

6(a)	series charges: $Q_s = Q_1 = Q_2$
	series p.d.s: $V_s = V_1 + V_2$
	parallel charges: $Q_s = Q_1 + Q_2$
	parallel p.d.s: $V_s = V_1 = V_2$
6(b)(i)	$E = \frac{1}{2} CV^2$
	p.d. = $[(2 \times 19 \times 10^{-3}) / (470 \times 10^{-6})]^{1/2}$ $= 9.0 \text{ V}$
6(b)(ii)	$E = Q^2 / 2C$ or $C = Q / V$
	$Q = (19 \times 10^{-3} \times 2 \times 470 \times 10^{-6})^{1/2}$
	or $Q = 470 \times 10^{-6} \times 9.0$
	$Q = 4.2 \times 10^{-3} \text{ C}$
6(b)(iii)	total charge unchanged
	total capacitance = $(470 + 180) \times 10^{-6} \text{ (F)}$
	$E = Q^2 / 2C = (4.23 \times 10^{-3})^2 / (2 \times 650 \times 10^{-6}) \text{ (= 0.014 J)}$
	$E = 14 \text{ mJ}$

5(a)	$Q = Q_1 = Q_2$ <u>and</u> $V = V_1 + V_2$
	$V = Q / C$ so: $Q / C = Q / C_1 + Q / C_2$ <u>leading to</u> $1 / C = 1 / C_1 + 1 / C_2$
5(b)	total capacitance = $C + \frac{1}{2}C = (3 / 2)C$
	total capacitance = gradient $= 400 \times 10^{-6} / 6.0$
	<i>either:</i> $C = (2 \times 400 \times 10^{-6}) / (3 \times 6.0) = 4.4 \times 10^{-5} \text{ F} = 44 \mu\text{F}$ <i>or:</i> $C = (2 \times 400) / (3 \times 6.0) = 44 \mu\text{F}$
5(c)(i)	$\tau = RC$
	$= 54 \times 10^3 \times (3/2) \times 44 \times 10^{-6}$ $= 3.6 \text{ s}$
5(c)(ii)	$0.15 = \exp(-t / 3.6)$
	$t = 6.8 \text{ s}$

7(a)	charge / potential (difference)								
	charge is charge on one plate, <u>and</u> potential is p.d. between the plates								
7(b)(i)	straight line starting at the origin								
	line with positive gradient ending at (V, Q)								
7(b)(ii)	work done is the area under the graph								
	$W = \frac{1}{2}QV$								
7(c)(i)	final p.d. shown as $V/4$ for both capacitors								
	final charges add together to give Q								
	charge on Y = $3 \times$ charge on X (and both charges shown as a multiple of Q)								
	Fully correct answer: <table><tr><td></td><td>X</td><td>Y</td></tr><tr><td>final p.d.</td><td>$V/4$</td><td>$V/4$</td></tr><tr><td>final charge</td><td>$Q/4$</td><td>$3Q/4$</td></tr></table>		X	Y	final p.d.	$V/4$	$V/4$	final charge	$Q/4$
	X	Y							
final p.d.	$V/4$	$V/4$							
final charge	$Q/4$	$3Q/4$							
7(c)(ii)	less than								

6(a)	equal charge on both capacitors
	$V_X + V_Y = V$
	$(Q / C_X) + (Q / C_Y) = (Q / C_T)$ <u>leading to</u> $(1 / C_X) + (1 / C_Y) = (1 / C_T)$
	or $(V_X / Q) + (V_Y / Q) = (V / Q)$ <u>leading to</u> $(1 / C_X) + (1 / C_Y) = (1 / C_T)$
6(b)(i)	$E = \frac{1}{2}CV^2$
	$V = \sqrt{[(2 \times 2.5 \times 10^{-3}) / (200 \times 10^{-6})]} = 5.0 \text{ V}$
6(b)(ii)	total capacitance = $600 \mu\text{F}$
	$E = \frac{1}{2} \times 600 \times 10^{-6} \times 5.0^2$ $(= 7.5 \times 10^{-3} \text{ J})$
	$= 7.5 \text{ mJ}$
6(b)(iii)	line with positive gradient starting at $(0, 2.5)$
	straight line passing through $(400, 7.5)$