MAJLIS PEPERIKSAAN MALAYSIA
Malaysian Examinations Council

PELANGI

LAPORAN PEPERIKSAAN STPM 2024

Biology (964)

Biology

964/1

OVERALL PERFORMANCE

For Semester 1, 1 507 candidates sat for the examination of this subject and 66.03% of them obtained a full pass.

The achievement of the candidates for this subject according to grades is as follows:

Grade	A	A–	B+	B	B–	C+	C	C–	D+	D	F
Percentage	2.72	3.46	8.56	7.61	15.22	13.93	14.53	6.49	3.53	3.19	20.77

RESPONSES OF CANDIDATES

SECTION A: *Multiple-Choice Questions*

Answer keys

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

General comments

In general, the questions were in the range of moderate questions where 30% to 70% of the candidates could answer them correctly.

SECTIONS B AND C: *Structured and Essay Questions*

General comments

In general, the questions covered all aspects, which include the lower order thinking skills (LOTS) and higher order thinking skills (HOTS). The questions covered a range of topics in the Semester 1 syllabus, which contained both factual recall questions and questions which required application of knowledge. 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 the movement of solutes across a selective permeable membrane. In part (*a*), most of the candidates managed to get at least one mark. The main issue was that candidates did not specify the molecule involved in the movement. Since it involved selective permeable membrane, not all molecule could pass through. The keyword referring to specific or particular molecule must be stated to earn a mark. The candidates would not obtain marks if they just stated, "movement of molecule passing through the membrane".

In part (*b*), majority of the candidates correctly identified the answer as either a carrier or transport protein.

In part (*c*)(i), most of the candidates were able to get marks. The candidates would not obtain a mark if the answer was passive transport as it was too general as well as diffusion or simple diffusion since it was specifically facilitated diffusion.

In part (*c*)(ii), many candidates lose mark because they identified that *P* would bind to the active side. *Q* was not an enzyme, thus, there was no active side for *P* to attach. The acceptable answer was *P* binds to the binding site of *Q*.

In part (*c*)(iii), most of the candidates gave the correct example for the answer such as glucose or amino acid.

Question 17

The question was about the enzymatic reaction. In part (*a*), majority of the candidates managed to get at least one mark by stating *activation energy is a minimal energy required by reactant*. However, candidates lost marks when they omitted the keyword minimum energy.

In part (*b*), correct labelling of the *x*- and *y*-axes was essential to get a mark for this part. Unfortunately, many candidates either mislabelled the axes or left out the labels entirely.

In part (*c*), most of the candidates were able to get two marks for this question. However, there were quite a few candidates who lose mark for explanation because they answered 'more product was formed'. For a specific enzymatic reaction, the amount of product formed was determined by the substrate. Thus, the answer 'more product was formed' was not acceptable. Rather the acceptable answer would be product *formed at higher rate or faster*. It was also incorrect to give answer such as 'more enzyme-substrate collision' since the enzyme and substrate did not move or collide but rather the molecules of enzyme-substrate that move or collide.

Question 18

In part (*a*), the question required the candidates to describe the breakdown of starch for energy production. Some of the candidates could not describe the breaks down of the bond between the monomers of starch. Most of the candidates were able to state the general points but stated both α-1,4 glycosidic bond and α-1,6 glycosidic bond were broken down in the breakdown of starch for energy production instead of only α-1,4 glycosidic bond. Some of the candidates merely wrote glucose instead of α-glucose as monomer of starch and explained the formation of starch which was incorrect. A few candidates misinterpreted the question entirely by explaining the full aerobic respiration process.

In part (*b*), the question was about the differences between saturated and unsaturated fatty acids. Most of the candidates were able to give appropriate answers to this question. However, some candidates confused the physical characteristics between saturated and unsaturated fats. There were candidates who wrote saturated fatty acids have single bond whereas unsaturated fatty acids have double bonds without mentioning between carbon atoms/hydrocarbon chains. Only a few of candidates attempted to answer saturated fatty acid cannot incorporate anymore to hydrogen atom, but unsaturated fatty acids can incorporate additional hydrogen atom, and saturated fatty acid does not have kink, but unsaturated fatty acids have kink.

