EnterMedSchool.org

Electricity: Ohm's Law and Capacitors

Exam — Electricity

Pre-med style questions on current, voltage, resistance, power, series/parallel circuits, meters, internal resistance, and capacitors (Q=CV, series/parallel, energy, dielectrics, and RC charging/discharging). Focused on conceptual traps and exam-style reasoning.

75 items — Printable Exam

Free & Open-Source

Generated February 20, 2026

Scan to visit online

1 **Electric current is best defined as:**

- A The total charge contained in a wire
- B The energy carried by electrons each second
- C The force pushing charges through a conductor
- D The rate of flow of electric charge
- E The resistance of a circuit to charge flow

2 **In a metal wire connected to a battery, the direction of conventional current is:**

- A The same direction as electron drift
- B Opposite to electron drift
- C Always from the negative terminal to the positive terminal in the external circuit
- D Random because electrons move randomly
- E Only within the battery, not in the wire

3 **Potential difference (voltage) between two points is best interpreted as:**

- A Charge per unit time
- B Energy transferred per unit charge
- C Force per unit charge
- D Energy transferred per unit time
- E Resistance per unit length

4 **A battery has emf E and internal resistance r. When it delivers current to an external circuit, the terminal potential difference is typically:**

A Greater than E because current "boosts" the voltage

B Equal to E for any current

C Less than E because some energy per charge is lost inside the battery

D Zero because voltage is used up in the battery

E Negative because internal resistance reverses polarity

5 **Ohm's law states that for an ohmic conductor:**

A Current is proportional to resistance

B Voltage is proportional to resistance

C Voltage is proportional to current, provided temperature (and other physical conditions) are constant

D Power is proportional to current

E Resistance is proportional to voltage for all materials

6 **Which component is most likely to be approximately ohmic over a wide range of currents at constant temperature?**

A A filament lamp

B A fixed metal resistor

C A diode

D An LED

E A thermistor

7 **A graph of voltage V (vertical axis) against current I (horizontal axis) for an ohmic resistor is a straight line through the origin. The slope of this line equals:**

A 1/R

B R

C Power

D Charge

E Capacitance

8 **A graph of current I (vertical axis) against voltage V (horizontal axis) for an ohmic resistor is a straight line through the origin. The slope of this line equals:**

A R

B 1/R

C IR

D V/R^2

E Capacitance

9 **A resistor stays at constant temperature. If the potential difference across it doubles, the current through it will:**

A Halve

B Double

C Quadruple

D Stay the same

E Become zero

10 **A uniform wire has resistance R. If its length is doubled (same material and cross-sectional area), its resistance becomes:**

A $R/2$

B R

C $2R$

D $4R$

E R^2

11 **A uniform wire has resistance R. If its cross-sectional area is doubled (same material and length), its resistance becomes:**

A $2R$

B R

C $R/2$

D $4R$

E R^2

12 **Which statement about resistivity is correct?**

A depends on the length of the conductor

B depends on the cross-sectional area of the conductor

C is a property of the material (and temperature), not the object's shape

D is the same as resistance R

E is measured in ohms (Ω)

13 **As the temperature of a typical metal wire increases, its resistance usually:**

A Decreases because electrons move faster

B Increases because lattice vibrations cause more collisions

C Stays constant because resistance depends only on length

D Becomes zero

E Becomes negative

14 **A filament lamp is connected to a battery. As the current increases, the filament heats up. Which best describes the lamp's I–V behavior?**

A Linear: V is always proportional to I

B Nonlinear: resistance increases with current/temperature, so the slope V/I increases

C Nonlinear: resistance decreases with current/temperature, so the slope V/I decreases

D The current becomes independent of voltage

E The lamp becomes a perfect conductor at higher current

15 **An NTC thermistor is a component whose resistance decreases when temperature increases. Which best explains why it is non-ohmic in typical use?**

A Because Ohm's law never applies to semiconductors

B Because the resistance changes as current heats it, so V is not proportional to I under changing temperature

C Because it has zero resistance at all temperatures

D Because it only works in parallel circuits

E Because current is not defined in thermistors

16 **Two resistors are connected in series to a battery. Which statement is always true (ideal components)?**

