Q.1 The dipole moment of a circular loop carrying a current I is m and the magnetic field at the centre of the loop is B_1.

When the dipole moment is made three times by keeping the current I same, the magnetic field at the centre of the loop becomes B_2.

The ratio of B_1 and B_2 is:

1. $\sqrt{2} : 1$

2. $2 : 1$

3. $\sqrt{3} : 1$

4. $1 : \sqrt{3}$

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

Q.2 A point charge q is placed at the center of a cube of side L.
The total electric flux passing through any three faces of this cube is:

1. $\dfrac{q}{\varepsilon_0}$

2. $\dfrac{q}{2\varepsilon_0}$

3. $\dfrac{q}{6\varepsilon_0}$

4. $\dfrac{q}{8\varepsilon_0}$

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

Q.3 Arrange the de-Broglie wavelengths associated with the following in decreasing order: (Given: $h = 6.6 \times 10^{-34}$ J·s)

(A) an electron (mass 9×10^{-31} kg) in the hydrogen atom moving with speed 3×10^6 m/s

(B) a bullet (mass 0.04 kg) travelling at speed 10^3 m/s

(C) a ball (mass 0.06 kg) moving with speed 1.0 m/s

(D) a dust particle (mass 1.0×10^{-9} kg) drifting with speed 3.3 m/s

Choose the correct answer from the options given below:
1. (D), (B), (C), (A)

2. (A), (D), (C), (B)

3. (B), (C), (D), (A)

4. (C), (A), (D), (B)

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

Q.4 A proton moves from south to north with a speed of 2×10^7 m/s. When a magnetic field is applied from west to east,

the proton gets an acceleration of 10^{12} m/s^2. The mass of the proton is 1.6×10^{-27} kg. The value of the magnetic field is:

1. 5×10^{-4} T

2. 5×10^{-5} T

3. 1×10^{-3} T

4. 1×10^{-4} T

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

Q.5 The ratio of total energy to the kinetic energy of an electron in a Bohr orbit of the hydrogen atom is
1. 1:1
2. 1:-2
3. -1:1
4. 2:-1

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

Q.6 A resistor of resistance 30 Ω and a capacitor of capacitance $(250 \, \pi^{-1})$ μF are connected in series to a 220 V, 50 Hz source. The current in the circuit is
1. 7.3 A
2. 5.5 A
3. 4.4 A
4. 4.0 A

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

Q.7 Two coaxial solenoids having number of turns per unit length 50 and 200, respectively, have same length 50 cm.

The area of cross-section of the two solenoids are 4 cm^2 and 6 cm^2, respectively. The mutual inductance of the two solenoids is:

1. $8\pi \times 10^{-3}$ H

2. $4\pi \times 10^{-4}$ H

3. $8\pi \times 10^{-7}$ H

4. $1.6\pi \times 10^{-2}$ H

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

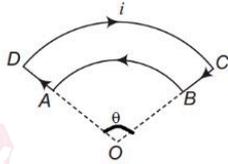**Q.8** A given p-n junction is forward biased. Which of the following statements is correct?
1. The electrons move from p-region to n-region.
2. The height of potential barrier is increased.
3. The height of potential barrier is decreased.
4. The width of depletion region increases.

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

Q.9

The figure shows a current loop having two circular arcs joined by two radial lines. If radius OA is 'a' and OD is 'b', the magnetic field at the centre O is.

:

1. $\left(\frac{\theta}{2\pi}\right)\left(\frac{\mu_0 i}{2a}\right)$

2. $\left(\frac{\theta}{2\pi}\right)\left(\frac{\mu_0}{2b}\right)$

3. $\left(\frac{\theta}{2\pi}\right)\left(\frac{\mu_0 i}{2}\right)\left(\frac{(b-a)}{ab}\right)$

4. zero

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

Q.10 Which of the following statements are true regarding alternating current:

(A) In an a.c. circuit containing resistance only, a.c. power is expressed in the same form as d.c. power ($P = I^2 R$), using a special value of current called root mean square (rms) or effective current, denoted by I_{rms}.

(B) A phasor is a vector.

