| | | |
|---|---|---|
| 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. $= [(2 \times 19 \times 10^{-3}) / (470 \times 10^{-6})]^{\frac{1}{2}}$ <br> $= 9.0$ V |
| 6(b)(ii) | $E = Q^2 / 2C$ **or** $C = Q / V$ |
| | $Q = (19 \times 10^{-3} \times 2 \times 470 \times 10^{-6})^{\frac{1}{2}}$ <br> **or** <br> $Q = 470 \times 10^{-6} \times 9.0$ <br> $Q = 4.2 \times 10^{-3}$ C |
| 6(b)(iii) | total charge unchanged |
| | total capacitance $= (470 + 180) \times 10^{-6}$ (F) |
| | $E = Q^2 / 2C = (4.23 \times 10^{-3})^2 / (2 \times 650 \times 10^{-6})$ (= 0.014 J) <br> $E = 14$ mJ |



| | |
|---|---|
| 5(a) | $Q = Q_1 = Q_2$ <u>and</u> $V = V_1 + V_2$ |
| | $V = Q / C$ so: <br> $Q / C = Q / C_1 + Q / C_2$ <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 <br> $= 400 \times 10^{-6} / 6.0$ |
| | *either*: $C = (2 \times 400 \times 10^{-6}) / (3 \times 6.0) = 4.4 \times 10^{-5}$ F $= 44\,\mu$F <br> *or*: $C = (2 \times 400) / (3 \times 6.0) = 44\,\mu$F |
| 5(c)(i) | $\tau = RC$ |
| | $= 54 \times 10^3 \times (3/2) \times 44 \times 10^{-6}$ <br> $= 3.6$ s |
| 5(c)(ii) | $0.15 = \exp(-t / 3.6)$ |
| | $t = 6.8$ 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 × charge on X (and both charges shown as a multiple of $Q$) <br> <u>Fully correct answer:</u> <br> (see table below) |
| 7(c)(ii) | less than |

Fully correct answer:

| | X | Y |
|---|---|---|
| final p.d. | $V / 4$ | $V / 4$ |
| final charge | $Q / 4$ | $3Q / 4$ |



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