Engineering Daily 22 [Set 04] EV

Current Electricity

Total Marks: 50 **Negative Marks:** 0.25 **Time:** 1 Hour

MCQ 50 marks

1. 3×10^{20} electrons flow through any cross-section of a 15 Ω wire every minute. How much heat is produced in the wire in 2 min?

(A) 9.6 J (B) 1440 J (C) 1152 J (D) 576 J

2. The current in a conductor rises uniformly from 0 to 4 A in the first 5 s and then stays constant for the next 3 s. What is the total charge that flows in these 8 s?

(A) 20 C (B) 22 C (C) 12 C (D) 32 C

3. Two wires of the same material are connected in series. If the ratio of their radii is 1 : 2, what is the ratio of the drift velocities of electrons in them?

(A) 2 : 1 (B) 1 : 4 (C) 1 : 2 (D) 4 : 1

4. A current of 3 A flows through a 1 m long copper wire of cross-sectional area 1.5 mm^2 ($n = 8.4 \times 10^{28}$ m^{-3}). Approximately how long does a free electron take to drift from one end of the wire to the other?

(A) 3.73 h (B) 1.87 h

(C) 31.1 min (D) 6.72 s

5. A wire of resistance 3 Ω is stretched so that its radius becomes half. What is the new resistance of the wire?

(A) 12 Ω (B) 48 Ω (C) 6 Ω (D) 24 Ω

6. A uniform wire of resistance 16 Ω is bent into a square. What is the equivalent resistance between any two adjacent corners of the square?

(A) 12 Ω (B) 3 Ω (C) 16 Ω (D) 4 Ω

7. The temperature coefficient of resistance of platinum is 0.0039 $°C^{-1}$. At what temperature will the resistance of a platinum wire be twice its resistance at 0°C?

(A) 390°C (B) 512.8°C

(C) 128.2°C (D) 256.4°C

8. The ratio of the lengths of two copper wires of equal mass is 1 : 2. What is the ratio of their resistances?

(A) 1 : 8 (B) 1 : 2 (C) 1 : 4 (D) 2 : 1

9. A wire of length 50 cm and diameter 0.4 mm has a resistance of 4 Ω. What is the resistivity of the material of the wire?

(A) 5.03×10^{-7} Ωm (B) 4.02×10^{-6} Ωm

(C) 2.51×10^{-7} Ωm (D) 1.01×10^{-6} Ωm

10. Resistors of 6 Ω and 3 Ω are connected in parallel, and resistors of 4 Ω and 4 Ω are connected in parallel. The two combinations are connected in series to an ideal 8 V source. What is the power dissipated in the 3 Ω resistor?

(A) 4 W (B) 5.33 W (C) 2.67 W (D) 8 W

11. Using all three resistors of 2 Ω each, which of the following equivalent resistances is NOT possible?

(A) 1 Ω (B) 6 Ω (C) $\frac{4}{3}$ Ω (D) 3 Ω

12. When a 2 Ω external resistor is connected to a battery, the terminal voltage is 4 V, and with a 5 Ω external resistor it is 5 V. What is the emf of the battery?

(A) 5.5 V (B) 6 V (C) 7 V (D) 9 V

13. A battery of internal resistance 0.5 Ω supplies current to an external resistor. If 20% of the total power generated by the battery is wasted as heat in the internal resistance, what is the value of the external resistance?

(A) 0.1 Ω (B) 0.4 Ω (C) 2 Ω (D) 2.5 Ω

14. Two cells, 6 V (internal resistance 1 Ω) and 2 V (internal resistance 1 Ω), are connected in series in opposition and joined to an external resistance of 2 Ω . What is the current?

(A) 0.5 A (B) 1.33 A (C) 2 A (D) 1 A

15. Two cells of emf 1.5 V each, with internal resistances 0.5 Ω and 1 Ω, are connected in parallel to an external resistance of 2 Ω. What is the current through the external resistance?

(A) 0.6 A (B) 0.75 A (C) 0.643 A (D) 1.2 A

16. n identical cells are connected once in series and once in parallel to the same external resistance R, and the current is the same in both cases. If the internal resistance of each cell is r, then—

(A) $R = n^2 r$ (B) $R = nr$ (C) $R = r$ (D) $R = \frac{r}{n}$

17. In the graph of terminal voltage versus current for a battery (with V on the vertical axis), the line cuts the V axis at 12 V and the I axis at 6 A. What is the current when a 4 Ω external resistor is connected to the battery?

(A) 6 A (B) 2 A (C) 1.5 A (D) 3 A

18. In a meter bridge, a wire coil is placed in the left gap and a 15 Ω resistor in the right gap, and at 0°C the null point is 40 cm from the left end. If the temperature coefficient of the coil is 0.004 $°C^{-1}$, where will the null point shift when the coil is heated to 100°C?

