Physics (960)

OVERALL PERFORMANCE

The number of candidates for this subject was 3469. The percentage of candidates who obtained a full pass was 75.06%, which indicated an increase of 1.61% compared to the results of the previous year.

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

Grade	A	A–	B+	B	B–	C+	C	C–	D+	D	F
Percentage	6.71	6.68	8.93	10.62	12.58	15.21	14.33	4.09	5.1	3.69	12.06

RESPONSES OF CANDIDATES

PAPER 960/1 (MULTIPLE-CHOICE)

Keys

Question number	Key	Question number	Key	Question number	Key
1	B	18	B	35	A
2	D	19	C	36	A
3	B	20	D	37	C
4	C	21	C	38	D
5	C	22	D	39	B
6	A	23	C	40	A
7	D	24	A	41	A
8	A	25	C	42	B
9	D	26	C	43	A
10	C	27	D	44	B
11	C	28	A	45	D
12	B	29	A	46	D
13	C	30	D	47	B
14	A	31	D	48	D
15	B	32	A	49	D
16	C	33	A	50	B
17	B	34	B		

General comments

The mean score was 24.72 and the standard deviation of the scores was 8.94. More than 70% of candidates answered questions 1, 6, 8, 25, 32, 37, 43 and 46 correctly. Question 9, 14, 19, and 29 were very difficult for candidates, with less than 30% of candidates answering correctly. The rest of the answers fell in the medium range with 30% to 70% of candidates obtaining correct answers.

PAPER 960/2 (STRUCTURE AND ESSAY)

General comments

Generally, the qualitative questions did not require much planning of the question paper as candidates were able to present the answer in a proper manner, while for quantitative questions candidates lacked proper planning in presenting their answers. The majority of candidates tend to shorten their answers by writing keywords only or listing out points with no details of explanation or elaboration. The overall performance of candidates was average with a mean of 40.93 and a standard deviation of 20.00.

Comments on the individual questions

Question 1

In part (*a*)(i), most candidates knew how to use the equation $v^2 = u^2 + 2as$ to determine the speed of the stone. However, nearly all the candidates did not use the coordinate system in solving kinematics problems. They wrongly substituted the sign for a and s in the equation as positive instead of negative.

In part (*b*), similar weaknesses were reflected in this section where candidates knew that they had to use the equation $v = u + at$ to determine the time taken for the stone to reach the ground, but wrongly substituted the sign for a.

Answers: (*a*) 41.87 m s^{-1}; (*b*) 6.72 s

Question 2

In part (*a*), the understandings of concept about damping among candidates were weak. Most candidates did not realise that: in under damping, the system is oscillating with decreasing amplitude; in critical damping, the system returns to the equilibrium at the shortest possible time; and in over damping, the system returns to its equilibrium in longer time.

In part (*b*), most candidates failed to state an example for the application of critical and over damping.

Question 3

In part (*a*) and (*b*), most candidates found this part relatively easy. The majority of candidates were able to give the formula and substitute the values correctly. However, some candidates did not understand the concept of relative motion between sound and source and between sound and observer. Hence, they wrongly substituted the sign for velocity.

Answers: (*a*) 552 Hz; (*b*) 520 Hz

Question 4

In part (*a*) and (*b*), most candidates were able to state the meaning of *ideal gas* and conditions under which a real gas can be approximated to an ideal gas.

In part (*c*), most candidates used the formula $pV = nRT$ to calculate the pressure of the ideal gas. However, some candidates failed to convert the temperature from °C to K and gave the answer to more than four significant figures.

Answer: (*c*) 5.804×10^4 Pa

Question 5

In part (*a*) and (*b*), most candidates gave the answer correctly as they understood the concept of capacitors in series and parallel based on the relationship $Q \propto C$.

Answers: (*a*)(i) 350 μC, (ii) 200 μC; (*b*) 5.75 V

Question 6

In part (*a*), surprisingly more than 95% of the candidates did not know the equation for a transformer. They used the equation for constant resistance $\frac{V_1}{I_1} = \frac{V_2}{I_2}$ instead of preserving power input equals to power output, $V_1I_1 = V_2I_2$, to calculate the current in the transmission line.

In part (*b*), most candidates did not use the formulae $P = I^2R$ and % Power loss = $\frac{\text{Power loss}}{\text{Power output}} \times 100\%$ to determine the power loss from the transmission line.

Answers: (a) 2.0 A; (*b*) 0.033 %

Question 7

In part (*a*), many candidates were unable to distinguish between excitation energy and ionisation energy of a hydrogen atom. They failed to mention excitation energy is the energy required to excite an electron from lowest energy state to higher energy state while ionisation energy is the energy required to move an electron from ground state to infinity.

In part (*b*)(i), most candidates were able to determine the energy of the photon correctly.

In part (*b*)(ii), most candidates knew how to use the formula $\Delta E = \frac{hc}{\lambda}$ to calculate the wavelength of the photon emitted. A few candidates made the mistake of not converting the energy from eV to J.