In part (*c*), the candidates were asked to describe the structure of double stranded polynucleotide. The candidates were required to describe the structure of DNA, the monomer that made up the DNA, component of the monomers, the bonds that link the monomers, the type of nitrogenous bases and the hydrogen bonds linking the paired bases. Many candidates were able to answer this question quite well. The candidates were able to state that polynucleotide DNA was made up from two anti-parallel strands. They also managed to state that there were two hydrogen bonds pairing between adenine-thymine and three hydrogen bonds pairing between cytosine-guanine. Some candidates lose marks for not mentioning nucleotide as monomer and deoxyribose sugar as pentose sugar in DNA. Candidates also listed the nitrogenous bases found in DNA but did not specify which nitrogenous bases were purines or pyrimidines. Wrong spelling of pyrimidines as pyramidine also led them to lose another mark. Other examples of spelling mistakes were spotted and cost them marks such as thymine was written as tymine, cytosine was written as cytocine and pyrimide was written as pyridine. Besides, there were candidates who were able to write phosphodiester bond that will join the monomers to produce polynucleotide.

Question 19

In part (*a*), the candidates were required to describe the processes that occur in the Calvin cycle. The candidates should avoid using general terms such as bind, combine and convert in explaining the processes in the Calvin cycle. Candidates must use accurate and specific terms in writing their answers. For instance, candidates should write *carbon dioxide is fixed with ribulose bisphosphate to form unstable 6-carbon compound*. Some candidates used RuBP as abbreviation of ribulose bisphosphate without mentioning its full name at first, which led to loss of a mark. In some cases, a few candidates wrongly spelt ribulose bisphosphate as ribulose biphosphate, 1,3-bisphosphoglycerate as 1,3-biphosphoglucerate which were not accepted as the answer. Some candidates were also confused whether to use the term oxidised or reduced in the reaction involved. For example, glycerate-1,3-bisphosphate was oxidised by NADPH, instead of *glycerate-1,3-bisphosphate was reduced by NADPH*. Some also made a mistake by mentioning NADH as reduction coenzyme in plants, instead of NADPH. However, most candidates were able to explain the processes correctly but unfortunately, they did not specify the number of molecules involved, for example, 6-carbon compounds immediately split into two molecules of phosphoglycerate, to form six molecules of glyceraldehyde-3-phosphate, to regenerate three RuBP. Some of the candidates also attempted to answer by using a diagram showing steps in the Calvin cycle which was not required to answer the question.

In part (*b*), the question was about differences between light dependent and light independent reaction. A conceptual knowledge was required for this type of question. Some candidates managed to obtain a few marks as they mentioned light dependent occurred in the thylakoid whereas light independent occurred in the stroma, photolysis of water occurred in light dependent reactions but did not occur in light independent reactions and light dependent reactions involve cyclic and non-cyclic

process, but light independent reactions involved only cyclic process or Calvin cycle. There were candidates who did not provide accurate and complete answers. For instance, they stated the end products for the light dependent reaction are ATP, NADPH, without mentioning oxygen as end products. Only a few candidates were able to differentiate the primary acceptor involved for light dependent and light independent reactions. Some candidates also misunderstood light dependent and light independent reactions with cyclic and non-cyclic photophosphorylation. Few candidates provided the answer in light dependent reaction, photochemical reaction involved, do not use ATP and NAPH and photophosphorylation occur but in light independent reaction, biochemical reaction involved, use ATP and NAPH and photophosphorylation does not occur.

Question 20

In part (*a*), the candidates were required to describe the synthesis of ATP from a glucose via substrate level phosphorylation involving glycolysis and Krebs cycle. The candidates needed to recognise that the Krebs cycle occurs twice because the two pyruvates are produced during glycolysis from one glucose molecule. Candidates must describe the steps in glycolysis that used and produced ATP so that the total net production of ATP is four. The candidates must describe substrate level phosphorylation occurs in glycolysis and Krebs/TCA/citric acid cycle.

