19. Capacitance

19.2 Energy stored in a capacitor

Paper 4

Marking Scheme

Q1.

(b)(i)	$E = \frac{1}{2}CV^2$	**C1**
	$V = \sqrt{[(2 \times 2.5 \times 10^{-3}) / (200 \times 10^{-6})]} = 5.0$ V	**A1**
(b)(ii)	total capacitance = 600 μF	**C1**
	$E = \frac{1}{2} \times 600 \times 10^{-6} \times 5.0^2$ $(= 7.5 \times 10^{-3}$ J)	**C1**
	= 7.5 mJ	**A1**
(b)(iii)	line with positive gradient starting at (0, 2.5)	**B1**
	straight line passing through (400, 7.5)	**B1**

Q2.

(c)(i)	$E = \frac{1}{2}CV^2$	**C1**
	$C = 2 \times 0.041 / 12^2 = 5.7 \times 10^{-4}$ F = 570 μF	**A1**

Q3.

(b)(ii)	work done is the area under the graph	**B1**
	$W = \frac{1}{2}QV$	**A1**
(c)(ii)	less than	**B1**

Q4.

(a)(ii)	$E_A = \frac{1}{2}CV^2$	**A1**
(b)(iii)	$\Delta E = \frac{1}{2}CV^2 - nCV^2$, where n is a multiple that is less than $\frac{1}{2}$ **or** total final energy $= \frac{1}{2} \times 4C \times (V/4)^2$ $= \frac{1}{8}CV^2$	**C1**
	$\Delta E = \frac{1}{2}CV^2 - \frac{1}{8}CV^2$ $= \frac{3}{8}CV^2$	**A1**

Q5.

(a)(i)	energy stored = area under graph	**C1**
	$= \frac{1}{2} \times 450 \times 10^{-6} \times 8.0 = 1.8 \times 10^{-3}$ J **or** 1.8 mJ	**A1**

Q6.

(c)(ii)	energy $= \frac{1}{2}CV^2$	**C1**
	$= \frac{1}{2} \times 15 \times 10^{-6} \times 12^2$ $= 1.1 \times 10^{-3}$ J	**A1**

Q7.

(c)	oppositely charged plates attract, so energy stored decreases	**B1**

Q8.

(c)(ii)	**1.** $Q = CV$	**C1**
	$= 1.2 \times 8.0$ $= 9.6\ \mu C$	**A1**
	2. $E = \frac{1}{2}QV$ **and** $V = Q/C$ **or** $E = \frac{1}{2}CV^2$ **and** $V = Q/C$ **or** $E = \frac{1}{2}Q^2/C$	**C1**
	$E = \frac{1}{2}(9.6 \times 10^{-6})^2 / (3.0 \times 10^{-6})$ $= 1.5 \times 10^{-5}$ J	**A1**