PHYSICS (960/1)

OVERALL PERFORMANCE

For Semester 1, 1 793 candidates sat for the examination of this subject and 59.12% 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	9.87	4.74	8.98	7.19	7.70	11.88	8.76	5.69	5.30	5.30	24.60

RESPONSES OF CANDIDATES

SECTION A: ***Multiple-Choice***

Answer Keys

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

General comments

More than 70% of the candidates answered Question 9 correctly. The rest of the questions were in the medium range with 30% to 70% of the candidates obtaining the correct answers.

SECTION 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. Candidates showed less ability in understanding physics concepts and explaining it in their own words.

Comments on the individual question

Question 16

In part (*a*), most candidates were able to calculate the time of flight of projectile *P* correctly. The candidates knew to make resolution of vector for trajectory *V* in component *x* as $s_x = u\cos 65t$ and substituted the value of s_x as 75 m.

In part (*b*), most candidates were able to determine the initial speed of projectile *Q*. Many candidates were able to express the equation for time of projectile *Q* using the horizontal motion equation and then substituted the equation for time into the vertical motion equation, $s_y = u_y t - \frac{1}{2}gt^2$, leaving $s_y = 0$. However, some candidates assumed that the time of flights for projectile *P* and projectile *Q* are the same, which was not true.

In part (*c*), most candidates were able to predict the most affected trajectory in the presence of air, but many of them were not able to state the reason behind it.

Answers: (*a*) 5.72 s, (*b*) 31 m s^{-1}

Question 17

In part (*a*)(i), most candidates were able to determine the temperature gradient along the rod using the equation $\frac{T_H - T_C}{\ell}$ and write the final answer with the correct unit.

In part (*a*)(ii), most candidates were able to determine the rate of heat flow in the rod using the formula, $H = kA\frac{T_H - T_C}{\ell}$. However, some candidates failed to understand that the rate of heat flow is a positive value.

In part (*b*), most candidates were able to mention that the heat was conducted through vibration and collision of atoms and diffusion of free electrons in the copper rod. However, common mistakes committed by candidates were using the term *particles* and *molecules* in the description. Besides, some candidates wrongly stated that collision between free electrons causes the transfer of heat. A handful of candidates used the term *electrons* rather than *free electrons* in their description.

Answers: (*a*)(i) 222 K m^{-1}; (ii) 10.7 W

Question 18

In part (*a*), most candidates were not able to correctly derive the equation of motion involving the tension of the string and the centripetal force. The centripetal force was given by $F_c = \frac{mv^2}{R}$ and the resultant force due to the tension of the string was $F = T - mg\cos\Theta$. However, some candidates were able to relate between the centripetal force and the resultant force due to the tension of the string as $T = m(\frac{v^2}{R} + g\cos\theta)$.

In part (*b*)(i), most candidates were able to write two equations, $T\cos 15° = mg$ and $T\sin 15° = \frac{mv^2}{r}$ from the Newton's second law. The candidates were also able to derive

equation, $\tan 15° = \frac{v^2}{rg}$, to determine the speed of the ball. However, half way through the calculation, some candidates failed to substitute the value of r = 1.5 sin15° into the equation to get the correct final answer.

In part (*b*)(ii), most candidates were able to get full marks in determining the centripetal acceleration using the formula $a_c = \frac{v^2}{r}$.

In part (*b*)(iii), most candidates were able to calculate the tension of the string using the equations $T \sin 15° = ma$ or $T \cos 15° = mg$.

In part (*c*), most candidates were not able to state the characteristics of centripetal force. Instead, most of the candidates stated the answer on how the centripetal force was formed.

Answers: (*b*)(i) 1.010 m s^{-1}; (*b*)(ii) 2.629 m s^{-2}; (*b*)(iii) 3.047 N

Question 19

In part (*a*), some candidates were able to get full marks by giving the meaning of the centre of gravity of an object. Some candidates lose marks due to wrongly using the term of *mass* instead of *weight* in their definition.

In part (*b*), most candidates were able to state the conditions for equilibrium of a rigid body correctly.

