MAJLIS PEPERIKSAAN MALAYSIA

Malaysian Examinations Council

PELANGI

2024

LAPORAN PEPERIKSAAN STPM

Physics (960)

Physics

960/1

OVERALL PERFORMANCE

For Semester 1, 1 229 candidates sat for the examination of this subject and 65.34% 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	8.91	6.49	9.99	7.41	11.07	12.66	8.81	2.66	5.25	2.50	24.25

RESPONSES OF CANDIDATES

SECTION A: *Multiple-Choice Questions*

Answer keys

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

General comments

More than 70% of the candidates answered question 12 correctly and less than 30% of the candidates answered question 15 correctly. The rest of the questions were in the medium range with 30% to 70% of the candidates obtaining the correct answers.

SECTIONS B AND C: *Structured and Essay Questions*

General comments

In general, the performance of the candidates was good in quantitative questions. Most candidates were able to use the correct formula and present the final answer with the correct significant figures and units. The steps for calculations were well organised and presented systematically. The performance of the candidates was satisfactory in qualitative questions. Some candidates have problems in understanding physics concepts and explaining it in their own words.

Comments on individual questions

Question 16

In part (*a*), the candidates were required to sketch all forces acting on the cyclist when it makes a turn at a corner with certain speed. Three forces, which friction, weight, and normal, were expected to be sketched or candidates provided friction and normal as resultant force together with weight. Most candidates provided the correct answer on weight but most of the mistakes came from their misunderstanding about centripetal force. Some candidates missed the mark due to the friction force and resultant force were not at the right positions.

In part (*b*), most candidates were able to relate the centripetal force to the frictional force, $\frac{mv^2}{t} = \mu mg$, to determine the radius of the turning of the bicycle.

In part (*c*), the candidates were asked about the leaning angle where it should increase in case the speed of the cyclist increases. Many candidates provided the wrong answer either the candidates were merely guessing the answer or the candidates had misunderstood the definition of leaning angle. The leaning angle should be taken from vertical the position of cyclist as the reference point but not from the horizontal or surface as the reference.

Answers: (*b*) 11.16 m

Question 17

In part (a), the candidates were asked to state the physical conditions for a real gas to behave as an ideal gas and provided the reason for the given answer. The expected answer should be low pressure and high temperature, as both physical conditions lead to negligible intermolecular forces between gas molecules. Most candidates were able to provide the correct answer for the physical conditions, but lose marks for the incorrect reason or inaccurate answer such as giving gas molecules collision as the reason.

In part (*b*)(i) and (ii), most candidates were able to relate the pressure and temperature using ideal gas equation $pV = nRT$. The common mistakes made by the candidates was using the wrong formulae and using temperature in degree Celsius instead of Kelvin.

Answers: (*b*)(i) 1.43; (*b*)(ii) 1.197

Question 18

In part (*a*), the candidates were required to show the conservation of linear momentum for two colliding objects by applying Newton's second law and third law of motion. Candidates were expected to start using the Newton's second law of motion, $F = \frac{mv - mu}{t}$, and Newton's third law of motion, $F_1 = -F_2$. Then, the candidates were expected to write the equation $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$ for the conservation of linear momentum. Many candidates were able to write the equation that represents the conservation of linear momentum. However, many candidates didn't show how the equation can be derived from the Newton's laws. They defined the laws instead of writing equations that represent the laws.

In part (b)(i), the candidates were required to determine the time taken by the sphere and the arrow to reach the floor. Candidates were expected to use the formula $s_y = u_y t + \frac{1}{2} a_y t^2$. Only a few candidates managed to solve the problem correctly. Many candidates committed with the mistakes such as wrongly substituted the value of s_y as 1.80 m which was the horizontal displacement rather than using the vertical displacement to determine the time and using incorrect formulae such as $v^2 = u^2 + 2as$, $v = ut + \frac{1}{2}gt$, $R = \frac{u^2 \sin 2\theta}{g}$.

In part (b)(ii), the candidates were required to calculate the speed of the arrow just before it strikes the wooden sphere. Candidates were expected to apply the principle of conservation of linear momentum in order to solve the problem, and the initial horizontal velocity obtained equals the speed of the arrow before striking the sphere. A majority of candidates used incorrect formulae such as $m_1 v_1 = m_2 v_2$ and $v^2 = u^2 + as$.

