

**How to use this worksheet.** Thirty questions, about 35 minutes. In a **series** combination the charge is the same on every capacitor; in **parallel** the voltage is the same. Those two facts settle most of Section B. Section D is six questions taken straight from the AAI ATC papers.

**Formula sheet**

$$C = Q/V \quad | \quad C = \epsilon_0 A/d \quad | \quad \text{With dielectric: } C' = kC \quad | \quad E = V/d \quad | \quad W = q\Delta V$$

$$\text{Series: } 1/C = 1/C_1 + 1/C_2 \quad | \quad \text{Parallel: } C = C_1 + C_2 \quad | \quad U = \frac{1}{2}CV^2 = Q^2/2C \quad | \quad \epsilon_0 = 8.854 \times 10^{-12} \text{ F/m}$$

**Section A · Level 1 — definitions and direct formulas**

*Eight questions. None should take more than twenty seconds.*

- The SI unit of capacitance is the:  
(1) Coulomb (2) Volt (3) Farad (4) Joule
- The SI unit of electric potential is the:  
(1) Newton (2) Volt (3) Farad (4) Tesla
- For a parallel plate capacitor, if the plate area  $A$  is doubled and everything else stays the same, the capacitance:  
(1) Doubles (2) Halves (3) Stays the same (4) Becomes four times
- Two capacitors of  $3 \mu\text{F}$  and  $6 \mu\text{F}$  are connected in parallel. The equivalent capacitance is:  
(1)  $2 \mu\text{F}$  (2)  $18 \mu\text{F}$  (3)  $4.5 \mu\text{F}$  (4)  $9 \mu\text{F}$
- The energy stored in a capacitor of capacitance  $C$  charged to potential  $V$  is:  
(1)  $CV^2$  (2)  $\frac{1}{2}CV^2$  (3)  $\frac{1}{2}C^2V$  (4)  $CV$
- The dielectric constant of vacuum is:  
(1) 0 (2)  $8.854 \times 10^{-12}$  (3) 1 (4) Infinite
- The work done in moving a charge along an equipotential surface is:  
(1) Zero (2) Equal to  $qV$  (3) Always negative (4) Maximum
- The equipotential surfaces around an isolated point charge are:  
(1) Parallel planes (2) Concentric spheres (3) Coaxial cylinders (4) Straight lines

**Working space — Questions 1 to 8**

*Definitions and one-line substitutions.*

**Section B · Level 2 — application and combinations**

*Eight questions. Series means equal charge, parallel means equal voltage.*

- Two capacitors of  $2 \mu\text{F}$  and  $3 \mu\text{F}$  are connected in series. The equivalent capacitance is:  
(1)  $5 \mu\text{F}$  (2)  $6 \mu\text{F}$  (3)  $1.2 \mu\text{F}$  (4)  $2.5 \mu\text{F}$
- Three capacitors of  $6 \mu\text{F}$  each are connected in parallel. The equivalent capacitance is:  
(1)  $2 \mu\text{F}$  (2)  $6 \mu\text{F}$  (3)  $12 \mu\text{F}$  (4)  $18 \mu\text{F}$
- A  $5 \mu\text{F}$  capacitor is charged to 100 V. The energy stored is:  
(1) 0.05 J (2) 0.025 J (3) 0.5 J (4) 2.5 J
- The charge stored on a  $4 \mu\text{F}$  capacitor connected across 50 V is:  
(1)  $12.5 \mu\text{C}$  (2)  $54 \mu\text{C}$  (3)  $200 \mu\text{C}$  (4)  $0.08 \mu\text{C}$

**13.** Two  $4\ \mu\text{F}$  capacitors are joined in series, and that combination is connected in parallel with a  $2\ \mu\text{F}$  capacitor. The total capacitance is:

- (1)  $4\ \mu\text{F}$  (2)  $10\ \mu\text{F}$  (3)  $2\ \mu\text{F}$  (4)  $8\ \mu\text{F}$

**14.** The plates of a capacitor are  $0.01\ \text{m}$  apart with  $100\ \text{V}$  across them. The uniform field between them is:

- (1)  $1\ \text{V/m}$  (2)  $10\ 000\ \text{V/m}$  (3)  $100\ \text{V/m}$  (4)  $1000\ \text{V/m}$

**15.** Moving a charge of  $2\ \mu\text{C}$  between two points requires  $6\ \mu\text{J}$  of work. The potential difference is:

- (1)  $12\ \text{V}$  (2)  $0.33\ \text{V}$  (3)  $8\ \text{V}$  (4)  $3\ \text{V}$

**16.** If the separation between the plates of a parallel plate capacitor is doubled, the capacitance:

- (1) Doubles (2) Halves (3) Is unchanged (4) Becomes four times

**Working space — Questions 9 to 16** *Reduce the circuit first, then substitute.*

### Section C · Level 3 — multi-step and conceptual

*Eight questions. Two steps or a physical insight each.*

**17.** A parallel plate capacitor has plate area  $0.2\ \text{m}^2$  and separation  $0.001\ \text{m}$  in vacuum. Its capacitance is closest to:

- (1)  $0.44\ \text{nF}$  (2)  $8.85\ \text{nF}$  (3)  $1.77\ \text{nF}$  (4)  $17.7\ \text{nF}$

**18.** Two  $10\ \mu\text{F}$  capacitors are connected in series across  $20\ \text{V}$ . The charge on each capacitor is:

- (1)  $200\ \mu\text{C}$  (2)  $100\ \mu\text{C}$  (3)  $50\ \mu\text{C}$  (4)  $400\ \mu\text{C}$

**19.** Capacitors of  $3\ \mu\text{F}$  and  $6\ \mu\text{F}$  are connected in series across  $18\ \text{V}$ . The total energy stored is:

- (1)  $3.24 \times 10^{-4}\ \text{J}$  (2)  $1.62 \times 10^{-4}\ \text{J}$  (3)  $9.72 \times 10^{-4}\ \text{J}$  (4)  $6.48 \times 10^{-4}\ \text{J}$

**20.** Capacitors of  $2\ \mu\text{F}$  and  $3\ \mu\text{F}$  are connected in parallel across  $10\ \text{V}$ . The total charge drawn is:

- (1)  $12\ \mu\text{C}$  (2)  $20\ \mu\text{C}$  (3)  $30\ \mu\text{C}$  (4)  $50\ \mu\text{C}$

**21.** A capacitor is charged and then disconnected from the battery. A dielectric of constant  $k$  is now inserted. The energy stored:

- (1) Increases  $k$  times (2) Decreases to one  $k$ -th (3) Is unchanged (4) Becomes  $k^2$  times

**22.** A capacitor stays connected to a battery while a dielectric of constant  $k$  is inserted. The charge on the plates:

- (1) Increases  $k$  times (2) Decreases to one  $k$ -th (3) Is unchanged (4) Becomes zero

**23.** Three capacitors of  $2\ \mu\text{F}$ ,  $3\ \mu\text{F}$  and  $6\ \mu\text{F}$  are connected in series. The equivalent capacitance is:

- (1)  $11\ \mu\text{F}$  (2)  $0.5\ \mu\text{F}$  (3)  $1\ \mu\text{F}$  (4)  $3.67\ \mu\text{F}$

**24.** The potential at a distance  $r$  from an isolated point charge  $q$  in vacuum is proportional to:

- (1)  $r^2$  (2)  $1/r^2$  (3)  $r$  (4)  $1/r$

**Working space — Questions 17 to 24** *Reduce the circuit first, then substitute.*

**Section D · Previous year questions***Every question exactly as it appeared in the paper.*

**25.** Two capacitors of capacitance  $3\ \mu\text{F}$  and  $6\ \mu\text{F}$  are connected in series combination. The equivalent capacitance of the system is equal to: **[PYQ 2025 · Shift 2]**

(1)  $9\ \mu\text{F}$  (2)  $2\ \mu\text{F}$  (3)  $6\ \mu\text{F}$  (4)  $3\ \mu\text{F}$

**26.** Two capacitors,  $6\ \mu\text{F}$  and  $12\ \mu\text{F}$ , are connected in series across a potential difference of  $30\ \text{V}$ . What is the voltage across the  $12\ \mu\text{F}$  capacitor? **[PYQ 2025 · Shift 2]**

(1)  $15\ \text{V}$  (2)  $25\ \text{V}$  (3)  $10\ \text{V}$  (4)  $20\ \text{V}$

**27.** The capacitance of a parallel plate capacitor with air between the plates is  $C$ . The area of the plates is  $A$  and the distance between them is  $d$ . If the distance is reduced to  $d/4$ , the capacitance becomes  $C'$ . What is the ratio  $C : C'$ , keeping every other parameter the same? **[PYQ 2025 · Shift 2]**

(1)  $4 : 1$  (2)  $1 : 2$  (3)  $1 : 4$  (4)  $2 : 1$

**28.** A parallel plate capacitor with air between the plates has capacitance  $C$ . When a dielectric of dielectric constant  $k$  is introduced between the plates, its capacitance becomes  $C'$ . Which relation is correct? **[PYQ 2025 · Shift 1]**

(1)  $C' = kC$  (2)  $C' = k^2C$  (3)  $C' = k/C$  (4)  $C' = k^2/C$

**29.** A parallel plate capacitor has plate area  $0.25\ \text{m}^2$  and plate separation  $0.002\ \text{m}$ , in vacuum, with  $15\ \text{V}$  across the plates. Taking  $\epsilon_0 = 8.854 \times 10^{-12}\ \text{F/m}$ , if the distance between the plates is reduced to half, calculate the capacitance and the energy stored at the same voltage. **[PYQ 2025 · Shift 1]**

(1)  $4.2\ \text{nF}$ ,  $5.2 \times 10^{-7}\ \text{J}$  (2)  $1.5\ \mu\text{F}$ ,  $6 \times 10^{-7}\ \text{J}$   
 (3)  $0.2\ \mu\text{F}$ ,  $3.4 \times 10^{-9}\ \text{J}$  (4)  $2.2\ \text{nF}$ ,  $2.5 \times 10^{-7}\ \text{J}$

**30.** When a charge of  $3\ \mu\text{C}$  is carried from point A to point B, the work done by the electric field is  $75\ \mu\text{J}$ . Determine the potential difference. **[PYQ 2021 · Shift 2]**

(1)  $225\ \text{V}$  (2)  $25\ \text{V}$  (3)  $100\ \text{V}$  (4)  $2.5\ \text{V}$

**Working space — Section D***These six are the real exam pattern. Show every step.***Stuck on any of these? Bring them to a live class.**

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