(A) 44.4 cm (B) 56 cm (C) 51.7 cm (D) 48.3 cm

19. The potential gradient of a potentiometer wire is 0.02 Vcm^{-1}. If the potential difference across a 2 Ω resistor is balanced at a length of 45 cm of the wire, what is the current through the resistor?

(A) 0.45 A (B) 0.9 A

(C) 1.8 A (D) 0.225 A

20. A potentiometer wire of length 100 cm and resistance 10 Ω, a resistor R and a driver cell of 2 V (negligible internal resistance) are connected in series. If a cell of emf 1 V has a balancing length of 60 cm, what is the value of R?

Ⓐ 6 Ω Ⓑ 2 Ω Ⓒ 1.67 Ω Ⓓ 8 Ω

21. In a Wheatstone bridge with P = 5 Ω, Q = 10 Ω, R = 15 Ω and S = 30 Ω, if the positions of the battery and the galvanometer are interchanged—

Ⓐ the bridge will still remain balanced

Ⓑ the balance of the bridge will be lost

Ⓒ the battery current will become zero

Ⓓ maximum current will flow through the galvanometer

22. A 30 Ω resistor is connected in series with a potentiometer wire of length 1 m and resistance 10 Ω, and a driver cell of 4 V (negligible internal resistance) is connected. What is the balancing length for a cell of emf 0.6 V?

Ⓐ 40 cm Ⓑ 60 cm Ⓒ 15 cm Ⓓ 6 cm

23. A shunt equal to $\frac{1}{9}$ of the resistance of a galvanometer is connected to it. What fraction of the main current passes through the galvanometer?

Ⓐ 11.1% Ⓑ 1% Ⓒ 10% Ⓓ 90%

24. A galvanometer becomes a voltmeter of range 0–2 V when a 1950 Ω resistor is connected in series, and of range 0–5 V when a 4950 Ω resistor is connected in series. What is the resistance of the galvanometer?

Ⓐ 100 Ω Ⓑ 25 Ω Ⓒ 75 Ω Ⓓ 50 Ω

25. A 1000 W iron runs 30 min daily and a 120 W TV runs 5 h daily. If each unit costs 7 taka, what is the bill for 30 days?

Ⓐ 231 taka Ⓑ 336 taka

Ⓒ 33 taka Ⓓ 126 taka

26. To measure the current in a circuit with an ideal 12 V source and a 10 Ω resistor, an ammeter of resistance 2 Ω is connected in series. What is the percentage error in the current measurement due to the ammeter?

Ⓐ 1.67% Ⓑ 20% Ⓒ 16.7% Ⓓ 83.3%

27. A 10 Ω resistor is connected to a battery of emf 6 V and internal resistance 0.5 Ω. An ammeter of resistance 0.5 Ω is mistakenly connected in parallel with the 10 Ω resistor. What will the ammeter read?

Ⓐ 0.57 A Ⓑ 5.85 A Ⓒ 6.15 A Ⓓ 12 A

28. Two 6 Ω resistors are connected in parallel and a 3 Ω resistor is connected in series with them, and the combination is connected to a source. What is the ratio of the heat produced in the 3 Ω resistor to that in either one of the 6 Ω resistors in the same time?

Ⓐ 2 : 1 Ⓑ 1 : 2 Ⓒ 1 : 1 Ⓓ 4 : 1

29. A '220 V – 1000 W' heater boils a certain amount of water in 5 min on a 220 V line. How long will the same heater take to boil the same water on a 110 V line? (Resistance constant; neglect heat loss)

Ⓐ 20 min Ⓑ 40 min

Ⓒ 2.5 min Ⓓ 10 min

30. What will be the power of a '220 V – 100 W' bulb when it is operated on a 200 V line? (Assume constant resistance)

Ⓐ 100 W Ⓑ 75.6 W Ⓒ 82.6 W Ⓓ 90.9 W

31. In a part of a circuit, going from point a one passes in order a 2 Ω resistor, a 6 V battery (positive terminal towards b, negligible internal resistance) and a 3 Ω resistor, and then reaches point b. If a current of 1 A flows from a towards b, what is $V_a - V_b$?

Ⓐ −1 V Ⓑ 1 V Ⓒ 11 V Ⓓ −11 V

32. Four equal resistors are connected once in series and once in parallel across the same potential difference. What is the ratio of the power dissipated in the parallel combination to that in the series combination?

Ⓐ 1 : 4 Ⓑ 4 : 1 Ⓒ 16 : 1 Ⓓ 1 : 16

33. At 20°C, a coil draws 2 A from a 12 V source. After running for some time, it heats up and draws 1.6 A from the same source. If the temperature coefficient of the coil (with respect to 0°C) is 0.004 $°C^{-1}$, what is its final temperature?