In part (c)(i), the candidates were required to define the elastic collision. Candidates were expected to state that a collision where there is no loss in total kinetic energy of the colliding objects. Only a few candidates managed to state the definition correctly. Majority of the candidates missed the keyword *total* which could change the concept of elastic collision. Some candidates defined the elastic collision as a collision where the objects separate or rebound after the collision, which was not accepted.

In part (c)(ii), the candidates were required to deduce an expression for the velocity of the first sphere after a collision in terms of m_1, m_2, and u. Candidates were expected to deduce the expression by using both conservation of linear momentum and conservation of kinetic energy. Candidates were also expected to state $u_2 = 0$ in order to get $v_1 = \frac{m_1 - m_2}{m_1 + m_2} u$. There were very small number of candidates who managed to do the question completely correct. Majority of the candidates deduced the expression from the conservation of linear momentum only. Thus, the expression obtained is $v_1 = \frac{m_1 u_1 - m_2 v_2}{m_1}$, which was wrongly deduced.

In part (c)(iii), the candidates were required to deduce the occurrence of the first sphere after the collision if both spheres have the same mass. Candidates were expected to substitute $m_1 = m_2$ into the expression obtained in (c)(ii) and hence they should get $v_1 = 0$. Candidates were also expected to state that the first sphere stops after the collision due to its speed was zero. However, only a few candidates managed to deduce the occurrence of the first sphere correctly. Many candidates didn't manage to make the deduction correctly due to the incorrect equation in (c)(ii). Some candidates simply stated the occurrence of the sphere without justification such as the sphere move to the opposite direction, and the sphere moves in constant speed.

Answers: (b)(i) 0.534 s; (b)(ii) 22.98 m s^{-1}

Question 19

In part (a), the candidates were required to explain the proportional limit, elastic deformation, and plastic deformation by using the stress-strain graph. Candidates were expected to sketch the stress-strain graph for a ductile material and label the proportional limit and elastic limit to help them explaining elastic deformation and plastic deformation clearer. Candidates were also expected to explain that; up to the proportional limit, the elongation of the material obeys Hooke's law, elastic deformation occurs up to the elastic limit and during the elastic deformation the material could return to its original length when the applied force is removed because net molecular/atomic attractive force brings the molecules/atoms back to their equilibrium positions, plastic deformation begins after the elastic limit or at yield point where the material is unable to return to its original length due to the dislocation or the planes of molecules slide over each other. Most candidates were able to sketch the graph correctly. However, many of them marked and labelled the proportional limit and elastic limit at incorrect point. Some of the candidates were unable to express the explanation correctly. For example, proportional limit is OA where the limit supposes to be at one point only and not in a range. There were also candidates who had misconception on the concepts of elastic deformation and plastic deformation.

In part (*b*)(i), the candidates were required to determine the stress on a hollow cylinder when it is compressed at both ends. Candidates were expected to use the formula for stress and to calculate the cross-sectional area of the hollow cylinder. Although majority of the candidates were able to write the formula of stress correctly, only a few candidates managed to solve the problem correctly. Many of them failed to calculate the area correctly. Majority of them did not write formula for the area, but made direct substitution which was accepted.

In part (*b*)(ii), the candidates were required to determine the change in length of the hollow cylinder due to the compression. Candidates were expected to use the formulae for Young's modulus, $E = \frac{\sigma}{\varepsilon}$, and strain, $\varepsilon = \frac{\Delta \ell}{\ell}$. Majority candidates were able to write the formulae of Young's modulus and strain correctly. However, only a few of them managed to get the expected answer. Many candidates made mistakes in the calculation such as using the incorrect value of area obtained in (*b*)(i) and early round off the intermediate answer.

Answers: (*b*)(i) 1.114×10^{6} N m^{-2}; (*b*)(ii) 6.366×10^{-6} m

Question 20

In part (*a*), the candidates were required to name two gas processes, *R* and *S*, based on the curves on a *p*-*V* graph given. Candidates were expected to name *R* as isothermal process and *S* as adiabatic process. Majority of the candidates had no problem in naming both *R* and *S* correctly.

