Section : **Physics**

Q.1 For a short electric dipole, identify the incorrect statement(s).
(A) The electric field intensity varies inversely with the cube of the distance from the center of the dipole.
(B) The electric field is directed from negative to positive charge.
(C) The electric potential at mid-point of the dipole is zero.
(D) The electric field intensity at mid-point of the dipole is zero.

Choose the correct answer from the option given below:
1. (A) and (C) only
2. (B) and (D) only
3. (A) only
4. (B) only

Options 1. 1
2. 2
3. 3
4. 4

Q.2 Which of the following properties are desired in materials for permanent magnets ?
(A) High retentivity
(B) High coercivity
(C) High permeability
(D) low permeability
Choose the correct answer from the options given below:
1. (A) and (D) only
2. (B) and (C) only
3. (A), (B) and (C) only
4. (A) and (C) only

Options 1. 1
2. 2
3. 3
4. 4

Q.3 In the context of the Photoelectric effect, identify the statements which support quantum nature of light.
(A) The electric charge of photoelectrons is quantized
(B) The maximum kinetic energy of photoelectrons depends on the frequency of the incident light, but is independent
of its intensity
(C) The photoelectric emission is an instantaneous process without any apparent time lag, even when the incident
radiation is made exceedingly dim
(D) There is a minimum frequency of light below which no photoelectrons are emitted
Choose the correct answer from the options given below:

1. (A), (B) and (D) only
2. (A), (B), (C) and (D)
3. (B), (C) and (D) only
4. (B) and (D) only

Options 1. 1
2. 2
3. 3
4. 4

Q.4 Light travels in the form of photons. Identify the correct statements
(A) Photons travel with the velocity of light in vacuum.
(B) The rest mass of photons is taken as zero.
(C) Photons have energy which depends on frequency.
(D) Photons have a momentum inversely dependent on frequency.
Choose the correct answer from the options given below.
1. (A), (B), (C), and (D)
2. (A), (C), and (D) only
3. (A), (B) and (C) only
4. (B), (C) and (D) only

Options 1. 1
2. 2
3. 3
4. 4

Q.5 There are two electric charges, Q1 and Q2, placed in vacuum. Identify the correct statements from the following
1. There will be an electrostatic force between them.
2. If these charges are placed in water, the force between them will increase.
3. The electrostatic force between them is a conservative force.
4. If both of the charges are doubled as 2Q1 and 2Q2, then the force between them will become 4 times.
Choose the correct answer from the options given below:
1. (A) and (D) only
2. (A) , (C) and (D) only
3. (A) and (C) only
4. (A) , (B) and (C) only

Options 1. 1
2. 2
3. 3

4. 4

Q.6 In a series LCR circuit, $C = 80\ \mu F$, $L = 5.0\ H$ and $R = 40\ \Omega$ are connected to a variable frequency source of 240 V.

The angular frequency of the source which drives the circuit at resonance will be:

1. $5\ rad\ s^{-1}$
2. $25\ rad\ s^{-1}$
3. $0.05\ rad\ s^{-1}$
4. $50\ rad\ s^{-1}$

Options 1. 1
2. 2
3. 3
4. 4

Q.7 A parallel plate air capacitor is charged, and then the battery is disconnected. Now on inserting a dielectric between the plates of the capacitor, which of the following change:

1. potential difference between the plates
2. charge on the plates
3. electric field between the plates
4. energy stored in the capacitor

Choose the correct answer from the options given below:

1. (A), (B) and (D) only
2. (A), (C) and (D) only
3. (B), (C) and (D) only
4. (A), (B), (C) and (D)

Options 1. 1
2. 2
3. 3
4. 4

Q.8 In Snell's law of refraction, the refractive index of the second medium with respect to the first medium (n_{21}) is:

1. a characteristic of the medium 1 only
2. a characteristic of the medium 2 only
3. independent of the angle of incidence.
4. not dependent on the wavelength of light

Options 1. 1
2. 2
3. 3
4. 4

Q.9 Two coherent light sources have intensities in the ratio 25: 16. The ratio of the intensities of maxima to minima, in the interference pattern due to them would be

1. 25 : 16
2. 9:1
3. 4:1
4. 81 :1

Options 1. 1
2. 2
3. 3
4. 4

Q.10 A long straight conductor carries a current of 304 A. The magnitude of the magnetic field due to the current at a distance of 6 cm from the conductor is

1. 3.002 mT
2. 1003 mT
3. 1.013 mT
4. 2.012 T

Options 1. 1
2. 2
3. 3
4. 4

Q.11 The half life of a radioactive substance is 20 s.

