EUNOIA JUNIOR COLLEGE

General Certificate of Education Advanced Level
Higher 2

PHYSICS

9646

SUGGESTED SOLUTIONS

October/November 2013

Paper 1
Multiple Choice

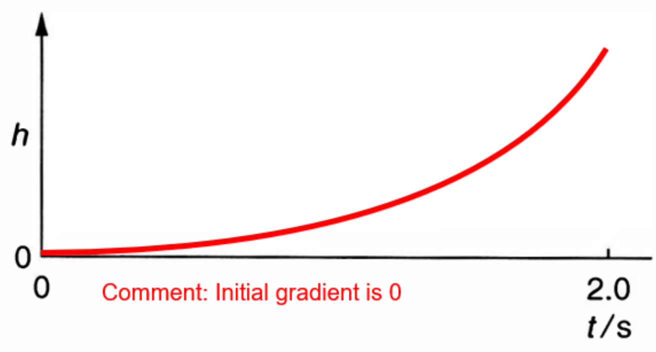
Question	*Key*	*Question*	*Key*
1	**A**	21	**B**
2	**C**	22	**B**
3	**A**	23	**C**
4	**D**	24	**B**
5	**C**	25	**A**
6	**B**	26	**A**
7	**A**	27	**D**
8	**D**	28	**A**
9	**C**	29	**A**
10	**A**	30	**B**
11	**B**	31	**A**
12	**D**	32	**A**
13	**A**	33	**B**
14	**A**	34	**B**
15	**D**	35	**B**
16	**C**	36	**C**
17	**C**	37	**B**
18	**C**	38	**B**
19	**B**	39	**C**
20	**A**	40	**D**

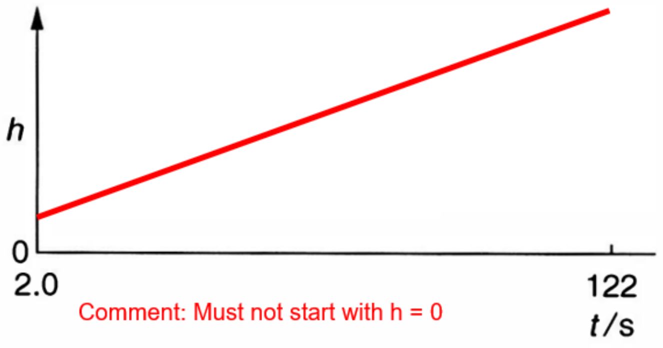
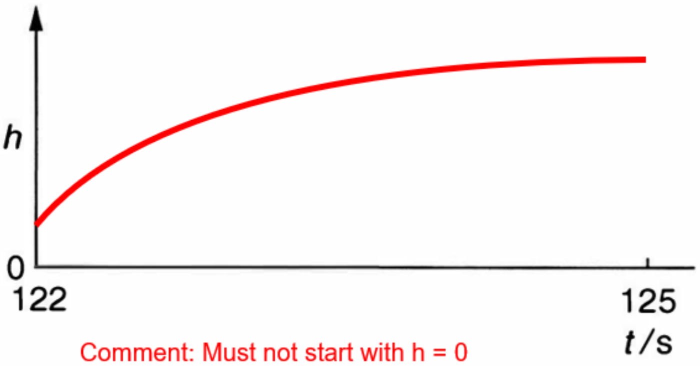
Notes

Q17: The mass at the end is 0.4 of the mass at the beginning, so 0.6 of the initial mass escapes. The equation $pV=nRT$ needed to be used throughout.

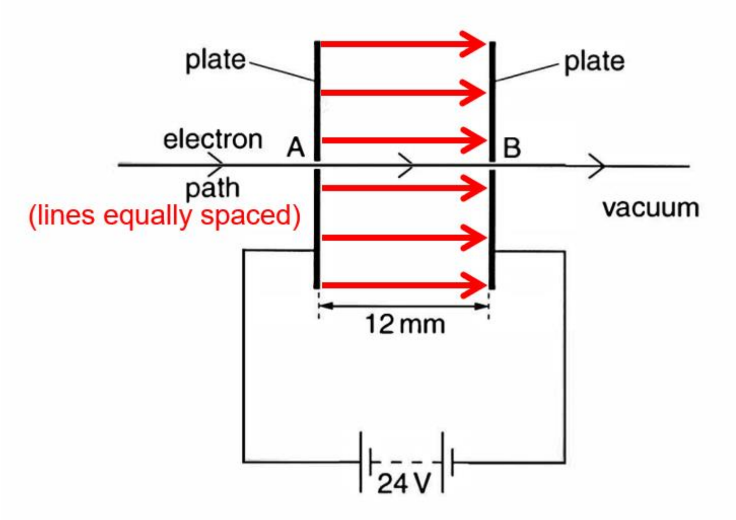
Q27: Most candidates chose option B, 12 ohms, indicating, perhaps that these candidates took into account the increase in resistance either as a result of the increase in length or the decrease in width, but not both.

