MAJLIS PEPERIKSAAN MALAYSIA

SASBADI

Laporan Peperiksaan STPM 2018

Physics (960)

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Physics (960)

SASBADI SDN. BHD. (139288-X)
(Anak syarikat milik penuh Sasbadi Holdings Berhad (1022660-T))
PETALING JAYA

MAJLIS PEPERIKSAAN MALAYSIA

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PHYSICS (960/1)

OVERALL PERFORMANCE

For Semester 1 2018, 2 269 candidates sat the examination for this subject and 62.27% 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	10.27	5.29	8.68	8.55	8.77	11.19	9.52	3.31	6.17	3.39	24.86

CANDIDATES' RESPONSES

SECTION A: *Multiple-Choice*

Answer Keys

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

General comments

More than 70% of the candidates answered Question 7 and Question 8 correctly. Question 1 was very difficult for the candidates to answer with less than 30% of the candidates answered it correctly. The rest of the questions were in the medium range with 30% to 70% of the candidates obtained the correct answers.

SECTION B AND C: *Structure and Essay*

General comments

Generally, the performance of the candidates was better in the calculation questions rather than the descriptive questions. The candidates were able to perform a simple and regular types of calculations. They were also able to do calculations of a higher order that involved more than two equations or concepts. However, there were few candidates who still wrote their final answers to more than four significant figures.

On the other hand, in the explanation-based answers, sometimes the candidates tended to be a bit lengthy in elaborating the same point rather than presenting the next point to obtain the next marks. This may be due to the inability of the candidates to recognise and differentiate concepts that are the same and concepts that are distinctly different.

Comments on the individual questions

Question 16

In part (*a*), the candidates were able to write the equations for components x and y, to determine the horizontal distance. However, most of them did not apply the correct value of acceleration as $a = -9.8 \text{ m s}^{-2}$. They did not put the minus sign for the acceleration, thus got the wrong final answer.

In part (*b*), most candidates were able to determine the time flight of the ball using one of the equations in part (*a*).

In part (*c*), most candidates were not able to resolve the distance into components x and y, to get the correct answer. However, the candidates knew how to use the equation $v^2 = u^2 + 2as$ to find the value of v_y, but they could not use $\sqrt{v_x^2 + v_y^2}$ to find the speed of the ball during the impact.

Answers: (*a*) 42.6 m, (*b*) 2.08 s, (*c*) 21.36 m s^{-2}

Question 17

In part (*a*), most candidates were able to state the differences between an ideal gas and a real gas in terms of molecules. Some candidates were confused between the volume of the gas and the volume of the gas molecules. They stated that, the volume of ideal gas was negligible but the volume of real gas was significant. It should be, in the ideal gas the volume of the molecules is negligible while in the real gas, the volume of the molecules is not negligible.

In part (*b*), not many candidates knew how to use the formula $E = \frac{3}{2}kT$ to determine the mean translational kinetic energy of a gas molecule. Some candidates used $E = \frac{3}{2}nkT$ where n was the number of moles, which was wrong.

In part (*c*), most candidates were able to write the formula $U = \frac{f}{2}nR\Delta T$ to determine the internal energy of the gas. However, most of the candidates were confused with the number of degree of freedom. Instead of $f = 5$, they substituted $f = 3$ in the formula of internal energy.

Answers: (*b*) 6.21×10^{-21}J, (*c*) 1 558 J

Question 18

In part (*a*)(i), most candidates were able to define impulse as the change in momentum. However, there were some candidates who wrote the definition as the rate of change of momentum, which was wrong. There were also candidates who defined the impulse by writing the formula and stated the meaning of the symbols used; $Ft = mv - mu$ or $Ft = \Delta p$ or $Ft = p_f - p_i$ which was accepted.

In part (*a*)(ii), most candidates were not able to score full marks. This was because they did not fulfill the requirements of the question, which was using the Newton law of motion. The derivation should have started from Newton's second law, $F = \frac{dp}{dt}$, then substituted, $p = mv$ to get the expression $Ft = mv - mu$.

In part (*b*)(i), most candidates stated that the average force exerting on the plasticine was larger than on the ball bearing, which was wrong. They related wrongly between larger average force with larger mass or larger area. The candidates should be able to state that when a piece of plasticine and a ball bearing of the same mass were dropped vertically from the same height, a change of momentum of the ball bearing was greater than the plasticine. The time impact of the plasticine was greater than the time impact of the ball bearing on the surface. Thus, the average force of the ball bearing on the metal surface is larger than the average force of the plasticine.