The time taken for its sample to decay $\frac{7}{8}$ th of the initial value is:

1. 20 s
2. 40 s
3. 60 s
4. 80 s

Options 1. 1
2. 2
3. 3

4. 4

Q.12 Nichrome element is used in household appliances because of the following characteristics
1. Its melting point is high
2. Its resistivity is large
3. It is tensile
4. It does not oxidize easily by the oxygen of the air when heated
Choose the correct answer from the options given below:
1. (A), (B) and (D) only
2. (A), (B) and (C) only
3. (A), (B), (C) and (D)
4. (B), (C) and (D) only

Options 1. 1
2. 2
3. 3
4. 4

Q.13 In Faraday's experiment on Electromagnetic Induction, in which of the following situations, more deflection will be shown by the galvanometer?
1. magnet is at rest inside the coil
2. magnet is accelerated towards the coil
3. magnet is in uniform motion towards the coil
4. magnet is decelerated away from the coil

Options 1. 1
2. 2
3. 3
4. 4

Q.14 The following statements are given related to Wheatstone Bridge:
1. when Wheatstone Bridge is balanced, no current flows through the galvanometer arm.
2. Wheatstone Bridge works on the principle of Kirchhoff's law.
3. Being a null method based experiment, the result is free from the effect of extra resistances (cell resistance) of the circuit
4. Wheatstone Bridge is most sensitive when all the four resistances are nearly of the same magnitude.
Choose the *correct* answer from the options given below:
1. (A), (B) and (D) only
2. (A), (B) and (C) only
3. (A), (B), (C) and (D)
4. (B), (C) and (D) only

Options 1. 1
2. 2
3. 3
4. 4

Q.15 The radii of curvature of the two surfaces of a concave lens are 20 cm each. The refractive index of the material of the lens is 1.5. The power of the lens would be-
1. -5 D
2. -1 D
3. 2.5 D
4. -0.5 D

Options 1. 1
2. 2
3. 3
4. 4

Q.16 A cell supplies a current of 0.6 A through a 3 Ω resistor and a current of 0.2 A through a 10 Ω resistor.
The internal resistance of the cell is:
1. 0.5 Ω
2. 1.0 Ω
3. 0.05 Ω
4. 0.01 Ω

Options 1. 1
2. 2
3. 3
4. 4

Q.17 With the rise in temperature, the electrical resistance
1. increases for a conductor and a semiconductor
2. decreases for a conductor and a semiconductor
3. increases for a conductor and decreases for a semiconductor
4. decreases for a conductor and increases for a semiconductor

Options 1. 1
2. 2
3. 3
4. 4

Q.18 Two long coaxial solenoids of the same length L have inner and outer coils with diameters D_1 and D_2 and number of turns N_1 and N_2, respectively. What will be the ratio of the self-inductance of the inner solenoid to the mutual inductance of both the solenoids?

1. $N_1N_2^{-1}$
2. $N_2N_1^{-1}$
3. $\frac{N_2D_2^2}{N_1D_1^2}$
4. $\frac{N_2D_2}{N_1D_1}$

Options 1. 1
2. 2
3. 3
4. 4

Q.19 In n-type semiconductors, A are the majority charge carriers and B are the minority charge carriers. Here A and B are:

1. A- electrons ; B- protons
2. A- protons ; B- electrons
3. A- electrons ; B- holes
4. A- holes ; B- electrons

Options 1. 1
2. 2
3. 3
4. 4

Q.20 A 600 pF capacitor is charged by a 150 V battery. The charge on the capacitor is:

1. 9 μC
2. 4 pC
3. 90 nC
4. 9 nC

Options 1. 1
2. 2
3. 3
4. 4

Q.21 The magnetic flux through a coil placed in a magnetic field is given by

$\phi = 5t^3 + 4t^2 + 2t - 5$ Wb

The resistance of the coil is 10 Ω.

