# Physicsaholics

**DPP – 1 (Current Electricity)**

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/55

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Q 1. The current flowing through wire depends on time as, $I = 3t^2 + 2t + 5$. The charge flowing through the cross - section of the wire in time $t = 0\ s$ to $t = 2\ s$ is:

(a) 22 C (b) 20 C
(c) 18 C (d) 5 C

Q 2. The charge flowing through a conductor varies with time as $q = 8t - 3t^2 + 5t^3$. Find time after which the current reaches to minimum value of current:
(a) 0.2 sec (b) 2 sec
(c) 1.2 sec (d) 2.5 sec

Q 3. The charge flowing through a conductor beginning with time t=0 is given by the formula $q = 2t^2 + 3t + 1$(coulomb). Find the current at the end of the $5^{th}$ seconds:
(a) 2.3 Amp (b) 25 Amp
(c) 2.5 Amp (d) 23 Amp

Q 4. In a conductor, 4 coulombs of charge flows for 2 seconds . The value of electric current will be:
(a) 4 Amp (b) 2 Amp
(c) 1 Amp (d) 3 Amp

Q 5. A current of 4.8 A is flowing in a conductor. The number of electrons passing per second through the conductor will be:
(a) $3 \times 10^{20}$ (b) $76.8 \times 10^{20}$
(c) $7.68 \times 10^{20}$ (d) $3 \times 10^{19}$

Q 6. When current i is flowing through a conductor, the drift velocity is v. If the value of current through the conductor and its area of cross-section is doubled, then new drift velocity will be:

(a) $4v$ (b) $\frac{v}{2}$
(c) $\frac{v}{4}$ (d) $v$

Q 7. Every atom makes one free electron in copper. If 1.1 ampere current is flowing in the wire of copper having 1 mm diameter, then the drift velocity (approx.) will be (Density of copper = $9 \times 10^3\ kg/m^3$ and atomic weight = 63):
(a) $0.3\ mm/sec$ (b) $0.1\ mm/sec$

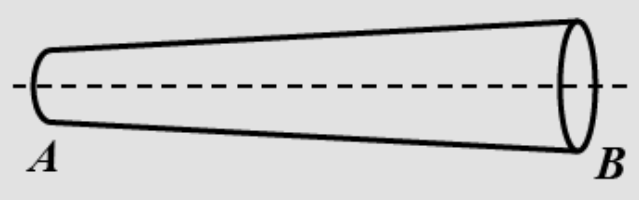
(c) 0.2 $mm/sec$ (d) 0.2 $cm/sec$

Q 8. An electric current of 16$A$ exists in a metal wire of cross section $10^{-6}\ m^2$ and length 1$m$. Assuming one free electron per atom. The drift speed of the free electrons in the wire will be: (Density of metal = $5 \times 10^4\ kg/m^3$ and atomic weight = 60):
(a) 0.5 $mm/sec$ (b) 0.2 $mm/sec$
(c) 0.4 $mm/sec$ (d) 7.5 $mm/sec$

Q 9. An electric cell of emf E is connected across a copper wire of diameter d and length $l$. The drift velocity of electrons in the wire is $V_d$. If the length of the wire is changed to $2l$, the new drift velocity of electrons in the copper wire will be:
(a) $V_d$ (b) $2V_d$ (c) $\frac{V_d}{2}$ (d) $\frac{V_d}{4}$

Q 10. Drift velocity $V_d$. varies with the intensity of electric field as per the relation:
(a) $V_d \propto E$ (b) $V_d \propto \frac{1}{E}$
(c) $V_d = constant$ (d) $V_d \propto E^2$

Q 11. A wire has a nonuniform cross sectional area as shown in the figure. A steady current i flows through it. Which one of the following statements is correct?