(C) Resonance phenomenon is exhibited by a circuit even if both L and C are not present in the circuit.

(D) For circuits used for transporting electric power, a low power factor implies less power loss in transmission.

Choose the **correct** answer from the options given below:

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

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

Q.11 A charge moving _____ to the direction of the magnetic field does not experience any magnetic Lorentz force.

(A) parallel
(B) perpendicular
(C) antiparallel
(D) at any acute angle

Choose the *correct* answer from the options given below:

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

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

Q.12 The electric field in a copper wire of cross-sectional area 2.0 mm^2 carrying a current of 1 A is:

(Given: Resistivity of copper $\rho = 2 \times 10^{-8}$ Ω·m)

1. 10^{-2} V/m

2. 5×10^{-2} V/m

3. 10^{-3} V/m

4. 2.5×10^{-2} V/m

Q.13 A capacitor of unknown capacitance is connected with a battery of V volts. The charge stored in it is 200 μC.

When the potential of the capacitor is reduced by 100 volts, the charge stored in it becomes 150 μC. The unknown capacitance is:

1. 0.5 μF

2. 1 pF

3. 4 μF

4. 1.5 μF

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

Q.14 Two long and parallel straight wires A and B carrying currents of 8.0 A and 5.0 A in the same direction are separated by a distance of 4.0 cm.

Estimate the force on 10 cm length of wire B:

1. 5×10^{-5} N, repulsive

2. 5×10^{-5} N, attractive

3. 2×10^{-5} N, attractive

4. 2×10^{-5} N, repulsive

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

Q.15 A beam of light of wavelength 500 nm from a distant source falls on a single slit of width 10^{-4} m,

and the resulting diffraction pattern is observed on a screen 2 m away. The width of the central bright fringe is:

1. 2×10^{-4} m

2. 2×10^{-3} m

3. 10^{-3} m
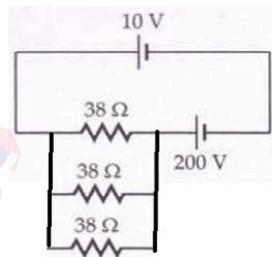
4. 2×10^{-2} m

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

Q.16

A 10 V battery of negligible internal resistance is connected with a 200 V battery and a set of parallel resistances as shown in the figure. The value of current in the circuit.

10 V

38 Ω

200 V

38 Ω

38 Ω

1. 5 A
2. 15 A
3. 10 A
4. 2 A

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

Q.17 In photoelectric effect, the stopping potential depends on the
1. intensity of the incident radiation
2. Frequency of the incident radiation only
3. nature of the material only
4. frequency of the incident radiation and nature of material both

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

Q.18 A pair of adjacent coils has a mutual inductance of 2.0 H. If the current in one coil changes from 0 to 25 A in 0.8 s, the
change of flux linkage with the other coil is
1. 50 Wb
2. 62.5 Wb
3. 20 Wb
4. 40 Wb

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

Q.19 Arrange the following electromagnetic waves in the increasing order of their energy:
(A) infrared rays
(B) AM radio waves
(C) y - rays
(D) Microwaves
Choose the *correct* answer from the options given below:
1. (A), (B), (C), (D)
2. (B), (D), (A), (C)
3. (C), (A), (D), (B)
4. (D), (C), (B), (A)

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

Q.20 The variation of resistivity of a metallic conductor with temperature is given correctly by which of the following relations?
(Where ρ_T is the resistivity at a temperature T and ρ_0 is the resistivity at a reference temperature T_0,
α is the temperature coefficient of resistivity, $T > T_0$)
1. $\rho_T = \rho_0[1 + \alpha(T - T_0)]$
2. $\rho_0 = \rho_T[1 + \alpha(T_0 - T)]$
3. $\rho_T = \rho_0[1 + \alpha(1 - T_0)]$
4. $\rho_T = [\rho_0 + \alpha(T - T_0)]$

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

Q.21

An electromagnetic wave moves in vacuum. Its speed is c.

Choose the correct options about the characteristics of electromagnetic waves:

(A) $c = \dfrac{1}{\sqrt{\mu_0 \varepsilon_0}}$

(B) Electromagnetic waves are transverse in nature.