In part (*b*)(ii), most candidates were able to determine the velocity of impact by using either the principle of conservation of energy or linear equation along the y-axis. However, most of them were only calculated for the average force for the plasticine without the average force for the ball bearing. They were thinking that the two objects had the same average force because the time of impact was given for both objects. They did not consider the change of momentum of the ball bearing was twice that of plasticine. Thus, the two forces should be different.

In part (*c*), most candidates were able to calculate the speed of the block with the bullet after the collision. The candidates used the principle of conservation of momentum for non-elastic collision.

Answers: (*b*)(ii) 3.13 N, 6.26 N, (*c*) 24.2 m s^{-1}

SEMESTER 1

Question 19

In part (*a*), not many candidates attempted to answer this question. Perhaps they did not know where to start in deriving the relationship between the linear velocity and the angular velocity for an object moving in a circle of radius, r, $v = r\omega$. Most candidates just wrote the relation by memory.

In part (*b*)(i), most candidates were not able to draw a labelled diagram acted on the car as it negotiates the curve. The candidates did not draw the friction on the surface of the road pointing towards the centre of the circular path, instead, most candidates drew it pointing outwards. Some candidates drew a rigid diagram of a car. Then, it became difficult for them to draw the forces acted, which was the normal reaction and frictional force, where it should be drawn on the surface between the tyres and the road. Many candidates also did not label the normal reaction and weight even though they drew the forces correctly.

In part (*b*)(ii), most candidates were able to get the answer correctly. Some candidates directly calculated using the relation $\mu mg = \frac{mv^2}{r}$ then, obtained $v = \sqrt{\mu gr}$ to determine the maximum speed of the car without skidding.

In part (*c*)(i), most candidates were not able to answer this part correctly. The candidates should have started to deduce the speed using the conservation of energy, $mgh = \frac{1}{2}mv^2$. The height of the mass was obtained from the trigonometry, $h = r\,(1 - \cos\,\theta)$. Hence, the speed of the mass was, $v = \sqrt{2gr(1 - \cos\,\theta)}$.

In part (*c*)(ii), most candidates were not able to calculate the angular displacement correctly. The candidates did not realise that the force must be balanced with the normal reaction, R. They had no idea where to start in solving the problem with the correct approach. The mass at position Q on the sphere would fly off when the reaction on the curved surface vanished, $R = 0$. Then, the force balanced, $mg\cos\theta - R = \frac{mv^2}{r}$ became $mg\cos\theta = \frac{mv^2}{r}$. Substituting the data to get the value of angular displacement.

Answers: (*b*)(ii) 20.59 m s^{-1}; (*c*)(ii) 48.2^{o}

SEMESTER 1

Question 20

In part (*a*), most candidates poorly explained the mechanism of heat conduction through a metal by diffusion of free electrons. Some candidates were using the term *electron* only and not the *free electrons*. Also, some candidates were able to identify that free electrons and atoms/ions as the agent for heat transfer but failed to explain how heat was transferred. Common misunderstanding observed in candidates' answers was to state that free electrons collided with the neighbouring electrons to transfer heat from the hot end to the cold end.

In part (*b*), most candidates were able to do this part satisfactorily by using the formula $\frac{dQ/dt}{A} = -k\frac{d\theta}{dx}$.

In part (*c*)(i), most candidates were not able to get the correct value for the double brick wall system, using the relation $\frac{dQ/dt}{A} = \frac{d\theta}{\sum \frac{x}{k}}$. However, the candidates knew how to determine the percentage change formula but did not get the correct answer.

In part (*c*)(ii), not many candidates attempted to answer this question. However, there were some candidates who were able to use the formula $\frac{dQ}{dt} = -k\frac{d\theta}{dx}$ to calculate the values of θ_1 and θ_2 correctly.

In part (*c*)(iii), candidates who got the correct answer in (*c*)(ii) were able to sketch a labelled graph correctly. Some very good candidates may think that the wall was not perfectly insulated so the graph was in curve shape rather than in straight line. This was also accepted. However, not many candidates scored full marks for sketching the correct graph due to the wrong labelling of temperatures and axes.