A The voltage across each resistor is the same

B The current through each resistor is the same

C The power dissipated by each resistor is the same

D The resistance of the combination is less than each resistor

E The total current equals the sum of currents through each resistor

17 **Two resistors R1 and R2 are connected in series. If R2 $>$ R1, then the voltage drop across R2 is:**

A Smaller than across R1 because current chooses the easier path

B Equal to across R1 because series circuits share voltage equally

C Greater than across R1 because the same current flows and $V = IR$

D Zero because the larger resistor blocks the circuit

E Unpredictable without knowing the battery's internal resistance

18 **Two resistors are connected in parallel to a battery. Which statement is always true (ideal components)?**

A The current through each resistor is the same

B The voltage across each resistor is the same

C The equivalent resistance is the sum of the resistances

D The voltage across the combination is zero

E The power dissipated by each resistor is equal

19 **Which statement about equivalent resistance is correct?**

A Two resistors in series have an equivalent resistance smaller than either one

B Two resistors in parallel have an equivalent resistance larger than either one

C For two resistors in parallel, the equivalent resistance is less than the smaller resistor

D Series and parallel give the same equivalent resistance

E Equivalent resistance is always the average of the resistances

20 **A circuit has a fixed battery voltage and a single resistor. If a second resistor is added in series, the total current drawn from the battery will:**

A Increase

B Decrease

C Stay the same

D Become zero for any added resistor

E Reverse direction

21 **A circuit has a fixed battery voltage and a single resistor. If a second resistor is added in parallel, the total current drawn from the battery will:**

- A Decrease because current splits
- B Increase because total equivalent resistance decreases
- C Stay the same because voltage stays the same
- D Become zero because parallel cancels resistance
- E Become unpredictable

22 **A single identical bulb is connected to an ideal battery. Then two identical bulbs are connected in series to the same battery. Compared with the single-bulb case, each bulb in series will be:**

- A Brighter
- B Dimmer
- C Same brightness
- D Off (no current flows)
- E Brightness cannot be compared without the bulb's color

23 **A single identical bulb is connected to an ideal battery. Then two identical bulbs are connected in parallel to the same battery. Compared with the single-bulb case, each bulb in parallel will be:**

- A Brighter
- B Dimmer
- C Same brightness

D Off because current splits

E Alternating between bright and dim

24 **Two resistors R1 and R2 are in series with a battery. Which resistor dissipates more power?**

A The smaller resistance always dissipates more power

B The larger resistance always dissipates more power

C They dissipate equal power in series

D Power depends only on the battery voltage, so it's equal

E Impossible to know without numerical values

25 **Two resistors R1 and R2 are connected in parallel across the same ideal battery. Which resistor dissipates more power?**

A The larger resistance always dissipates more power

B The smaller resistance always dissipates more power

C They dissipate equal power in parallel

D Power depends only on current, so it's equal

E Impossible to know without numerical values

26 **Which expression for electrical power is always valid for any circuit element?**

A $P = IV$

B $P = I/R$

C $P = V/R$

D $P = IR$

E $P = V^2I$

27 **For a resistor that obeys Ohm's law, which expression for power dissipated in the resistor is correct?**

A $P = V + I$

B $P = I^2R$

C $P = R/I^2$

D $P = V/R^2$

E $P = R^2/I$

28 **For a resistor that obeys Ohm's law, which alternative expression for power is correct?**

A $P = V^2/R$

B $P = V/R^2$

C $P = R/V^2$

D $P = V^2R$

E $P = (V/R)^2R^2$

29 **A heater uses power P for a time t. The electrical energy transferred is:**

A $E = P/t$

B $E = Pt$

C $E = P^2t$

D $E = It$

E $E = V/t$

30 **A fuse in a household circuit is designed to:**

A Increase current when needed

B Measure voltage in parallel

C Melt and break the circuit if current exceeds a safe value

D Provide extra resistance to save energy

E Store charge to smooth out voltage

31 **Compared with a fuse, a circuit breaker has the advantage that it:**

A Works only for low voltages

B Can be reset after tripping

C Always allows more current before breaking

D Stores electrical energy

E Reduces the resistance of the circuit

32 **A voltmeter should be connected:**

A In series with the component, with very low resistance

B In parallel with the component, with very high resistance

C In parallel with the component, with very low resistance

D In series with the component, with very high resistance

E Across the battery only, never across components

33 **An ammeter should be connected:**

A In series with the component, with very low resistance

B In parallel with the component, with very low resistance

C In series with the component, with very high resistance

D In parallel with the component, with very high resistance

E Only across the battery terminals

34 **If a voltmeter mistakenly had a LOW resistance and was connected in parallel across a resistor, what would be the main consequence?**

