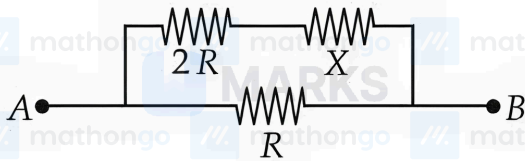


Q1. JEE Main 2026 (21 January Shift 2)

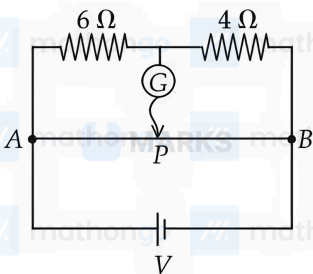
Two known resistances of $R\Omega$ and $2R\Omega$ and one unknown resistance $X\Omega$ are connected in a circuit as shown in the figure. If the equivalent resistance between points A and B in the circuit is $X\Omega$, then the value of X is ____ Ω .



- (1) $(\sqrt{3} - 1)R$ (2) $2(\sqrt{3} - 1)R$
(3) $(\sqrt{3} + 1)R$ (4) R

Q2. JEE Main 2026 (21 January Shift 2)

The total length of potentiometer wire AB is 50 cm in the arrangement as shown in figure. If P is the point where the galvanometer shows zero reading then the length AP is ____ cm.



- (1) 25 (2) 30 (3) 20 (4) 15

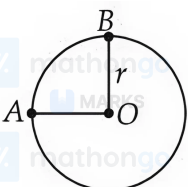
Q3. JEE Main 2026 (21 January Shift 2)

A battery with EMF E and internal resistance r is connected across a resistance R . The power consumption in R will be maximum when :

- (1) $R = 2r$ (2) $R = r/2$ (3) $R = r$ (4) $R = \sqrt{2}r$

Q4. JEE Main 2026 (23 January Shift 1)

A wire of uniform resistance $\lambda\Omega/\text{m}$ is bent into a circle of radius r and another piece of wire with length $2r$ is connected between points A and B (AOB) as shown in figure. The equivalent resistance between points A and B is ____ Ω .



- (1) $\frac{3\pi\lambda r}{8}$ (2) $\frac{6\pi\lambda r}{3\pi+16}$ (3) $2\pi\lambda r$ (4) $(\pi + 1)2r\lambda$

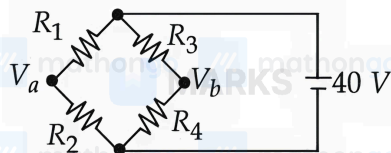
Q5. JEE Main 2026 (28 January Shift 2)

Which one of the following is not a measurable quantity?

- (1) Voltage (2) Resistance
(3) Displacement current (4) Voltage difference

Q6. JEE Main 2026 (28 January Shift 2)

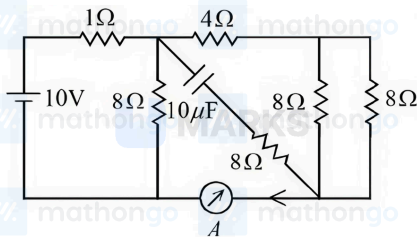
A Wheatstone bridge is initially at room temperature and all arms of the bridge have same value of resistances ($R_1 = R_2 = R_3 = R_4$). When R_3 resistance is heated to some temperature, its resistance value has gone up by 10%. The potential difference ($V_a - V_b$) (after R_3 is heated) is ____ V.



- (1) 1.05 (2) 0.95 (3) 0 (4) 2

Q7. JEE Main 2026 (24 January Shift 2)

The reading of the ammeter (A) in steady state in the following circuit (assuming negligible internal resistance of the ammeter) is ____ A.