In part (*b*), the candidates were required to describe the changes in the internal energy and the heat supplied, each in isothermal and adiabatic processes. Candidates were expected to describe the changes in the processes based on the first law of thermodynamic. Candidates should describe that in isothermal process, the temperature of the gas remains unchanged and thus there is no change in the internal energy. Therefore, the heat supplied is used for the gas to do work. While in adiabatic process, there is no heat entering or leaving the gas thus the decrease in internal energy is for the gas to do work. There were many candidates who able to describe the gas processes completely correct. There were also candidates who mistakenly stated that the internal energy in isothermal process is zero instead of the change in internal energy is zero.

In part (*c*), the candidates were asked to calculate the heat supplied in *R* based on the curve of the *p*-*V* graph given. Candidates were expected to use the formula of work done in isothermal, $W = nRT \ln \frac{V_2}{V_1}$ since $\Delta Q = W$. Alternatively, candidates could also use $W = p_2 V_2 \ln \frac{V_2}{V_1}$. Many candidates were able to write the formula correctly. However, some of them failed to get the correct answer due to executing the calculation wrongly.

In part (*d*), the candidates were required to calculate that the work done in *S* based on the *p*-*V* graph given. Candidates were expected to use the formula for work done in adiabatic process, $W = \dfrac{nR}{\gamma - 1}(T_2 - T_1)$, and the equation $T_1V_1^{\gamma - 1} - T_2V_2^{\gamma - 1}$ to determine the initial temperature. Candidates were also expected to recognise that nitrogen gas is a diatomic gas, and thus $\gamma = 1.40$. There were also candidates who committed with mistakes such as using $\gamma = 1.67$, and using the volume in cm^3.

Answers: (*b*) 717 J, (*d*) 760 J

Physics 960/2

OVERALL PERFORMANCE

For Semester 2, 1 155 candidates sat for the examination of this subject and 61.65% 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	10.82	4.62	7.16	6.63	10.12	10.21	12.09	5.36	7.24	5.67	20.09

RESPONSES OF CANDIDATES

SECTION A: *Multiple-Choice Questions*

Answer keys

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

General comments

More than 70% of the candidates answered question 8, 10 and 15 correctly. The rest of the questions were in the medium range with 30% to 70% of the candidates obtaining the correct answers.

SECTIONS B AND C: *Structured and Essay Questions*

General comments

The candidates performed well in quantitative questions. They were able to use the correct formulae to start the calculation. However, some candidates were rather weak in solving questions that consists of many working steps to get the final answers. Some candidates also wrote the final answer incorrectly by not converting the final answer to the correct significant figures.

Comments on individual questions

Question 16

In part (*a*), only a few candidates were able to sketch the graph of resistivity against temperature that show the curve and linear line. The candidates knew that the resistivity increases with temperature but did not knew that the resistivity is not zero, even at absolute zero temperature. The candidates also did not show clearly how the resistivity changes with temperature at high and low temperatures, as indicated in the question. Some of the candidates sketched the graph for semiconductors. It shows that the candidates were not able to differentiate between temperature and resistivity for metal and semiconductors.

In part (*b*), most candidates were able to state the factor that affects the resistance of the transmission power line. However, some candidates mentioned only the area or surface of the copper wire instead of the cross-sectional area of the copper wire. Some candidates also mentioned types of material, which was not accepted because the question already mention that the transmission power line was made by copper.

In part (*c*), most candidates were not able to calculate the diameter of the wire of the transmission power line. The candidates misinterpreted the cross-sectional area for diameter. Candidates may determine the area and forget to relate it back to the diameter using $A = \pi r^2$. They might also forget to double the radius to determine the diameter.

Answers: (*c*) 1.046×10^{-2} m

Question 17

In part (*a*), most candidates were able to calculate the root mean square (rms) current using the formula $P = VI$. However, most candidates wrote the final answer in one significant figure only, which were not accepted. Most candidates were unaware that the value given on the label was the rms voltage and the peak voltage, thus leading the candidates to made mistakes in the formula and the calculations for the correct value of the rms current.

In part (*b*), most candidates were able to calculate the peak current by using the formula $I_{peak} = \sqrt{2} I_{rms}$.

In part (*c*), the choice of fuse was actually based on the answer on part (*b*). Most candidates were able to choose the correct fuse, which was 10 A and state reasons that the value of the fuse was nearer to the peak value of the current and to reduce power dissipation.

Answers: (*a*) 5.0 A, (*b*) 7.071 A

Question 18

In part (*a*), most candidates stated that an electric force existed because the electron was opposite charge with the point charge $+Q$. Thus, they provided the correct answer by stating that an attractive force exists. However, a few candidates provide information on the magnitude of the force, which can actually be shown by formula, $F = eE$.