A It would measure the voltage more accurately

B It would draw significant current and change the circuit's behavior (measurement error)

C It would stop current in the whole circuit

D The resistor would become ohmic

E Voltage would become negative

35 **If an ammeter mistakenly had a HIGH resistance and was placed in series, what would be the main consequence?**

A It would increase current because resistance adds power

B It would greatly reduce the circuit current, making the measurement unrepresentative

C It would not affect current because series current is fixed

D It would reverse the current direction

E It would make the circuit parallel

36 **A 'short circuit' is dangerous primarily because it:**

A Increases resistance so much that devices stop working

B Creates a very large current that can cause overheating and fire

C Makes voltage negative

D Eliminates the need for fuses

E Stops all charge movement

37 **An 'open circuit' means:**

A The resistance is very small

B The current is maximum

C There is a break so no complete path for current (current is zero)

D The battery voltage becomes infinite

E The circuit becomes parallel

38 **Kirchhoff's junction rule states that at a junction (node):**

A Voltage is the same in all branches

B Sum of currents entering equals sum of currents leaving

C Sum of resistances equals zero

D Current is the same in all branches

E Power is conserved in each component

39 **Kirchhoff's loop rule states that around any closed loop in a circuit:**

A The sum of currents is zero

B The sum of resistances is zero

C The sum of potential differences (rises and drops) is zero

D The sum of powers is zero

E Voltage is always the same across all elements

40 **Two resistors form a potential divider (series) connected to a battery. The output voltage is measured across the LOWER resistor R2. If R2 is increased (battery voltage fixed), the output voltage across R2 will:**

A Increase

B Decrease

C Stay the same

D Become zero

E Become equal to the current

41 **A potential divider has R1 on top and R2 on bottom. The output is taken across R2. If R1 is increased while R2 and the supply stay fixed, the output voltage across R2 will:**

A Increase

B Decrease

C Stay the same

D Become equal to the supply voltage

E Become negative

42 **A battery has emf E and internal resistance r. Which statement is correct when the battery supplies a larger current to a load?**

A Terminal voltage increases because more electrons leave the battery

B Terminal voltage decreases because the internal voltage drop Ir increases

C Terminal voltage stays equal to E always

D Emf decreases to conserve energy

E Internal resistance becomes zero

43 **A battery is not connected to anything (open circuit). Ideally, the terminal potential difference measured across its terminals equals:**

A 0

B Its emf

C Half its emf

D Negative emf

E Ir

44 **Capacitance C is defined as:**

A $C = V/Q$

B $C = Q/V$

C $C = IV$

D $C = IR$

E $C = V/I$

45 **The SI unit of capacitance is the farad (F). One farad is equivalent to:**

A $C \cdot V$

B V/C

C C/V

D J/C

E $N \cdot m$

46 **For a capacitor with fixed capacitance C, if the charge on it doubles, the potential difference across it will:**

A Halve

B Double

C Quadruple

D Stay the same

E Become zero

47 **For a capacitor connected to a fixed battery voltage V, if the capacitance doubles, the charge stored on the capacitor will:**

A Halve

B Double

C Quadruple

D Stay the same

E Become zero

48 **A charged capacitor primarily stores energy in:**

A The motion of electrons through the capacitor

B The electric field between its plates

C The magnetic field inside the plates (only)

D Heat in the dielectric (always)

E The capacitor's resistance

49 **Which expression gives the energy stored in a capacitor of capacitance C at potential difference V?**

A $U = CV$

B $U = (1/2)CV^2$

C $U = IV$

D $U = V^2/C$

E $U = (1/2)C/V^2$

50 **A capacitor remains at fixed capacitance C. If the voltage across it doubles, the stored energy becomes:**