Starting with glucose was phosphorylated into glucose-6-phosphate followed by isomerized or rearranged into fructose-6-phosphate. Fructose-6-phosphate was then phosphorylated to form fructose-1,6-bisphosphate. So, the total number of ATP used in energy investment phase was 2 ATP. The majority of the candidates answered this part correctly.

In general, candidates did well in explaining the processes which occurred in glycolysis and Krebs cycle. However, they were unable to specify the number of molecules involved. For instance, candidates tend to mention glycerate-1,3-bisphosphate undergoes phosphorylation/substrate level phosphorylation to form glycerate-3-phosphate and ATP instead of *2 molecules of glycerate-1,3-bisphosphate undergoes phosphorylation/substrate level phosphorylation to form 2 molecules of glycerate-3-phosphate and 2 ATP*. Few candidates did not use scientific terms to describe the reactions such as convert, combine, change to, dephosphorylated, decarboxylated instead of phosphorylated, isomerized, substrate-level-phosphorylation, and oxidative decarboxylation, which led to a loss of marks. There were candidates still using 'bi' and 'di' which should be bis instead. Some candidates mixed up all the biochemical reactions as well as wrongly spelt the name of substrates and product formed. Some candidates answered, 2 ATP are produced by glycolysis without mentioning net. The candidates were also able to mention that net 4 ATP were produced from a molecule of glucose by substrate level phosphorylation, which was also accepted as the correct answer. Most candidates also included electron transport chain and chemiosmosis in the explanation which were not required to answer the question. The candidates tend to calculate the number of ATP production from NADH and $FADH_2$ produced in glycolysis, link reaction and Krebs cycle in electron transport chain as well.

In part (*b*), the candidates were required to explain the similarities between alcoholic and lactic acid fermentations. Unfortunately, many candidates just listed the similarities without an explanation. However, marks were still given for the correct similarities, such as, both are anaerobic, both regenerate NAD^+ and both produce 2 ATP. In order to give marks for both similarity and its explanation, the candidates' answers should be, both are anaerobic because fermentations take place in the absence/lack of oxygen or both regenerate NAD^+ because NAD^+ will be reused in glycolysis or both produce 2 ATP because only undergoes glycolysis.

Biology

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OVERALL PERFORMANCE

For Semester 2, 1 398 candidates sat for the examination of this subject and 59.37% of them obtained a full pass.

The achievement of the candidates for this subject according to grades is as follows:

Grade	A	A–	B+	B	B–	C+	C	C–	D+	D	F
Percentage	6.53	5.74	8.69	10.12	10.41	7.82	10.06	6.68	4.74	7.75	21.46

RESPONSES OF CANDIDATES

SECTION A: *Multiple-Choice Questions*

Answer keys

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

General comments

In general, Questions 1, 2 and 6 were in the range of easy questions. Almost 80% of the candidates managed to answer Questions 1, 2 and 6 correctly. Meanwhile, the rest of the questions were in the range of moderate questions where 30% to 70% of the candidates could answer them correctly.

SECTIONS B AND C: *Structured and Essay Questions*

General comments

In general, the questions covered all aspects, which include the lower order thinking skills (LOTS) and higher order thinking skills (HOTS). The questions covered a range of topics in the Semester 2 syllabus, which contained both factual recall questions and questions which required application of knowledge. The questions were able to differentiate between the low ability and high ability candidates.

Comments on the individual questions

Question 16

This question required candidates to give a brief definition of residual volume and calculate the volumes of the tidal, expiratory reserve and vital based on the given spirogram. To answer this question, candidates were required to have knowledge and understanding about the recording taken by a spirometer and its relationship to lung volume. Candidates needed to know how to calculate the lung volume correctly.

In part (*a*), candidates were required to give the meaning of residual volume. Many candidates failed to obtain any mark due to the difficulty in giving an accurate definition for the residual volume. Though they might understand it, but they failed to use the correct and precise word to describe it. Majority of candidates could not state the meaning of residual volume which the amount of air left in the lung after full exhale. Many candidates lose mark as they missed out the keywords 'remains in the lung and after forced exhalation'. Some candidates did not get any mark as they only state 'volume', instead of 'volume of air'.

