Name of the Student:_____
Max. Marks : 24 Marks **Time : 24 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable answers		Additional guidance	Mark
(i)	• Use of $V = {}^{Q}/_{4\pi\varepsilon_0 r}$	(1)	Example of calculation 7.30×10^{-13} J = $\left(\frac{8.99\times10^{9}\text{Nm}^2\text{C}^{-2}\times79\times1.6\times10^{-19}\text{C}}{r}\right)\times2\times1.6\times10^{-19}\text{C}$ $r = 4.98 \times 10^{-14}$ m	4
	• Identifies number of (positive) charges for alpha or gold nucleus	(1)		
	• Use of $W = VQ$	(1)		
	• $r = 5 \times 10^{-14}$ m so textbook statement is correct **Or** $V = 7.27 \times 10^{-13}$ J so textbook statement is correct (MP4 dependent on MP1)	(1)		
(ii)	• Use of $E_k = \frac{p^2}{2m}$	(1)	Accept Use of $Ek = \frac{1}{2}mv^2$ and $p = mv$ Example of calculation 7.30×10^{-13} J $= p^2/2 \times 4 \times 1.66 \times 10^{-27}$kg $p = 9.9 \times 10^{-20}$ kg m s^{-1}	3
	• Converts atomic mass to kg	(1)		
	• $p = 9.9 \times 10^{-20}$ kg m s^{-1}	(1)		

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
	The only correct answer is B A is not the correct answer, as this is a correct equation of motion in the vertical plane. C is not the correct answer, as this is a correct equation of motion in the vertical plane. D is not the correct answer, as this is a correct equation of motion in the vertical plane. .		1

Q3.

Question Number	Acceptable answers		Additional guidance	Mark
(i)	• Use of $E = V / d$	(1)	Example of calculation 3×10^6 V m^{-1} = V / 0.002 m V = 6000 V	2
	• V = 6000 V	(1)		
(ii)	• (A spark is) a current (drawn from the supply)	(1)	Accept "lost volts" are present/increases	3
	• A potential difference is produced across the internal resistance of the supply	(1)	Accept reduces the terminal potential difference which is shown on the voltmeter	
	• According to $V = E - Ir$ V decreases **Or** (the decrease in V) is large because the internal resistance is large	(1)		

Q4.

Question Number	Acceptable answers		Additional guidance	Mark
	Either • j has units A m^{-2}	(1)		4
	• E has units V m^{-1} or N C^{-1}	(1)	Example: Units of $\frac{E}{j} = \frac{\text{Vm}^{-1}}{\text{Am}^{-2}} = \Omega\text{m}$ and these are the units of ρ	
	• ρ has units of Ω m	(1)	**Or** find agreements for both sides using options shown below:	
	• Algebra to show units the same on both sides	(1)	Units of $\frac{E}{j}$ are $\frac{\text{N C}^{-1}}{\text{Am}^{-2}} = \frac{\text{Nm}^2}{\text{AC}} = \frac{\text{Jm}}{\text{AC}} = \frac{\text{kgms}^{-2}\,\text{m}^2}{\text{A}^2\text{s}} = \frac{\text{kgm}^3\text{s}^{-3}}{\text{A}^2}$	
	Or If formulas have been used:		Units of $\rho = \Omega\text{m} = \frac{\text{V}}{\text{A}}\text{m} = \frac{\text{Nm}^2}{\text{CA}} = \frac{\text{Jm}}{\text{CA}} = \frac{\text{kgms}^{-2}\text{m}^2}{\text{A}^2\text{s}} = \frac{\text{kgm}^3\text{s}^{-3}}{\text{A}^2}$	
	• Substitution using $\rho = RA/l$	(1)		
	• Substitution using $E = V/d$	(1)		
	• Substitution using $R = V/I$	(1)		
	• The equations above and $j = I/A$ need to be rearranged and simplified with Ω (or R) appearing on either side	(1)		

Q5.

Question Number	Answer	Mark
	D	1

Q6.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An explanation that makes reference to the following points: • The potential difference creates an electric field • An (electric) field/force does work on the electrons (increasing their kinetic energy) **Or** an (electric) field/force accelerates the electrons (increasing their velocity) (1) (1)		2

Q7.

Question Number	Answer		Mark
	Use of $F_E = kQ_1Q_2/r^2$	(1)	
	Use of $W = mg$	(1)	
	Resolve vertically $T\cos\theta = mg$ **and** Resolve horizontally $T\sin\theta = F_E$	(1)	
	Attempt to combine components to give tan θ ($\tan\theta = F_E/mg$)	(1)	
	$\theta = 41°$ to $42°$	(1)	
	$T = 0.035$ N	(1)	
	Or		
	Use of $F_E = kQ_1Q_2/r^2$	(1)	
	Use of $W = mg$	(1)	
	Use of Pythagoras to find tension force	(1)	
	Tan $\theta = F_E/mg$ **Or** $\cos\theta = mg/T$ **Or** $\sin\theta = F_E/T$	(1)	
	$\theta = 41°$ to $42°$	(1)	
	$T = 0.035$ N	(1)	**6**
	(if they halve the separation or halve the electric force they can still get MP1 and so could score MP1,2, 3 & 4)		
	Example of calculation		
	Weight of sphere = 0.0027 kg × 9.81 N kg^{-1} = 0.026 N		
	Electric force $F_E = kQ_1Q_2/r^2$		
	= 8.99 ×10^{9}N m^2 C^{-2} × (4.0 × 10^{-7} C)^2 / 0.25^2 m^2 = 0.023 N		
	Vertically $T\cos\theta = mg$		
	Horizontally $T\sin\theta = F_E$		
	Tan $\theta = F_E/mg$ = 0.023 N/ 0.026 N		
	$\theta = 41°$		
	sub into vertical equation		
	$T = mg/\cos\theta$ = 0.026 N /cos 41		
	$T = 0.034$ N		

Q8.

Question Number	Answer	Mark
	C	**1**