Answers: (*b*)(i) 12.1 eV, (ii) 103 nm

Question 8

In part (*a*) and (*b*), only a few candidates were able to answer this part well. Most candidates were not able to relate $N_0 = nN_A$ instead they used the molar mass $m = 222$ and were confused between activity with number of nuclides present.

Answers: (a) 5.72×10^{16} s^{-1},

(b) 116 days/1.002×10^7s

Question 9

In part (*a*)(i), almost all candidates were unable to define restoring force and state the restoring force in the system correctly.

In part (*a*)(ii), many candidates mentioned that the spring constant as the contributor to the restoring force instead of the tension in the spring or weight of the mass.

In part (*b*)(i), many candidates were unable to state the expressions for the tension *P* and *Q*. They used *e* as the symbol for extended length instead of relating to the question $(x_0 - l)$ and $(x - l)$.

In part (*b*)(ii), only the candidates who were able to answer part (*b*)(i) correctly were able to deduce the angular frequency as $\omega^2 = \frac{k}{m}$.

In part (*c*), most candidates were able to apply the correct formula for natural frequency as $f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$. However, they failed to calculate the mass of the copper atom *m* and thus, failed to get the correct answer for the spring constant *k*.

Answer: (*c*) 41.3 N m^{-1}

Question 10

In part (*a*)(i), the performance of the candidates was excellent. Most of them obtained full marks in determining the position, size of the image and nature of the image of the concave mirror.

In part (*a*)(ii), most candidates were able to sketch a ray diagram to show the formation of the image. The common mistake made by the candidates was not drawing arrows on the rays in the ray diagram.

In part (*b*), most candidates were able to write the refraction formula as $\frac{n_1}{u} + \frac{n_2}{v} = \frac{n_2 - n_1}{R}$. However, candidates were confused in using the sign convention as normally they were given the object placed on the left side of the boundary, but in the given diagram the object was on the right side of the boundary. What the candidates should do was to define the *x*-axis pointing to the left, so the standard of the sign convention would be as the usual.

In part (*c*), the performance of the candidates was unsatisfactory. Most candidates did not realise that the reflection by the spherical mirror occurred first before the refraction by the glass bowl. Most candidates used the image of refraction in part (*b*) as the object for reflection by the spherical mirror. Thus candidates were not able to determine the location of the final image.

Answers: (*a*)(i) v = 13.3 cm, h_i = 1.66 cm; (*b*) −18.8 cm; (*c*) −12.6 cm

Question 11

In part (*a*)(i) and (ii), most candidates failed to explain the elastic and plastic deformation in terms of molecular behaviour of matter. They focussed only on the object returned to its original size or shape rather than the molecules or atoms returned to their original position.

In part (*b*)(i), (ii) and (iii), many candidates who attempted this question obtained high marks.

In part (*b*)(iv), however, most candidates were not able to proceed with their calculation to solve the problem to find the energy of the plastic strain. Only a handful of candidates were able to states that the energy of the plastics strain was equalled to the area under the graph.

Answers: (*b*)(i) 1.529×10^8 N m^{-2}, (ii) 9.172×10^{10} N m^{-2}, (iii) 0.15 J, (iv) 0.10 J

Question 12

In part (*a*), most candidates were able to explain the meaning of peak value as maximum value of a.c., but they failed to explain the meaning of *r.m.s. value*.

In part (*b*), almost all candidates were able to derive an expression for peak voltage as $V_0 = \sqrt{2PR}$.

In part (*c*)(i), most candidates obtained the correct expression for V as $V = L\omega I_0 \cos(\omega t)$. However, they wrongly put the negative sign instead of positive sign, and got mixed up between the back e.m.f. and the voltage across the inductor.

In part (*c*)(ii), most candidates were not able to derive an expression for the reactance instead they just quoted that $X_L = \omega L$.

In part (*c*)(iii), most candidates did not have problem sketching the phasor diagram of V and I in the circuit. Some candidates also sketched the sinusoidal graph of V and I against time which was accepted as an answer.

In part (*c*)(iv), candidates did well in this part using the correct formula $V_{r.m.s.} = IX_L$ to solve the problem.

Answer: (*c*)(vi) 20.42 V

Question 13

In part (*a*)(i), most candidates were able to state V_0 as the stopping potential, but they failed in explaining its existence.

In part (*a*)(ii), almost all candidates were able to sketch the new curve of graph I against V if the same monochromatic light of higher intensity was used. However, they were not able to explain the shape of the curve drawn.

In part (*a*)(iii), most candidates were able to explain microscopically the photoelectric effect if monochromatic light of higher frequency was used. However, a few candidates mentioned that photons energy was increased. They went straight to photo currents.

In part (*b*)(i), most candidates were able to obtained full marks for calculating the number of photons per second that cross any section of the beam by using the formula $P = \frac{nhc}{\lambda}$.