(C) Both the electric field and magnetic field vibrate perpendicular to the direction of propagation of waves

(D) Electromagnetic waves are longitudinal in nature.

Choose the **correct** answer from the options given below:

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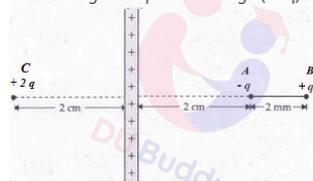3. (C) and (D) only
4. (A) and (B) only

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

Q.22

An electric dipole consists of charges $\pm 2 \times 10^{-8}$ C, separated by a distance of 2 mm. It is placed on the right side near a long line charge of density 4×10^{-4} C m^{-1}. The negative charge of dipole is at a distance of 2 cm from the line charge as shown in figure. A positive charge (+2q) is placed on the left at 2 cm at point C. Given q = 2×10^{-8} C

(A) Force $|F_A|$ exerted on negative charge at point A due to line charge

(B) Force $|F_B|$ exerted on positive charge at point B due to line charge

(C) Net force on the dipole $|F_{net}|$ due to line charge

(D) Force $|F_C|$ exerted on charge **+2q** at point C due to line charge

If the forces $|F_A|, |F_B|, |F_C|, |F_{net}|$ are arranged in decreasing order, then

Choose the **correct** answer from the options given below:

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

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

Q.23

Match List-I with List-II

List-I	List-II
(Electronic Device)	(Function)
(A) Stabilizer	(I) Used to convert a.c. voltage into d.c. voltage
(B) Filter	(II) Used either for stepping up or stepping down the a.c. voltage
(C) Rectifier	(III) Used for constant output voltage even when the input voltage or load current changes
(D) Transformer	(IV) Used to remove any ripple in the rectified output voltage

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

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

Q.24 The susceptibility of a paramagnetic material is χ at 27°C. At what temperature will its susceptibility be $\chi/3$?

1. 900 °C
2. 627 °C

3. $-173\,°\text{C}$

4. $100\,°\text{C}$

Q.25 If 200 MeV energy is released in the fission of a single nucleus of uranium-235, how many fissions per second will produce a power of 32 kW?

1. 10^{13}

2. 10^{15}

3. 10^{19}

4. 10^{21}

Q.26 There are four capacitors: C_1, C_2, C_3 and C_4 with equal capacitance C_0.
(A) for capacitor C_1 area of the plates is doubled
(B) for capacitor C_2 distance between the plates is tripled
(C) the capacitor C_3 is filled completely with a material having dielectric constant $K = 3$
(D) for capacitor C_4 there is no change
If the capacitors are arranged in decreasing order of their capacitances, then
Choose the **correct** answer from the options given below:
1. (A), (B), (C), (D)
2. (C), (A), (D), (B)
3. (B), (A), (D), (C)
4. (C), (B), (D), (A)

Q.27 A proton and an alpha particle accelerated through different potential differences have the same de-Broglie
wavelength. The ratio of their respective accelerating potentials is
1. 2:1
2. 8:1
3. 4:1
4. 1:1

Q.28 An object is placed at 5 cm in front of a concave mirror with a radius of curvature of 20 cm. The distance of the image
from mirror and its nature are
1. 10 cm, virtual and erect
2. 10 cm, real and inverted
3. 15 cm, real and inverted
4. 3.3 cm, virtual and erect

Q.29 The electric field component of an electromagnetic wave in vacuum is $\vec{E} = 3\cos(1.8y + 5.4 \times 10^8 t)$ N/C, where y is in
meter and t is in seconds. The frequency of the wave is (approximately)
1. 86 MHz
2. 40 MHz
3. 15 MHz

4. 27 MHz

Q.30 Match List-I with List-II

List-I	List-II
(Electromagnetic waves)	(Application)
(A) Infrared	(I) diagnostic tool in medicine
(B) X-rays	(II) water purification
(C) UV rays	(III) communication radar
(D) Microwaves	(IV) improving visibility in foggy days

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

Q.31 Identify the correct statement in the context of Rutherford scattering of α-particles by a target nucleus:

1. For large impact parameter values, α-particle suffers large deviation.

2. For small impact parameter values, the deviation in the trajectory of α-particle is negligible.

3. The perpendicular distance of the initial velocity vector of the α-particle from the centre of the nucleus is called impact parameter.