In part (*b*), most candidates were able to describe the motion of an electron that enters perpendicularly to a uniform electric field. Almost all candidates can state that the electron moves with a parabolic path, but very few mentioned that such a path was produced because the horizontal motion of the electron in the electric field was unaffected. Most candidates only explain that a force acts on the electron, causing it to deflect to the side of a higher potential or positive plate. Some candidates confused between electric field and magnetic field and thus explained the Hall effect instead of the electron’s motion.

In part (*c*), candidates know that they need to use force on the electron to determine its motion but cannot relate the force to acceleration. Some of them relate the force with the electric field strength instead. Many candidates can relate the vertical and horizontal motions with the time the electron takes to move but make the wrong conclusion in stating whether the electron can exit the plates. Only a few candidates made the wrong deduction because they were unaware that the electron entered the region at the middle of the plates and used 4.0 cm instead of 2.0 cm for the vertical displacement. However, as marks are allocated for the correct formulae used to determine the electron's vertical and horizontal displacement, candidates obtained some marks for this question. Most of them were able to write the formula $F = ma$, $s = ut + \frac{1}{2}at^2$. Some of them made mistakes by assuming that horizontal velocity is increasing, which was incorrect in physics.

Answers: (c) 7.3 cm < 8.0 cm, could not exit the plate

Question 19

In part (*a*), candidates were asked to state two principles applied in Kirchhoff’s laws. However, most candidates did not read the question carefully and stated the two Kirchhoff laws instead of the principles applied.

In part (*b*)(i),(ii), about half of the candidates answered correctly by applying Kirchhoff’s second law for (*b*)(i), and Kirchhoff’s first law and second law for (*b*)(ii). However, candidates made mistakes when determining the direction of the current flow or incorrectly applied Kirchhoff’s loop rule, resulting in the wrong value of emf obtained. The same mistake was made in (*b*)(ii) when determining the values of currents.

In part (*c*), most candidates were able to explain the usage of the shunt, which was a lowresistance resistor connected in parallel, in order to convert a galvanometer into an ammeter, and the usage of the multiplier, which was a high-resistance resistor connected in series, in order to convert a galvanometer into voltmeter. Several of them supported their explanation with diagrams showing how the shunt and multiplier were connected to the galvanometer.

Answers: (*b*)(i) 41 V; (*b*)(ii) I_2 = 0.90 A; I_3 = 0.35 A

Question 20

In part (*a*)(i), not many candidates were able to write the expression for magnetic flux because they failed to figure out the angle between the magnetic field and the plane. Almost half of the candidates did not know the difference between magnetic flux and magnetic flux linkage and gave the answer $NBA \sin \theta$ instead of $BA \sin \theta$.

In part (*a*)(ii), many candidates were not able to state the ways or methods to induce e.m.f. in the loop. Most of them stated, change the angle, change the magnetic field and change the angle between the magnetic field and the plane of the loop, and change the area of the coil, which were not accepted because they did not state how the angle, magnetic field, and area can be changed. They also suggested that the coil was rotated or moved but did not state how it would be rotated or moved so that e.m.f can be induced.

In part (*b*), most candidates were able to derive the self-inductance of a solenoid because it only required candidates to state the formula $\phi = NBA$ and $\phi = LI$. Subsequently, the candidates could obtain the correct final answer.

In part (*c*), most candidates mistakenly thought they needed to use the formula derived in part (*b*) for self-inductance and thus cannot obtain the answer. Certain candidates did not know they needed to deduce the maximum emf induced in the coil from the concept of electromagnetic induction before relating the maximum emf induced with the root mean square voltage given in the question. Hence, they did not manage to calculate the value of N. However, most candidates can relate the frequency of rotation with angle and thus relate it with the rate of change of flux, which gives them some marks in this question.

Answers: (*c*) 360

Physics 960/3

OVERALL PERFORMANCE

For Semester 3, 1 145 candidates sat for the examination of this subject and 59.04% 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	9.79	6.21	5.59	7.95	9.53	10.40	9.57	5.31	4.81	5.16	25.68

RESPONSES OF CANDIDATES

SECTION A: *Multiple-Choice Questions*

Answer keys

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

General comments

More than 70% of the candidates answered question 1 correctly and less than 30% of the candidates answered question 8 correctly. The rest of the questions were in the medium range with 30% to 70% of the candidates obtaining the correct answers.