In part (*b*)(ii), most candidates were just able to write the formula of the pressure exerted as $P = \frac{F}{A}$, but they were not able to proceed with their calculation to solve the problem. Candidates also failed to relate pressure to the change of momentum per unit area.

Answers: (b)(i) 3.88×10^{18}, (ii) 7.07×10^{-4} N m^{-2}

Question 14

In part (*a*), a few candidates were able to define mass defect and nuclear binding energy correctly. However, they failed to mention that energy is required to *separate completely* the nucleon in the nucleus. Some even mentioned that energy is required to break the nucleus completely.

In part (*b*), most candidates were able to sketch the shape of the graph correctly, but they did not use the graph to explain a fusion reaction. Some candidates sketched the graph starting from the origin which was wrong. The most common mistake made by the candidates was using the terms small nucleus to form bigger nucleus instead of lighter nuclei to form heavier nuclei.

In part (c)(i), some candidates did not know the symbol for tritium and deuterium. The energy Q was also missing from the equation and thus, they were unable to calculate the binding energy for each of the deuterium, tritium and helium nuclei.

In part (c)(ii), a majority of candidates were able to answer this part satisfactory. However, those who answered correctly made a mistake by giving the answer to more than four significant figures.

In part (c)(iii), most candidates did not do well for this part. They made a mistake of not subtracting the mass of electron from the given mass since the atomic mass was given not the mass of nucleus.

In part (c)(iv), many candidates did not know that they had to calculate the binding energy per nucleon for each nuclide to be used as a reason in determining the most and the least stable nuclides.

Answers: (c)(ii) 17.59 MeV; (iii) 2.26 MeV, 8.477 MeV, 28.30 MeV

PAPER 960/4 (WRITTEN PRACTICAL TEST)

General comments

In general, most candidates still faced problems extracting information from a graph for analysis and not consistently using SI units when calculating values in an equation containing several variables. However, candidates showed an improvement in plotting a graph by using proper scales and axes.

Comments on the individual questions

Question 1

In part (a), most candidates were able to calculate the value of initial velocity u, final velocity v and acceleration a correctly. However, when tabulating these values, they did not convert the values to the SI unit, and failed to record the values in the proper significant figures.

In part (b), most candidates were able to plot the graph of a against W from the data that they had tabulated in (a) correctly with the proper scales and axes and managed to obtain and draw a straight line curve.

In part (c)(i), most candidates knew that they had to use more than half of the data set in determining the gradient of the graph. However, most candidates failed to read the data according to the precision of the axes and were not able to calculate the gradient with the correct significant figures and unit.

In part (c)(ii), most candidates failed to recognise that the mass of the vehicle was the reciprocal of the gradient and very few candidates were able to give the answer to the correct significant figures and unit.

In part (d), most candidates were able to give the correct sources of error as friction and values of vehicle length ℓ and distance s.

In part (e), very few candidates were able to give reasonable suggestions on how to improve the accuracy of the experiment.

In part (f), most candidates were able to give the correct prediction for the acceleration a of the vehicle as gravitational acceleration when the mass of the slotted weight was very much larger than that of the vehicle.

Answers: (c)(i) 6.56 kg^{-1}; (c)(ii) 0.152 kg

Question 2

In part (*a*), very few candidates were able to state the reason why a few drops of oil were dripped into the hole in the aluminium cylinder before the thermometer was inserted which was to ensure good thermal contact between the thermometer and the block of aluminium.

In part (*b*), most candidates knew that the purpose of insulation and using insulating board was to prevent heat lost from the aluminium cylinder to the atmosphere.

In part (*c*), very few candidates were able to understand the situation why the beginning part of the graph was not linear.

In part (*d*)(i), most candidates were able to determine the gradient of the linear part of the graph in the heating process.

In part (*d*)(ii), however, most candidates failed to recognise that from the equation $\theta = \frac{P}{mc}t + \theta_0$, the gradient of the graph θ against t was equivalent to $\frac{P}{mc}$. Thus, they were not able to determine the specific heat capacity of aluminium c.

In part (*e*), most candidates were not able to explain the reasons why the specific heat capacity of aluminium in (*d*)(ii) was different from the actual value which was due to cooling and thus, lowered the maximum temperature obtained.

In part (*f*)(i), most candidates were able to give the correct maximum temperature and thus, in part (*f*)(ii), they also were able to calculate the new value of specific heat capacity of aluminium using the correct maximum temperature in (*f*)(i) and the equation $\theta = \frac{P}{mc}t + \theta_0$.

In part (*g*), most candidates were able to give the reasonable answer as to what will happen to the results if the aluminium cylinder was not insulated at all.

Answers: (*d*)(i) 0.20 °C s^{-1}, (*d*)(ii) 1000 J kg^{-1} $°C^{-1}$; (*f*)(i) 83°C, (*f*)(ii) 909 J kg^{-1} $°C^{-1}$