Paper 2
Structured Questions

Qns		Marks
1(a)	$s = ut + ½ at^2$ $= 0 + ½ (1.5)(2^2) = 3.0$ m height = s (sin 40°) = 1.9 m	**M1** **M1** **A1**
1(b)(i)	a = 0 Resultant Force = 0 N = mg = (95)(9.81) = 930 N	**A1**
1(b)(ii)	Man has zero acceleration and hence experienced no resultant force. Since there are only 2 forces, the normal contact force must be of the same magnitude as weight.	**A1**
1(c)(i)	Three forces: normal contact force, weight, and friction of ground on man. Note: Existence of friction between man and the floor of the cable car was rarely mentioned. Some common errors include erroneous additional quantities such as air resistance and driving force.	**A1**
1(c)(ii)	Horizontal frictional force will cause the man to accelerate horizontally. The normal contact force is larger in magnitude than the man's weight, resulting in a vertical acceleration. The resultant force causes the man to accelerate upwards along the cable.	**A1** **A1**
1(d)	Distance moved during deceleration, s, $s = ½ (v + u)t = ½ (0 + 3.0) (3) = 4.5$ total distance moved in direction of motion = 3.0 + (3.0 x 120) + 4.5 = 367.5 m vertical distance travelled = 367.5(sin 40°) = 236 m Gain in potential energy = mgh = (95)(9.81)(236) $= 2.2 \times 10^5$ J	**M1** **M1** **A1**
1(e)(i)	 Comment: Initial gradient is 0	**A1**

Qns		Marks
1(e)(ii)	 Comment: Must not start with h = 0	**A1**
1(e)(iii)	 Comment: Must not start with h = 0	**A1**
2(a)	Product of force and the time duration of the impact. Comment: Some answers were unacceptable as definition because the wording given was imprecise, for example, impulse was defined as the force acting for or over a certain period of time.	**B1**
2(b)(i)	Magnitude of change in momentum, Δp = Area of inverted triangle = $\frac{1}{2}(0.32)(0.50)$ = 0.080 N s $\Delta p = m(\Delta v) \rightarrow \Delta v = \frac{\Delta p}{m} = \frac{0.080}{0.150} = 0.53\ \mathrm{ms}^{-1}$	**C1** **C1** **A1**
2(b)(ii)1.	Force increases at a uniform rate in the negative direction. Velocity decreases at an increasing rate from 0.267 ms^{-1} until it comes to a rest at t = 0.50 s	**B1** **B1**
2(b)(ii)2.	Force increases at a uniform rate in the positive direction. Velocity increases from rest at a decreasing rate until it reaches 0.267 ms-1 in the negative direction.	**B1**
3(a)(i)	Resultant force, of constant magnitude, acting on object must point in a direction that is perpendicular to the direction of motion of the object towards a centre. Notes: It is insufficient to mention only the centripetal force without addressing the resultant force.	**A1**

Qns		Marks
3(a)(ii)	Acceleration is the rate of change of velocity with respect to time. Velocity is vector quantity. Here, it has constant magnitude but changing direction.	**A1**
3(b)(i)	Gravitational force acting on object provides the centripetal force necessary for the object to move in a circular motion $F_G = F_c \rightarrow \frac{GMm}{r^2} = \frac{mv^2}{r}$ $r = \frac{GM}{v^2} = \frac{(6.67 \times 10^{-11})(6 \times 10^{24})}{2500^2} = 6.4 \times 10^7 \text{ m}$ Note: Must mention gravitational force provides the centripetal force.	**M1** **C1** **A1**
3(b)(ii)1.	Potential energy of satellite, *U*, decreases. $U = -\frac{GMm}{r}$. When *r* is smaller, *U* becomes more negative, *U* decreases.	**A1**
3(b)(ii)2.	Kinetic energy of the satellite, E_k increases. $E_k = \frac{GMm}{2r} = -\frac{1}{2}U$. When *r* is smaller, E_K increases.	**A1**
4(a)	The internal energy of a substance is the sum of the kinetic energy due to the random motion of the molecules and potential energy due to intermolecular forces of attraction Note: Examiners deem "**sum"** and "**random**" as key words to the definition.	**A1**
4(b)(i)	$pV = nRT = \frac{M_{total}}{m_{molar}}RT$ $M_{total} = \frac{pVm_{molar}}{RT} = \frac{(10^5)(0.075)(0.030)}{(8.314)(25 + 273.15)}$ $= 0.091 \text{ kg}$	**C1** **C1** **A1**
4(b)(ii)	The oven is not air-tight but has constant volume. Some air leaves the oven when heated. $pV = nRT \rightarrow pV = \frac{M_{total}}{m_{molar}}RT \rightarrow pV = \frac{\rho V}{m_{molar}}RT \rightarrow \frac{pm_{molar}}{R} = \rho T$ $\frac{\rho_{25}}{\rho_{200}} = \frac{200 + 273.15}{25 + 273.15} = 1.59$	 **C1** **A1**