SECTIONS B AND C: *Structured and Essay Questions*

General comments

In general, good and moderate candidates were able to answer questions in the form of knowledge, understanding and application by using the correct formula. While weak candidates were able to answer questions of knowledge and used the formulas to solve a straightforward questions. The candidates knew the importance of writing the answers in suitable number of significant figures and unit. Only a few candidates still wrote their final answer in more than four significant figures.

Comments on individual questions

Question 16

In part (*a*), candidates were asked to explain the formation of nodes in a standing wave. They were expected to describe how standing waves formed through the superposition of incident and reflected waves on a string and explain nodes as areas of zero amplitude, where crests and troughs interfere destructively. Most candidates understood the concept of nodes correctly. However, they did not provide a complete explanation, focusing only on either the formation of standing waves or the formation of nodes. Some candidates missed key words, such as *reflected wave*, *opposite direction*, or *superposition*, which led to incomplete explanations of standing wave formation. Meanwhile, a few candidates had misconceptions about nodes, often describing the characteristics of standing waves or incorrectly associating nodes with zero speed.

In part (*b*), candidates needed to determine the speed of the transverse wave on the string. They were expected to recognize that the string length equals two wavelengths ($l = 2\lambda$) and use the equation $v = f\lambda$. The common mistakes made by the candidates was used the irrelevant formulas for velocity, such as $\sqrt{\frac{T}{\mu}}$. Additionally, candidates often not able to identify the equivalent number of wavelengths, for example, by incorrectly stating that $l = 4\lambda$ or $\lambda = 2l$. This misunderstanding shows the candidates not understand the concept of four loops.

In part (*c*), candidates were required to calculate the mass, M, of the object that pulls the string taut. They were expected to use the formula $v = \sqrt{\frac{T}{\mu}}$ and then $T = Mg$. Some candidates incorrectly used the formula for mass per unit length of the string, $\mu = \frac{m}{l}$, to calculate M. This shows that the candidates were not able to distinguish between the mass of the string, m, and the mass of the object, M.

Answers: (*b*) 60 m s^{-1}, (*c*) 0.0367 kg

Question 17

In part (*a*), the candidates were asked to determine the angle for the second-order diffraction of light with a wavelength of 560 nm, incident on a diffraction grating with 300 lines per mm. Candidates were expected to use the formula $d \sin\theta = n\lambda$ and in which $d = \frac{1}{N}$. However, some candidates incorrectly substituted the value of d as 300 or 300×10^3, while others carelessly substituted the value of N as 300 instead of 300×10^3. Some candidates also wrongly used the formula $2d \sin\theta = n\lambda$.

In part (*b*), the candidates were asked to determine the highest order of the diffraction pattern. They were expected to use either $\theta = 90°$ or $\sin\theta = 1$, to determine the maximum number of diffraction orders that could be formed on the screen. Most candidates were able to answer the question correctly. However, a few candidates who used the appropriate method made the mistake of counting the orders on both sides of the central maximum, leading them to get 10 or 11. Some candidates incorrectly rounded the final answer to 6.

In part (*c*), candidates were asked to explain why a diffraction pattern was not observed if the wavelength is 5000 nm. They were expected to use the same method as in part (*b*), which gives $n = 0.67$, and should have stated that no first minimum could form on the screen or that the central maximum is too wide for the diffraction pattern to be observed. Alternatively, candidates could have stated that a wavelength of 5000 nm is outside the visible light range, making the diffraction pattern invisible to the human eye. Most candidates correctly wrote $n > 1$ or $\frac{d}{\lambda} > 1$, but incorrectly explained that as the wavelength increases, the diffraction angle becomes wider and thus cannot be observed on the screen. This question was challenging for many candidates. While they recognised that 5000 nm represents a very large wavelength, they struggled to connect this with the number of orders, n, and could not fully understand why the diffraction pattern would not be observable. Some candidates calculated $n = 0.67$ (where $n < 1$) but were unable to explain why the diffraction pattern cannot be observed with a wavelength of 5000 nm.