In part (*b*), candidates were required to calculate the tidal volume, expiratory reserved volume and vital capacity based on spirogram. Many candidates were able to answer the questions correctly. However, some candidates only wrote the value without showing their calculations.

Question 17

This question required the candidates to identify the labelled structure for the neuromuscular junction and their role in impulse generation. To answer this question, candidates were required to have knowledge about the transmission of impulse at neuromuscular junction.

In part (*a*), most candidates successfully identified the labelled structures as T tubule, mitochondria and synaptic vesicle. However, some candidates wrongly spelt the names of the structures. A few candidates left this section empty or wrongly identified the structures.

In part (*b*)(i), most candidates were able to identify the neurotransmitter that involved at the synapse of a neuromuscular junction, which was an acetylcholine. However, a few candidates lose mark on this question with the wrong spelling such as acetycholine and with unspecific terms such as neurotransmitter or neurotransmitter vesicle or vacuole.

In part (*b*)(ii), candidates needed to describe the mechanism that was involved in the transmission of *W* at the synapse. Most candidates only scored 1 mark because they failed to give a direct answer and only wrote "*W* binds to receptors on the postsynaptic membrane or sarcolemma". They lose mark because they did not mention what happens next. Many candidates explained about the transmission of impulse from presynaptic membrane until the end which was a very long answer.

In part (*c*)(i), most candidates obtained full mark for this question. However, some candidates did not give a direct answer and lose marks when they talked about the mechanisms of release of neurotransmitter from the presynaptic knob to neuromuscular junction. Candidates were required to answer what will happen to *W*, either it could still bind to the receptor or not. Many candidates focused on curare as the answer instead of *W* which was wrong. The candidates explained about curare that blocked the transmission of impulse, but forgot to explain about *W*.

In part (*b*)(ii), many candidates could answer this question correctly which was no generation of action potential. Candidates could correlate the outcome of curare at a neuromuscular junction and were aware that acetylcholine could not bind to the receptor when curare was present which had resulted in no action potential to be generated.

Question 18

In part (*a*), the question were about the germination process of barley seed. Though the question was direct, not many candidates opted to answer this question. The candidates who chose to answer this question seemed to memorise the process. As a results, they could not fully described the details of germination process which start from the water imbibition into seed through micropyle that cause the seed to swell and break the seed coat. Then abscisic acid will be diluted by water to remove dormancy. The embryo then produce gibberellin which triggers the aleurone layer. The aleurone layer releases hydrolytic enzyme to break the food reserves into monomer. This will cause the radicle to emerge first followed by plumule. A handful of candidates managed to answer this question by using the appropriate terminology such as imbibition and osmosis. However, some candidates had wrongly spelled gibberellin, aleurone layer, micropyle and abscisic acid. Only a few candidates managed to mention abscisic acid was diluted by water to remove dormancy. Candidates also had the tendency to lose marks by failing to mention correctly the structure that was responsible for releasing the hydrolytic enzyme, others mentioned aleurone layer that produced amylase. Only a few candidates managed to mention that radicle emerge first, followed by the plumule. Some candidates described seed development instead of seed germination.

In part (*b*), candidates were required to describe the growth curve of a grasshopper with the aid of labelled diagram. Although the question did not specifically mentioned the growth pattern, it referred to the intermittent growth undergoes by an insect. As grasshopper undergoes the hemimetabolous and experiences ecdysis normally for 4-5 times which should be depicted in the step-like curve drawn by the candidates. Most candidates missed out the point on how the insect take in air not water or food during ecdysis to increase their size before being limited by the newly hardened exoskeleton. They also missed a mark by drawing less or more steps instead of ideally 4-5 steps for a grasshopper. They also mentioned that grasshoppers take in air and water during ecdysis instead of only air is take in. Only a few candidates managed to mention life cycle that involved incomplete metamorphosis, growth limited by hard exoskeleton, each stage in between ecdysis was called instar and growth stopped when they reach adult stage.

