Higher Capacitors Answers

1. a) Electrical charge and electrical energy.

b) Farads (F).

c) 1 Farad = 1 Coulomb /Volt. (CV^{-1})

2. a) $Q = 9x10^{-3}C$.

b) $E_{cap} = 2.25x10^{-2}J$.

3. a) $V_c = 0V$.

b) $V_R = 9V$.

c) $I = 7.5x10^{-4}A$.

d) Range = 0 to 1mA.

e) $I = 2.5x10^{-4}A$.

f) $V_c = 9V$.

g) $V_R = 0V$.

h) $E_{cap} = 1.62 \times 10^{-5}J$.

i) $Q = 3.6 \times 10^{-6}C$.

4. a) I = 0.05A.

b) i) The ammeter reading will decrease gradually from a maximum value to zero.

ii) The lamp will decrease brightness gradually from a maximum to zero.

c) i) Increase the initial current.

ii) Increase the voltage when the capacitor is fully charged.

5. a) The voltage dropped across the resistor.

b) Current and frequency are independent of each other in a resistive ac circuit.

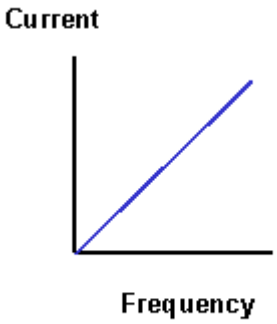
The graph shows a zero gradient above the x-axis.

c) Current and frequency are directly proportional to each other in a capacitive ac circuit.

A graph of current against frequency is a SLTO.

6. a) i) I_p = 283mA.

ii)



b) i) Q = 0.02C.

ii) E_{cap} = 0.36J.

7. a) i) $V_c = 6V$.

ii) $I_{max} = 7.5 \times 10^{-3}A$.

iii)

b) **Two reasons:**

The initial discharge current is greater than the initial charging current.

The time for the capacitor to discharge is less than the charging time.

c) $E_{cap} = 0.18J$.

8. a) i) $V_s = 15V$.

ii) t = 40s.

iii) $V_c = 9V$.

b) i) A) Q = 0.096C.

B) $E_{cap} = 288J$

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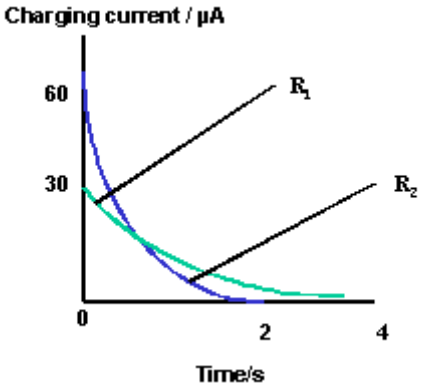
ii) I = 48A.

9. a) 5µF = A capacitor will store 5 micro coulombs of charge per volt across it.

b) i) R = 200,000Ω.

ii)



c) i) The resistance of the variable resistor must be decreased to keep the charging current constant.

ii) Q = 1mC.

iii) C = 200µF.

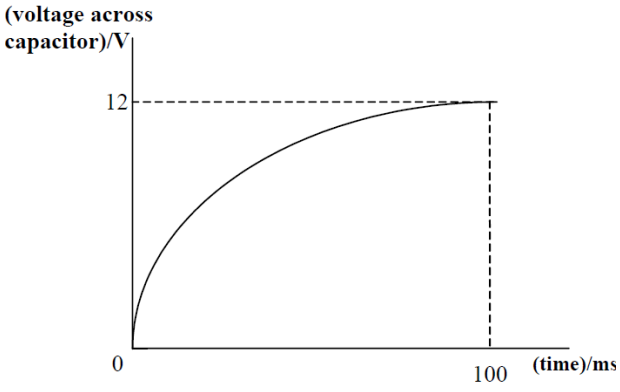
10. a) C = (12.5 ± 0.4) µF

b) i) E_{cap} = 0.16J

ii) A) When the switch is opened the capacitor discharges through the resistor and relay coil. The discharge current magnetises the coil closing the switch in the lamp circuit, causing the lamp to light. As the discharge current gradually falls the coil loses its magnetism and the switch in the lamp circuit opens. When this happens the lamp goes off.

B) Increasing the value of the capacitor increases the discharge time. The energy stored in the capacitor is also greater. This means that the lamp will stay lit for longer.

11. a)

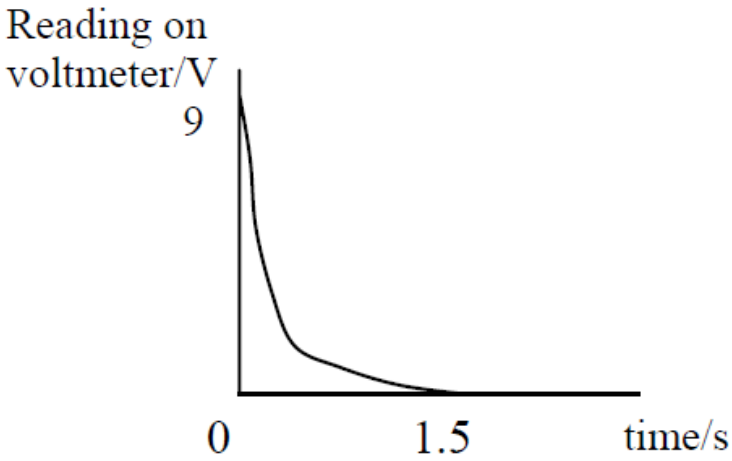


b) i) $V_c = 4V$.

ii) $E_{cap} = 8 \times 10^{-4}J$.

c) Use a resistance of less than 400Ω.

12. a) i)



ii) Time will be longer.

Initial charging current is less.

iii) Q = 0.011C.

b) i) $E_{cap} = 8.9 \times 10^{-2}J$.

ii) $I = 9 \times 10^{-5}A$.

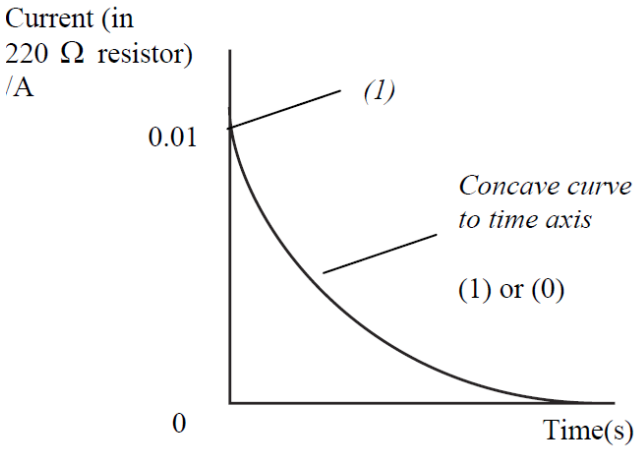
13. a) V = 2.2V.

b) i) Energy is required to move electrons against the electric field between the plates.

ii) V_c = 2.2V.

iii) $E_{cap} = 8 \times 10^{-5}$J.

iv)



14. a) i) I max = 4×10^{-3}A.

ii) $E_{cap} = 8.46 \times 10^{-3}$J

iii) Increasing the supply voltage would increase the energy storing capacity of the capacitor. This is because the final voltage, across the fully charged capacitor, would be higher.

b) $E_{total} = 6.35 \times 10^{-2}$J => **$1.65 \times 10^{16}$photons**.

15. a) I = 2.5×10^{-5}A.

b) Q = 1.8×10^{-2}C.

c) E_{cap} = 0.16J.