- (1) 1 (2) $1/2$ (3) 0 (4) 2

Q8. JEE Main 2026 (24 January Shift 2)

A moving coil galvanometer of resistance 100Ω shows a full scale deflection for a current of 1 mA. The value of resistance required to convert this galvanometer into an ammeter, showing full scale deflection for a current of 5 mA, is ____ Ω

- (1) 0.5 (2) 2.5 (3) 10 (4) 25

Q9. JEE Main 2026 (24 January Shift 2)

A regular hexagon is formed by six wires each of resistance $r\Omega$ and the corners are joined to the centre by wires of same resistance. If the current enters at one corner and leaves at the opposite corner, the equivalent resistance of the hexagon between the two opposite corners will be

- (1) $\frac{3}{4}r$ (2) $\frac{4}{5}r$ (3) $\frac{3}{5}r$ (4) $\frac{5}{8}r$

Q10. JEE Main 2026 (24 January Shift 2)

In a meter bridge experiment to determine the value of unknown resistance, first the resistances 2Ω and 3Ω are connected in the left and right gaps of the bridge and the null point is obtained at a distance l cm from the left. Now when an unknown resistance $x\Omega$ is connected in parallel to 3Ω resistance, the null point is shifted by 10 cm to the right of wire. The value of unknown resistance x is _____ Ω .

Q11. JEE Main 2026 (22 January Shift 2)

An electric power line having total resistance of 2Ω , delivers 1 kW of power at 250 V. The percentage efficiency of transmission line is _____.

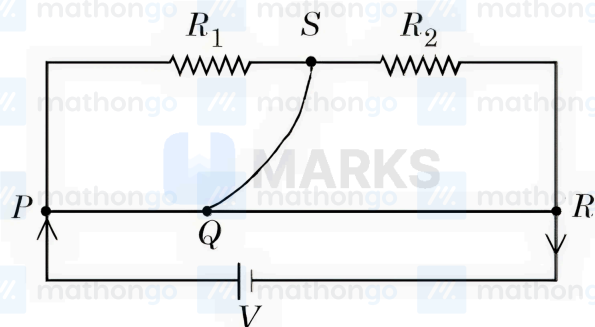
- (1) 100 (2) 92.5 (3) 96.9 (4) 86.5

Q12. JEE Main 2026 (22 January Shift 2)

A cylindrical conductor of length 2 m and area of cross-section 0.2 mm^2 carries an electric current of 1.6 A when its ends are connected to a 2 V battery. Mobility of electrons in the conductor is $\alpha \times 10^{-3} \text{ m}^2/\text{V.s}$. The value of α is :
(electron concentration = $5 \times 10^{28}/\text{m}^3$ and electron charge = $1.6 \times 10^{-19}\text{C}$)

Q13. JEE Main 2026 (22 January Shift 1)

A meter bridge with two resistances R_1 and R_2 as shown in figure was balanced (null point) at 40 cm from the point P . The null point changed to 50 cm from the point P , when 16Ω resistance is connected in parallel to R_2 . The values of resistances R_1 and R_2 are _____.



- (1) $R_2 = 4\Omega, R_1 = \frac{4}{3}\Omega$ (2) $R_2 = 16\Omega, R_1 = \frac{16}{3}\Omega$
(3) $R_2 = 12\Omega, R_1 = \frac{12}{3}\Omega$ (4) $R_2 = 8\Omega, R_1 = \frac{16}{3}\Omega$

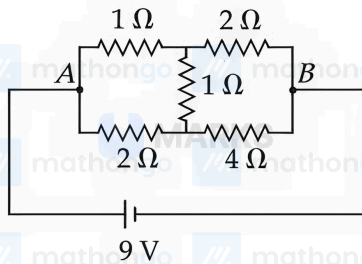
Q14. JEE Main 2026 (23 January Shift 2)

To compare EMF of two cells using potentiometer the balancing lengths obtained are 200 cm and 150 cm. The least count of scale is 1 cm. The percentage error in the ratio of EMFs is _____.

- (1) 1.65 (2) 1.45 (3) 1.75 (4) 1.16

Q15. JEE Main 2026 (21 January Shift 1)

The heat generated in 1 minute between points A and B in the given circuit, when a battery of 9 V with internal resistance of 1Ω is connected across these points is ____ J .



Q16. JEE Main 2026 (28 January Shift 1)

For the two cells having same EMF E and internal resistance r , the current passing through the external resistor 6Ω is same when both the cells are connected either in parallel or in series. The value of internal resistance r is ____ Ω .