In part (*c*)(i), most candidates were not able to sketch all the forces that acted on the ladder correctly. Only a few candidates were able to sketch the normal force that acted on the ladder at the upper end and the two forces that act at the bottom of the ladder, which were the normal force that the floor acted on the ladder and the frictional force that acted between the ladder and the floor. Some candidates just labelled the weight of the ladder, forgetting to label the pushing force that the boy acted on the ladder.

In part (*c*)(ii), most candidates were not able to determine the forces exerted by the wall and the floor on the ladder correctly. This was due to the weaknesses of the candidates to sketch all the forces that acted on the ladder, which was in part (*c*)(i).

In part (*c*)(iii), most candidates were only able to write the formula of the frictional force as $f = \mu R$. They were not able to write the equation for moment of force to determine the length that could be climbed by the boy before the ladder slips.

Answers: (*b*)(ii) R_w = 319 N, F_v = 1030 N, F_w = 319 N and f = 319 N; (*b*)(iii) 13.4 m

Question 20

In part (*a*)(i), most candidates were able to state correctly the meaning of molar heat capacity at the constant pressure of an ideal gas.

In part (*a*)(ii), most candidates were able to use the molar heat capacities of hydrogen gas at constant pressure and at constant volume to determine the heat supplied and change in internal energy of gas. Then, the candidates used the first law of thermodynamics to determine the work done by the gas. Some candidates also applied the formula $W = p\Delta V$ and related it to the ideal gas equation $W = nR\Delta T$ to determine the work done by the gas.

In part (*b*), most candidates were able to explain the changes of the temperature in the system. The candidates related it with the adiabatic process, which was the changes of heat, $\Delta Q = 0$. Hence, the work done by the gas caused an increase in the internal energy of the gas molecules in the cylinder and caused the temperature of the gas molecules to increase.

In part (*c*), most candidates were able to sketch the thermodynamics processes involved in the *pV* graph. The processes involved were isobaric compression, isothermal expansion and isometric change.

In part (*d*)(i), most candidates were able to calculate the final volume of the gas by using the ideal gas equation and the concept of isothermal compression process.

In part (*d*)(ii), most candidates were able to calculate the work done by the gas using the equation $W = nRT\ln(\frac{V_2}{V_1})$ or $W = nRT\ln(\frac{P_1}{P_2})$. However, some candidates mistook the process as an adiabatic expansion and used the wrong equation to solve the question.

Answers: (*a*)(ii) 1008 J, (*d*)(i) 0.123 m^3; (*d*)(ii) 5498 J

PHYSICS (960/2)

OVERALL PERFORMANCE

For Semester 2, 1 772 candidates sat for the examination of this subject and 64.16% 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	11.17	6.88	5.87	6.04	13.32	12.75	8.13	5.59	5.36	5.47	19.41

RESPONSES OF CANDIDATES

SECTION A: ***Multiple-Choice***

Answer Keys

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

General comments

More than 70% of the candidates answered Question 4, 6, 14 and 15 correctly. The rest of the questions were in the medium range with 30% to 70% of the candidates obtaining the correct answers.

SECTION 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 wrongly by not converting the final answer to the correct significant figures. While for the sketching diagram, some candidates did not understand the concept of changing of the respective angles to the related physical quantities.

Comments on the individual questions

Question 16

In part (*a*), a few candidates were able to state the reason of the electric field of the parallel plate capacitor decreases when the dielectric was inserted. Most candidates stated using the formula of capacitance, which was not accepted. The candidates should understand the concepts of polarisation on the molecule of dielectric to give the reason in this question.

In part (*b*), most candidates were not able to determine the amount of charge, *Q*, in the capacitor. The candidates were not able to use the formula, $E_o = \frac{Q}{\varepsilon_o A}$, to determine *Q*. They just wrote the formula, $Q = CV$, but were not able to derive *C* and *V* to get the formula as $E_o = \frac{Q}{\varepsilon_o A}$.

In part (*c*), most candidates were not able to determine the dielectric constant of the dielectric. The candidates were not able to use the formula $\varepsilon_r = \frac{E_o}{E}$ or $C = \frac{\varepsilon_o \varepsilon_r A}{d}$ to get the final answer. Suprisingly, quite a number of candidates write the unit in the final answer which was wrong.