In part (*d*), most candidates did not know that the polystyrene consists of small air pockets. Also, very few could answer using the concept of energy loss by air convection. Many of them just gave a reason that polystyrene was a better insulator than air without mentioning any comment about transfer of heat by conduction and convection.

Answers: (*b*) 48 W m^{-2} , (*c*)(i) 89.7% ; (ii) 33.4ºC, 22.6ºC

PHYSICS (960/2)

OVERALL PERFORMANCE

For Semester 2 2018, 2 261 candidates sat the examination for this subject and 60.37% 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	9.29	5.93	5.35	5.04	11.10	11.72	11.94	5.22	4.78	4.91	24.72

CANDIDATES' RESPONSES

SECTION A: *Multiple-Choice*

Answer Keys

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

General comments

More than 70% of the candidates answered questions 1, 5, 14 and 15 correctly. Question 2 was very difficult for the candidates to answer with less than 30% of the candidates answered it correctly. The rest of the questions were in the medium range with 30% to 70% of the candidates obtained the correct answers.

SECTION B AND C: *Structure and Essay*

General comments

Generally, the performance of the candidates was better in calculation questions rather than descriptive questions. The candidates were able to perform a simple and regular types of calculations. They were also able to do calculations of a higher order that involved more than two equations or concepts. Most candidates realised the importance of writing the unit and stating the final answers in suitable number of significant figures. However, there were few candidates who still wrote their final answers to more than four significant figures.

On the other hand, in the explanation-based answers, sometimes the candidates tended to be a bit lengthy in elaborating the same point rather than presenting the next point to obtain the next marks. This may be due to the inability of the candidates to recognise and differentiate concepts that are the same and concepts that are distinctly different.

Comments on the individual questions

Question 16

In part (*a*), most candidates were able to use Ampere's law to derive an expression for the magnetic flux density at a distance *r* from a long straight conductor carrying current *I*. The correct expression of Ampere's law is $\oint \vec{B} \bullet \vec{dl} = \mu_o \Sigma I$, $\Sigma B\ dl\ cos\ \theta = \mu_o\ \Sigma I$ or $\Sigma B\ dl = \mu_o \Sigma I$. The candidates who did not start the derivation from the correct equation were not given any mark for the derivation. There were many candidates who wrote the expression without showing any derivative steps and hence were not awarded with any mark.

In part (*b*)(i), most candidates were able to derive an expression for force per unit length acting on wire *D* due to current in *C*. The candidates who understood the concept of magnetic force on a current carrying wire in a magnetic field were able to derive an expression using the formula $F = BIL$. The magnetic flux density, *B*, was obtained from part (*a*). By substituting into the formula, the candidates had no problem to express the correct expression force per unit length. However, some candidates lost their marks as they did not state their answers in terms of the symbols I_{C} and I_{D} as given in the diagram.

In part (*b*)(ii), most candidates were able to determine the magnitude and direction of the force per unit length on wire *D*. However, some candidates lost their marks due to the wrong unit of force per unit length. For the direction of the force, using the Fleming left hand rule, candidates should be able to get the direction of the force. However, many candidates were careless and did not mention the direction of the force acting on wire *D*.

Answers: (*b*)(ii) 7.44×10^{-5} N m^{-1}, away from wire *C*

Question 17

In part (*a*), most candidates were able to determine the impedance of the circuit from the relation $V_{rms} = I_{rms}Z$. However, some candidates mistook the value of impedance as the reactance of the capacitor and used the equation $V_{rms} = I_{rms}X_c$ to obtain the reactance of the capacitor. After that, the candidates applied the equation $Z = \sqrt{R^2 + X_c^2}$ to calculate the impedance and finally got the wrong answer.

In part (*b*), most candidates were able to use the formula $Z = \sqrt{R^2 + X_c^2}$ correctly to calculate the reactance of the capacitor. Some candidates tried to use the relation $X_C = \dfrac{1}{2\pi fC}$ but failed as the frequency *f* was not given.

In part (*c*), most candidates were able to write the relation between the reactance and frequency of a.c. as $X_C = \dfrac{1}{2\pi fC}$ and determined the frequency of the a.c. source. Some candidates were simply used the formula $\omega = 2\pi f$ without getting any answers.