Question 19

In part (*a*)(i), candidates were required to describe the roles of antidiuretic hormone (ADH). The answer should be *regulates the blood osmotic pressure*, but very few candidates used the term *regulate or maintain*. A few candidates described what happens when ADH level increases or decreases. Most candidates who managed to obtain one mark were able to state that ADH increases permeability of distal convoluted tubules and collecting ducts to water. Therefore, ADH causes less volume and more concentrated urine to be produced. Some candidates wrongly spelled convoluted and mentioned hypertonic urine instead of concentrated urine which caused them to lose mark. Some candidates missed a point by stating that regulation happens in cells or body instead of blood. Only a few candidates were able to mention ADH increases permeability of the collecting ducts to urea. Some candidates were confused between urea and urine. Most candidates could not correlate ADH with the amount of urine produced.

In part (*a*)(ii), many candidates had problems to clearly describe the roles of aldosterone. They should have indicated that aldosterone regulates the blood osmotic pressure which helps in regulating normal sodium and potassium ion levels in the blood. Aldosterone also helps regulate water reabsorption at kidney tubules causing the increase in the permeability of the distal tubules and collecting ducts to Na^+ and water. Same as ADH, many candidates failed to mention that *aldosterone regulates the blood*

osmotic pressure. They also mentioned about what will happen when aldosterone increases or decreases. Other than getting the fact wrong or mixed with other topics, candidates also didn't use the correct terms. Some candidates answered this question by describing the renin angiotensin aldosterone system.

In part (*b*), candidates were required to describe the process of reducing water loss by stomata during drought. This question required candidates to answer about the process of how stomata close. Many candidates had no issues in answering this question. They indicated that the water stress causing stomata to close. However, some candidates used overly general terms instead of specific ones. For instance, they wrote "plant cells" instead of *mesophyll cells* produce abscisic acid. Some candidates used inappropriate terms for certain points such as stimulate/produce abscisic acid. Another mistake was when candidate wrongly stated that ABA moved into the guard cells instead of bind to the receptor at the plasma membrane of guard cells. Some candidates did not mention several key points such as in which conditions are the plant is facing i.e. during water stress/dry/arid condition. The movement of potassium ions that caused the change of causes water potential in guard cells which leads to the movement of water to the adjacent mesophyll cells. Candidates often stated that water diffuses out from the guard cells, but they failed to specify where the water molecules go i.e. into the surrounding cells or intercellular spaces. Many candidates did not explicitly mention that this water movement occurs via osmosis.

Question 20

In part (*a*), required candidates to describe the causes and symptoms of malarial infection whereas part (*b*) needed the candidates to state the prevention methods for minimising the infection. This question was the most popular, as almost all candidates answered this question, and many candidates obtained good marks. Most candidates had problems in correctly writing scientific name according to binomial nomenclature. Thus, many lose mark for this point, either they had wrongly spelt the name or failed to conform to writing standard. Most candidates thought infectious agent are usually bacteria or virus. Thus, they had identified Plasmodium as a virus or bacteria without realising it is a protozoon. Majority of candidates also failed to mention the word 'female' for the vector, i.e. Anopheles mosquito. Only a little number of candidates managed to state that human/monkey are host for the parasite. Some candidates had mistakenly written that mosquito was the host instead of the vector. Some candidates provided an answer regarding the lifecycle of malarial parasites in the human body instead of stating the vector and host that was involved in the malaria infection. Regarding symptoms, most candidates accurately listed the common signs of malaria infection. However, a few candidates mixed up the symptoms with other infectious disease. Many candidates mentioned about the mechanism of infection which is not asked.

In part (*b*), the candidates were required to state the prevention methods to reduce malaria infection. Most candidates could answer this question with ease. Majority of candidates were able to state more than three correct ways to prevent malaria. However, there were few candidates who failed to secure some marks. This was due to some candidates had focused their answers on social services, government efforts for prevention, and general awareness. Some of the candidates did not answer precisely. For instance, they wrote people should wear long shirt instead of wearing long pants and long-sleeved shirts. Quite a handful of candidates mentioned introducing sterile male into the environment to reduce dengue infection, which was accepted as an answer. Common mistakes committed by some candidates include incorrect spelling of larvicide, using pesticide instead of insecticide, and not specifically writing fogging insecticide as a preventive method.

