

How to use this worksheet. Thirty questions, about 35 minutes. For any wire question remember that resistance depends on the **square** of the radius, not the radius itself. For any battery circuit, add the internal resistance to the external resistance before dividing into the emf. Section D is seven questions taken straight from the 2025 AAI ATC papers.

Formula sheet

$$V = IR \quad | \quad R = \rho L/A \quad | \quad R \propto 1/r^2 \text{ for a wire of radius } r$$

$$\text{Series: } R = R_1 + R_2 \quad | \quad \text{Parallel: } 1/R = 1/R_1 + 1/R_2 \quad | \quad V = \varepsilon - Ir \quad | \quad I = \varepsilon/(R + r)$$

$$P = VI = I^2R = V^2/R \quad | \quad I = nAev_d \quad | \quad \sigma = ne^2\tau/m$$

Section A · Level 1 — definitions and direct formulas

Eight questions. None should take more than twenty seconds.

- The SI unit of electrical resistance is the:
(1) Ampere (2) Ohm (3) Volt (4) Watt
- The SI unit of resistivity is:
(1) Ohm metre (2) Ohm per metre (3) Ohm (4) Siemens
- The resistance of a uniform conductor is directly proportional to its:
(1) Cross-sectional area (2) Radius (3) Length (4) Temperature only
- The SI unit of conductance is the:
(1) Ohm (2) Ohm metre (3) Farad (4) Siemens
- Kirchhoff's junction rule is a statement of the conservation of:
(1) Energy (2) Charge (3) Momentum (4) Mass
- The relation between current and drift velocity in a conductor is:
(1) $I = nAev_d$ (2) $I = nAe \div v_d$ (3) $I = nev_d \div A$ (4) $I = Aev_d \div n$
- Which quantity remains the same for every component in a series circuit?
(1) Voltage (2) Power (3) Current (4) Resistance
- The power dissipated in a resistor R carrying current I is:
(1) IR (2) $I \div R$ (3) IR^2 (4) I^2R

Working space — Questions 1 to 8

Definitions and one-line substitutions.

Section B · Level 2 — networks and Ohm's law

Eight questions. Reduce the network before you substitute.

- Resistors of $3 \, \Omega$ and $6 \, \Omega$ are connected in parallel. The equivalent resistance is:
(1) $2 \, \Omega$ (2) $9 \, \Omega$ (3) $4.5 \, \Omega$ (4) $18 \, \Omega$
- Three resistors of $6 \, \Omega$ each are connected in parallel. The equivalent resistance is:
(1) $18 \, \Omega$ (2) $6 \, \Omega$ (3) $2 \, \Omega$ (4) $3 \, \Omega$
- A potential difference of $12 \, V$ is applied across a $4 \, \Omega$ resistor. The current is:
(1) $48 \, A$ (2) $3 \, A$ (3) $0.33 \, A$ (4) $8 \, A$
- The power dissipated when $12 \, V$ is applied across a $4 \, \Omega$ resistor is:
(1) $3 \, W$ (2) $48 \, W$ (3) $16 \, W$ (4) $36 \, W$

13. If the length of a wire is doubled while its area stays the same, its resistance:

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

14. If the radius of a wire is doubled while its length stays the same, its resistance becomes:

- (1) Twice as large (2) Half as large (3) One quarter as large (4) Four times as large

15. A 100 W bulb runs for 10 hours. The energy consumed is:

- (1) 1 kWh (2) 10 kWh (3) 100 kWh (4) 0.1 kWh

16. A copper wire of length 2 m and cross-sectional area $1 \times 10^{-6} \text{ m}^2$ has resistivity $1.7 \times 10^{-8} \Omega \text{ m}$. Its resistance is:

- (1) 3.4 Ω (2) 0.34 Ω (3) 0.0034 Ω (4) 0.034 Ω

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

Section C · Level 3 — cells, internal resistance and conduction

Seven questions. Add the internal resistance first.

