PRACTICE MCQs

CLASS 12 PHYSICS (TERM - I)

CURRENT ELECTRICITY

BY

learn-o-hub
learning simplified

Question 1:
SI unit of electric current is ______.
(a) Volt
(b) Coulomb
(c) Ampere
(d) Degree

Answer: (c) Ampere
One ampere is equal to flow of one coulomb per one second.

Question 2:
When a current I is set up in a wire of radius r, the drift velocity is v_d. If the same current is set up through a wire of radius 2r, the drift velocity will be
(a) v_d
(b) $2v_d$
(c) $(v_d/4)$
(d) $(v_d/2)$

Answer: (c) $(v_d/4)$
The relation between current and drift velocity given by,
$I=neAv_d$
Here I is the same in both cases. n will also be the same in both cases because the material is the same. The value of n depends upon the nature of material only and not on the dimensions.
Where n = number of electrons per unit volume and e=charge on electron
And A= area
Therefore, $v_d= (I/neA)$ (1)
For wire with radius 2r,
area $A' = (2r)^2\pi$
$= 4\pi r^2$
Therefore, for wire of radius 2r drift velocity $v_d'= (I/neA')$
$=(I/ne(4A))$
$=(v_d/4)$

Question 3:
Which among the following options represents Ohm's Law?
(a) $V \propto I$
(b) $V \propto I^2$
(c) $V \propto 1/I$
(d) $V^2 \propto I$

Answer: (a) V ∝ I

Let I be the current flowing through a conductor and let V be the potential difference between the ends of the conductor. Then, the Ohm's law states that V ∝ I

Question 4:

In the equation V = RI, what is the constant of proportionality R known as? conductor.

(a) Relativity
(b) Retentivity
(c) Resistance
(d) Capacitance

Answer: (c) Resistance

The SI units of resistance is ohm, and is denoted by the symbol Ω. The resistance R not only depends on the material of the conductor but also on the dimensions of the conductor.

Question 5:

Let 'l' and 'A' represent the length and cross-sectional area of the conductor, How will the resistance vary with 'l' and 'A'?

(a) Area of cross section, Length
(b) Length, Area of cross section
(c) Square of the length, area of cross section
(d) All of the above

Answer: (b) Length, Area of cross section

Resistance will be directly proportional to Length and inversely proportional to Area of cross-section.

Question 6:

What isCurrent per unit area?

(a) Electric current
(b) Current density

(c) Resistivity
(d) Potential difference

Answer: (b) Current density
Current per unit area I/A, is called current density and is denoted by j. The SI unit of the current density are A/m^2.

Question 7:
Electrical resistivity of the materials vary over a wide range. Metals have _____ resistivity.
(a) Moderate
(b) High
(c) Low
(d) Zero

Answer: (c) Low
Electrical resistivity of substances varies over a very wide range. Metals have low resistivity, in the range of 10^{-8} Ω m to 10^{-6} Ω m. Insulators like glass and rubber have 10^{22} to 10^{24} times greater resistivity.

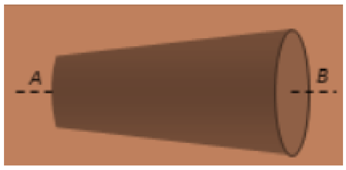
Question 8:
What is the magnitude of the drift velocity per unit electric field known as?
(a) Mobility
(b) Resistivity
(c) Conductivity
(d) Capacitance

Answer: (a) Mobility
Mobility μ defined as the magnitude of the drift velocity per unit electric field
$\mu = |V_d|/E$
The SI unit of mobility is m^2/Vs and is 10^4 of the mobility in practical units.
Mobility is positive.