A Twice as large

B Four times as large

C Half as large

D One quarter as large

E Unchanged

51 **A capacitor stays connected to a battery so V is constant. If capacitance C doubles, the stored energy becomes:**

A Half as large

B Twice as large

C Four times as large

D Unchanged

E Zero

52 **Two capacitors are connected in parallel to a battery. Which statement is correct?**

A The charge on each capacitor is the same

B The voltage across each capacitor is the same

C The equivalent capacitance is smaller than either capacitor

D The current through each capacitor is constant forever

E Parallel capacitors always reduce total stored energy

53 **Two capacitors are connected in series. Which statement is correct (ideal capacitors)?**

A Each capacitor has the same voltage

B Each capacitor stores the same charge magnitude

C The equivalent capacitance is the sum of the capacitances

D The equivalent capacitance is greater than each individual capacitance

E No charge can exist on capacitors in series

54 **Which statement about equivalent capacitance is correct?**

A Capacitors in series add directly: $C_{eq} = C1 + C2$

B Capacitors in parallel add directly: $C_{eq} = C1 + C2$

C Capacitors in parallel always reduce total capacitance

D Capacitors in series always give C_{eq} larger than each capacitor

E C_{eq} for series is always the average of C1 and C2

55 **Two identical capacitors each of capacitance C are connected in series. Their equivalent capacitance is:**

A 2C

B C

C C/2

D C^2

E 0

56 **Two identical capacitors each of capacitance C are connected in parallel. Their equivalent capacitance is:**

A C/2

B C

C 2C

D C^2

E 0

57 **For a parallel-plate capacitor, capacitance increases if you:**

A Decrease the plate area

B Increase the plate separation

C Increase the plate area

D Remove charge from the plates

E Decrease the battery voltage

58 **For a parallel-plate capacitor, capacitance decreases if you:**

- A Decrease the plate separation
- B Increase the plate separation
- C Insert a dielectric
- D Increase the plate area
- E Increase the charge on the plates

59 **Inserting a dielectric between capacitor plates (without changing geometry) generally causes the capacitance to:**

- A Decrease
- B Increase
- C Stay the same
- D Become zero
- E Become negative

60 **An uncharged capacitor is connected to a DC battery through a resistor. Immediately after connection ($t = 0+$), the capacitor behaves most like:**

- A An open circuit (no current)
- B A short circuit (very low voltage across it initially)
- C A constant current source
- D A diode

E A fuse

61 **In the same RC charging circuit, after a long time (steady state with DC), the capacitor behaves most like:**

A A short circuit

B A resistor of value R

C An open circuit (no current through it)

D A current source

E A transformer

62 **The time constant τ of an RC circuit is:**

A $= R/C$

B $= RC$

C $= C/R$

D $= R + C$

E $= 1/(RC)$

63 **The SI unit of the RC time constant $\tau = RC$ is:**

A Ohm (Ω)

B Farad (F)

C Second (s)

D Volt (V)

E Watt (W)

64 **In an RC charging circuit, after one time constant = RC, the capacitor voltage Vc is approximately:**

A 0% of the final battery voltage

B 37% of the final battery voltage

C 50% of the final battery voltage

D 63% of the final battery voltage

E 100% of the final battery voltage

65 **In an RC charging circuit, after one time constant , the current has fallen to approximately:**

A 0% of its initial value

B 37% of its initial value

C 50% of its initial value

D 63% of its initial value

E 100% of its initial value

66 **If resistance R in an RC circuit is doubled while capacitance C stays the same, the time constant becomes:**

A Half as large

B Twice as large

C Four times as large

D Unchanged

E Zero

67 **If capacitance C in an RC circuit is doubled while resistance R stays the same, the time constant becomes:**

A Half as large

B Twice as large

C Four times as large

D Unchanged

E Zero

68 **An uncharged capacitor is charged from an ideal battery through a resistor R. Which statement about the INITIAL charging current (t = 0+) is correct?**

A It depends on the capacitance C: larger C gives larger initial current

B It depends on the capacitance C: larger C gives smaller initial current

C It is approximately V/R and does not depend on C

D It is zero because capacitors block DC

E It is infinite because the capacitor is a short circuit forever

69 **A capacitor initially charged to voltage V0 discharges through a resistor R. After one time constant = RC, the capacitor voltage is approximately:**