17. A battery of emf 12 V and internal resistance 1 Ω drives a 5 Ω external resistor. The current in the circuit is:

- (1) 2.4 A (2) 2 A (3) 12 A (4) 1.2 A

18. For the same circuit, the terminal voltage of the battery is:

- (1) 12 V (2) 2 V (3) 10 V (4) 14 V

19. Three cells of 2 V each, with internal resistance 0.5 Ω each, are joined in series across a 3.5 Ω resistor. The current is:

- (1) 1.2 A (2) 1.71 A (3) 4 A (4) 0.4 A

20. Two wires of the same material and length have radii in the ratio 1 : 2. The ratio of their resistances is:

- (1) 1 : 2 (2) 2 : 1 (3) 1 : 4 (4) 4 : 1

21. The conductivity σ of a conductor with n free electrons per unit volume, electron charge e , mass m and mean collision time τ is:

- (1) $\sigma = ne^2m \div \tau$ (2) $\sigma = ne^2\tau \div m$ (3) $\sigma = nem \div e^2\tau$ (4) $\sigma = m\tau \div ne^2$

22. Two identical resistors dissipate the most total power for a given supply voltage when connected:

- (1) In series (2) One alone (3) In parallel (4) Power is the same either way

23. The resistance of a pure metallic conductor as its temperature rises:

- (1) Increases (2) Decreases (3) Stays constant (4) Falls to zero

Section D · Previous year questions

Every question exactly as it appeared. All seven from the 2025 papers.

24. In a closed circuit, a battery of emf 10 V and internal resistance of 0.4 Ω is connected to an external resistor such that the current flowing through the circuit is 2 A. What will be the value of the external resistor? **[PYQ**

2025 · Shift 1]

- (1) 5 Ω (2) 4.6 Ω (3) 5.2 Ω (4) 9.2 Ω

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

25. Which of the following represents the correct relation between the emf ε and the terminal voltage V of a cell supplying current I through internal resistance r ? **[PYQ 2025 · Shift 1]**

- (1) $V = \varepsilon + Ir$ (2) $V = \varepsilon - Ir$ (3) $V = \varepsilon \times Ir$ (4) $V = \varepsilon \div Ir$

26. A battery with an EMF of 25 V and an internal resistance of 2 Ω is connected to a 4 Ω and a 12 Ω resistor in parallel. What will be the total current drawn from the battery? **[PYQ 2025 · Shift 2]**

- (1) 5 A (2) 3 A (3) 1.5 A (4) 10 A

27. Two wires of equal length and having radius 1 cm and 4 cm respectively are made of the same material. The ratio of the resistance of the wires is given by: **[PYQ 2025 · Shift 2]**

- (1) 1 : 4 (2) 4 : 1 (3) 1 : 16 (4) 16 : 1

28. Two cylindrical wires, A and B, made of the same material with equal lengths but different radii r_1 and r_2 , are first connected in series and then in parallel. What is the ratio of the effective resistance in the series combination to that in the parallel combination? **[PYQ 2025 · Shift 1]**

- (1) $[(r_1^2 + r_2^2) \div r_1 r_2]^2$ (2) $[r_1 r_2 \div (r_1^2 + r_2^2)]^2$ (3) $[(r_1^2 + r_2^2) \div r_1 r_2]^4$ (4) $[r_1 r_2 \div (r_1^2 + r_2^2)]^4$

29. A reverse bias voltage of 10 V is applied across a p-n junction diode such that the current flowing through the diode in the reverse bias configuration is 2 μA . What will be the resistance of the diode in this configuration? **[PYQ 2025 · Shift 1]**

- (1) 5000 k Ω (2) 50 k Ω (3) 500 k Ω (4) 5 k Ω

30. Which of the following materials exhibits behaviour that violates Ohm's law under specific conditions? **[PYQ 2025 · Shift 2]**

- (1) A copper wire at room temperature, where current increases in direct proportion to voltage (2) A semiconductor at low temperatures, where current does not increase linearly with applied voltage (3) A resistor with a constant voltage source, where voltage is proportional to current (4) A metallic wire at constant temperature, where current increases linearly with voltage

Working space — Section D

These seven are the real exam pattern. Show every step.

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