- (1) 6 (2) 3 (3) 4 (4) 9

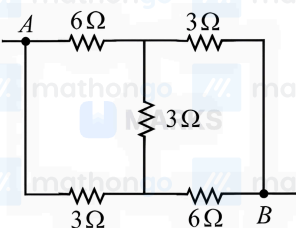
Q17. JEE Main 2026 (28 January Shift 1)

In the potentiometer, when the cell in the secondary circuit is shunted with 4Ω resistance, the balance is obtained at the length 120 cm of wire. Now when the same cell is shunted with 12Ω resistance, the balance is shifted to a length of 180 cm . The internal resistance of cell is ____ Ω

- (1) 4 (2) 12 (3) 6 (4) 3

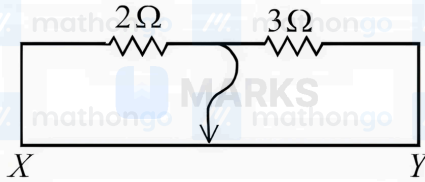
Q18. JEE Main 2026 (28 January Shift 1)

The equivalent resistance between the points A and B in the following circuit is $\frac{x}{5}\Omega$. The value of x is ____.



Q19. JEE Main 2026 (24 January Shift 1)

Two resistors 2Ω and 3Ω are connected in the gaps of bridge as shown in figure. The null point is obtained with the contact of jockey at some point on wire XY . When an unknown resistor is connected in parallel with 3Ω resistor, the null point is shifted by 22.5 cm toward Y . The resistance of unknown resistor is ____ Ω .



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

Q20. JEE Main 2026 (24 January Shift 1)

Two resistors of 100Ω each are connected in series with a 9 V battery. A voltmeter of 400Ω resistance is connected to measure the voltage drop across one of the resistors. The voltmeter reading is ____ V .

- (1) 2 (2) 3 (3) 4 (4) 4.5

ANSWERS AND SOLUTIONS

1. (1) 2. (2) 3. (3) 4. (2) 5. (1) 6. (2) 7. (1) 8. (4)
9. (2) 10. 6 11. (3) 12. 1 13. (4) 14. (4) 15. 1080 16. (1)
17. (1) 18. 21 19. (1) 20. (3)

1. (1) The circuit has $2R$ and X in series (top branch) parallel to R (bottom branch).

The equivalent resistance is $R_{eq} = \frac{(2R+X) \cdot R}{3R+X} = X$.

Setting up the equation: $X(3R + X) = R(2R + X)$, which simplifies to $X^2 + 2RX - 2R^2 = 0$.

Using the quadratic formula: $X = \frac{-2R \pm 2R\sqrt{3}}{2} = R(-1 \pm \sqrt{3})$.

Since resistance must be positive, $X = (\sqrt{3} - 1)R \Omega$.

2. (2) In this potentiometer, for zero galvanometer reading, the potential at P must equal the potential at the junction between the 6Ω and 4Ω resistors.

The voltage distribution across the resistors is $V_{junction} = E \times \frac{6}{6+4} = 0.6E$ from point A.

Since the potentiometer wire is uniform with length 50 cm, the potential distribution is also uniform.

Therefore, $\frac{AP}{AB} = \frac{6}{10}$, giving $AP = 50 \times 0.6 = 30$ cm.

3. (3) Power consumed in external resistance R is $P = \frac{E^2 R}{(R+r)^2}$.

To find maximum, differentiate with respect to R :

$$\frac{dP}{dR} = E^2 \frac{(R+r)^2 - 2R(R+r)}{(R+r)^4} = E^2 \frac{r-R}{(R+r)^3}$$

$$\frac{dP}{dR} = 0 \text{ gives } R = r.$$

This is the maximum power transfer theorem: maximum power is delivered when the external load resistance equals the source internal resistance.