SEMESTER 2

In part (*d*), most candidates were able to calculate the phase angle between voltage and current using the equation $\tan\theta = \frac{X_c}{R}$ *or* $\sin\theta = \frac{X_c}{Z}$. However, few candidates stated the phase angle between the current and voltage as 90°. This clearly shows that the candidates could not differentiate between the voltage supply and the voltage across the capacitor.

Answers: (a) 122.2 Ω; (b) 91.5 Ω; (c) 79 Hz; (d) 48.5°

Question 18

In part (*a*)(i), most candidates were able to write the equation of Coulomb's law, $F = \frac{q_1 q_2}{4\pi\varepsilon_o r^2}$, correctly and determined the electrostatic force between two charges. However, some candidates did not realise that forces are vector quantities and the resultant force could only be found by vector sum of the forces. Candidates who realised it as vector were able to resolve the forces into the vertical and horizontal components and then, used Pythagoras theorem to determine the resultant force or by using cosine rule. Majority of the candidates did not resolve the forces, which indicated that the candidates were very poor in dealing with vector sum. Most of the candidates were also able to state the direction of the resultant force correctly.

In part (*a*)(ii), most candidates knew that the permittivity of the medium is $\varepsilon = \varepsilon_r\varepsilon_o$ and were able to determine the new electrostatic force $F' = \frac{1}{\varepsilon_r}F$. Then, the candidates were able to calculate the percentage of the electrostatic force reduced when air was replaced by water with a relative permittivity of 80.0. Some candidates rounded off the intermediate calculated value too early causing an error in the final answer.

In part (*a*)(iii), only a handful of candidates were able to explain that cooking salts were made up of ions and that the electrostatic force between the ions reduced after placing it in the water thus, causing the bonds to break easily. Common mistakes done by the candidates were to categorise cooking salts as molecules that will form bond with water molecules easily.

In part (*b*)(i), most candidates stated the electric flux through a surface instead of a closed surface or the permittivity of medium instead of permittivity of vacuum. Some candidates even mixed up between electric flux with magnetic flux. This shows that the candidates' understanding of Gauss's law was very limited.

In part (*b*)(ii), most candidates started off the solution by using Gauss's law. Yet, they failed to see that the electric flux emerged out on both sides of the plate, i.e. $\Phi = 2EA$. Some poor candidates wrongly used the formula $E = \frac{Q}{4\pi\varepsilon_o r^2}$, since it is only true for a point charge. In the final part of this question, not many candidates were able to state the direction of the electric field which was perpendicularly outward from the surface of the plate.

Answers: (*a*)(i) 1.56×10^4 N with the direction upwards, (ii) 98.75%; (*b*)(ii) 3.39×10^8 N C^{-1}

Question 19

In part (*a*)(i), most candidates did not score full marks as they gave incomplete definition of the Kirchhoff's laws. For Kirchhoff's first law, some candidates stated *at a point* instead of *junction* and thus the answer was not accepted. Similarly, for Kirchhoff's second law, many candidates did not mention the phrase *closed loop* or *algebraic sum* in their answers.

SEMESTER 2

In part (*a*)(ii), most candidates were able to score the first mark by writing $E_1 + E_2 = IR_1 + IR_2 + IR_3$ for the circuit that consisted of two e.m.f.s and three resistors arranged in series. However, they did not express the current I in terms of the other parameters.

In part (*b*)(ii), most candidates were not able to show that Kirchhoff's law is consistent with the Principle of Conservation of Energy. Candidates should have used the total power supplied by batteries = $IE_1 + IE_2$ and that the rate of heat dissipated in resistors = $I^2R_1 + I^2R_2 + I^2R_3$. By equating the power supplied and the rate of heat dissipated, the Kirchhoff's second law could be verified.

In part (*c*)(i), most candidates were not able to determine the current measured by an ammeter. The candidates did not realise that the polarities of the batteries were connected in reverse and therefore, the answers they obtained were not correct. Others also used Kirchhoff's second law but failed to realise it was only one loop. So, the value of current flow should be the same. This could be the weakness of the candidates to understand what is meant by algebraic sum as required by the law.

In part (*c*)(ii), many candidates substituted the current obtained in the previous part to calculate the resistance of the bulb without realising that the current changed when the switch was closed. There were also many candidates who tried to solve three equations with three unknown currents without realising that the task could be simplified by substituting one of the currents equal to zero at the very beginning.