The induced current through the coil at $t = 2$ s is:

1. 7.8 A
2. 15.6 A
3. 0.78 A
4. 3.9 A

Options 1. 1
2. 2
3. 3
4. 4

Q.22 A proton enters a uniform magnetic field of 0.2 T with speed v. It describes a semicircular path of radius 5 cm and comes out of the field. The final speed of the proton will be

1. 0.5 v
2. v
3. 4 v
4. 0.02 v

Options 1. 1
2. 2
3. 3
4. 4

Q.23 The main causes of energy loss in transformers are
1. Hysteresis loss
2. Flux leakage
3. Eddy current
4. Damping

Choose the correct answer from the options given below:
1. (A), (B) and (D) only
2. (A), (B) and (C) only
3. (A), (B), (C) and (D)
4. (B), (C) and (D) only

Options 1. 1
2. 2
3. 3
4. 4

Q.24 A ferromagnetic core of susceptibility 799 is subjected to a magnetizing field. The permeability of the material is

(Take $\mu_0 = 4\pi \times 10^{-7}\ \text{T m A}^{-1}$)

1. $3.2\pi \times 10^{-4}\ \text{T m A}^{-1}$
2. $3.2 \times 10^{-4}\ \text{T m A}^{-1}$
3. $3.2\pi \times 10^{-5}\ \text{T m A}^{-1}$
4. $3.2\pi \times 10^{-7}\ \text{T m A}^{-1}$

Options 1. 1
2. 2
3. 3
4. 4

Q.25 A regular hexagon of side 12 cm has a charge of 6 μC at each of its vertices.
What will be the potential at the centre of the hexagon?

1. $2.7 \times 10^{4}\ \text{V}$
2. $4.5 \times 10^{6}\ \text{V}$
3. $2.65 \times 10^{-16}\ \text{V}$
4. $2.7 \times 10^{6}\ \text{V}$

Options 1. 1
2. 2
3. 3
4. 4

Q.26 An eye specialist prescribes spectacles having a combination of a converging lens of focal length 25 cm and a
diverging lens of focal length of 20 cm. The power of the combination of two lenses (in dioptre) is
1. + 1.0
2. - 1.0
3. + 1.1
4. +2.0

Options 1. 1
2. 2
3. 3
4. 4

Q.27 Match List-I with List-II for the band gap energy for different materials

List-I	List-II
Substances	Band gap Energy
(A) Germanium	(1) 1.1 eV
(B) Silicon	(II) 0.7 eV
(C) Insulator	(III) Zero
(D) metal	(IV) 5 eV

Choose the correct answer from the options given below:
1. (A) - (11), (B) - (1), (C) - (IV), (D) - (III)
2. (A) - (1), (B) - (1), (C) - (III), (D) - (IV)
3. (A) - (1), (B) - (1), (C) - (IV), (D) - (III)
4. (A) - (I1), (B) - (IV), (C) - (I), (D) - (III)

Options 1. 1
2. 2
3. 3
4. 4

Q.28 A circular coil with 5 turns, each of radius 7 cm, carries a current of 1.4 A.
The magnetic field at the center of the coil is:

1. $10^{-5}\ \text{T}$
2. $2 \times 10^{-5}\ \text{T}$

3. $\pi \times 10^{-5}$ T
4. $2\pi \times 10^{-5}$ T

Options 1. 1
2. 2
3. 3
4. 4

Q.29 The speed of electromagnetic waves in a material medium is given by (symbols have their usual meanings):
1. $v = (\mu\varepsilon)^{0.5}$
2. $v = (\mu_0\varepsilon_0)^{-0.5}$
3. $v = (\mu\varepsilon)^{-0.5}$
4. $v = (\mu_0\varepsilon_0)^{0.5}$