Qns		Marks
5(a)	 Notes: Must use ruler to construct the field lines. Field lines must touch the plates and have even spacing between them to demonstrate a constant field.	A1
5(b)(i)	$F = QE = Q\left(\frac{\Delta V}{d}\right) = (1.6 \times 10^{-19})\left(\frac{24}{12 \times 10^{-3}}\right)$ $= 3.2 \times 10^{-16}\ \mathrm{N}$	C1 A1
5(b)(ii)	$W = Fd = (3.2 \times 10^{-16})(12 \times 10^{-3}) = 3.8 \times 10^{-18}\ \mathrm{J}$	A1
5(b)(iii)	$Initial\ KE = E = \frac{1}{2}mv_i^2 = \frac{1}{2} \times 9.11 \times 10^{-31} \times (4.5 \times 10^6)^2$ $= 9.22 \times 10^{-18} J$ Electron slows down as it moves from A to B due to repulsion $Final\ KE = 9.22 \times 10^{-18} - 3.8 \times 10^{-18} E = 5.38 \times 10^{-18} J$ $speed = \sqrt{\frac{2E_K}{m}} = \sqrt{2 \times 5.38 \times \frac{10^{-18}}{9.11} \times 10^{-31}} = 3.44 \times 10^6$	M1 M1 A1
6(a)	Emission of electrons from a cold metal surface when electromagnetic radiation of sufficiently high frequency falls on it.	B1

<table>
<tr><th>Qns</th><th></th><th>Marks</th></tr>
<tr><td>6(b)</td><td>Electrons near the surface of the metal need to be supplied with a minimum amount of energy to overcome work-function energy before they can be removed from the surface.

Photons must transfer this minimum amount of energy to these electrons for them to be removed. So these photons must possess this minimum amount of energy.

Photon energy is given by product of Planck constant and frequency $E = hf$. Photons with this minimum amount of energy must have a minimum frequency, hence photons must have frequency above this threshold frequency for the photoelectric effect to take place.

Note: Candidates generally quoted the Einstein photoelectric equation but did not always mention that hf was the energy of a photon. Many answers omitted the term photons or work-function energy.</td><td>B1

B1

B1</td></tr>
<tr><td>7(a)</td><td>-190 $^{\circ}$C to 10 $^{\circ}$C, R increases linearly with θ. R reaches a peak of 2080 Ω at 15 $^{\circ}$C.

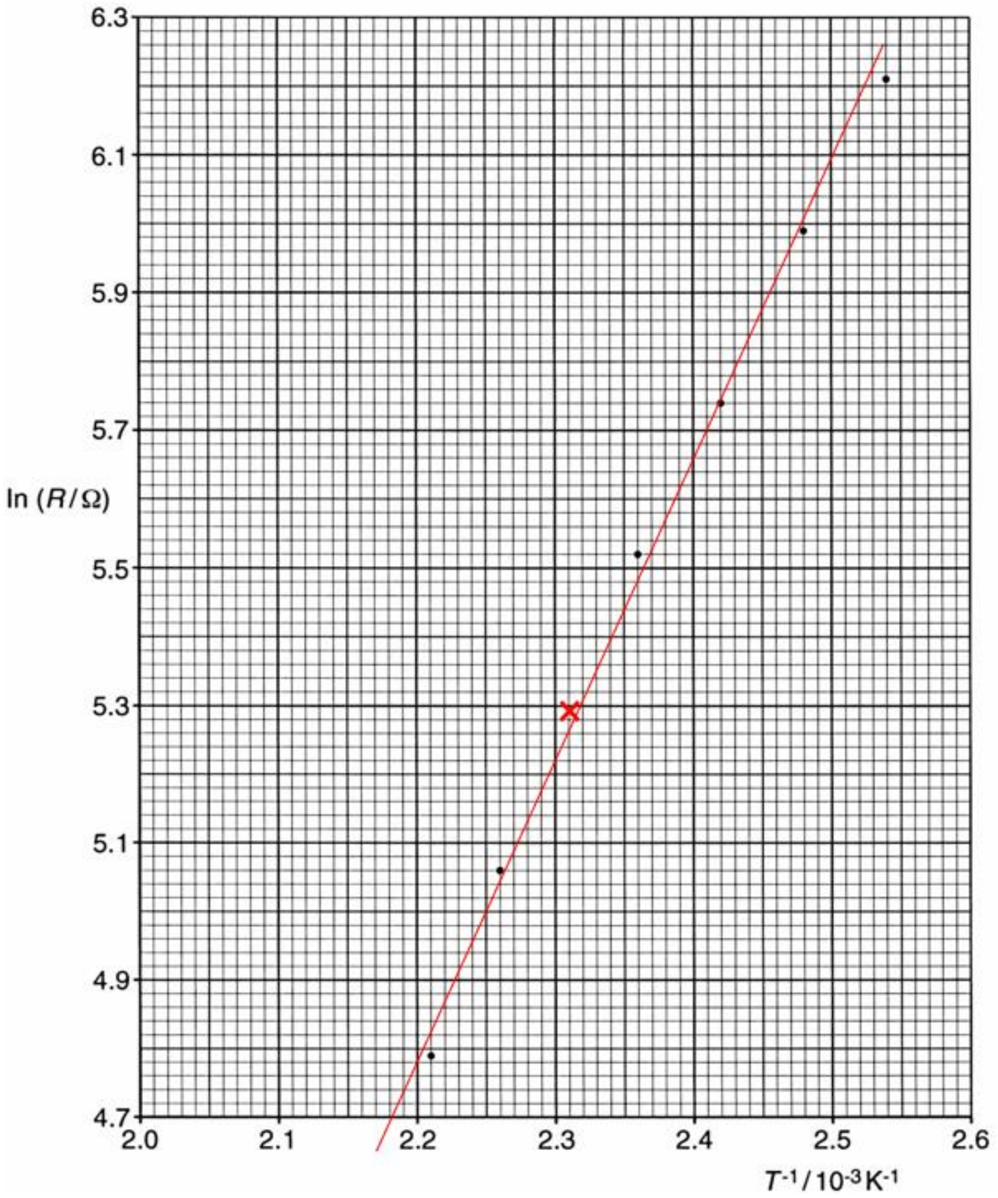
15 $^{\circ}$C to 40 $^{\circ}$C, R decreases at an increasing rate with θ. 40 $^{\circ}$C to 100 $^{\circ}$C, R decreases linearly with θ. 100 $^{\circ}$C to 200 $^{\circ}$C, R decreases at a decreasing rate with θ.</td><td>B1