Question 9:
Wire bound resistors are made by winding the wires of an alloy namely manganin, constantan, nichrome etc. because
(a) They have high resistivity
(b) They have low resistivity
(c) It is easier to use these alloys
(d) Their resistivities are relatively insensitive to temperature

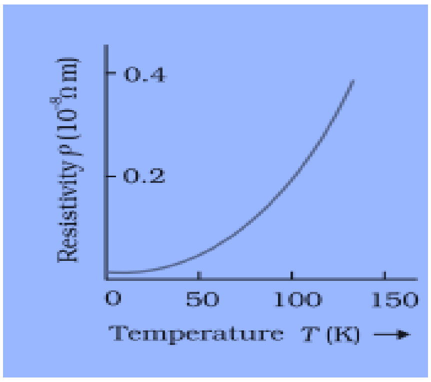
Answer: (d) Their resistivities are relatively insensitive to temperature
Commercially produced resistors for domestic use or in laboratories are of two major types: wire bound resistors and carbon resistors. Wire bound resistors are made by winding the wires of an alloy, viz., manganin, constantan, nichrome or similar ones.

Question 10:
A wire has a non-uniform cross-sectional area as shown in figure. A steady current i flows through it. Which one of the following statements is correct?
(a) The drift speed decreases on moving from A to B
(b) The drift speed of electron is constant
(c) The drift speed increases on moving from A to B
(d) The drift speed varies randomly



Answer: (c) The drift speed increases on moving from A to B
The current through the conductor is given by
$I = neAv_d$
where, n is number of electrons crossing per unit area, e is electronic charge, A is area of cross section of conductor and v_d is the drift velocity(speed) of electrons.
Also, $v_d = (I/neA)$
As the steady(constant) current i flows through the given conductor and n and e are constant, hence drift speed is inversely proportional to the area of cross section of conductor i.e.
$v_d \propto (1/A)$
As the area of cross section of given conductor is increases from A to B, hence drift speed of electrons decreases on moving from A to B.

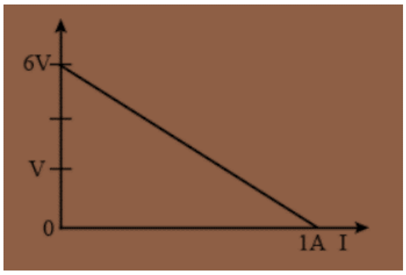
Question 11:
The following graph represents the change in resistivity of copper with temperature. What can you infer from the graph?



(a) Resistivity of copper decreases with increase in temperature
(b) Resistivity of copper decreases with decrease in temperature
(c) Resistivity of copper increases with increase in temperature
(d) Resistivity of copper increases with decrease in temperature

Answer: (c) Resistivity of copper increases with increase in temperature

Question 12:
The plot of the variation of potential difference across a combination of three identical cells in series, versus current is shown alongside. What is the emf and internal resistance of each cell?

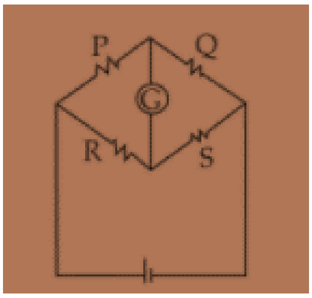


(a) Emf = 2V and r= 2Ω
(b) Emf = 6V and r= 6Ω
(c) Emf = 2V and r= 6Ω
(d) Emf = 6V and r= 2Ω

Answer: (b) Emf = 6V and r= 6Ω
Voltage across cell combination,
V= E-Ir
When current I=0,
Therefore, V=E
From graph, when I=0, V=6V
Or E=6V
As I=1A, at V=0 (from graph)
Therefore, V=E-Ir

Or 0= 6-Ir
Or -6 =-Ir
Or r=6 Ω

Question 13:
The given figure shows the Wheatstone bridge method for measurement of unknown resistance R. The balanced equation for Wheatstone bridge is



(a) (P/R) = (Q/S)
(b) (P/S) =(Q/R)
(c) (P/R) =(S/Q)
(d) (R/P) = (Q/S)

Answer: (a) (P/R) = (Q/S)
A Wheatstone bridge is an electrical circuit used to measure an unknown electrical resistance by balancing two legs of a bridge circuit. It is said to be balanced when the ratio of two resistances on the left side is equal to the ratio of two resistances on the right.