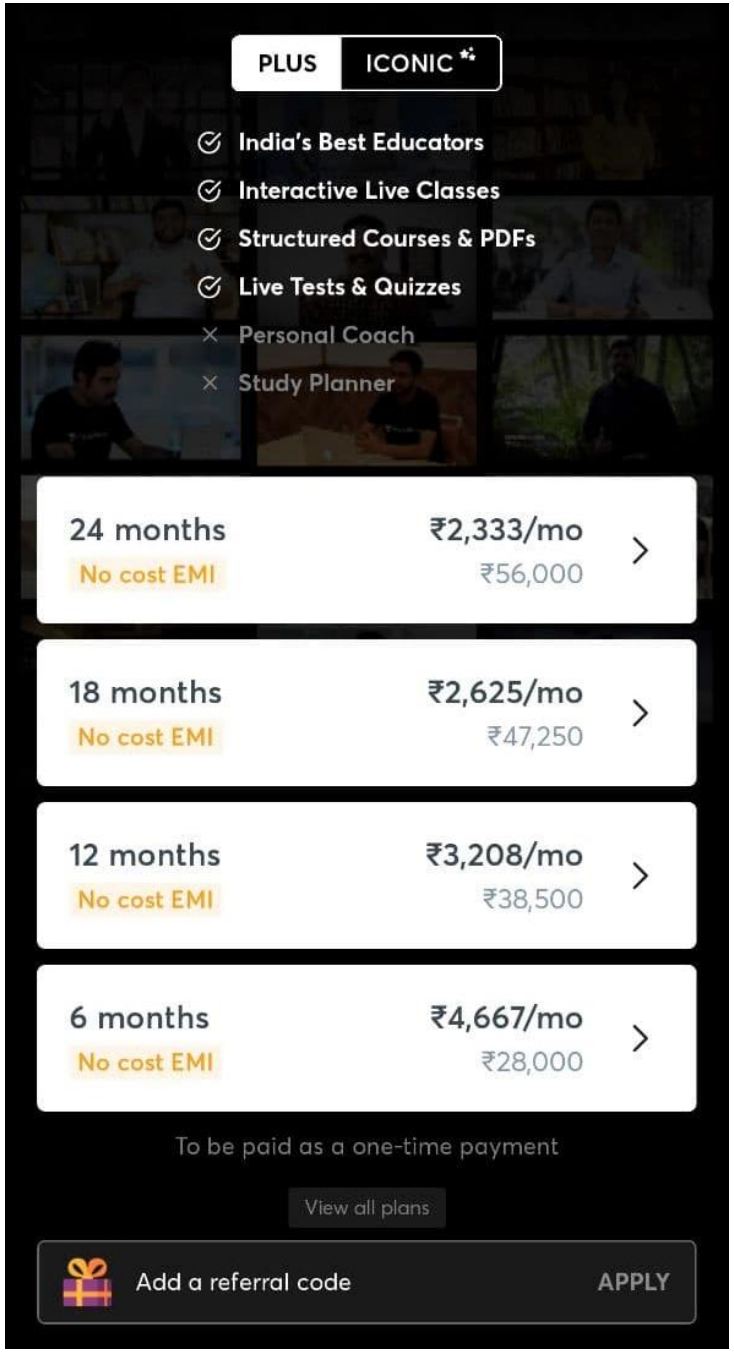

(a) Drift speed of the electron is constant
(b) Drift speed decreases on moving from A to B
(c) Drift speed increases on moving from A to B
(d) Drift speed varies randomly

Q 12. A conductor carries a current of 50 μ A. If the area of cross-section of the conductor is 50 $mm^2$, then value of the current density in A/$m^2$ is:
(a) 0.5 (b) 1
(c) $10^{-3}$ (d) $10^{-6}$

Q 13. A steady current flow in a metallic conductor of non-uniform cross-section. The quantity/ quantities constant along the length of the conductor is/are:
(a) Current, electric field and drift speed
(b) Drift speed only
(c) Current and drift speed
(d) Current only

# Answer Key

| | | | | |
|---|---|---|---|---|
| **Q.1 a** | **Q.2 a** | **Q.3 d** | **Q.4 b** | **Q.5 d** |
| **Q.6 d** | **Q.7 b** | **Q.8 b** | **Q.9 c** | **Q.10 a** |
| **Q.11 b** | **Q.12 b** | **Q.13 d** | | |