In part (*c*)(iii), most candidates were able to write the formula to obtain the power dissipated by the bulb. However, some candidates substituted the current obtained from part (*c*)(i) and got the incorrect final answer.

Answers: (*c*)(i) 0.75 A, (ii) 1.50 A, 6.0 Ω, (iii) 13.5 W

Question 20

In part (*a*), most candidates gave the definition of self-inductance instead of explaining self-induction. The candidates should have realised that self-induction is a phenomenon where an e.m.f. is induced in a coil when there is a change of current through the same coil. Self-induction usually occurs in coils, solenoids or inductors. When the current through a coil varies, the magnetic flux linkage through the same coil also varies. Thus, from Faraday's Law, an e.m.f. is induced. Many candidates explained that self-induction was caused by the change of magnetic flux in the same coil without emphasising that this change was caused by the changing current through the coil. Candidates should have realised that the induced e.m.f. due to the change in the external magnetic field was not known as self-induction. Some candidates who stated the phenomenon of self-induction correctly failed to give the reason that the changing current in the coil caused the changing of the magnetic flux through the same coil and thus, losing one mark for the explanation.

In part (*b*), most candidates managed to get two out of three marks allocated for the explanation of the changes in the brightness of the bulb that could occur when an iron core was inserted into the coil. Most candidates stated that the insertion of the iron core will increase the self-inductance of the coil and thus, producing a back e.m.f. which in turn will reduce the current through the bulb. Thus, the brightness of the bulb decreases. However, many candidates failed to describe the change in brightness of the bulb. Better candidates were able to mention reduction in potential difference across the bulb or reduction in current in circuit due to the induced current producing dimmer light. Very few candidates were able to mention that the brightness of the bulb returned to its initial condition when the current became steady.

In part (*c*)(i), most candidates were able to apply the formula $E = L\frac{dI}{dt}$ to determine the self-inductance of the coil. However, some candidates lost their marks for leaving the self-inductance with a negative value or wrong units.

In part (c)(ii), most candidates were able to use the formula $N\Phi = LI$ to determine the magnetic flux. However, some candidates calculated the magnetic flux linkage from the equation $\Phi = LI$ but did not divide by the number of turn, N. One common mistake made by the candidates was not giving the final answer in the correct S.I. unit.

In part (d)(i), good candidates were able to use the relation $V_{supply} = V_{back} + IR$ to obtain the answer. Poor candidates were just using $V_{back} = IR$. There was a misconception that there were two currents flowing in the opposite directions in the circuit, one caused by the battery and another due to the back e.m.f. induced in the coil. There were also candidates who mistook the potential difference across the bulb as the back e.m.f. in the coil.

In part (d)(ii), majority of the candidates were able to determine the rate of change of current from the equation $E = -L\frac{dI}{dt}$. A number of candidates failed to get the second marks as they left their answers in the negative value. These candidates did not realise that when the switch was closed, the current was increasing and the induced e.m.f. should be negative.

Answers: (c)(i) 2.45×10^{-3} H, (ii) 1.96×10^{-5} T m^2 ; (d)(i) 5.0 V, (ii) 2.5 A s^{-1}

PHYSICS (960/3)

OVERALL PERFORMANCE

For Semester 3 2018, 2 257 candidates sat the examination for this subject and 62.08% 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	13.16	4.52	5.58	6.16	12.10	9.88	10.68	3.99	7.22	4.34	22.37

CANDIDATES' RESPONSES

SECTION A: *Multiple-Choice*

Answer Keys

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

General comments

More than 70% candidates answered questions 1, 2 and 5 correctly. The rest of the questions were in the medium range with 30% to 70% of the candidates obtained the correct answers.

SECTION B AND C: *Structure and Essay*

General comments

Generally, the candidates performed better in questions that required the candidates to compute the answers rather than descriptive questions. The candidates were able to perform calculations and gave the final answers with the correct significant figures and units. However, there were still a few candidates who rounded the values of their intermediate steps, and this led to the final answers fell short of the right value and significant figures.