Question 14:
Ohm’s law fails if:
(a) V depends on I non-linearly
(b) The relation between V and I depends on the sign of V
(c) The relation between V and I is non-unique
(d) All of the above

Answer: (d) All of the above

Question 15:
Three resistors 3 Ω, 5 Ω and 6 Ω are combined in series. What is the total resistance of the combination?
(a) 3 Ω
(b) 14 Ω
(c) 5 Ω
(d) 6 Ω

Answer: (b) 14 Ω

Total resistance R of 3 resistors connected in series is given by, $R = R_1 + R_2 + R_3$

R = (3 + 5 + 6) Ω = 14 Ω

Question 16:

In Meter Bridge or Wheatstone bridge for measurement of resistance, the known and the unknown resistances are interchanged. The error so removed is

(a) End correction

(b) Index error

(c) Due to temperature effect

(d) Random error

Answer: (a) End correction

In meter bridge experiment, it is assumed that the resistance of the L shaped plate is negligible, but actually it is not so. The error created due to this is called, end error. To remove this the resistance box and the unknown resistance must be interchanged and then the mean reading must be taken.

Question 17:

The length of a potentiometer wire is l. A cell of emf E is balanced at a length (l/3) from the positive end of the wire. If the length of the wire is increased by (l/2). At what distance will the same cell give a balance point.

(a) (2l/3)

(b) (l/2)

(c) (l/6)

(d) (4l/3)

Answer: (b) (l/2)

Let x = Length

Potential gradient for the first case $=(E_0)/(l)$

$E= (1/3)\ (E_0/l)$

$=(E_0/3)$ (1)

Potential gradient in the second case.

$=(E_0/(3l/2))$

$=(2E_0/3l)$

Therefore, $E=(x)\ (2E_0/3l)$ (2)

From equations (i) and (ii), we get
$(E_0/3) = (2E_0/3l)\ x$
Therefore, x = (1/2)

Question 18:
A galvanometer acting as a volt meter will have with its coil.
(a) a high resistance in parallel
(b) a high resistance in series
(c) a low resistance in parallel
(d) a low resistance in series

Answer: (b) a high resistance in series
Galvanometer is a very sensitive instrument. A voltmeter will be added in parallel between the points across which voltage drop has to be measured. Sothe same voltage which to be measured will flow through galvanometer. Therefore, to prevent the damage to the instrument, only a small current need to be passed through it. This can be achieved by putting a high resistance in series with the galvanometer coil.

Assertion Reason Based Questions

In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.
(a) Both assertion and reason are true and the reason is the correct explanation of assertion.
(b) Both assertion and reason are true but the reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Assertion is false but reason is true.

Question 19:
Assertion: At any junction, the sum of the currents entering the junction is equal to the sum of currents leaving the junction.
Reason: When currents are steady, there is no accumulation of charges at any junction or at any point in a line. Thus, the total current flowing in, must equal the total current flowing out.

Answer: (a) Both assertion and reason are true and the reason is the correct explanation of assertion.

Question 20:
Assertion: The algebraic sum of changes in potential around any closed loop involving resistors and cells in the loop is zero
Reason: Electric potential is dependent on the location of the point. Thus starting with any point if we come back to the same point, the total change must be zero. In a closed loop, we do come back to the starting point and hence the rule.

Answer: (a) Both assertion and reason are true and the reason is the correct explanation of assertion.

Question 21:
Assertion: The resistance R of a conductor depends on its length l and cross-sectional area A
Reason: ρ, called resistivity depends on temperature and pressure

Answer: (b) Both assertion and reason are true but the reason is not the correct explanation of assertion.

Question 22:
Assertion: The electromotive force of a cell is always greater than its terminal voltage.
Reason: Electromotive force is the potential difference when no current is drawn. When current is drawn, there will be potential drop across the internal resistance of the cell. So, terminal voltage will be less than the electromotive force.

Answer: (a) Both assertion and reason are true and the reason is the correct explanation of assertion.

Question 23:
Assertion: The resistivity of the metal increases with increase in temperature
Reason: The average time between successive collisions decreases with increase in temperature, hence the resistivity of the metal increases.