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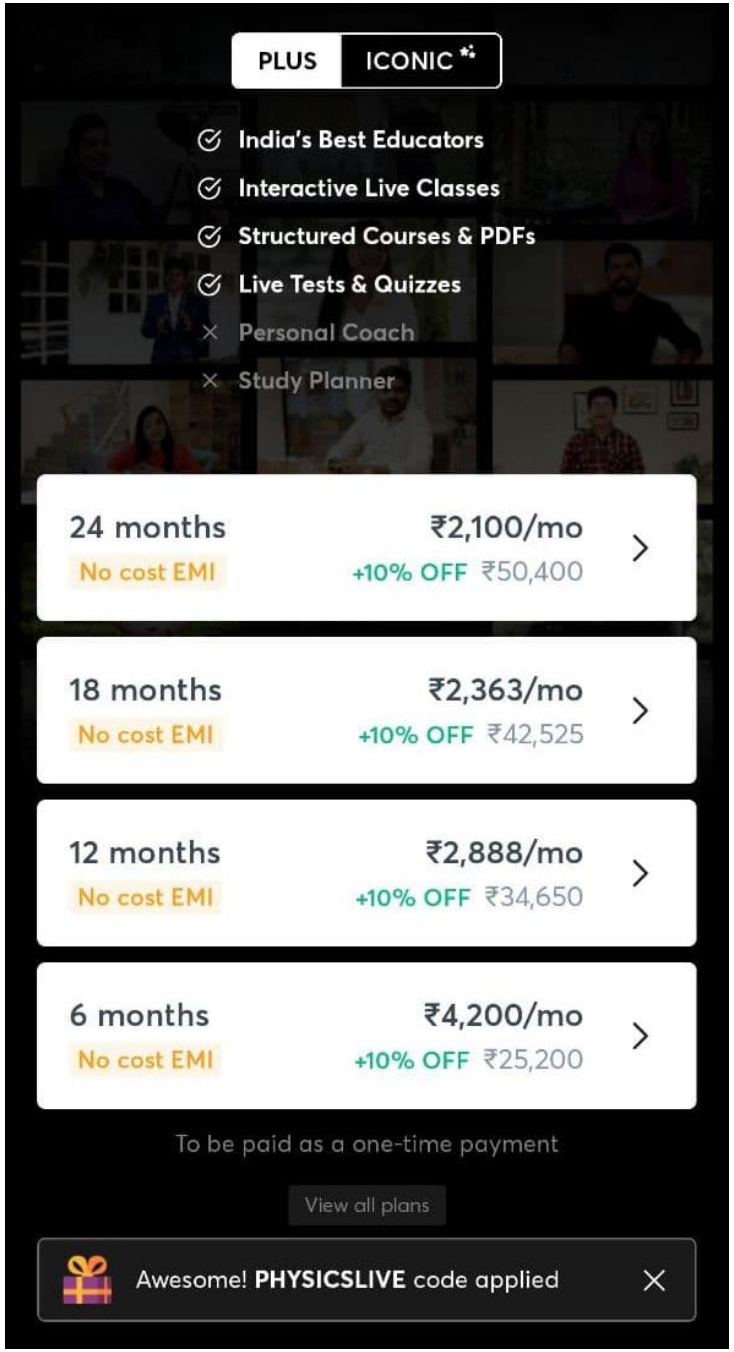


# Written Solution

## DPP-1 Current Electricity: Current, Current density, Drift velocity

## By Physicsaholics Team

Solution: 1

$$I = 3t^2 + 2t + 5$$

$$\frac{dq}{dt} = 3t^2 + 2t + 5$$

$$\int dq = \int_0^2 (3t^2 + 2t + 5)\, dt$$

$$q = (t^3 + t^2 + 5t)_0^2$$

$$q = 8 + 4 + 10 - 0$$

$$\boxed{q = 22\,C}$$

Ans. a

Solution: 2

$$q = 8t - 3t^2 + 5t^3$$

$$I = \frac{dq}{dt} = 8 - 6t + 15t^2$$

For maximum

$$\frac{dI}{dt} = 0 \Rightarrow -6 + 30t = 0$$

$$t = \frac{1}{5}\ \text{sec}$$

$$\frac{d^2I}{dt^2} = 30 > 0$$ (it will have minima)