B1</td></tr>
<tr><td>7(b)</td><td>when $R = 1780\ \Omega$, $\theta = 50°\text{C}$, so $1780 \times 50 = 89\ 000$

when $R = 240\ \Omega$, $\theta = 150°\text{C}$, so $240 \times 150 = 36\ 000$

since the product of $R\theta$ is not the same, R is not inversely proportional to θ</td><td>M1

A1</td></tr>
<tr><td>7(c)(i)</td><td>
<table>
<tr><th>R/Ω</th><th>$\theta/°\text{C}$</th><th>$T^{-1}/10^{-3}\text{K}^{-1}$</th><th>$\ln(R/\Omega)$</th></tr>
<tr><td>500</td><td>120</td><td>2.54</td><td>6.21</td></tr>
<tr><td>400</td><td>130</td><td>2.48</td><td>5.99</td></tr>
<tr><td>310</td><td>140</td><td>2.42</td><td>5.74</td></tr>
<tr><td>250</td><td>150</td><td>2.36</td><td>5.52</td></tr>
<tr><td>200</td><td>160</td><td>2.31</td><td>5.30</td></tr>
<tr><td>158</td><td>170</td><td>2.26</td><td>5.06</td></tr>
<tr><td>120</td><td>180</td><td>2.21</td><td>4.79</td></tr>
</table>
</td><td>A1</td></tr>
</table>

Qns		Marks
7(c)(ii)		**A1**
7(d)(i)	$R = Ae^{\frac{E_g}{2kT}}$ $\ln R = \frac{E_g}{2k}(T^{-1}) + \ln A$ (Linearization) The proposal is true if a graph of ln(*R*) against T^{-1} is linear. The graph of ln(*R*) against T^{-1} shown in Fig. 7.3 is linear for θ above 100°C. This supports the proposal.	**M1** **A1**

Qns		Marks
7(d)(ii)1.	Gradient = $\frac{\Delta y}{\Delta x} = \frac{6.10-5.00}{(2.500-2.250)\times 10^{-3}}$ $= 4400$ $E_g = 2k(4400) = 2(1.38 \times 10^{-23})(4400) = 1.21 \times 10^{-19}\text{ J} = 0.76\text{ eV}$	**M1** **M1** **A1**
7(d)(ii)2.	$5.00 = \ln A + 4400(2.250 \times 10^{-3}) \rightarrow A = 0.0074\ \Omega$	**A1**
7(e)	n-type semiconductor is doped with impurity that has donor energy level just below conduction band. There is a much greater increase in mobile charge carriers (electrons) in conduction band and hence lower resistance in a n-type semiconductor as compared to an intrinsic semiconductor at any temperature.	**A1** **A1**
7(f)	As temperature increases, <u>no change in the number of mobile charge carriers</u> (electrons), but there is an increase in lattice ion vibration. Resistance increases with rise in temperature	**A1**

<table>
<tr><th>Qns</th><th></th><th>Marks</th></tr>
<tr><td>8</td><td>

Variables
θ as independent variable
R as dependent variable
Keep length of wire constant

Measurements
Labelled diagram of apparatus: wire in oil bath or oven or beaker with water and source of heat.
Circuit diagram to measure resistance.
Use thermometer to measure the temperature of wire/oil/oven. (Could be on diagram if labelled.)
Method to determine resistance from circuit, e.g. read off ohmmeter/$R = V/I$
Method to determine R_0 e.g. use ice-water mixture.
Do not allow ice (allow ice at 0 °C or melting ice).

