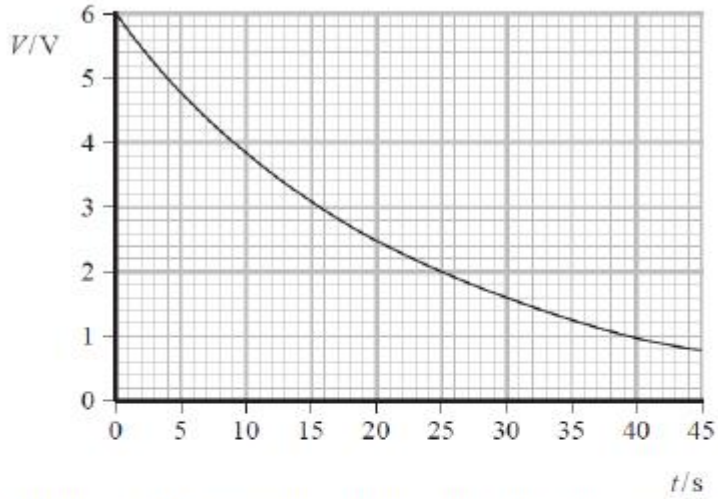
Name of the Student:_____
Max. Marks : 17 Marks **Time : 17 Minutes**

Mark Schemes

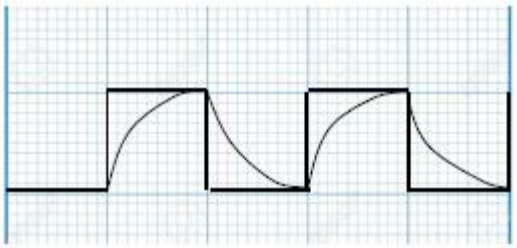
Q1.

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

Q2.

Question Number	Acceptable Answer	Additional Guidance	Mark
	• A pair of corresponding V and t values read from graph **(1)** • Use of $V = V_0 e^{-\frac{t}{RC}}$ **Or** Use of time constant = RC **(1)** • $C = 270\ \mu F$ **(1)** • Use of ±20% with 220 μF [Largest $C = 264\ \mu F$, smallest $C = 176\ (\mu F)$] **(1)** • Comparison of 264 (μF) [176 (μF) if their calculated C is too low] with calculated value of C from graph and conclusion consistent with this **(1)**	 Allow use of tangent at $t = 0$ to determine intercept on x-axis and obtain value for time constant; then calculate C gives MP1, MP2 and MP3 MP3:Value should be correct and have units <u>Example of calculation</u> $1.0 = 6.0e^{\frac{40\ s}{82\times10^3\ \Omega\times C}}$ $\therefore \ln\left(\frac{1.0\ V}{6.0\ V}\right) = -\frac{40\ s}{82\times10^3\ \Omega\times C}$ $\therefore C = \frac{-40\ s}{-1.79\times82\times10^3\ \Omega} = 2.72\times10^{-4}\ C$ Largest value of capacitance = 1.2 × 220 μF = 264 μF	**5**

Q3.

Question Number	Acceptable answers		Additional guidance	Mark
	• Time axis: one cycle = 50 OR two cycles =100	(1)	Example of calculation $T = 1/f = 1/20\ Hz = 0.050\ s$ Two cycles $= 2 \times 0.050\ s = 0.10\ s = 100\ ms$ Time Constant $= 100 \times 50 \times 10^{-6} = 0.005\ s$ In half a cycle (0.025 s) there are 0.025 s / 0.005 s = 5 Time constants	5
	• Use of time constant = *RC*	(1)		
	• Charging curve, from 25 ms to 50 ms, just about reaching 5V as shown (ecf from their T)	(1)	Ignore anything drawn in the first half cycle	
	• One corresponding discharge curve	(1)		
	• Curve should look exponential	(1)	Time period should be marked 50 ms or equivalent	