Answers: (*a*) 19.63°, (*b*) 5

Question 18

In part (*a*), the candidates were asked to define simple harmonic motion. They were expected to state that simple harmonic motion was the motion of an object where its acceleration is directly proportional to its displacement from the equilibrium point and directed toward that point. Most candidates were able to correctly define simple harmonic motion. However, some candidates showed misconceptions by stating irrelevant concepts.

In part (*b*)(i), the candidates were asked to derive the equation for the motion of a sewing machine needle undergoing simple harmonic motion. The candidates were expected to start with the general equation, $x = A \cos \omega t$ or $x = A \sin \omega t$ or $x = A \cos(\omega t + \phi)$, and then calculate the value of amplitude, A, and angular speed, ω. Only a very small number of candidates managed to deduce the equation correctly. Majority candidates who were able to use the correct formula in determining A and ω either expressed the final equation in π such as $x = 20.0 \sin(28\pi t)$or write the amplitude in inappropriate number of significant figures such as $x = 0.02 \cos(87.96t)$. Some candidates began the deduction with incorrect equation for simple harmonic motion such as $x = A \sin(\omega t - kx)$.

In part (*b*)(ii), the candidates were asked to determine the maximum speed of the needle and its position relative to the table. The candidates were expected to use the formula $v_{max} = \omega A$, which occurs at the equilibrium point and determine the needle's position at the equilibrium point, which was 5.00 mm below the table surface. Only a few candidates correctly answered both the maximum speed and the position. Many candidates correctly determined the maximum speed but either failed to determine the position or didn't state it at all. Some candidates also used irrelevant or incorrect formulas, such as $v_{max} = \omega^2 x$.

In part (*b*)(iii), the candidates were required to determine the contact force exerted by the needle on the cloth using the formula $F = ma$, where $a = \omega^2 x$. Some candidates used the correct formula but substituted the value of displacement, x, with amplitude, A.

In part (*c*) the candidates were required to list three differences between free and forced oscillations. The expected answers included key distinctions such as frequency (natural frequency in free oscillations versus driven frequency in forced oscillations), the type of force involved (restoring force alone in free oscillations compared to an additional external driving force in forced oscillations), and amplitude behavior (damped over time in free oscillations versus sustained or even increasing in forced oscillations). Most candidates were answered limited to one or two points, often focusing narrowly on the presence of an external force. Some candidates were answered unrelated aspects without clearly contrasting the two types of oscillations.

Answers: (*b*)(ii) 1.759 m s^{-1} and 5.00 cm below the surface of the table, (*b*)(iii) 1.161 N

Question 19

In part (a)(i), the candidates required to identify the type of spherical mirror based on the characteristics of the image given. The expected answer was concave mirror deduced from the virtual image and the image distance greater than the focal length. Most candidates simply concluded that the mirror was concave mirror without provided complete reasoning.

In part (a)(ii), the candidates required to calculate the distance of the object from the mirror. The candidates were expected to calculate using the formula $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$. Many candidates applied the correct formula, but the common mistakes were included incorrectly substituting the value of f as 15.0 cm and sign for v as positive.

In part (b), the candidates required to determine the position of the final image of a black dot formed by a glass sphere. The candidates were expected to apply the refraction formula at both spherical surfaces, $\frac{n_1}{u} + \frac{n_2}{v} = \frac{n_2 - n_1}{r}$. Only a small number of candidates provided a complete correct solution. Most mistakes made by the candidates was stopped their calculations after analysing only the first surface's refraction, failed to account for the negative sign of u when calculating the second surface's refraction.

In part (c), the candidates required to compare the characteristics of the image between convex mirrors and concave lenses. The expected answer included three similarities which was virtual, upright, and diminished images. Most candidates incorrectly compare between convex mirror and concave mirror.

Answers: (a)(ii) 8.182 cm, (b) 3.91 cm

Question 20

In part (a), the candidates required to derive the expression for the radii of the hydrogen atom. Most candidates were able to derive the correct expression by equating the centripetal force, F_c, to Coulomb attraction force, F_e. Then the candidates were able to relate by applying Bohr's angular momentum quantization, $mvr = \frac{mh}{2\pi}$. Finally the candidates were successfully obtained the expression for radii as $r_n = \left(\frac{\varepsilon_o h^2}{\pi m e^2}\right)n^2$.