Answers: (*b*) 7.08 nC, (*c*) 3.6

Question 17

In part (*a*) most candidates were able to calculate the magnetic flux linkage using the formula, $\phi_B = NBA \cos \theta$, but did not continue their calculation to determine the changes of the magnetic flux using $\Delta\phi_B = -2NBA \cos 45°$.

In part (*b*), most candidates were able to calculate the e.m.f. induced in the coil. Majority of them were able to apply Faraday's law and Lenz's law and get the final answer correctly using the equation $\varepsilon = \frac{\Delta\phi_B}{\Delta t}$.

In part (*c*), most candidates were able to calculate the average current that flows through the coil using the formula $I = \frac{\varepsilon}{R}$.

Answers: (*a*) 7.1×10^{-4} Wb, (*b*) 7.1×10^{-3} V, (*c*) 1.34×10^{-5} A

Question 18

In part (*a*), most candidates were able to explain the mechanism of conduction of electric current in a metal, but some candidates lose marks because they used the term *electrons* instead of *free electrons*. Some candidates also lose mark by not explaining that the free electrons were accelerated with the presence of the electric field and free electrons moved with different velocities after colliding with ions, which produces drift velocity.

In part (*b*), most candidates were able to determine the current flows in the wire using the

formula of resistivity, $R = \frac{\ell}{\sigma A}$, conductivity, $\sigma = \frac{1}{\rho}$, and Ohm's law, $R = \frac{V}{I}$, to get the equation, $I = \frac{\sigma A V}{\ell}$.

In part (*c*), most candidates were able to calculate the drift velocity using the equation *I* = *nAve*. However, some candidates were not able to score full marks due to wrongly calculating the value of the number of charge carriers per unit volume, which could be calculated using the formula of density and the number of mole, that relates to Avogadro number.

Answers: (*b*) 0.57 A (*c*) 3.54×10^{-6} m s^{-1}

Question 19

In part (*a*), only a few candidates were able to derive the magnetic field at a point of distance *r* from the wire using the Ampere's law, $\oint B \bullet dl = \mu_o I$.

In part (*b*)(i), most candidates were not able to determine the magnitude of magnetic flux density at the midpoint between the straight current carrying conductors since the magnitude of the two wires should be added as $B_X = B_1 + B_2$. Some candidates only wrote the formula of the magnetic flux density as $B = \frac{\mu_o I}{2\pi r}$.

In part (*b*)(ii), most candidates were able to determine the magnitude of magnetic flux density at the centre of the coil using the formula, $B_Y = \frac{\mu_o N I}{2r}$.

In part (*c*), most candidates were able to sketch the graph of magnetic force, *F*, on the wire against angle, θ, between 0° to 180°. Most candidates knew the peak of the graph was at *F* = *IlB* and θ = 90°. However, some candidates sketched the sinusoidal graph, which was wrong.

In part (*d*), most candidates were not able to score full marks in calculating the current in the solenoid if the magnetic force is equal to its weight. Many candidates were rather weak in relating the formula of weight, formula of density, formula of volume, formula of force on the current carrying conductor in the magnetic field and formula of magnetic field of solenoid to show the final formula for current in the solenoid. The candidates were also not able to identify two types of current that flow in the wire using the formula *F* = *IlB* and current that flow in the coil due to the magnetic induction using formula $B=\mu_o n I_s$.

Answers: (*b*)(i) 1.6×10^{-5} T; (*b*)(ii) 2.5×10^{-5} T, (*d*) 5.5 A

Question 20

In part (*a*), the candidates had no problem in stating the difference between the direct current and the alternating current.

In part (*b*), most candidates were able to state at least one difference between resistance and reactance based on the dependence on frequency. Most of them lose marks, as they were

unaware that they need to state the differences between resistance and reactance in an alternating current circuit only. The candidates compared between resistance in direct current circuit and reactance in alternating current circuit. Quite a number of candidates gave definition for resistance and reactance using formula as one of the differences, which was not accepted. Only a minority of them was able to mention about the phase shift between voltage and current for reactance.