Comments on the individual questions

Question 16

In part (*a*), most candidates knew the formulae of intensity level, $\beta = 10 \log \frac{I}{I_o}$, and intensity of sound, $I = \frac{P}{A}$, to determine the power of sound for the explosion of the firecracker. However, some candidates did not realise that a point source of sound produced was a spherical wave front with area of $4\pi r^2$ instead of circular wave front of πr^2.

In part (*b*), most candidates were able to get the answer correctly. However, some candidates rounded up the figures in intermediate steps of their calculation too early with less than four significant figures, consequently giving the final answer in the wrong number of significant figures. Some candidates gave the answer as intensity instead of intensity level.

In part (*c*), most candidates were able to differentiate sound wave as a longitudinal wave and light wave as transverse wave but unfortunately, many candidates wrote that light waves consist of particles oscillating perpendicularly to the direction of propagation of waves. This shows that some candidates had the wrong concept about light, as light is an electromagnetic waves consisting of oscillations of electric field and magnetic fields perpendicularly with the direction of propagation. There were also some candidates who stated that sound wave travels parallel to the direction of propagation and light wave travels perpendicular to direction of propagation, which was a totally wrong concept. Some candidates also lost their marks when they used polarisation to differentiate the properties of sound and light, as polarisation was not a property of propagation.

Answers: (*a*) 1.26 mW, (*b*) 56.5 dB

Question 17

In part (*a*), most answers presented were good and well organized. However, some candidates did not know what the question meant by the combined mass that has been converted to energy. They used the mass of deuterium and tritium atom instead and they calculated the mass loss in part (*b*) which caused them to lose mark.

In part (*b*), most candidates were able to write the Einstein's mass-energy equation and calculated the energy released in the reaction correctly. Few candidates did not score due to the improper used of the mass-energy equation. Some candidates multiplied the mass loss in u with c^2, while others converted to kg and multiplied with 935 MeV.

The performance of candidates in part (*c*) was not satisfactory. To calculate the combined mass of deuterium and tritium needed to supply energy to a city for 30 days, candidates were required to calculate the total energy for the city for 30 days using the formula, $E = Pt$, taking into account the efficiency of the reactor using the efficiency equation, calculating the number of reactions required by dividing by the energy per reaction and finally calculating the combined mass of deuterium and tritium required. Unfortunately, most candidates did not perform well as they did not decipher the steps required. Most candidates were only able to get 2 marks from the formula $E = Pt$ and efficiency equation.

Answers: (*a*) 0.375%, (*b*) 2.82×10^{-12} J, (*c*) 70.17 kg

Question 18

In part (*a*), candidates were expected to state the differences in terms of energy transfer, amplitude and phase of oscillation and the presence of nodes and antinodes. Most candidates were able to score a mark with stating the energy was transferred in progressive wave and the energy was not transferred in standing waves. Amplitude was also popular among many of the candidates as they stated that progressive waves do not have nodes and antinodes while standing waves have nodes and antinodes. All particles oscillated in a progressive wave while particles at the nodes for the standing waves were stationary. Phase difference was also widely stated by the candidates, but most of them did not mention that within a wavelength and within two consecutive nodes to qualify for the mark.

In part (*b*), most candidates were able to use the equations $\omega = 2\pi f$, $k = \frac{2\pi}{\lambda}$, and $v = f\lambda$, to determine the speed of the wave. However, some candidates did not score for the answer because they stated the answer in one significance figure, 0.8 m s^{-1}.

The performance of candidates in part (*c*)(i) was not satisfactory. Most candidates were not able to get the marks because they used resultant amplitude instead of resultant displacement in stating the principle of superposition. A large number of candidates also did not state the phrase *when two waves superpose/meet*.

In part (*c*)(ii), most candidates were able to deduce an equation for the standing wave formed when a given wave was reflected from a fixed end. There were some candidates who memorised the derivation from the books without applying the equation given in the question.

In part (*c*)(iii), most candidates were able to identify the amplitude in the standing wave equation. However, some candidates did not realise that kx was measured in the unit radians.

In part (*c*)(iv), most candidates were able to state that the minimum length for fundamental mode was half a wavelength and gave the correct answer. However, some candidates made a relation between the minimum wavelength to the fundamental mode of vibration and used the simple pendulum equation instead.

