19. Capacitance

A-Level Physics Name: ______________ Score: ______

1. Capacitance is the charge stored per unit:

   ☐ potential difference

   ☐ current

   ☐ resistance

   ☐ time

2. The energy stored in a capacitor is:

   ☐ $\frac{1}{2}CV^2$

   ☐ CV^2

   ☐ $\frac{1}{2}CV$

   ☐ $\frac{1}{2}QV^2$

3. During discharge through a resistor, the charge on a capacitor:

   ☐ decays exponentially

   ☐ falls in a straight line

   ☐ stays constant

   ☐ rises steadily

4. A capacitor holds 0.012 C at 4.0 V. What is its capacitance, in mF?

   ______________ mF

5. A 2.0 μF capacitor is charged to 1000 V. How much energy does it store?

   ______________ J

6. The charge during discharge is given by:

   ☐ $Q_0e^{-t/RC}$

   ☐ $Q_0e^{t/RC}$

   ☐ $Q_0(1-e^{-t/RC})$

   ☐ $\dfrac{Q_0}{t}$

7. Doubling the charge on a capacitor doubles the voltage, so its capacitance stays the same.

   ☐ True ☐ False

8. Why is there a factor of ½ in the stored-energy formula?

☐ the average p.d. during charging is only V/2

☐ half the charge leaks away

☐ the capacitor is only half full

☐ energy is always halved

9. A capacitor of 500 μF discharges through a 2000 Ω resistor. What is the time constant?

    ________________ s

10. A 2.0 μF and a 3.0 μF capacitor are in parallel. What is the total capacitance, in µF?

    ________________ µF

A-Level Physics

1. **potential difference**

   $C = \dfrac{Q}{V}$ — charge per volt, in farads.

2. $\frac{1}{2}CV^2$

   Equivalent forms: $W = \frac{1}{2}QV = \frac{1}{2}CV^2 = \dfrac{Q^2}{2C}$.

3. **decays exponentially**

   The bigger the charge, the bigger the current — giving an exponential decay.

4. **3 mF**

   $C = \dfrac{Q}{V} = \dfrac{0.012}{4.0} = 0.0030$ F $= 3.0$ mF.

5. **1 J**

   $W = \frac{1}{2}CV^2 = \frac{1}{2} \times 2.0 \times 10^{-6} \times (1000)^2 = 1.0$ J.

6. $Q_0e^{-t/RC}$

   Discharge falls toward zero: $Q = Q_0e^{-t/RC}$ (the $1 - e^{-t/RC}$ form is for *charging*).

7. **True**

   $C = \dfrac{Q}{V}$ is fixed by the capacitor's size and dielectric — Q and V rise together.

8. **the average p.d. during charging is only V/2**

   The p.d. rises from 0 to V as it charges, so the average is V/2 — hence the triangle area $\frac{1}{2}QV$.

9. **1 s**

   $\tau = RC = 2000 \times 500 \times 10^{-6} = 1.0$ s.

10. **5 µF**

    In parallel capacitances add: $2.0 + 3.0 = 5.0$ μF.