- A 0% of V0
- B 37% of V0
- C 50% of V0
- D 63% of V0
- E 100% of V0

70 **When a charged capacitor discharges through a resistor, the energy originally stored in the capacitor is mainly converted into:**

- A Gravitational potential energy
- B Kinetic energy of the capacitor plates
- C Heat in the resistor (thermal energy)
- D Extra electric charge created from nothing
- E Mass of the electrons

71 **A capacitor is charged from an ideal battery of voltage V through a resistor until fully charged. (Ideal components.) Compared to the total energy supplied by the battery, the energy finally stored in the capacitor is:**

- A All of it (100%)
- B About half of it; the other half is dissipated as heat in the resistor
- C About a quarter of it
- D Zero; no energy is stored in a capacitor

E More than the battery supplied (energy gain)

72 **A capacitor remains connected to a battery (constant V). A dielectric is inserted fully between the plates. What happens?**

A Capacitance decreases, charge decreases, stored energy decreases

B Capacitance increases, voltage increases, charge stays the same

C Capacitance increases, voltage stays the same, charge increases

D Capacitance increases, charge stays the same, voltage increases

E Nothing changes because the battery fixes everything

73 **A charged capacitor is isolated (disconnected from any battery) so its charge Q is fixed. A dielectric is inserted fully between the plates. What happens?**

A Capacitance increases, voltage decreases, stored energy decreases

B Capacitance increases, voltage increases, stored energy increases

C Capacitance decreases, voltage decreases, stored energy decreases

D Capacitance stays the same because it is isolated

E Charge becomes zero instantly

74 **A capacitor C is charged to voltage V and then disconnected from the battery. It is then connected in parallel to an identical uncharged capacitor. Which statement is correct (ideal wires, no battery)?**

A Final voltage remains V and total stored energy stays the same

B Final voltage becomes V/2 and some energy is dissipated (e.g., as heat/radiation) during charge redistribution

C Final voltage becomes 2V because charge doubles

D Final voltage becomes zero because charge cancels

E Charge is not conserved in capacitors, so nothing can be predicted

75 Why can a capacitor help smooth the output of a rectifier (reducing ripple in a DC supply)?

A Because it permanently increases the battery voltage

B Because it converts AC directly into DC without losses

C Because it stores charge when voltage is high and releases charge when voltage drops, reducing fluctuations

D Because it blocks all current so the output becomes constant

E Because capacitance decreases when voltage changes

#	Ans	Answer Text
1	D	The rate of flow of electric charge
2	B	Opposite to electron drift
3	B	Energy transferred per unit charge
4	C	Less than E because some energy per charge is lost inside the battery
5	C	Voltage is proportional to current, provided temperature (and other phys...
6	B	A fixed metal resistor
7	B	R
8	B	1/R
9	B	Double
10	C	2R
11	C	R/2
12	C	is a property of the material (and temperature), not the object's shap...
13	B	Increases because lattice vibrations cause more collisions
14	B	Nonlinear: resistance increases with current/temperature, so the slope V...
15	B	Because the resistance changes as current heats it, so V is not proporti...
16	B	The current through each resistor is the same
17	C	Greater than across R1 because the same current flows and $V = IR$
18	B	The voltage across each resistor is the same
19	C	For two resistors in parallel, the equivalent resistance is less than th...
20	B	Decrease
21	B	Increase because total equivalent resistance decreases
22	B	Dimmer
23	C	Same brightness
24	B	The larger resistance always dissipates more power
25	B	The smaller resistance always dissipates more power
26	A	$P = IV$
27	B	$P = I^2R$
28	A	$P = V^2/R$
29	B	$E = Pt$
30	C	Melt and break the circuit if current exceeds a safe value
31	B	Can be reset after tripping
32	B	In parallel with the component, with very high resistance
33	A	In series with the component, with very low resistance
34	B	It would draw significant current and change the circuit's behavior (mea...
35	B	It would greatly reduce the circuit current, making the measurement unre...
36	B	Creates a very large current that can cause overheating and fire
37	C	There is a break so no complete path for current (current is zero)
38		Sum of currents entering equals sum of currents leaving