Name of the Student:_____
Max. Marks : 18 Marks **Time : 18 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable answers	Additional guidance	Mark
(i)	• Vrms = 3.5 V (1)	Example of calculation $V_{rms} = \frac{5}{\sqrt{2}} = 3.54$ V	1
(ii)	An explanation that makes reference to the following points: • "5" is the peak value (of pd) (1) • Use of $T = 1/f$ **Or** $\omega = 2\pi/T$ **Or** $\omega = 2\pi f$ (1) • Uses $\omega = 100\pi$ to show that the time period should be 0.02 s **Or** Uses $f = 50$ to show that sin $2\pi ft$ is sin $100\pi t$ **Or** Uses $T = 0.02$ to show that $100\pi 0.02 = 2\pi$ (1)	Accept max for peak Alternative MP2: recognises that one period/cycle of the sine wave is an angle of 2π	3

Q2.

Question Number	Answer	Additional guidance	Mark
(a)(i)	thermionic emission		**(1)**

Question Number	Acceptable Answer	Additional guidance	Mark
(a)(ii)	• equate $\frac{1}{2}mv^2$ and VQ (1) • $v = 2.3 \times 10^7$ m s^{-1} (1)	Example of calculation: $E = 1500\text{ V} \times 1.6 \times 10^{-19}\text{ C} = 2.4 \times 10^{-16}\text{ J}$ $v = \sqrt{\frac{2 \times 2.4 \times 10^{-16}\text{ J}}{9.11 \times 10^{-31}\text{ kg}}} = 2.3 \times 10^7$ m s^{-1}	**(2)**

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Question Number	Acceptable Answer	Additional guidance	Mark
(b)(i)	• use of $F = EQ$ and $E = \frac{V}{d}$ (1) OR see $F = \frac{VQ}{d}$ • equate $F = ma$ and $F = EQ$ (1)		**(2)**

Question Number	Acceptable Answer	Additional guidance	Mark
(b)(ii)	• use of speed = distance/time (1) • $t = 8.7 \times 10^{-10}$ (s) (1) • use of a = $\frac{VQ}{dm}$ (1) • use of $s = ut + \frac{1}{2}at^2$ (1) with $u = 0$ and vertical acceleration to find s • $s = 3.3 \times 10^{-4}$ m (1)	Example of calculation: $t = \frac{0.02\ \text{m}}{2.3 \times 10^{7}\ \text{m s}^{-1}} = 8.7 \times 10^{-10}$ s $s = \frac{1}{2} \times \left(\frac{50\ \text{V} \times 1.6 \times 10^{-19}\ \text{C}}{0.01\ \text{m} \times 9.11 \times 10^{-31}\ \text{kg}} \right) \times (8.7 \times 10^{-10}\ \text{s})^2$ $s = 3.3 \times 10^{-4}$ m	**(6)**

Question Number	Acceptable Answer	Additional guidance	Mark
(c)	• use of $V = V_0/\sqrt{2}$ (1) • vertical line (1) • positive and negative deflection shown (1) • maximum deflection 75 V (1)	Example of calculation: $V_0 = 53\ \text{V} \times \sqrt{2} = 75\ \text{V}$	**(4)**

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