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OVERALL PERFORMANCE

For Semester 3, 1 389 candidates sat for the examination of this subject and 63.07% of them obtained a full pass.

The achievement of the candidates for this subject according to grades is as follows:

Grade	A	A–	B+	B	B–	C+	C	C–	D+	D	F
Percentage	11.82	4.25	7.28	5.62	11.46	9.94	12.70	6.40	2.88	5.91	21.74

RESPONSES OF CANDIDATES

SECTION A: *Multiple-Choice Questions*

Answer keys

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

General comments

In general, Questions 5 and 8 were in the range of easy questions. More than 70% of the candidates managed to answer Questions 5 and 8 correctly. Meanwhile, the rest of the questions were in the range of moderate questions where 30% to 70% of the candidates could answer them correctly.

SECTIONS B AND C: *Structured and Essay Questions*

General comments

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

Comments on the individual questions

Question 16

In part (*a*)(i), candidates were required to identify the type of mutation based on the diagram given which was chromosomal mutations. Most of the candidates were able to answer them correctly. The candidates who wrote deletion as the answer were given a mark. However, there were candidates who were confused between gene mutation and chromosomal mutation.

In part (*a*)(ii), candidates were required to explain how this mutation occurred. Candidates needed to mention the lost or deleted parts or segments of chromosomes. Many candidates lose marks because they wrote delete of fragments instead of part or segment of a chromosome. Some candidates wrote 'deletion of chromosome or deletion of base sequence'. The diagram clearly showed that the chromosome becomes shorter, but candidates were unable to write the proper terms.

In part (*a*)(iii), candidates were required to state three effects of mutation that occurred during meiosis. Candidates needed to mention that the chromosome becomes shorter affected the gamete and thus leads to abnormality in the offspring. However, most candidates were unable to get marks for this question, which caused candidates to wrongly explain and link the idea of non-disjunction of chromosomes to this question. Most of the candidates wrote the base sequence is deleted, causing the frameshift mutation and lead to non-disjunction.

In part (*b*)(i), candidates were required to state the syndrome suffered by the baby if experiencing this mutation, and candidates should write *Cri-du-chat syndrome*. Most of the candidates could answer correctly but a few candidates spelt it wrongly. A few candidates misspelled the name of the syndrome involved as chi du chat, kri du chat, cri du cat, and cry do cat, which were not accepted. But quite a few candidates wrote Down syndrome and Klinefelter syndrome which cause a misunderstanding that this mutation was due to non-disjunction.

In part (*b*)(ii), candidates were required to state the characteristics caused by Cri-du-chat syndrome. This question was dependent on the previous question. There were many answers given by the candidates that relates to the Cri-du chat syndrome, like *mental retardation, crying like a cat*, or *producing a meow sound as crying*.

Question 17

In part (*a*)(i), candidates were required to name an example of enzyme *M*, but only a few candidates could correctly name the restriction enzyme using the proper upper and lower case. But there were a lot of candidates who just generally wrote restriction enzyme or endonuclease without writing the specific name. Examples of the enzyme are restriction enzyme and restriction endonuclease. There were candidates' who lose marks as they spelt EcoRI wrongly as ECOR1 or ECoR1. This question required candidates to really practice and memorize the names of restriction enzymes.

In part (*a*)(ii), candidates were required to state the function of enzyme M and candidates should write the *enzyme cuts the DNA into fragments with identical sticky ends or cut plasmid into linear molecules with complementary sticky ends*. Some of the answers were incomplete, they missed some keywords like complementary or identical. Example: "to cut DNA into DNA fragments" or "to cut DNA to produce sticky ends" without "to produce sticky ends" and "DNA fragments," respectively, which led them to lose marks.

In part (*b*), candidates were required to name the vector used in recombinant technology besides plasmid. Most of the candidates were able to state the other vectors as *bacteriophage and lambda phage*

as the correct answers. However, a few candidates wrongly spelled the answer as bacteriopage, which was not accepted as the correct answer. Also, a few candidates wrote virus, which was a wrong answer.