Answer: (a) Both assertion and reason are true and the reason is the correct explanation of assertion.

Case Study Based Questions

Question 24:

Metals have a large number of free electrons nearly 10^{28} per cubic metre. In the absence of electric field, average terminal speed of the electrons in random motion atroom temperature is of the order of 10^5 m s^{-1}When a potential difference V is applied across the two ends of a given conductor, the free electrons in the conductor experiences a force and are accelerated towards the positive end of the conductor. On their way, they suffer frequent collisions with the ions/atoms of the conductor and lose their gained kinetic energy. After each collision, the free electrons are again accelerated due to electric field, towards the positive end of the conductor and lose their gained kinetic energy in the next collision with the ions/atoms of the conductor. The average speed of the free electrons with which they drift towards the positive end of the conductor under the effect of applied electric field is called drift speed of the electrons.

1) Magnitude of drift velocity per unit electric field is
(a) current density
(b) current
(c) resistivity
(d) mobility

2) The drift speed of the electrons depends on
(a) dimensions of the conductor
(b) number density of free electrons in the conductor
(c) both (a) and (b)
(d) neither (a) nor (b)

3) We are able to obtain fairly large currents in a conductor because
(a) the electron drift speed is usually very large

(b) the number density of free electrons is very high and this can compensate for the low values of the 6-electron drift speed and he very small magnitude of the electron charge
(c) the number density of free electrons as well as the electron drift speeds are very large and these compensate for the very small magnitude of the electron charge
(d) the very small magnitude of the electron charge has to be divided by the still smaller product of the number density and drift speed to get the electric current

4)Drift speed of electrons in a conductor is very small i.e., i = 10^{-4} m s^{-1}. The Electric bulb glows immediately. When the switch is closed because
(a) drift velocity of electron increases when switch is closed
(b) electrons are accelerated towards the negative end of the conductor
(c) the drifting of electrons takes place at the entire length of the conductor
(d) the electrons of conductor move towards the positive end and protons of conductor move towards negative end of the conductor

5) The number density offree electrons in a copper conductor is 8.5×10^{28} m^{-3}. Howlong does an electron take to drift from one end of a wire 3.0 m long to its other end? The area of cross-section of the wire is $2.0 \times 10^{-6} m^2$ and it is carrying a current of 3.0 A.
(a) 8.1×10^4 s
(b) 2.7×10^4 s
(c) 9×10^3 s
(d) 3×10^3 S

Answer:

1) (d) mobility
Mobility μ is defined as the magnitude of drift velocity per unit electric field.
$\mu=(|v_d|\backslash E)$
Its SI unit is m^2/Vs

2) (c) both (a) and (b)
Drift velocity, $v_d = (I/neA)$
where, n⟶ no. of free electrons
I⟶ current flowing
A⟶ Area of cross section
e⟶ charge on electron

3) (b) number density of free electrons in the conductor

$I=neAv_d$

v_d is of order of few ms^{-1}, $e=1.6 \times 10^{-19}$ C

A is the order of mm^2, so a large I is due to a large value of n in conductors.

4) (c) the number density of free electrons as well as the electron drift speeds are very large and these compensate for the very small magnitude of the electron charge

When we close the circuit, an electric field is established instantly with the speed electromagnetic waves which causes electrons to drift at every portion of the circuit, due to which the current is set up in the entire circuit instantly. The current which is set up does not wait for the electrons to flow from one end of the conductor to another. Thus, the electric bulb glows immediately when switch is closed.