Options 1. 1
2. 2
3. 3
4. 4

Q.30 The current in a resistive series circuit is 7.0 A.
On adding a resistance of 1.6 Ω in the same circuit in series, the current drops to 5.0 A.
The original resistance of the circuit is:
1. 1.0 Ω
2. 4.0 Ω
3. 2.0 Ω
4. 8.0 Ω

Options 1. 1
2. 2
3. 3
4. 4

Q.31 In a large building, there are 20 bulbs of 40 W each, 5 bulbs of 100 W each, 5 fans of 80 W each, and 1 heater of 1 kW.
The voltage supply is 220 V. The minimum capacity of the main fuse of the building should be
1. 12.27 A
2. 10.42 A
3. 8.31 A
4. 6 A

Options 1. 1
2. 2
3. 3
4. 4

Q.32 In a Young's double-slit experiment, the slits are separated by 0.28 mm and the wavelength of light used is 6000 A.
The fringes are observed on a screen placed 1.4 m away from the slits. The distance between the central bright fringe and the fourth bright fringe will be
1. 0.3 cm
2. 0.6 cm
3. 1.2 cm
4. 2.4 cm

Options 1. 1
2. 2
3. 3
4. 4

Q.33 Two concentric coils of radius 2π cm each are placed with their planes at right angles to each other and carry currents of 3 A and 4 A, respectively. The net magnetic field in Wb/m^2 at the center of the coils will be

1. 10^{-5}
2. zero
3. 7×10^{-5}
4. 5×10^{-5}

Options 1. 1
2. 2
3. 3
4. 4

Q.34 In a coil, the current is changed from 12 A to 24 A in 1 s. The self-induced emf of the coil is 24 V. The change in energy in the coil is

1. 432J
2. 360 J
3. 216 J
4. 108 J

Options 1. 1
2. 2
3. 3
4. 4

Q.35 The energy required to excite an electron in hydrogen atom to its first excited state is

1. 13.6 eV
2. 3.4 eV
3. 10.2 eV
4. - 13.6 eV

Options 1. 1
2. 2
3. 3
4. 4

Q.36 A printed page is kept pressed by a glass cube-shaped paper-weight of edge 3.0 cm.
The refractive index of the glass is $\mu = 1.5$.
By what amount will the printed letters appear to be shifted when viewed from the top?

1. 1.0 cm
2. 0.5 cm
3. 2.0 cm
4. 2.5 cm

Options 1. 1
2. 2
3. 3
4. 4

Q.37 The ratio of the radius of the third orbit to that of the second orbit in a hydrogen atom is

1. 3:2
2. 9:4
3. $\sqrt{2} : \sqrt{3}$
4. 4:9

Options 1. 1
2. 2
3. 3
4. 4

Q.38 A point charge of 17.7 μC is placed at a perpendicular distance of 5 cm from the centre of a square.
The amount of electric flux going through the square will be:
(Given $\varepsilon_0 = 8.85 \times 10^{-12}\ C^2N^{-1}m^{-2}$)

1. $3.33 \times 10^5\ N{\cdot}m^2/C$
2. $2.00 \times 10^6\ N{\cdot}m^2/C$
3. $4.08 \times 10^6\ N{\cdot}m^2/C$
4. $6.4 \times 10^7\ N{\cdot}m^2/C$

Options 1. 1
2. 2
3. 3

4. 4

Q.39 If the radii of curvature of the faces of a double convex lens are 10 cm and 15 cm, respectively and its refractive index is 1.5, the focal length of the lens in air is

1. 6 cm
2. 12 cm
3. 30 cm
4. 28 cm

Options 1. 1
2. 2
3. 3
4. 4

Q.40 A current through a wire varies with time, as $I = \alpha t + \beta t^2$ where $\alpha = 10\ \text{A s}^{-1}$ and $\beta = 4\ \text{A s}^{-2}$. How much charge will cross through a section of the wire in 12 s?