4. (2) The wire bent into a circle of radius r has resistance $\lambda \cdot \pi r$ for the semicircular arcs, and the straight wire of length $2r$ has resistance $\lambda \cdot 2r$. The three paths between A and B (two semicircular arcs of the circle and one straight wire through center) are in parallel.

$$\frac{1}{R_{AB}} = \frac{2}{\lambda \pi r} + \frac{1}{\lambda \cdot 2r} + \frac{2}{\lambda \cdot 3\pi r}$$

$$= \frac{1}{\lambda r} \left[\frac{2}{\pi} + \frac{1}{2} + \frac{2}{3\pi} \right]$$

$$= \frac{1}{\lambda r} \left(\frac{12+3\pi+4}{6\pi} \right) = \frac{1}{\lambda r} \cdot \frac{16+3\pi}{6\pi}$$

$$R_{AB} = \lambda r \left(\frac{6\pi}{16+3\pi} \right) = \frac{6\pi \lambda r}{3\pi+16}$$

5. (1) In electrostatics and circuit theory, potential (voltage) at a single point is defined relative to a reference point (usually infinity or ground where potential is assumed to be zero).

Absolute voltage at a point is not a physically measurable quantity because only the difference in potential between two points can be measured using instruments like a voltmeter.

Resistance can be measured using an ohmmeter or bridge circuits.

Displacement current is a physical quantity that can be calculated and its effects (magnetic field) can be measured.

Voltage difference (potential difference) is the standard quantity measured between two points in a circuit.

Therefore, absolute voltage is not a measurable quantity.

6. (2) Initially, the Wheatstone bridge is balanced with $R_1 = R_2 = R_3 = R_4 = R$.

Since the bridge is balanced, the potential difference across the bridge is zero: $V_a - V_b = 0$ V.

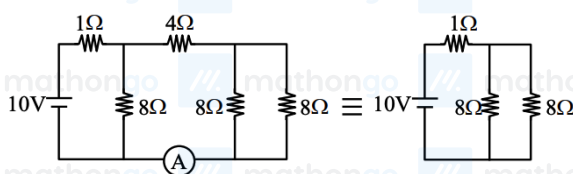
When R_3 is heated and its resistance increases by 10%: $R'_3 = 1.1R$

The voltage at node a (between R_1 and R_2): $V_a = 40 \times \frac{R_2}{R_1 + R_2} = 40 \times \frac{R}{R + R} = 40 \times \frac{1}{2} = 20$ V

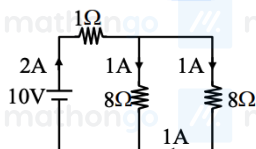
The voltage at node b (between R'_3 and R_4): $V_b = 40 \times \frac{R_4}{R'_3 + R_4} = 40 \times \frac{R}{1.1R + R} = 40 \times \frac{1}{2.1} \approx 19.05$ V

Therefore: $V_a - V_b = 20 - 19.05 = 0.95$ V

7. (1) In steady state,



$$I = 2\text{ A}$$



The ammeter reads 1 A.

8. (4) To convert a galvanometer to an ammeter, a shunt resistance S is connected in parallel. For full-scale deflection:

Current through galvanometer: $I_g = 1$ mA

Total current: $I = 5$ mA

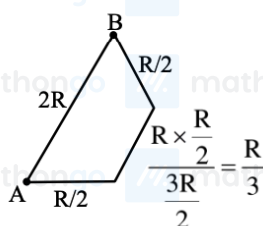
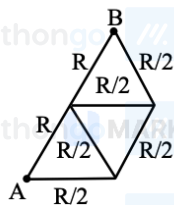
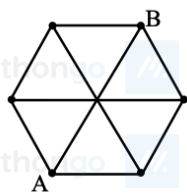
Current through shunt: $I_s = 5 - 1 = 4$ mA

Since voltage across both is equal: $I_g \cdot G = I_s \cdot S$

$$0.001 \times 100 = 0.004 \times S$$

$$S = \frac{0.1}{0.004} = 25 \Omega$$

9.