In part (*c*), candidates were required to describe the process *P*. This part needed the candidates to understand and explain the insertion and ligation process. Most candidates were able to mention the use of DNA ligase correctly but wrongly explained the proper process in forming the recombinant DNA or plasmid. Candidates needed to avoid using general terms such as fuse, put, combine or bind in explaining the processes in their answers. Candidates must use accurate scientific terms such as insert.

In part (*d*)(i), candidates were required to name step *Q*, and the answer given by candidates should be transformation, and most of the candidates were able to write it correctly. There were just a few candidates who misunderstood it with insertion and ligation. The candidates were unsure and lacked knowledge and understanding of the proper process in recombinant technology.

In part (*d*)(ii), candidates were required to describe step *Q*. The candidates should clearly explain the process of transformation. Candidates who answered correctly question 17 (*d*)(i) were only able to explain the process of transformation. A few students were unable to use the proper terms in their answers, like "inserted back or put back" into the host cell instead of transforming or introducing the recombinant plasmid into the host cell.

Question 18

In part (*a*), candidates were required to describe three different levels of biodiversity in Malaysia. Many of the candidates seemed to understand the concept of different diversity levels. The candidates were able to state different diversity levels, which were *species diversity, genetic diversity, and ecosystem diversity*.

But some candidates wrote ecosystem diversity as ecological diversity which was not accepted as the answer. Some inappropriate words, such as the first level, second level, and third level of biodiversity, were used by many candidates, and all these were not accepted as the answers.

Some candidates described the taxonomic rank–Kingdom, phylum, or level of organization within the biosphere – species, population, ecosystem, biome as the answer, which were not accepted as the correct answer.

In part (*b*), candidates were required to state four importance of plant genetic diversity in National Park. Most candidates were able to state the importance correctly. Most candidates were able to state the *prevention of plant species extinction* and *their used in research and development*. Most candidates could score and get full marks for this question. Candidates were able to mention that *the plant diversity can provide wood production for economic value*, also *serve as recreational value to attract tourism for ecotourism*, and *as source for medication*. Most candidates wrote "to prevent the plant from extinction" and "for research and development," which were accepted as the correct answers.

In part (*c*), candidates were required to define in-situ and ex-situ conservation. There were also a few candidates who were unable to differentiate between in-situ and ex-situ conservation. Most candidates were able to define ex-situ conservation as a program that *conserves species of flora or fauna in their original habitat*.

However, most of the candidates did not gain marks for ex-situ conservation. Candidates tend to write that "ex-situ conservation is to conserve flora or fauna outside their original habitat," which caused them to lose marks. Only a few candidates managed to gain marks, as they wrote, that *ex-situ conservation is to conserve flora or fauna outside their original habitat with human-controlled setting or authorised by a human*.

Question 19

The question was about the sigmoid growth of the Paramecium population. In part (*a*), most candidates were able to write that *the population growth rate increases slowly during the lag phase*. However, only a few candidates managed to mention that it was due to low reproductive individuals in the population or the population is adapting to the new environment.

This question required candidates to explain the growth curve of the *Paramecium* population. Candidates should explain the phases of the sigmoid curve, starting from the lag phase to the log phase until growth levelled off at equilibrium and reached carrying capacity. Most candidates were able to explain that the growth started at the lag phase and entered the log phase, but they were unable to explain that the growth decreased as the population increased. Candidates were also unable to clearly explain the reason for the growth decreased, like facing competition due to a shortage of food sources. There were a few students who were unable to differentiate between growth and growth curve as the question needed candidates to explain growth curve.

A few candidates managed to mention that the *Paramecium* population will compete for food resources as the population increases. Many of the candidates defined carrying capacity, which did not give any mark. Candidates were required to write as *the population reached the carrying capacity or the population growth rate become constant during stationary phase*.

Candidates also managed to write that the birth rates are equal to death rates during the stationary phase. Population growth rate was zero was also accepted as the answer. However, if the candidates mentioned population becomes zero, it was not accepted as the answer. Some candidates also lose marks due to the writing of the scientific name in the correct way.