Data

<table>
<tr><td>R against θ</td><td>R/R_0 against θ</td><td>θ against R</td></tr>
<tr><td>α = gradient / R_0</td><td>α = gradient</td><td>$\alpha = 1/(R_0 \times \text{gradient})$
$\alpha = -1/(\text{y-intercept})$</td></tr>
</table>

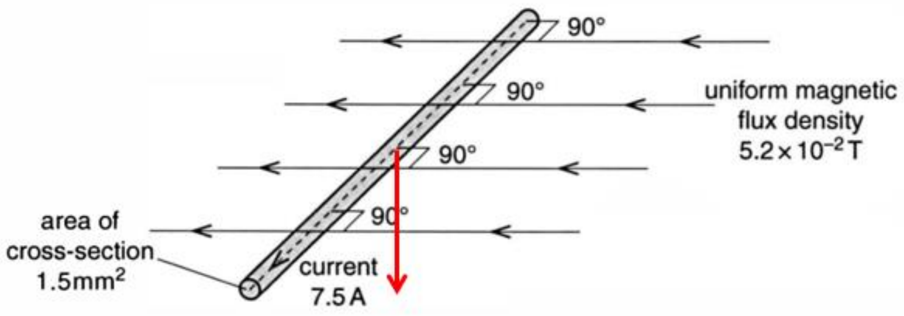
Safety
Reasoned method to prevent injury from hot water/hot wire e.g. gloves (to prevent injury) from hot water/wire; goggles to prevent splashes from hot water; do not touch hot wire/beaker.

Additional detail
Use long/thin wire to increase resistance
Stir liquid
Wait for temperature to stabilise
Relationship is valid if straight line, provided plotted graph is correct
Relationship is valid if straight line not passing through origin, provided plotted graph is correct (any quoted expression must be correct, e.g. y-intercept = R_0)
Use small current to minimise heating effect