(2)

$$R_{eq} = \frac{2R \times \frac{4R}{3}}{2R + \frac{4R}{3}} = \frac{8R^2}{10R} = \frac{4}{5}R$$

10. (6) Meter bridge null point condition: $\frac{R_1}{R_2} = \frac{l}{100-l}$

Initial: $R_1 = 2\Omega$, $R_2 = 3\Omega$, null at l cm

$\frac{2}{3} = \frac{l}{100-l}$ gives $2(100-l) = 3l$, so $l = 40$ cm

When $x\Omega$ connected in parallel with 3Ω : $R'_2 = \frac{3x}{3+x}\Omega$

New null point at $(40 + 10) = 50$ cm from left:

$$\frac{2}{R'_2} = \frac{50}{50} = 1$$

$$\frac{2(3+x)}{3x} = 1 \text{ gives } 6 + 2x = 3x$$

$$x = 6\Omega$$

11. (3) Current in transmission line: $I = \frac{P}{V} = \frac{1000}{250} = 4$ A.

Power loss: $P_{loss} = I^2 R = 4^2 \times 2 = 32$ W.

Efficiency: $\eta = \frac{P - P_{loss}}{P} \times 100\%$

$$= \frac{1000 - 32}{1000} \times 100\%$$

$$= 96.8\% \text{ which rounds to } 96.9\%.$$

12. (1) For a cylindrical conductor with length 2 m, cross-section $0.2 \text{ mm}^2 = 0.2 \times 10^{-6} \text{ m}^2$, carrying 1.6 A at 2 V.

Resistance: $R = V/I = 2/1.6 = 1.25 \Omega$.

Resistivity: $\rho = RA/L = 1.25 \times 0.2 \times 10^{-6}/2$

$$= 0.125 \times 10^{-6} \Omega \cdot \text{m}.$$

Using $\rho = 1/(ne\mu)$, mobility: $\mu = 1/(ne\rho)$

$$= 1/(5 \times 10^{28} \times 1.6 \times 10^{-19} \times 0.125 \times 10^{-6})$$

$$= 1/(1 \times 10^3) = 10^{-3} \text{ m}^2/\text{V}\cdot\text{s}.$$

Thus $\alpha = 1$.

13. (4) Initial balance at 40 cm: $\frac{R_1}{R_2} = \frac{40}{60} = \frac{2}{3} \dots(i)$

With 16Ω parallel to R_2 , null point at 50 cm:

$$\frac{R_1}{\frac{16R_2}{16+R_2}} = \frac{50}{50} = 1 \Rightarrow R_1 = \frac{16R_2}{16+R_2} \dots(ii)$$

From (i): $R_1 = \frac{2}{3}R_2$.

Substituting in (ii): $\frac{2}{3}R_2 = \frac{16R_2}{16+R_2}$.

$$\frac{2}{3} = \frac{16}{16+R_2} \Rightarrow 2(16+R_2) = 48 \Rightarrow R_2 = 8 \Omega.$$

$$R_1 = \frac{16}{3} \Omega.$$

14. (4) $\epsilon = \lambda \ell$ (Potential gradient)

$$\epsilon_1 = \lambda \ell_1$$

$$\epsilon_2 = \lambda \ell_2$$

$$y = \frac{\epsilon_1}{\epsilon_2} = \frac{\ell_1}{\ell_2}$$

$$\frac{\Delta y}{y} = \frac{\Delta \ell_1}{\ell_1} + \frac{\Delta \ell_2}{\ell_2}$$

$$\frac{\Delta y}{y} = \frac{1}{200} + \frac{1}{150}$$

$$\frac{\Delta y}{y} \times 100 = \left(\frac{1}{200} + \frac{1}{150} \right) \times 100 = \left(\frac{3+4}{600} \right) \times 100 = \frac{7}{6} = 1.16\%$$

15. (1080) Wheatstone bridge with $P = 1\Omega$, $Q = 2\Omega$, $R = 2\Omega$, $S = 4\Omega$

$$\frac{P}{Q} = \frac{R}{S} = \frac{1}{2} \rightarrow \text{Bridge is balanced, no current through middle } 1\Omega.$$

$$R_{AB}: \text{Upper } (3\Omega) \text{ and Lower } (6\Omega) \text{ in parallel} = \frac{3 \times 6}{9} = 2\Omega$$

$$\text{Total resistance} = 1 + 2 = 3\Omega$$

$$\text{Current } I = \frac{9}{3} = 3 \text{ A}$$

$$\text{Power between A and B: } P = I^2 R_{AB} = 9 \times 2 = 18 \text{ W}$$

$$\text{Heat in 1 min} = 18 \times 60 = 1080 \text{ J}$$

16. (1) For series connection of two cells: $I_s = \frac{2E}{2r+6}$.

