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

Mark Schemes

Q1.

Question Number	Acceptable answers	Additional guidance	Mark
(i)	• Use of $\rho = \frac{m}{V}$ (1) with $V = \pi r^2 L$ • $\mu = 1.09 \times 10^{-3}$ (kg m^{-1}) (to at least 3 sf) (1)	For MP1, accept use of ρA Example of calculation: $\mu = \frac{m}{L} = \frac{V\rho}{L} = \frac{\pi r^2 L \rho}{L} = \pi r^2 \rho$ $\therefore \mu = \pi\left(\frac{1.14 \times 10^{-3}\text{ m}}{2}\right)^2 \times 1070\text{ kg m}^{-3}$ $\mu = 1.09 \times 10^{-3}\text{ kg m}^{-1}$	2

Question Number	Acceptable answers	Additional guidance	Mark
(ii)	• Use of $L = \frac{\lambda}{2}$ (1) • Use of $v = f\lambda$ (1) • Use of $v = \sqrt{\frac{T}{\mu}}$ (1) • $T = 140$ N (ecf from (a)(i)) (1)	Example of calculation: $\lambda = 2 \times 0.41\text{ m} = 0.82\text{ m}$ $v = 440\text{ Hz} \times 0.82\text{ m} = 361\text{ m s}^{-1}$ $361\text{ m s}^{-1} = \sqrt{\frac{T}{1.09 \times 10^{-3}\text{ kg m}^{-1}}}$ $\therefore T = (361\text{ m s}^{-1})^2 \times 1.09 \times 10^{-3}\text{ kg m}^{-3}$ $T = 142$ N	4

Q2.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	• Bottom plate marked positive **Or** bottom terminal of power supply marked positive (1)	Accept top plate marked negative or top terminal of power supply marked negative	1
(ii)	• Calculates volume of oil drop (1) • Use of $\rho = \frac{m}{V}$ (1) • Use of $E = \frac{V}{d}$ (1) • Use of $F = mg$ **and** $F = Eq$ (1) • Use of $N = \frac{q}{e}$ (1) • $N = 4.2$ so student's expectation not supported by data **Or** $N = 4.2$ which is not a whole number **Or** $N = 4.2$ so taking experimental error into account student's expectation may be supported by data (1)	Example of calculation $V = \frac{4}{3}\pi \times (1.78 \times 10^{-6}\ \text{m})^3 = 2.36 \times 10^{-17}\ \text{m}^3$ $m = 2.36 \times 10^{-17}\text{m}^3 \times 920\ \text{kg m}^{-3} = 2.17 \times 10^{-14}\ \text{kg}$ $E = \frac{4870\ \text{V}}{1.55 \times 10^{-2}\ \text{m}} = 3.14 \times 10^{5}\ \text{V m}^{-1}$ $q = \frac{2.17 \times 10^{-14}\ \text{kg} \times 9.81\ \text{N kg}^{-1}}{3.14 \times 10^{5}\ \text{N C}^{-1}} = 6.78 \times 10^{-19}\ \text{C}$ $N = \frac{6.78 \times 10^{-19}\text{C}}{1.60 \times 10^{-19}\ \text{C}} = 4.23$	6

Q3.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to **max two** of the following points: • The oil drop initially accelerates **Or** it takes time for the oil drop to reach terminal velocity (1) • (Initially) weight of oil drop not balanced by the drag force (+ upthrust) **Or** Weight of oil drop must be balanced by the drag force (+ upthrust) (1) • (If measurements are taken immediately) the calculated velocity will be less than the terminal velocity (1)	Accept use of standard symbols	2

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	• Positions from scale used to determine displacement (1) • Use of $v = \frac{s}{t}$ (1) • $v = 3.4 \times 10^{-5}$ m s^{-1} → 3.5×10^{-5} m s^{-1} (1)	Example of calculation Displacement = 6.65 mm − 2.50 mm = 4.15 mm $v = \frac{4.15 \times 10^{-3}}{2 \times 60\ \text{s}} = 3.46 \times 10^{-5}$ m s^{-1}	3