</td><td></td></tr>
</table>

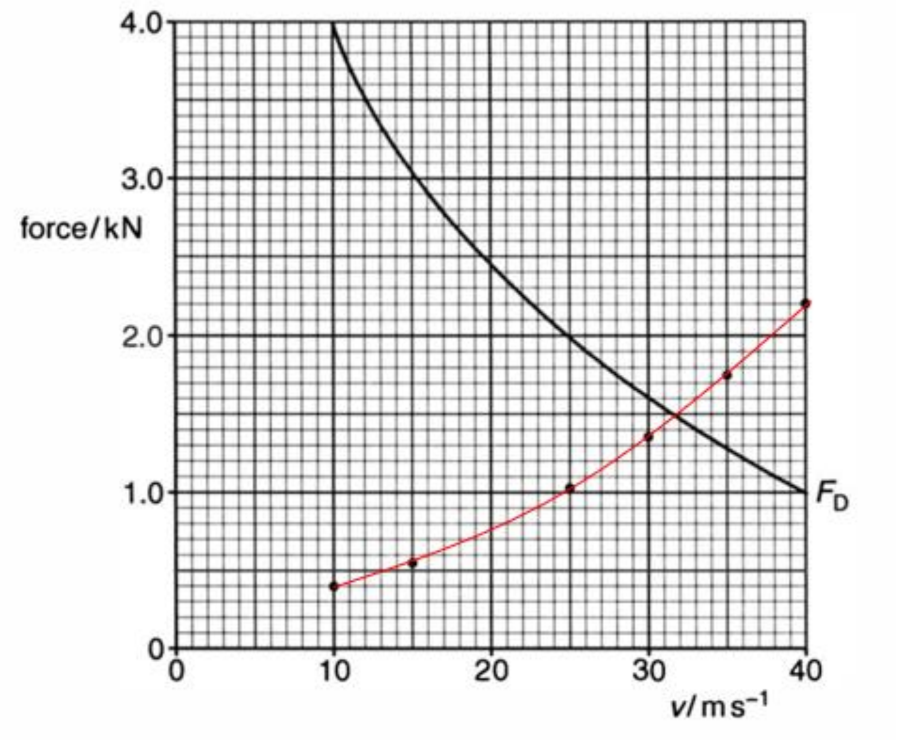
Paper 3
Longer Structured Questions

Qns		Marks
1(a)	Work done per unit mass in bringing a small test mass from infinity to that point.	**B1**
1(b)	Loss in gravitational potential energy of rock = Gain in kinetic energy of rock $0-\left(-\frac{GM_{Mars}m_{rock}}{r}\right)=\frac{1}{2}m_{rock}v^2$ $v=\sqrt{\frac{2GM_{mars}}{r}}=\sqrt{\frac{2(6.67\times10^{-11})(6.4\times10^{23})}{\frac{1}{2}(6.8\times10^{3}\times10^{3})}}$ = 5010 m s^{-1} Notes: Candidates were expected to explain their work in terms of changes in potential energy and in kinetic energy. Merely writing $E_P = E_K$ is not enough of an explanation of method.	**M1** **A1**
1(c)(i)	$\frac{3}{2}kT=\frac{1}{2}m<c^2>\rightarrow\ T=\frac{1}{3}\frac{m}{k}<c^2>=\frac{4u<c^2>}{3k}$ $=\frac{4(1.66\times10^{-27})(5010^2)}{3(1.38\times10^{-23})}=4030\text{ K}$	**M1** **A1**
1(c)(ii)	Yes. Surface temperature of Mars is similar or lower than Earth's 300 K. Hence, there is insufficient ambient temperature for helium-4 to escape which requires 4030 K to do so.	**A1** **A1**
2(a)(i)	From Fig. 2.2, the power dissipated in the resistor when $R = 4.0\ \Omega$ is 9.0 W Since the resistor is in series with the battery, current in the circuit, I, = current in the resistor. $P_R = I^2R \rightarrow I=\sqrt{\frac{P_R}{R}}=\sqrt{\frac{9}{4}}=1.5\ A$	**M1** **M1**
2(a)(ii)	$P_T = 13.5\text{ W for }R = 4.0\ \Omega$ $P_T = IE \rightarrow E=\frac{P_T}{I}=\frac{13.5}{1.5}=9.0\text{ V}$	**M1** **A1**
2(b)(i)	Power dissipated by internal resistance of battery Note: Incorrect to say power dissipated by battery or wires.	**A1**

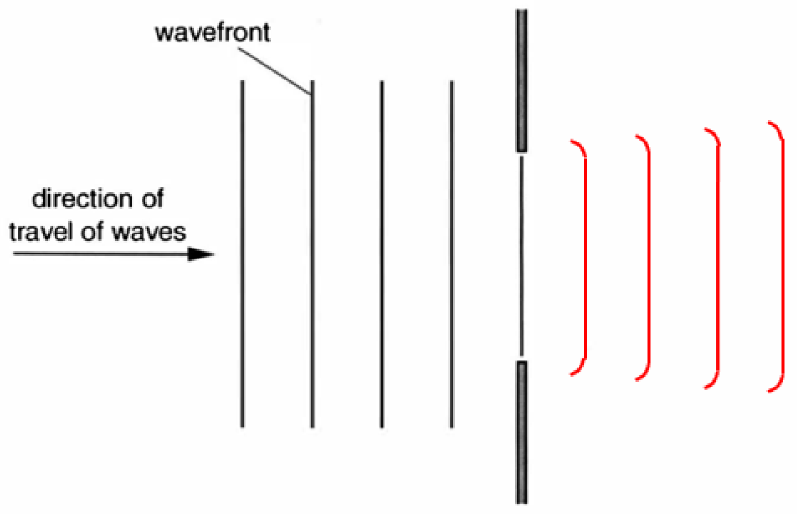
Qns		Marks
2(b)(ii)	$E = I(R + r) \rightarrow r = \frac{E}{I} - R$ $r = \frac{9}{1.5} - 4 = 2.0\ \Omega$	**M1** **A1**
2(c)(i)	2.0 Ω	**A1**
2(c)(ii)	$\frac{P_R}{P_T} \times 100\% = \frac{2}{4} \times 100\% = 50\%$	**A1**
2(c)(iii)	As resistance increases from 4 to 10, efficiency of power transfer increases.	**A1**
3(a)(i)	 Note: A ruler should always be used to draw a straight line.	**A1**
3(a)(ii)	$F = BIL \sin\theta$ $\frac{F}{L} = BI \sin 90° = (5.2 \times 10^{-2})(7.5)$ $= 0.39\ \text{Nm}^{-1}$	**M1** **A1**
3(b)(i)	Total number of electrons per unit length of wire = (number of free electrons per unit volume)(volume of a unit length of wire) $= (7.8 \times 10^{28})[1.5 \times (10^{-3})^2] = 1.17 \times 10^{23}$ Force on each electron = (total force)/(total number of electrons) $= \frac{0.39}{1.17 \times 10^{23}} = 3.3 \times 10^{-24}\ \text{N}$ Note: This is an example where candidates are expected to derive a given result. Questions of this sort require an explanation of the working presented.	**M1** **A1**