In part (b)(i), the candidates required to calculate the number of electrons that hit the target per second. Only a small number of candidates correctly applied the formula $N = \frac{I}{e}$, substituted $I = \frac{\mathrm{d}Q}{\mathrm{d}t}$ and $Q = Ne$ to solve the problem. Most candidates who attempted the question struggled with units, typically either failing to include the 'per second' (s^{-1}) notation or presenting the answer as a simple count of electrons rather than as an electron flux rate.

In part (b)(ii), the candidates needed to calculate the minimum X-ray wavelength. Most candidates were able to calculate the minimum wavelength using equation, $\lambda_{min} = \frac{hc}{eV}$. However, some candidates solved the problem using incorrect formulas such as $\lambda = \frac{h}{p}$ and $2d \sin \theta = m\lambda$.

In part (b)(iii), the candidates required to sketch and label a graph of intensity against wavelength of the X-ray spectrum. Most candidates were able to sketch the continuous spectrum and characteristic spectrum. Only a few candidates were forgot to label minimum wavelength in the graph.

In part (*b*)(vi), the candidates required to determine the average energy per second of the X-ray produced. Most candidates were able to use the formula $P = VI$ to determine the output power by considering the efficiency of X-ray tube operation of 1.0%.

Answers: (*b*)(i) 6.25×10^{16} electrons; (*b*)(ii) 8.879×10^{-12} m; (*b*)(iv) 14 W

PAPER 960/5 (WRITTEN PRACTICAL TEST)

Comments on the individual questions

Question 1

In part (*a*), most candidates were not able to calculate the value of mean for width, w, mean for thickness, t, and bending, B, correctly. Then, the candidates were able to complete the table correctly.

In part (*b*), most candidates were able state vernier calliper to measure w, and micrometre screw gauge to measure t.

In part (*c*), most candidates were able to plot the graph of B against m.

In part (*d*)(i), most candidates were able to determine the gradient of the graph with the triangle size covering more than $\frac{1}{3}$ of the graph paper based on the data obtained.

In part (*d*)(ii), the candidates were not able to calculate the E correctly.

In part (*e*), most candidates were not able to calculate the percentage error of the result experiment due to difficulty of the candidates in answering part (*d*)(ii).

Answers: (*d*)(i) 0.36 m kg^{-1}; (*d*)(ii) 6.73×1010 N m^{-2}, (e) 2.46%

Question 2

In part (*a*), most candidates were able to calculate the value of $\frac{1}{R}$ and ln V with the correct significant figures.

In part (*b*), most candidates were not able to describe the procedure to measure V correctly.

In part (*c*), most candidates were able to plot a graph of ln V against $\frac{1}{R}$ with the correct labelled axes and all the points were marked correctly. Most candidates were also able to draw a best straight line through the plotted points.

In part (*d*)(i), most candidates were able to determine the gradient of the graph with the triangle size covering more than $\frac{1}{3}$ of the graph paper.

In part (*d*)(ii), most candidates were also able to determine the value of capacitance, C, correctly. Some candidates missed to write the unit in their final answer.

In part (*e*), only a few candidates were able to state the precautionary step for the experiment as charging battery should have a constant e.m.f.

In part (*f*), most candidates were not able to suggest the methods that can improve the accuracy of V by using longer discharging time and repeating the measurement of V.

Answers: (*d*)(i) $6.67 \times 10^3\ \Omega$, (d)(ii) 1.50×10^{-3} F

Question 3

In part (*a*), most candidates were able to plot the graph of d against u with the correct labelled axes and all the points were marked correctly. Most candidates were also able to draw a best straight line through the plotted points.

In part (*b*)(i), most candidates were able to determine the minimum value for d correctly but in part (*b*)(ii), the candidates were not able to estimate the absolute uncertainty from the graph. Thus, in part (*b*)(iii), the candidates were not able to calculate the percentage of uncertainty due to difficulty to determine the absolute uncertainty in (*b*)(ii).

In part (*c*)(i), some candidates were able to determine the focal length using the equation $d = 4f$ and hence, were also able to determine the focal length of the concave lens using formula $\frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{f}$.

In part (*d*), some candidates were able to state sources of error in the experiment as the flame candle was not stationary and the position of the combined lens and the candle light was not certain.

In part (*e*), most candidates were not able to suggest ways to improve the accuracy of the experiment.

Answers: (*b*)(iii) 0.25%, (*c*)(i) 20.1 cm; (*c*)(ii) −19.9 cm

LAPORAN PEPERIKSAAN STPM 2024

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