D. $\boxed{t = 0.2\ \text{sec}}$

Ans. a

Solution: 3

$$q = 2t^2 + 3t + 1$$

$$I = \frac{dq}{dt} = 4t + 3$$

$$4t = 5 \text{ sec}$$

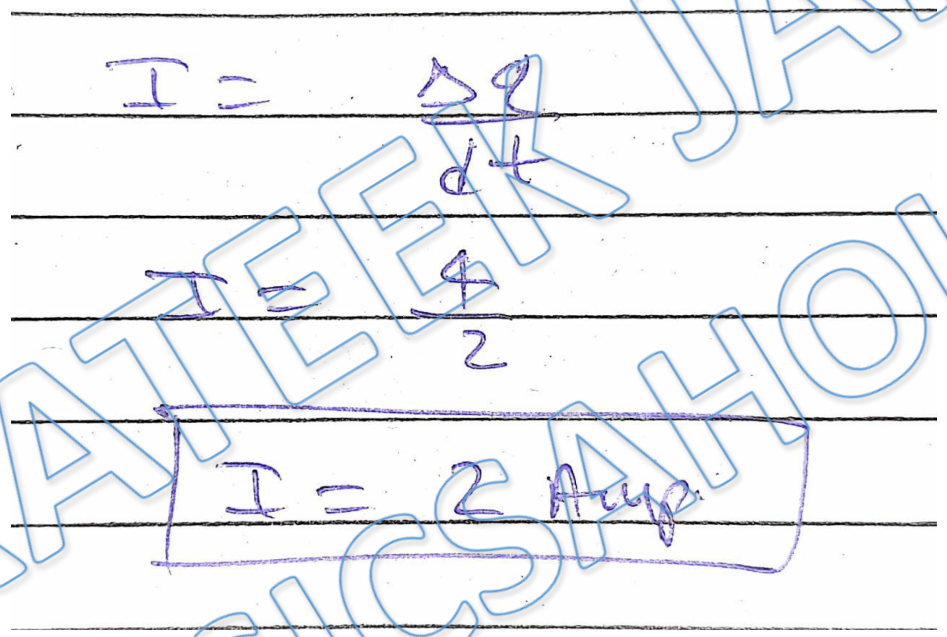
$$I = 4 \times 5 + 3$$

$$\boxed{I = 23 \text{ Amp}}$$



Ans. d

Solution: 4






Ans. b

Solution: 5

$I = 4.8$ Amp

means $4.8$ C/sec

in one sec; $q = 4.8$ Coulomb

$4.8 = n \times 1.6 \times 10^{-19}$

$$n = 3 \times 10^{19}$$



Ans. d

Solution: 6

$$I = nAV_d$$

$$V_d = \frac{I}{nAe}$$

$$V_d \propto \frac{I}{A}$$

$$\frac{V_d}{V_d'} = \frac{I/A}{2I/2A} = \frac{1}{1}$$

$$\boxed{V_d' = V_d}$$

or $\boxed{V_d' = V}$ $\because V_d = V$ (given)

Ans. d

Solution: 7

$$V_d = \frac{I}{neA}$$

$n$ = no. of electrons in unit volume

mass of copper in unit volume $= 9 \times 10^3$ kg.

no. of copper atoms in unit volume $= \frac{9 \times 10^8}{63} \times 10^3$ mole

$$= \frac{9 \times 10^3 \times 10^3}{63} \times 6.023 \times 10^{23} \ m^{-3}$$

$$n = 8.60 \times 10^{28}$$

$$A = \frac{\pi d^2}{4} = \frac{3.14 \times (0.001)^2}{4} = 7.85 \times 10^{-7} \ m^2$$

$$V_d = \frac{1.1}{(8.5 \times 10^{-7})(1.6 \times 10^{-19})(8.6 \times 10^{28})}$$

$$V_d = \frac{1.1}{7.5 \times 1.6 \times 8.6 \times 10^2}$$

$$V_d = 0.01 \times 10^{-2} \ m/s$$

$$\boxed{V_d = 0.1 \ mm/s}$$

Ans. b

Solution: 8

$$V_d = \frac{I}{neA}$$

$$n = \frac{5 \times 10^4 \times 10^3 \times 6.623 \times 10^{23}}{60}$$

$$= \frac{5 \times 6.623}{60} \times 10^{30} \; m^{-3}$$

$$= 5.01 \times 10^{29} \; m^{-3}$$

$$A = 10^{-6} \; m^2$$

$$V_d = \frac{16}{5.01 \times 10^{29} \times 1.6 \times 10^{19} \times 10^{-6}}$$