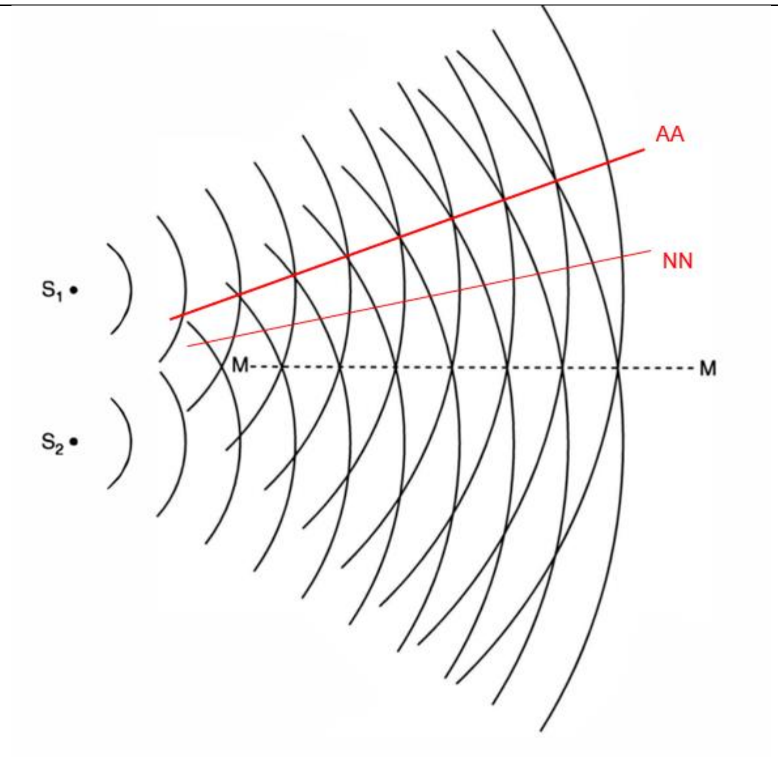
Qns		Marks
3(b)(ii)	$F = Bqv$ $v = \frac{F}{Bq} = \frac{3.3 \times 10^{-24}}{(5.2 \times 10^{-2})(1.6 \times 10^{-19})}$ $= 4.01 \times 10^{-4}\ \text{ms}^{-1}$	M1 A1
3(c)	Free electrons are uniformly distributed in the wires. When switch is closed, battery produces an electric field through the wire. All electrons including those near the lamp, move simultaneously. Hence lamp is lit almost immediately. Note: The basic concept is that the electric field in the wire, produced by the battery, would cause all the electrons to move almost simultaneously.	A1 A1
4(a)	Induced *e.m.f.* in a conductor *is directly proportional* to the rate of change of magnetic flux linkage.	A1 A1
4(b)(i)	r.m.s. output voltage = $\frac{9.0}{\sqrt{2}}$ $\frac{N_P}{N_S} = \frac{V_P}{V_S} \rightarrow N_P = N_S\left(\frac{V_P}{V_S}\right) = 260\left(\frac{240}{\frac{9}{\sqrt{2}}}\right)$ $= 9800$	M1 M1 A1
4(b)(ii)	An input current sets up a magnetic field in the primary coil. This forms a magnetic flux linkage at the secondary coil. The magnetic flux linkage at the secondary coil is in phase with the current and p.d from the primary coil. According to Faraday's law, the *e.m.f* at the secondary coil is directly proportional to the rate of change of magnetic flux linkage. The induced emf is not in phase with the input potential difference. The output potential difference is given by the induced *e.m.f.* Hence the output potential difference **is not in phase** with the input potential difference. Note: This question asked candidates to compare the phase of the input and output potential difference, but in most of the incorrect answers, the word phase was not used or included. Very few candidates referred to the rate of change of flux in the core giving rise to the output *e.m.f.*	B1 B1 A1

Qns		Marks
5(a)(i)	$E = \frac{hc}{\lambda}$ $\lambda = \frac{hc}{E} = \frac{(6.63 \times 10^{-34})(3 \times 10^{8})}{4.53 \times 10^{-14}}$ $= 4.39 \times 10^{-12}$ m	 M1 A1
5(a)(ii)	$p = \frac{h}{\lambda} = \frac{6.63 \times 10^{-34}}{4.39 \times 10^{-12}}$ $= 1.51 \times 10^{-22}$ Ns	M1 A1
5(b)	The initial total momentum of the nucleus is zero. By Principle of Conservation of Momentum, the nucleus must move in the opposite direction because the photon has momentum and the net external force is zero.	B1 B1
6(a)(i)	Draw the line of best fit Points (0.20, 0.60) and (1.38, 0.96) lie on the line of best fit. Gradient $= \frac{\Delta y}{\Delta x} = \frac{0.96 - 0.06}{1.38 - 0.20} = 0.762 \text{ ms}^{-2}$ Since $s = ut + \frac{1}{2}at^2 = 0 + \frac{a}{2}t^2$ (Correct substitution) $a = 2(0.762) = 1.52 \text{ ms}^{-2}$	M1 M1 M1 M1 A1
6(a)(ii)1.	Data points are scattered about the line of best fit.	A1
6(a)(ii)2.	Line of best fit does not pass through the origin.	A1
6(a)(iii)	Best fit line is the weighted average of the data points and compensates for random errors which can be both over and under estimates of the true value.	A1
6(b)(i)	$F_R = 280 + 1.2v^2 = 280 + 1.2(20^2) = 760$ N	A1

Qns		Marks
6(b)(ii)		**A1**
6(b)(iii)1.	Maximum speed is when the driving force is equal in magnitude to the resistive force. The point of intersection in the 2 graphs is $v = 31.5\ \mathrm{ms}^{-1}$ (Required to explain answer)	**M1** **A1**
6(b)(iii)2.	$P = F_D v = \|F_R\| v = (1.5 \times 10^3)(31.5)$ $= 47.3 \times 10^3 \mathrm{W}$	**M1** **A1**
6(b)(iii)3.	Read off graph, F_R = 750 N Net force $F_{net} = ma = F_D - F_R$ $a = \frac{F_D - F_R}{m} = \frac{2.45 \times 10^3 - 750}{950} = 1.79\ \mathrm{ms}^{-2}$	**M1** **M1** **A1**
6(c)	There is a component of weight which acts down the slope that acts in the opposite direction of the driving force. For the same power output of the car, the driving force must be larger, to equal the vector sum of the component of weight down the slope and the resistive force. The driving force is inversely proportional to the maximum speed possible.	**M1** **M1** **M1**

