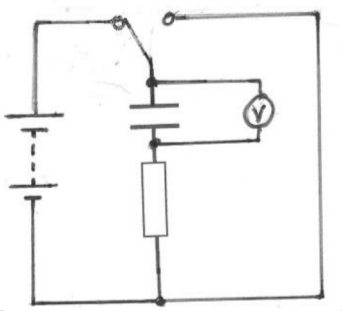
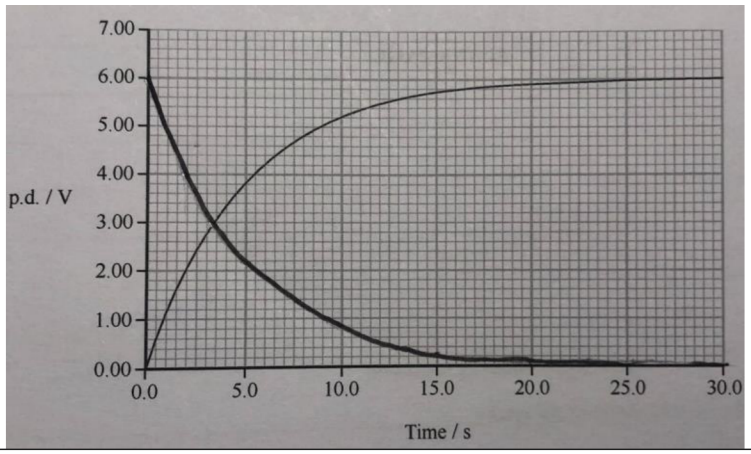
Question number	Answer		Mark
17 (a)	• Battery in series with capacitor and resistor • Voltmeter/datalogger/oscilloscope in parallel with capacitor • Appropriate switching mechanism and discharge circuit completed Example of diagram: 	(1) (1) (1)	**3**
17 (b) (i)	• Exponential decline • Symmetry with charging curve, starts at 6.00 V, curves cross at 3.00 V Example of graph 	(1) (1)	**2**
17 (b) (ii)	• Use of $I = I_0 e^{-\frac{t}{RC}}$ with $V = IR$ • Apply total p.d. = sum of p.d.s • Suitable algebra Example of derivation $I = I_0 e^{-\frac{t}{RC}}$ $V_R = RI_0 e^{-\frac{t}{RC}}$ $I_0R = V_0$ $V_R = V_0 e^{-\frac{t}{RC}}$ $V_{cap} = V_0 - V_R$ $V = V_0 - V_0 e^{-\frac{t}{RC}}$	(1) (1) (1)	**3**

17 (b) (iii)	• Use of $V = V_0(1 - 1/e) = 0.63\ V_0$ for V at time constant (1) • Read time constant off graph = 4.9 s (allow range 4.5 s to 5.0 s) (1) • Use of time constant = RC (1) • $C = 1.5 \times 10^{-5}$ F, so choose 15 μF capacitor (1) ($C = 1.4 \times 10^{-5}$ F to $C = 1.5 \times 10^{-5}$ F when rounded to 2 s.f.) **Or** • Draws tangent to line at t = 0 s to intercept p.d. = 6.00 V line (1) • Read time constant off graph = 4.9 s (allow range 4.5 s to 5.0 s) (1) • Use of time constant = RC (1) • $C = 1.5 \times 10^{-5}$ F, so choose 15 μF capacitor (1) ($C = 1.4 \times 10^{-5}$ F to $C = 1.5 \times 10^{-5}$ F when rounded to 2 s.f.) **Or** • Record corresponding values of V and t from point (or points) on graph (1) • Use of $V = V_0 - V_0 e^{-\frac{t}{RC}}$ (1) • Convert to correct logarithmic form (1) • $C = 1.5 \times 10^{-5}$ F, so choose 15 μF capacitor (1) ($C = 1.3 \times 10^{-5}$ F to $C = 1.5 \times 10^{-5}$ F when rounded to 2 s.f.) **Or** • $\frac{V_0}{2} = V_0 e^{-\frac{t_{\frac{1}{2}}}{RC}}$ (1) • $RC = t_{½} / \ln 2$ (1) • Records time for V to increase to ½ V_0 (3.4 s) (allow range 3.0 s to 3.5 s) (1) • $C = 1.5 \times 10^{-5}$ F, so choose 15 μF capacitor (1) ($C = 1.3 \times 10^{-5}$ F to $C = 1.5 \times 10^{-5}$ F when rounded to 2 s.f.) <u>Example of calculation</u> V at time constant time = 0.63 × 6.00 V = 3.8 V Time from graph = 4.9 s 4.9 s = $C \times 3.3 \times 10^5$ Ω $C = 1.48 \times 10^{-5}$ F	**4**

17 (b) (iv)	• Use of $Q = CV$ (ecf for C from (iii)) (1) • $Q = 9.0 \times 10^{-5}$ C (1) Example of calculation 1.5×10^{-5} F × 6.00 V = 9.0×10^{-5} C	**2**
17 (b) (v)	• Use of $W = ½\ CV^2$ (ecf for C from (iii)) **Or** Use of $W = ½\ QV$ (ecf for Q from (iv)) **Or** Use of $W = ½\ Q^2/C$ (ecf for C from (iii), for Q from (iv)) (1) • $W = 2.7 \times 10^{-4}$ J (1) Example of calculation: $W = ½ \times 1.5 \times 10^{-5}$ F × $(6.00\ \text{V})^2 = 2.7 \times 10^{-4}$ J	**2**
	Total for question 17	**16**