SEMESTER 3

Answers: (*b*) 0.80 m s^{-1}, (*c*)(iii) 0.0251 m; (*c*)(iv) 0.628 m

Question 19

In part (*a*), most candidates were able to state Huygen's principle as every point on a wavefront may be considered as a source of secondary wavelets that spreads out in forward directions with a speed equal to the speed of propagation of the wave. The new wavefront was given by the surface tangential to the secondary wavelets. Some candidates were not able to obtain full marks because they missed these two phrases; *in forward directions* and *same speed as the wave*.

In part (*b*)(i), most candidates were not able to sketch the wavefronts of the incident light correctly. Although most candidates were able to sketch the secondary wavelets produced by the double slits correctly, very few candidates were able to sketch the tangential new wavefronts to demonstrate Huygen's principle and its perpendicular line that leads to a bright fringe.

In part (*b*)(ii), most candidates were able to use the fringe separation formula $\Delta y = \frac{\lambda D}{a}$. However, there were candidates who interpreted the question differently, some calculated the distance between adjacent bright and dark fringes while an equal number of them thought it was the distance between the neighbouring bright fringes. There were also a significant number of candidates who calculated both bright-bright and dark-dark distances.

In part (b)(iii), almost all candidates were able to state that the fringe separation decreases when a shorter wavelength monochromatic source is used.

In part (b)(iv), most candidates realised that a phase shift of half a wavelength by one of the slits will produce a phase change of π radian. As a result, the original constructive interference will change into destructive interference and vice versa. Thus, the bright and dark fringes will interchange. Less than a quarter of the candidates were able to predict the pattern change. Among those who got the pattern change correct, only few were able to give a correct reason for it.

In part (b)(v), most candidates knew that water has a high refractive index than air and thus, the wavelength of light in water is shorter than its wavelength in air. As a result, the fringe separation decreases. A large number of candidates were able to arrive at the correct answer for the fringe separation. However, among them only about half were able to state that the wavelength of light in water is shorter.

Answer: (b)(ii) 0.0739 m

Question 20

In part (a)(i), most candidates were able to obtain two marks out of three marks. Most of them missed the keyword *high speed electrons* and *metal target*. The candidates should have understood that when high speed electrons bombard on the metal target, the electrons will undergo deceleration and will radiate part or all their kinetic energy as X-ray photons.

In part (a)(ii), most candidates were able to sketch typical X-ray spectra correctly. However, a large number of candidates did not label the axes of the graph correctly. A typical X-ray spectra is a graph of intensity against wavelength consisting of a continuous spectrum and a characteristic line spectrum. Some candidates also did not label continuous spectrum and the characteristic lines spectrum.

In part (b)(i), most candidates were able to determine the speed of electrons by equating the gain in kinetic energy and the work done by the electric field.

In part (b)(ii), most candidates knew that the minimum wavelength of X-ray is produced when all the kinetic energy of an electron is radiated as a single photon when the electron decelerates during collision with the anode target. Thus, they used the formula, $\lambda_{min} = \frac{hc}{eV}$.

In part (b)(iii), almost all candidates were able to apply the de Broglie hypothesis to determine the de Broglie wavelength of the accelerated electrons using the formula, $\lambda = \frac{h}{p}$.

Performance of candidates in part (c)(i) and (ii) was also very encouraging as majority of the candidates obtained maximum marks. The candidates were able to write the equations for the energy of photon and Bragg's law correctly and determine the energy of the X-ray photon and the inter lattice separation.

Answers: (b)(i) 8.38×10^{7} m s^{-1}, (b)(ii) 6.22×10^{-11} m, (b)(iii) 8.68×10^{-12} m; (c)(i) 7.10×10^{-16} J, (c)(ii) 6.73×10^{-10} m.

PAPER 960/5 *Written Practical Test*

Question 1

In part (*a*), almost all candidates were able to calculate power and $(\theta_2 - \theta_1)$ consistency with the significance figures.

In part (*b*), most candidates were able to determine the resistance of the coil by using the Ohms law or formula $P = I^2R$.

In part (*c*), most candidates were able to plot a graph of P against $(\theta_2 - \theta_1)$ with the correct labelled axes and units. The candidates also knew how to use a suitable scale and all the points were correctly plotted. Furthermore, some candidates were able to draw the best straight line through the plotted points.

In part (*d*), most candidates were able to calculate the gradient of the graph with triangle size covering more than $\frac{1}{3}$ of the graph paper. However, almost all candidates did not get full marks because of the incorrect significant figures or did not give any units.

