), the candidates were required to identify the structures of a cross section diagrams of liver and kidney. The majority of the candidates were unable to name the structures correctly. Subsequently, the candidates failed to state the functions of some of these structures, such as Question (*a*)(ii) and (*b*)(ii).

Question 3

The question was about the concept of inheritance. For part (*b*), most candidates were able to answer the questions correctly and in accordance to the answer scheme. However, for part (*c*), most candidates seem to fail to construct the genetic diagram as required.

For part (*e*)(i), the question required the candidates to understand the test cross. The candidates did not seem to understand well the meaning of the test cross. Subsequently, the candidates failed to answer Question (*e*)(ii) correctly.