In part (*c*)(i), most candidates were able to determine the impedance in the circuit using the formula, $Z = \sqrt{R^2 + X_L^2}$. The candidates also had no problem to determine the value of reactance of the inductor using the formula, $X_L = 2\pi fL$, before substituting into the formula of impedance.

In part (*c*)(ii), most candidates were able to determine the root means square voltage across the inductor using $V_{rms} = I_{rms} X_L$.

In part (*c*)(iii), most candidates also were able to calculate the phase angle of the circuit using $\tan\theta = \frac{X_L}{R}$.

In part (*c*)(iv), most candidates were able to sketch the phasor diagram of the circuit correctly. However, a few candidates labelled *V* and *I* at the wrong position. This showed that the candidates did not know the voltage leads current in *RL* circuit.

Answers: (*c*)(i) 12.08 Ω; (*c*)(ii) 10.92 V; (*c*)(iii) 65.5^o

PHYSICS (960/3)

OVERALL PERFORMANCE

For Semester 3, 1 758 candidates sat for the examination of this subject and 59.79% 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	9.10	5.80	4.04	8.82	9.39	11.26	11.38	6.09	2.62	5.29	26.22

RESPONSES OF CANDIDATES

SECTION A: ***Multiple-Choice***

Answer Keys

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

General comments

All the questions were in the medium range with 30% to 70% of the candidates obtaining the correct answers. Only Question 2 was very difficult for the candidates to answer with less than 30% of the candidates answering it correctly.

SECTION 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 the individual questions

Question 16

In part (*a*), most candidates were able to determine the distance of the formed image by refraction at spherical surface using the formula $\frac{\eta_1}{u}+\frac{\eta_2}{v}=\frac{\eta_2-\eta_1}{r}$. However, the candidates were not able to score full marks because they were not able to state the position of the formed image. They did not realise that the negative value means the virtual image and the position should be at the same side with the object.

In part (*b*), most candidates were not able to sketch the correct ray diagram from the principal axis that showed the formation of the image. A few candidates drew a vertical arrow object and sketched ray diagram based on the vertical object drawn, not based on the object on the principal axis given in the question. A few candidates also did not draw an arrow on the light rays which was not accepted. However, some candidates were able to score one mark because they knew the light incident ray from air to glass was refracted towards the normal line.

In part (*c*), most candidates were able to determine the distance of the formed image by reflection using the formula $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$. However, the candidates mistakenly substituted the value of *f* neither positive nor 15 cm in the calculation and gave the wrong final answer. Most candidates were also not able to state the position of the formed image which should be at the opposite side of the spherical surface.

Answers: (*a*) −11.3 cm, (*c*) −3.33 cm

Question 17

In part (*a*), most candidates were not able to give the reason for the difference of mass of the nucleus of helium which is less than the total mass of two protons and two neutrons. Only good candidates were able to state that energy was required to separate the nucleus into its individual nucleon.

In part (*b*), most candidates were not able to calculate the mass loss for the reaction. The candidates wrongly wrote the formula as the formula of mass defect or mass of products minus mass of reactants.

In part (*c*), most candidates were able to calculate the required energy in Joule that enables the reaction to occur using the formula $E = \Delta mc^2$. However, some candidates gave the answer in MeV which was not required by the question because they used the direct conversion from mass in u to eV.

In part (*d*), most candidates were able to determine the minimum speed of the nucleus of helium that enables the reaction to occur using the formula of kinetic energy, $E=\frac{1}{2}mv^2$. However, some candidates wrongly used the mass in unified atomic mass, u, and not in kg causing them to get the wrong final answer.

Answers: (*b*) -1.228×10^{-30} kg, (*c*) 1.106×10^{-13} J, (*d*) 5.77×10^{6} m s^{-1}

Question 18

In part (*a*), most candidates were able to describe the propagation of sound waves in air. They were able to state that sound wave is a longitudinal wave. However, some candidates repeated the explanation of longitudinal wave as the direction of particles vibrate is parallel to the direction of wave propagation and not given the description of compression and rarefaction, causing them to lose mark.

