GET BETTER AT PHYSICS · MARK SCHEME

Charging & Discharging Capacitors: tiered multiple choice

AQA A-level Physics · 7408 · Specification 3.7.4.4 · 6 questions · 6 marks

1 mark per correct letter | Worked reasoning for every question | **How students did** = from AQA examiner reports, where available

Answer key

Q1	Q2	Q3	Q4	Q5	Q6
D	C	A	A	D	C

Easy

Questions 1–3

1 **D**

Fraction of energy left after two time constants · AQA June 2022 · A-level Paper 2 · Q21

$RC = 2.0 \times 10^{-3} \times 15 \times 10^{3} = 30$ s, so 1.0 minute is 2RC. The charge falls to Q_0e^{-2}. Energy $\propto Q^2$, so it falls to e^{-4} of its starting value: $1/e^4$.

Watch out: $1/e^2$ (B) is the fraction of charge left, not energy.

2 **C**

Maximum discharge current · AQA June 2019 · A-level Paper 2 · Q21

$V_0 = Q / C = 15 \times 10^{-6} \div 1.0 \times 10^{-6} = 15$ V. The current is largest at the start: $I = V_0 / R = 15 \div 25 = 0.60$ A.

Watch out: Check the units: 0.60 mA (A) would need a resistance of 25 kΩ.

3 **A**

Fraction of charge left after 4.8 s · AQA June 2017 · A-level Paper 2 · Q21

$RC = 120 \times 10^{-6} \times 20 \times 10^{3} = 2.4$ s. $Q / Q_0 = e^{-4.8/2.4} = e^{-2} = 0.14$.

Watch out: 0.37 (B) is the fraction left after one time constant; 4.8 s is two.

Medium

Questions 4–6

4 **A**

Maximum current from the stored energy · AQA November 2020 · A-level Paper 2 · Q22

$E = \frac{1}{2}CV^2$, so $V = \sqrt{(2E / C)} = \sqrt{(2 \times 4.5 \times 10^{-3} \div 10 \times 10^{-6})} = \sqrt{900} = 30$ V. Maximum current $= V / R = 30 \div 25 = 1.2$ A.

Watch out: 30 A (C) is the pd in volts, not the current.

How students did: Between 30% and 50% of students got this right in November 2020.

5 **D**

V and I graphs while charging · AQA November 2021 · A-level Paper 2 · Q20

When the switch closes, the uncharged capacitor has no pd, so the current starts at its maximum. As charge builds up, V across the capacitor rises towards the emf and the current falls towards zero: pair D.

Watch out: The pd across the capacitor and the current change in opposite ways while it charges.

6 **C**

Resistance needed for a constant charging current · AQA June 2025 · A-level Paper 2 · Q18

At t = 30 s the charge is Q = It = $6.0 \times 10^{-3} \times 30 = 0.18$ C, so $V_C = Q / C = 0.18 \div 0.300 = 0.60$ V. The rest of the emf is across R: 2.0 − 0.60 = 1.4 V. R = $1.4 \div 6.0 \times 10^{-3} = 233\ \Omega$.

> **Watch out:** 333 Ω (D) uses the full 2.0 V across R and ignores the pd across the capacitor.

End of mark scheme. Answers from AQA's published keys; explanations written for this pack. AQA material is © AQA. More free packs and 1-to-1 tuition: **www.getbetteratphysics.co.uk**

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