In part (*e*), most candidates recognised that the gradient of the graph was equal to $\frac{mc_w}{t}$ and were able to calculate the specific heat capacity of water from part (*d*). However, there were some candidates who calculated c_w from the data in the table given and averaged the values. Although the values were in the correct range, they did not get any marks because they used the wrong technique.

In part (*f*), the candidates were able to comment that the value of c_w obtained in the experiment was higher than the expected value.

In part (*g*), the candidates were also able to explain the reason an insulation jacket was used in the experiment, which was to reduce heat loss to the surrounding through convection and radiation.

In part (*h*), most candidates were not able to explain why the heat absorbed by the apparatus was negligible in the experiment. They did not realise that at a steady state, all parts of the apparatus had a constant temperature. Therefore, the apparatus absorbed very little heat.

Answers: (*b*) 1.94 Ω, (*d*) 2.13 W $°C^{-1}$, (*e*) 4260 J kg^{-1} $°C^{-1}$.

Question 2

In part (*a*), most candidates were able to plot a graph of V against I correctly. The candidates were able to label the axes with the correct units. The candidates also knew how to use a suitable scale and all the points were correctly plotted. Most candidates were also able to draw a best-fit curve through the plotted points.

In part (*b*), the candidates were asked to calculate the gradient of the tangent of the graph at $V = 4.00$ V. Almost half of the candidates recognised that they first need to draw a tangent at the voltage in question and find the slope of that particular tangent. Many candidates just drew a straight line between the points and determined the slope of that line which was wrong.

In part (*c*), most candidates were able to state correctly that the resistance increased with voltage but were not able to provide reasons for their answers. The candidates should have observed that the gradient of the slopes increased with increase in voltages, which indicated the rise in the resistance.

In part (*d*), almost half of the candidates answered *yes* without giving any reasons, which was obviously wrong since the graph was not a straight-line graph.

In part (*e*), not many candidates were able to cite battery as one of the sources of error in the experiments.

In part (*f*), surprisingly not many candidates were able to suggest repeating the experiments several times and take the average as one of the procedures to improve the accuracy of the data.

In part (*g*), only a few candidates were able to give the correct answer why the ammeter should not be connected in series with the battery in this experiment. Many candidates were not aware that if the ammeter was connected that way, it would not measure the current through the bulb and thus, the resistance of the bulb could not be measured.

Answer: (*b*) 13.9 Ω

Question 3

In part (*a*)(i) and (*a*)(ii), most candidates were not aware that although most of the points did not lie on the graph, the experiment was considered accurate since they were not far off from the best-fit curve. Most candidates were able to observe that the graph was a straight-line graph but did not elaborate that the intercept of the curve was due to the end errors of the open pipe.

In part (*b*), most candidates were able to calculate the gradient of the graph with triangle size covering more than $\frac{1}{3}$ of the graph paper. However, almost all candidates did not get full marks because of the incorrect significant figures or did not give the correct units.

In part (*c*), most candidates did not calculate the value of v from the gradient of the graph using the expression, gradient = $\frac{2}{v}$, but rather extracted the corresponding value of $\frac{1}{f}$ associated with value l and used the equation $2f(l + 2c) = v$ to calculate v by assuming $c = 0$.

In part (*d*), most candidates were able to determine the intercept of the graph at the vertical axis with the correct accuracy. However, some candidates did not give the unit associated with it and therefore, did not get any marks.

In part (*e*), most of the candidates were not able to determine c since they were not able to associate the value of the intercept as equal to $\frac{4c}{v}$.

In part (*f*), not many candidates were able to analyse the effects of using a PVC pipe with a smaller diameter in the experiment correctly. Most candidates thought that the smaller pipe will increase v, which was wrong. In fact it will have a smaller end correction but softer resonance sound.

In part (*g*), most candidates were able to calculate the percentage of error for the value obtained in the experiment if the speed of sound in air is 340 m s^{-1}.

Answer: (*b*) 6.2×10^{-3} s m^{-1}, (*c*) 322.6 m s^{-1}, (*d*) 0.20 m s, (*e*) 1.61 cm, (*g*) 5.12%

Laporan Peperiksaan STPM 2018

LAPORAN PEPERIKSAAN STPM 2018 PHYSICS (960)

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