In part (*b*)(i), most candidates were not able to derive the expression for the frequency of the string when the string vibrates at the fundamental mode correctly. They were able to write the formula $v = f\lambda$. Some candidates left the equation as $f = \frac{v}{2L}$ without substituting the velocity of the string as $v = \sqrt{\frac{T}{M}}$. Some candidates mistakenly took *M* as mass of the string, and not mass per unit length as stated in the question. Thus, the final expression for the frequency became $f = \frac{1}{2L}\sqrt{\frac{TL}{M}}$.

In part (*b*)(ii), a few candidates were able to sketch the shape of the string for the second overtone and determine the distance between two consecutive nodes in terms of the fundamental wavelength. Some candidates wrongly sketched the shape for the first overtone, but they were able to state the distance between two consecutive nodes as $\frac{\lambda}{2}$. Candidates who managed to solve the distance between two consecutive nodes left their final answer in fraction as $\frac{\lambda_o}{6}$ rather than solve the fraction properly.

In part (*c*)(i), most candidates were able to determine the frequency of the siren heard by the passengers in the bus using the formula $f' = \left(\frac{V + V_o}{V - V_s}\right) f_s$. However, there were some candidates who were not able to differentiate between the source and the observer, causing the formula to be used wrongly and led to the wrong answer. There were a few candidates who mistakenly wrote the equation as $f' = \left(\frac{V - V_s}{V}\right) f_s$.

In part (*c*)(ii), most candidates were not able to determine the wavelength of the sound waves reflected by the bus and heard by the ambulance driver correctly. Most candidates used the correct formula, $v = f\lambda$, but substituted the wrong value of frequency, either the actual frequency of the siren or the apparent frequency heard by the bus passengers.

In part (*c*)(iii), most candidates were able to state the change in the frequency heard by the passengers of the bus after the ambulance overtook the bus as frequency heard was decreased. However, some candidates calculated the frequency and did not write the final answer as decrease or any word equivalent to decrease.

Answer: (*b*)(ii) $0.167\lambda_o$, (*c*)(i) 1100 Hz; (*c*)(ii) 0.266 m

Question 19

In part (*a*)(i), most candidates were not able to sketch the graph to show the variation of light intensity with distance from the central fringe on the screen correctly. The candidates were not aware that the intensity of the pattern was almost constant. So, most candidates wrongly sketched the graph by showing the pattern of a single slit diffraction.

In part (*a*)(ii), most candidates were able to determine the frequency of the light which passes through the slits using the formula $f = \frac{c}{\lambda}$. Most candidates also knew how to use the formula $y_m = \frac{m\lambda D}{d}$ to determine the wavelength of the light. However, some candidates were not aware that the order was the second order, m = 2. A few candidates also made the mistake of doing early round off on the intermediate value in their calculation.

In part (*a*)(iii), most candidates were able to determine the path difference between the light that arrived at *B* from the two slits. The candidates knew for the dark fringes, the path difference is $\delta = \left(m - \frac{1}{2}\right)\lambda$. Some candidates who managed to use the correct equation made mistakes such as substituting the incorrect value of m, using incorrect value of λ, or leaving the final answer in terms of λ.

In part (*b*)(i), most candidates were not able to calculate the wavelength of the light within the thin soap film using the formula $n = \frac{c}{v}$. Some candidates mistakenly assumed that the refractive index is directly proportional to wavelength. Some candidates were also not aware that for refraction, frequency of the wave is constant.

In part (*b*)(ii), most candidates were not able to calculate the minimum thickness of the thin soap film that produces a constructive interference for the reflected light. Some candidates used the path difference $\Delta = (m \pm \frac{1}{2})\lambda$, and substituted the wrong value of m causing them to lose mark.