5) (b) 2.7 x 10^4 s

Number density of free electrons in a copper conductor, n = 8.5 × 10^{28} m^{-3}

Length of the copper wire, l = 3.0 m

Area of cross-section of the wire, A = 2.0 × 10^{-6} m^2

Current carried by the wire, I = 3.0 A,

which is given by the relation, $I = nAeV_d$

Where, e = 1.6 x 10^{-19} C

$v_d=(I)/(neA)$ (1)

The time taken by the electron to drift from one end to other end of the wire is

t=(L/vd)

=(LneA)/(I) (2)

= [(3.0m) (8.5 x 10^{28} m^{-3}) (1.6 x 10^{-19}C) (2.0x$10^{-6}$$m^2$)]/ (3.0A)

=2.7 x 10^4 s

Question 25:

According to Ohm's law, the current flowing through a conductor is directly proportional to the potential difference across the ends of the conductor i.e. $I \propto V$or (V/I)=R where R is resistance of the conductor Electrical resistance of a conductor is the obstruction posed by the conductor to the flow of electric current through it. It depends upon length, area of cross-section, nature of material and temperature of the conductor We can write $R \propto (l/A)$ or $R=\rho(l/A)$ where ρ is electrical resistivity of the material of the conductor.

1) Dimensions of electric resistance is

(a) $[ML^2 T^{-3} A^{-1}]$
(b) $[ML^2T^{-3}A^{-2}]$
(c) $[M^{-1} L^3 T^{-1} A]$
(d) $[M^{-1}L^2T^2A^{-1}]$

2) The current in a conductor and the potential difference across its ends are measured by an ammeter and a voltmeter. The meters draw negligible currents. The ammeter is accurate but the voltmeter has a zero error (that different conditions are 1.75 A, 14.4 V and 2.75 A, 22.4 V.)
(a) 0.4 volts
(b) 0.8 volts
(c) -0.4 volt
(d) -0.8 volts

3) Specific resistance of a wire depends upon
(a) mass
(b) cross-sectional area
(c) length
(d) None of the Above

4) The slope of the graph between potential difference and current through a conductor is
(a) a straight line
(b) curve
(c) first curve then straight line
(d) first straight line then curve

5) The resistivity of the material of a wire 1.0 m long, 0.4 mm in diameter and having a resistance of 2.0 ohm is
(a)$1.57\times10^{-6}\Omega m$
(b) $5.25\times10^{-7}\Omega m$
(c) $7.12\times10^{-5}\Omega m$
(d) $2.55\times10^{-7}\Omega m$

Answer.

1) (a) $[ML^2 T^{-3} A^{-1}]$
Since according to Ohm's Law:
V = IR
Hence, R = (V/I)

Also, V=(W/q)
Potential = $[M^1L^2T^{-2}]/[AT]$
Therefore, $[V] = [M^1L^2T^{-3}A^{-1}]$
Therefore $R = [M^1L^2T^{-3}A^{-1}]/[A]$
$= [M^1L^2T^{-3}A^{-2}]$

2) (a) 0.4 volts
Let the voltmeter reading when the voltmeter has zero error be V.
In both the conditions, $R_1=R_2$
i.e. $(V_1/I_1) = (V_2/I_2)$
or $(I_1R/I_2R) = (V_1/V_2)$
(1.75/2.75) = (14.4−V)/(22.4−V)
Or(7/11) = (14.4−V)/(22.4−V)
or 7×(22.4−V) = 11(14.4−V)
or 156.8−7V = 158.4−11V
-4V = -1.6
or V = 0.4V.
Positive and negative zero error indicates that the needle of the voltmeter is to the right or left of the zero marked on the device if zero voltage is applied across the voltmeter.

3) (d) None of the Above
Specific resistance depends only on the material of the wire and is independent of mass and dimensions of the material.

4) (a) a straight line
A graph of voltage against current is a straight line through the origin. Hence voltage drop across the conductor is directly proportional to the current through it.The slope of a voltage—current graph is equal to the resistance R of the conductor.Electrical resistance can be defined as the opposition offered by a conductor to the flow of electric current.

5) (d) $2.55\times10^{-7}\Omega m$
Given:
R = 2Ω
l = 1 m
d = 0.4 mm = 0.0004 m
Cross section area of wire $A = (\pi d^2)/(4)$
$= (\pi \times 0.0004)/(4)$
$= 1.256 \times 10^{-7}\ m^2$

Resistivity of the material $\rho = (RA)/(l)$

Therefore, $\rho = (2 \times 1.256 \times 10^{-7})/(1)$

$= 2.55 \times 10^{-7}\ \Omega m$

****