Qns		Marks
7(a)	Vertical upward force exerted by the surrounding fluid when a body is submerged in a fluid. It is due to the difference in pressure exerted by the fluid at the top and bottom surfaces of the submerged body.	**B1** **B1**
7(b)	pressure at bottom surface $p_{bottom} = h\rho g + p_{atm}$ pressure at liquid surface $p_{surface} = p_{atm}$ Difference in force exerted $F = \Delta p(A) = h\rho gA$ Since tube is floating, magnitude of weight is same as magnitude of force acting on tube bottom: $mg = h\rho gA$ $\therefore m = h\rho A$	**M1** **M1** **A1**
7(c)(i)	The magnitude of acceleration *a* is directly proportional to magnitude of displacement from the equilibrium position *x* with the constant of proportionality being $\left(\frac{\rho Ag}{m}\right)$. The acceleration *a* is in the opposite direction to displacement from equilibrium position *x* denoted by the negative sign.	**B1** **B1** **B1**
7(c)(ii)	by comparing $a = -\omega^2 x$ with $a = -\left(\frac{\rho Ag}{m}\right)x$ $\omega = 2\pi f = \sqrt{\frac{\rho Ag}{m}}$ $f = \frac{1}{2\pi}\sqrt{\frac{\rho Ag}{m}}$ $= \frac{1}{2\pi}\sqrt{\frac{(1.0\times10^{3})(4.2\times10^{-4})(9.81)}{32\times10^{-3}}} = 1.8\text{ Hz}$	**M1** **M1** **A1**
7(d)(i)1.	period of oscillation = 0.5000 s frequency $f = \frac{1}{T} = \frac{1}{0.5000} = 2.000\text{ Hz}$	**M1** **A1**

Qns		Marks
7(d)(i)2.	$\sqrt{\frac{\rho_{new}}{\rho_{old}}} = \frac{f_{new}}{f_{old}}$ $\rho_{new} = \rho_{old}\left(\frac{f_{new}}{f_{old}}\right)^2 = (1.0 \times 10^3)\left(\frac{2}{1.8}\right)^2$ $= 1.23 \times 10^3 \text{ kg m}^{-3}$	**C1** **A1**
7(d)(ii)1.	The water waves formed due to the oscillating cylinder transports energy away from the oscillating system. Damping occurs. Fluid friction acts over the submerged surfaces of the tube when there is relative motion between tube and fluid. Work is done against dissipative force of fluid friction, removes energy from oscillating system. Note: Challenging question for most students. Many referred to friction or viscous forces without giving any information as to where these forces act. Some thought that upthrust would act as a dissipative force.	**A1** **A1**
7(d)(ii)2.	$\Delta E = E_{t=0} - E_{t=1}$ $= \frac{1}{2}m\omega^2 x_0^2 - \frac{1}{2}m\omega^2 (x_0')^2 = \frac{1}{2}m\left(\frac{2\pi}{T}\right)^2 (x_0^2 - (x_0')^2)$ $= \frac{1}{2}(32 \times 10^{-3})\left(\frac{2\pi}{0.5000}\right)^2 (10^{-4})(1.50^2 - 0.85^2)$ $= 0.000386 \text{ J}$	**C1** **C1** **A1**
8(a)(i)	 (No observable diffraction since the slit width >> wavelength) **4 wavefronts must be clearly drawn**	**A3**

Qns		Marks
8(a)(ii)	More circular wavefronts, centred on gap Larger angle of spreading	**A1** **A1**
8(b)(i)	Coherent sources **emit waves** that have a **constant phase difference**	**A1** **A1**
8(b)(ii)	 AA – Crest meets Crest NN – Crest meets Trough	**A1** **A1**
8(c)(i)	fringe separation = 1.3 mm, $x = \frac{\lambda D}{a}$ so, $\lambda = \frac{ax}{D} = \frac{(1.3\times10^{-3})(1.2\times10^{-3})}{247\times10^{-2}}$ $= 6.3 \times 10^{-7}\text{m}$	**C1** **C1** **C1** **A1**
8(c)(ii)	D must be much larger than a (> 1000 times)	**A1**
8(c)(iii)1.	Dark fringe is now brighter Bright fringe is less bright	**A1** **A1**
8(c)(iii)2.	The bright fringes become less bright. More fringe patterns appears	**A1** **A1**
8(c)(iii)3.	*D* and hence fringe separation no longer constant. Fringe separation changes linearly with *D*. (smaller *D*, smaller separation and brighter fringes and vice versa)	**A1** **A1**