$$= \frac{16}{5.01 \times 16 \times 10^4} = 1.99 \times 10^{-4} \; m/s$$

$$V_d = 0.199 \times 10^{-3} \; m/s = 0.2 \; mm/s$$

$$\boxed{V_d = 0.2 \; mm/s}$$

Ans. b

Solution: 9

$$V_d = \frac{I}{neA}$$

$$I = \frac{V}{R}$$ $V$ = Potential difference

$R$ = Resistance of wire

$$R = \frac{\rho l}{A}$$

$$V_d = \frac{V}{neAR} = \frac{V}{neA\rho l} \times A = \frac{V}{ne\rho l}$$

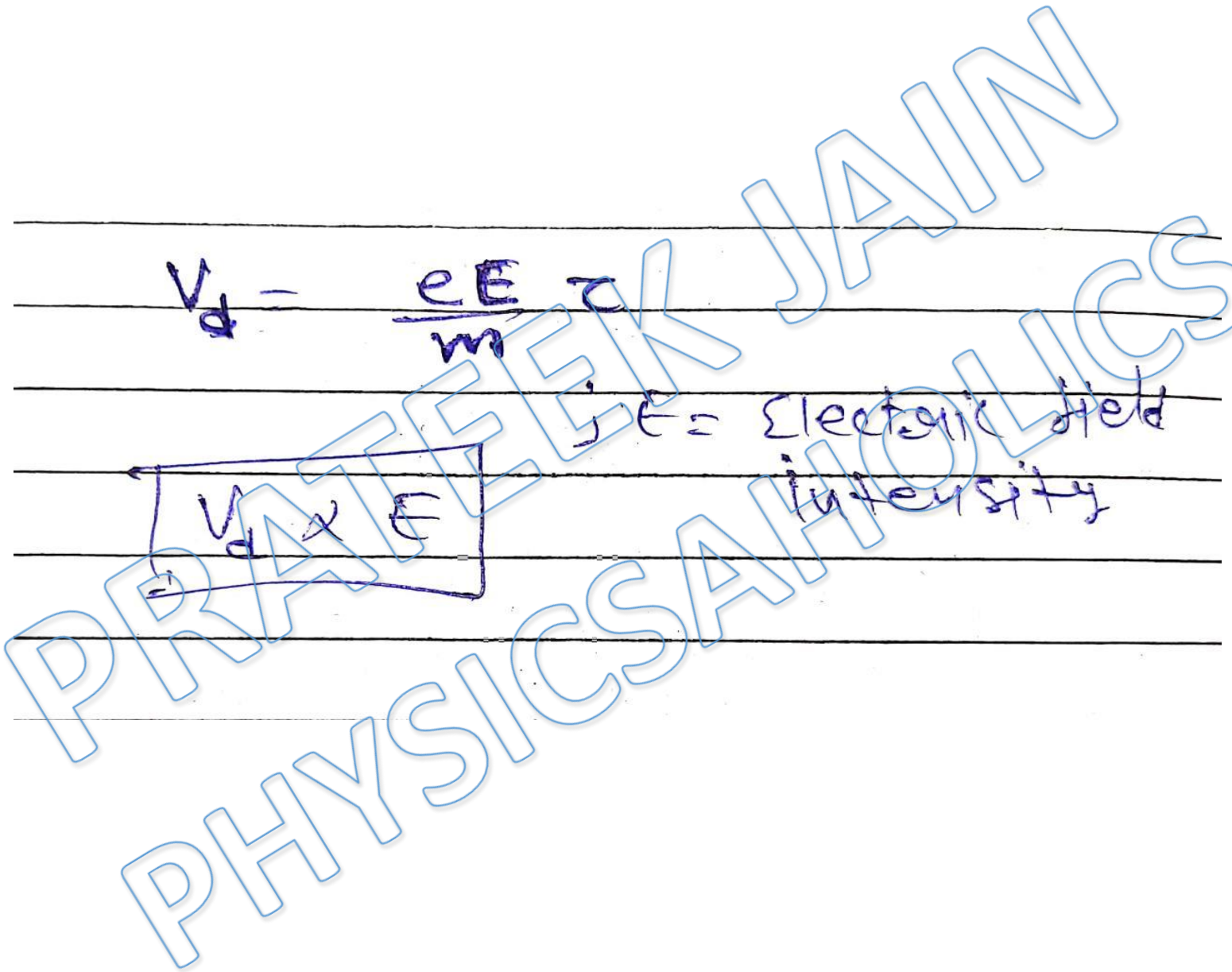
$$V_d \propto \frac{1}{l}$$

$$\frac{V_d}{V_d'} = \frac{2l}{l}$$

$$\Rightarrow \boxed{V_d' = \frac{V_d}{2}}$$

Ans. c

Solution: 10






Ans. a

Solution: 11

$$v_d = \frac{I}{neA}$$

$$v_d \propto \frac{1}{A}$$

$$A_B > A_A$$

$$(v_d)_B < (v_d)_A$$

$\therefore$ Drift speed decreases on moving from A to B

Ans. b

Solution: 12

$$J = \frac{I}{A}$$

$$= \frac{50 \times 10^{-6}}{50 \times 10^{-6}}$$

$$\boxed{J = 1 \text{ A/m}^2}$$



Ans. b

Solution: 13

$$J = \frac{I}{A}$$

$$\Rightarrow J \propto \frac{1}{A}$$

$$J = \sigma E$$

$$\Rightarrow E \propto J \propto \frac{1}{A}$$

$$V_d = \frac{I}{nqA}$$

$$\Rightarrow V_d \propto \frac{1}{A}$$

$$I = \frac{V}{R}$$

I (Current) does not depends on cross-section area.

$\therefore$ I = Constant.

Ans. d

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