Ⓐ 107.5°C Ⓑ 62.5°C

Ⓒ 82.5°C Ⓓ 87.5°C

34. The resistance of a tungsten bulb when glowing is 10 times its resistance at 20°C. If the temperature coefficient of tungsten (with respect to 0°C) is 0.0045 $°C^{-1}$, what is the temperature of the filament when glowing?

Ⓐ 2020°C Ⓑ 2420°C

Ⓒ 2000°C Ⓓ 2200°C

35. The V –I graphs of two conductors (with V on the vertical axis and I on the horizontal axis) are straight lines through the origin making angles of 30° and 60° with the I axis respectively. What is the ratio of the resistances of the two conductors?

Ⓐ $1 : \sqrt{3}$ Ⓑ 3 : 1 Ⓒ 1 : 2 Ⓓ 1 : 3

36. A copper wire and an aluminium wire have equal length and equal resistance. The resistivity of copper is 1.7×10^{-8} Ωm and its density is 8900 kgm^{-3}; the resistivity of aluminium is 2.8×10^{-8} Ωm and its density is 2700 kgm^{-3}. What is the approximate ratio of the mass of the copper wire to that of the aluminium wire?

Ⓐ 2 : 1 Ⓑ 3.3 : 1

Ⓒ 1 : 2 Ⓓ 1.65 : 1

37. If the potential difference across a conductor is kept unchanged and its length is doubled (same cross-section), the drift velocity of the electrons—

(A) will become four times (B) will be halved

(C) will remain unchanged (D) will be doubled

38. Each of the 12 edges of a cube has a resistance of 4 Ω . What is the equivalent resistance between the two ends of a face diagonal of the cube?

(A) 3.33 Ω (B) 4 Ω (C) 3 Ω (D) 2.33 Ω

39. The power dissipated in a 2 Ω external resistor connected to a cell is the same as that dissipated when an 8 Ω external resistor is connected. What is the internal resistance of the cell?

(A) 6 Ω (B) 3 Ω (C) 5 Ω (D) 4 Ω

40. A battery of emf 12 V and internal resistance 0.2 Ω is to be charged at 5 A from a 15 V DC source. What resistance must be connected in series with the source?

(A) 0.4 Ω (B) 0.2 Ω (C) 3 Ω (D) 0.6 Ω

41. Two 10 kΩ resistors are connected in series to an ideal 20 V source. If a voltmeter of resistance 10 kΩ is connected across one of the resistors, what does it read?

(A) 13.33 V (B) 5 V

(C) 10 V (D) 6.67 V

42. An ammeter is made by connecting a 1 Ω shunt to a galvanometer of resistance 99 Ω. If the shunt is halved, by approximately what factor does the range of the ammeter increase?

(A) 4 times (B) 2 times

(C) 0.5 times (D) 1.99 times

43. Eight cells, each of 1.5 V and internal resistance 0.4 Ω, are arranged in two rows with 4 cells in series in each row. What is the current when the arrangement is connected to an external resistance of 1.2 Ω?

(A) 2.14 A (B) 3 A (C) 4 A (D) 1.5 A

44. A completely discharged '12 V – 40 Ah' battery is being charged at 5 A. If the charging efficiency is 80%, how long will it take to become fully charged?

(A) 10 h (B) 8 h (C) 12.5 h (D) 6.4 h

45. The coil of a heater boils a certain amount of water in 12 min. If the coil is cut into two equal pieces and the pieces are connected in parallel to the same source, how long will it take to boil the same water?

(A) 3 min (B) 24 min (C) 48 min (D) 6 min

46. Maximum power is transferred to the external resistance when a 2 Ω resistor is connected to a battery. What must the external resistance be for the efficiency of the battery to be 80%?

(A) 4 Ω (B) 1.6 Ω (C) 8 Ω (D) 10 Ω

47. Two bulbs rated '220 V – 40 W' and '220 V – 60 W' are connected in series across a 220 V source. What is the total power dissipated?

(A) 50 W (B) 100 W (C) 24 W (D) 20 W

48. Two batteries, 10 V (internal resistance 1 Ω) and 5 V (internal resistance 2 Ω), are connected in parallel with their positive terminals together. A 5 Ω external resistor is connected to this combination. What is the current through the external resistor?

(A) 1.88 A (B) 1.47 A (C) 1.15 A (D) 2 A

49. When two resistors R_1 and R_2 are connected in parallel to a source, the power dissipated in R_1 is 3 times that in R_2. If the resistors are connected in series to another source, what will be the ratio of the power dissipated in R_1 to that in R_2?

(A) 1 : 3 (B) 3 : 1 (C) 9 : 1 (D) 1 : 9

50. A cell of emf 1.5 V and internal resistance 0.25 Ω supplies a current of 2 A for 5 min. How much electrical energy is delivered to the external circuit in this time?

(A) 600 J (B) 300 J (C) 900 J (D) 1200 J