In part (*b*), the question was about the distribution pattern of organisms. The candidates were required to describe the three types of population distribution patterns together with the correct diagram. Most of the candidates were able to mention the type of population distribution pattern correctly, such as *uniform distribution*, *random distribution*, and *clumped distribution*. Candidates must use the correct term to gain marks.

However, some of the candidates described the modes of selection which are stabilising, directional and disruptive which were totally not related to this question.

Question 20

In part (*a*), candidates were required to describe the DNA fingerprinting technique. Candidates should describe the technique, starting from collecting sample tissues from the burnt victim and continuing with a comparison of the DNA profile with other potential family members. There was a good sign that most of the candidates who attempted this question were able to describe clearly the steps in this technique. There were just a few candidates who were unable to explain the step that involves using a DNA probe clearly. Candidates could understand and illustrate this step well, but they were unsure of the reason why this step was conducted.

Many of the candidates understood the use of autoradiography, but they tended to write "to visualize the dark bands" instead of *DNA profile*, which caused them to lose marks. None of the candidates mentioned that the technique also required *the tissue samples of the potential family members of the victim* so that the DNA profiles from both the victim and family members could be compared. A few writing mistakes were spotted, especially in the Southern blotting technique, which should be capitalized.

In part (*b*), candidates were required to describe the use of recombinant technology towards the oil-decomposing bacteria. This process started with isolation, restriction, insertion, transformation, and amplification. Most of the candidates understood the basic concept of the production of transgenic organisms.

Candidates answered the process by starting with "the isolation of gene of interest for oil-degrading from bacteria." However, only a few candidates managed to mention the correct name of the bacteria, which was either *Pseudomonas putida* or *Pseudomonas aeruginosa*. Most of the candidates only mentioned *Pseudomonas* sp.

Some candidates only mentioned "restriction enzyme cut the gene of interest and plasmid" without mentioning "same restriction enzyme" which caused them to lose marks. Many candidates also wrote that "ligase is used in the insertion and ligation to produce recombinant plasmid" instead of "DNA ligase".

As for the transformation, some candidates described that the recombinant plasmid is inserted into the bacteria host cell instead of using the correct term, which was "transformed" or "introduced." Some of the candidates mention that the transgenic bacteria undergo amplification instead of "undergo cloning or multiply." There were also candidates who wrongly stated the use of cDNA, which was inserted into the restricted plasmid.

PAPER 964/5 (WRITTEN PRACTICAL TEST)

Question 1

The question was about osmosis. Most of the candidates were able to answer part (*a*), (*c*)(i), and (*f*) (i) correctly. The candidates had problems to state the precautionary step to improve the accuracy of the experiment.

Question 2

The question was about respiratory system of a rat. In part (*a*) some candidates had problems in identifying the trachea, lung and diaphragm. In part (*b)* some candidates could not state the function of trachea, lung and diaphragm. Most of the candidates were able to answer part (*c*)(i) which was alveolus. In part (*c*)(ii) most candidates were unable to explain the characteristic of alveolus that enable the gaseous exchange.

Question 3

The question was about dihybrid cross between two heterozygous pea plants. Most of the candidates had no problem answering the questions in part (*a*), (*c*)(i), and (*d*). However, most candidates failed to calculate the expected ratio, expected number of counts, and divergence based on the formula provided in part (*b*).

LAPORAN PEPERIKSAAN STPM 2024

PENERBITAN PELANGI SDN. BHD.
(198201009396)

WISMA PELANGI
Lot 8, Jalan P10/10, Kawasan Perusahaan Bangi,
43650 Bandar Baru Bangi, Selangor, Malaysia.
T: +603-8922 3993 E: customerservice@pelangibooks.com

Majlis Peperiksaan Malaysia
Persiaran 1, Bandar Baru Selayang,
68100 Batu Caves, Selangor Darul Ehsan.
Tel: 03-6126 1600 Faks: 03-6136 1488
E-mel: ppa[at]mpm.edu.my