Answers: (*a*)(ii) 5.18×10^{14} Hz; (a)(iii) 8.694×10^{-7} m, (*b*)(i) 440 nm; (*b*)(ii) 110 nm

Question 20

In part (*a*), most candidates were able to explain the production of the continuous spectrum in X-rays correctly but most candidates were not able to explain the production of the characteristic line spectrum correctly. The candidates wrongly explain the production of characteristics line spectrum as the excitation process in a nucleus causing them to lose marks. A few candidates did not use the correct terms in describing the process such as stating that the electrons in the inner shell ejected to the higher level instead of knocked out after being bombarded by high speed electrons from the cathode.

In part (*b*), most candidates were able to determine the shortest X-ray wavelength using the relationship $eV = \frac{hc}{\lambda}$. Some candidates did not know that the electric potential energy is equal to eV and mistakenly used kinetic energy equal to electrical energy causing them to lose marks.

In part (*c*), most candidates were able to determine the spacing of the crystal planes using the equation $2d\sin\theta = m\lambda$. Some candidates made mistakes in the calculation by calculating $\sin\theta$ in radian, and rounding off the final answer in the wrong significant figures.

In part (*d*), most candidates were not able to compare the X-ray spectra if a higher potential difference is used with the aid of a graph. The candidates did not label the axis of the graph properly. Some candidates just sketched the continuous spectrum curve without showing the characteristic line spectrum. Some candidates were also not able to write the comparison of the spectra correctly.

Answers: (*b*) 4.14×10^{-11} m, (*c*) 1.699×10^{-10} m

PAPER 960/5 (WRITTEN PRACTICAL TEST)

Comments on the individual questions

Question 1

In part (*a*), most candidates were not able to calculate the corresponding values of f and f^2 of the different radius r. Thus the candidates were not able to complete the table.

In part (*b*), most candidates were able to plot the graph of f^2 against $\frac{1}{r}$ with incorrect calculated data from the table in (*a*). The axes of the graph were correctly labelled with units and suitable scale. The candidates were also able to draw a best straight line through the plotted points.

In part (*c*)(i), most candidates were able to state the reason of obtaining the mean time for each 20 revolutions as inconsistency in the speed of the rubber stopper.

In part (*c*)(ii), almost all candidates were able to state the type of error as random error.

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 also able to calculate the mass of the rubber stopper using $\text{gradient} = \frac{Mg}{m\left(4\pi^2\right)}$.

In part (*e*), most candidates were able to state the factors that may cause the result of the experiment to be less accurate as difficult to maintain the same speed of the rubber stopper, the string was not horizontally swung and the string may be extended while swung.

Answers: (*d*)(i) 0.710 $s^2\,m^{-1}$; (*d*)(ii) 0.0350 kg

Question 2

In part (*a*), most candidates were able to calculate the mean value of $T_{\frac{1}{2}}$ with the correct significant figures.

In part (*b*), most candidates were able to plot a graph of $T_{\frac{1}{2}}$ against *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 (*c*), most candidates were able to determine the resistance of resistor after the capacitor is discharge to half of the initial charge by showing on the graph the value obtained.

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*)(i), only a few candidates were able to state the effect of the resistance of voltmeter to the measurement of $T_{\frac{1}{2}}$.

In part (*e*)(ii), most candidates were not able to suggest a way to minimise the effect of resistance in the voltmeter.

In part (*f*), most candidates were able to state the precaution that should be taken in the experiment as the capacitor should be fully discharged each time before recharged to the initial voltage and used the stable power source.

Answers: (*c*)(i) 4.35 kΩ, (*d*)(i) 2.39 ms Ω^{-1}; (*d*)(i) 3.30 mF

Question 3

In part (*a*), most candidates were able to calculate the value of A_n with the correct significant figure, but not able to calculate the value of $\ln A_n$.

In part (*b*), most candidates were not able to plot the graph of $\ln A_n$ against *n* because of the incorrect value of $\ln A_n$.

In part (*c*), most candidates were also not able to describe a procedure to improve the accuracy of x_n.

In part (*d*)(i), most candidates were not able to determine the gradient of graph correctly and hence in part (*d*)(ii), the candidates were not able to determine the value of the damping factor, *b.*

In part (*e*), not many candidates were able to explain the reason of using softer spring that could increase the accuracy of the experiment.

Answers: (*d*)(i) 0.34; (*d*)(ii) 21 g s^{-1}