$$\text{For parallel connection: } I_p = \frac{E}{r/2+6} = \frac{2E}{r+12}.$$

$$\text{Given } I_s = I_p: \frac{2E}{2r+6} = \frac{2E}{r+12}$$

$$\text{This gives } 2r + 6 = r + 12, \text{ so } r = 6\Omega.$$

17. (1) In a potentiometer, the internal resistance r of a cell is given by the formula $r = R \left(\frac{l_0}{l} - 1 \right)$, where l_0 is the balancing length in open circuit, l is the balancing length when shunted with resistance R .

This can be rewritten as $\frac{l_0}{l} = 1 + \frac{r}{R}$ or $l = \frac{l_0}{1+r/R}$.

Case 1: $R_1 = 4\Omega$ and $l_1 = 120$ cm.

$$120 = \frac{l_0}{1+r/4} = \frac{4l_0}{4+r} \dots (i)$$

Case 2: $R_2 = 12\Omega$ and $l_2 = 180$ cm.

$$180 = \frac{l_0}{1+r/12} = \frac{12l_0}{12+r} \dots (ii)$$

Dividing equation (ii) by (i):

$$\frac{180}{120} = \frac{12l_0}{12+r} \times \frac{4+r}{4l_0}$$

$$\frac{3}{2} = \frac{3(4+r)}{12+r}$$

$$\frac{1}{2} = \frac{4+r}{12+r}$$

$$12 + r = 8 + 2r$$

$$r = 4\Omega$$

The internal resistance of the cell is 4Ω .

18. (21) Using Kirchhoff's laws on the bridge circuit with resistances $6\Omega, 3\Omega, 3\Omega, 6\Omega$ and applying a 1V test voltage:

From the loop equation:

$$6i_1 + 3(2i_1 - i) = 3(i - i_1)$$

$$15i_1 = 6i \Rightarrow i_1 = \frac{2}{5}i \dots (1)$$

From the second loop:

$$3(i - i_1) + 6i_1 = 1$$

$$3i + 3i_1 = 1$$

$$\left(3 + \frac{6}{5} \right) i = 1$$

$$i = \frac{5}{21} \text{ A} = \frac{1V}{R_{eq}}$$

$$R_{eq} = \frac{21}{5} = 4.2 \Omega$$

19. (1) In a Wheatstone bridge with 2Ω and 3Ω , the null point is found when $\frac{R_1}{R_2} = \frac{l}{L-l}$.

Initial balance: $\frac{2}{3} = \frac{l_1}{L-l_1}$ gives $l_1 = \frac{2L}{5}$.

For standard wire length $L = 100$ cm, $l_1 = 40$ cm.

When unknown resistance R is connected in parallel with 3Ω , equivalent resistance becomes $\frac{3R}{3+R}$.

New null point: $\frac{2}{\frac{3R}{3+R}} = \frac{l_2}{L-l_2}$, which simplifies to $\frac{2(3+R)}{3R} = \frac{l_2}{L-l_2}$.

Null point shifts 22.5 cm toward Y: $l_2 = 40 + 22.5 = 62.5$ cm.

Substituting: $\frac{2(3+R)}{3R} = \frac{62.5}{37.5} = \frac{5}{3}$

$$6(3+R) = 15R \Rightarrow 18 = 9R \Rightarrow R = 2 \Omega$$

20. (3) When the 400Ω voltmeter is connected in parallel with one 100Ω resistor, the equivalent resistance is

$$R_{eq} = \frac{100 \times 400}{500} = 80\Omega.$$

Total circuit resistance: $R_{total} = 100 + 80 = 180\Omega$.

Circuit current: $I = 9/180 = 0.05$ A.

Voltmeter reading (voltage across parallel combination): $V = 0.05 \times 80 = 4$ V