1. 106 C
2. 696 C
3. 912 C
4. 3024 C

Options 1. 1
2. 2
3. 3
4. 4

Q.41 According to Bohr's theory, the angular momentum of an electron revolving in the second orbit of the hydrogen atom will be:

1. πh
2. $2\pi h$
3. $\frac{\pi}{h}$
4. $\frac{h}{\pi}$

Options 1. 1
2. 2
3. 3
4. 4

Q.42 A magnetic field energy of 34×10^{-6} J is stored in an inductor of inductance 1.7 mH in an LC circuit. The current flowing in the inductor is:

1. 0.141 A
2. 0.2 A
3. 1.41 A
4. 0.004 A

Options 1. 1
2. 2
3. 3
4. 4

Q.43 At an instant of time, a magnetic field is applied along the velocity of the particle. The acceleration produced in the particle will be

1. along the velocity.
2. Opposite to the direction of velocity.
3. Perpendicular to the direction of velocity.
4. Zero.

Options 1. 1
2. 2
3. 3
4. 4

Q.44 Which of the following statements is NOT true about X-rays?

1. Wavelength Range: 100 Å – 0.1 Å
2. Frequency Range:10^{11} Hz – 10^{14} Hz
3. Source: Sudden deceleration of fast-moving electrons by a metal target
4. More energetic than UV rays

Options 1. 1
2. 2
3. 3

4. 4

Q.45 Identify the important features of the semiconductor devices from the following
1. Semiconductor devices require cathode heating for the production of charge carriers.
2. They have long life and high reliability.
3. They are small in size and consume low power.
4. They operate at high voltage.

Choose the correct answer from the options given below:
1. (A) and (D) only
2. (B) and (C) only
3. (A) and (B) only
4. (B), (C) and (D) only

Options 1. 1
2. 2
3. 3
4. 4

Q.46 Which of the following statements is correct for a compound microscope?
1. Both the objective and the eye piece should have large aperture
2. Both the objective and the eye piece should have large focal lengths.
3. The eyepiece essentially functions like a simple microscope or a magnifier.
4. The final image is erect with respect to the original object.

Options 1. 1
2. 2
3. 3
4. 4

Q.47 Assume an electric field $E = 30x\,\hat{i}$ exists in space.
If V_0 is the potential at the origin and V_A is the potential at $x = 2\,\text{m}$, then the potential difference $V_A - V_0$ is:
1. $-40\,\text{V}$
2. $-60\,\text{V}$
3. $0\,\text{V}$
4. $60\,\text{V}$

Options 1. 1
2. 2
3. 3
4. 4

Q.48 The work functions of Cesium and Platinum are 1.9 eV and 5.7 eV, respectively. The ratio of their threshold
wavelengths, respectively is
1. 1:3
2. 3:1
3. 1:9
4. 9:1

Options 1. 1
2. 2
3. 3
4. 4

Q.49 A series combination of two capacitors $C_1 = 3\,\mu\text{F}$ and $C_2 = 6\,\mu\text{F}$ is connected in parallel with a third capacitor $C_3 = 4\,\mu\text{F}$.
This system is connected to a 10 V battery. The total energy stored in the system is:
1. $4 \times 10^{-4}\,\text{J}$
2. $3 \times 10^{-4}\,\text{J}$
3. $6 \times 10^{-4}\,\text{J}$
4. $9 \times 10^{-4}\,\text{J}$

Options 1. 1
2. 2
3. 3
4. 4

Q.50 The peak value of the electric field associated with an electromagnetic wave traveling through vacuum is $8.1\,\text{N}\cdot\text{C}^{-1}$.
The peak value of the associated magnetic field will be:
1. $24.3 \times 10^{8}\,\text{T}$
2. $2.7 \times 10^{-8}\,\text{T}$
3. $2.7 \times 10^{8}\,\text{T}$
4. $24.3 \times 10^{-8}\,\text{T}$

Options 1. 1

2. 2
3. 3
4. 4