2017 Ph H1 Q18

Section: Electricity

Topic: Capacitors

Question Summary
A 6.0 V supply with negligible internal resistance is connected to a network with resistors 480 Ω and 120 Ω and a 30 μF capacitor as shown. Find the maximum energy stored in the capacitor.

Worked Solution
At steady state on d.c., the capacitor is open-circuit and charges to the p.d. across the 120 Ω resistor of the divider.

Voltage divider: $V_C = 6.0 \times (120 / (480 + 120)) = 6.0 \times (120 / 600) = 1.2$ V.
Energy in a capacitor: $E = \frac{1}{2} C V^2 = \frac{1}{2} \times 30 \times 10^{-6} \times (1.2)^2 = 0.5 \times 30 \times 10^{-6} \times 1.44 \approx 2.16 \times 10^{-5}$ J.
$\approx 2.2 \times 10^{-5}$ J.

Final Answer: E

Revision Tips

- On d.c., a capacitor behaves as an open circuit after charging: use divider to find its final voltage.
- Energy formulae: $E = \frac{1}{2} C V^2 = \frac{1}{2} QV = Q^2/(2C)$.
- Convert μF to F before substituting.