4. Impact parameter depends on mass of the target nucleus.

Q.32

In the circuit diagram shown in the figure, the resistance $R_1 = 10\ \Omega$, $R_2 = 15\ \Omega$ and E= 20 V. When the switch S is closed, the ratio of i_1 to i_3 will be

1. 6:5
2. 20:3
3. 4:3
4. 5:3
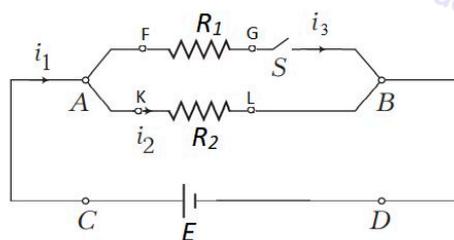
Q.33

The refractive indices of glass and water are $\frac{3}{2}$ and $\frac{4}{3}$, respectively.

If the speed of light in water is 2.25×10^8 m/s, the speed of light in glass will be:

1. 2×10^8 m/s

2. 1.5×10^8 m/s

3. 1.95×10^8 m/s

4. 2×10^6 m/s

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

Q.34 Three parallel plates (each of area A) are separated by distances d_1 and d_2 respectively.

The in-between spaces are filled with dielectrics of relative permittivity ϵ_1 and ϵ_2. The permittivity of free space is ϵ_0.

The capacitance of the combination is:

1. $\dfrac{\epsilon_0 \epsilon_1 \epsilon_2}{\epsilon_2 d_1 + \epsilon_1 d_2}$

2. $\dfrac{\epsilon_0 \epsilon_1 \epsilon_2 A}{\epsilon_2 d_1 + \epsilon_1 d_2}$

3. $\dfrac{\epsilon_2 d_1 + \epsilon_1 d_2}{\epsilon_0 \epsilon_1 \epsilon_2 A}$

4. $\dfrac{\epsilon_1 \epsilon_2 A}{\epsilon_2 d_1 + \epsilon_1 d_2}$

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

Q.35 A short bar magnet placed with its axis at 30° with a uniform external magnetic field of 0.24 T experiences a torque of
magnitude 0.048 N m. The magnetic moment of the magnet is

1. 0.1 A·m^2

2. 0.2 A·m^2

3. 0.4 A·m^2

4. 0.23 A·m^2

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

Q.36 A hot electric iron has resistance of 88 Ω and is used with a 220 V source.

The electrical energy consumed in 4 h is:

1. 7.92×10^6 J

2. 7.92×10^7 J

3. 2.2×10^3 J

4. 1.32×10^5 J

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

Q.37 At sunrise and sunset the sun appears reddish due to
1. scattering of light
2. polarisation of light
3. Reflection of light
4. colour of the sky

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

Q.38 What will be the energy required to remove the electron from the first excited state of Li^{++},

if the ground state energy of the electron in a hydrogen atom is -13.6 eV?

1. 7.65 eV

2. 10.4 eV

3. 13.6 eV

4. 30.6 eV

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

Q.39 An 80 Ω resistor is connected to a 240 V, 50 Hz AC supply. The net power consumed over a full cycle is:

1. *zero*
2. 240 W
3. 339 W
4. 720 W

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

Q.40 Two point charges 2 μC and 3 μC are placed at a distance of 5 cm from each other.

The magnitude of the electrostatic force between them is:

1. 21.6 N

2. 30.2 N

3. 43.2 N

4. 53.8 N

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

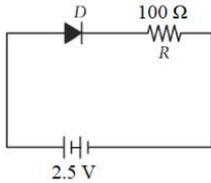**Q.41** The magnification (m) and focal length (f) of a plane mirror are:
1. $m = +1; \ f = zero$
2. $m = +1; \ f = \infty$
3. $m = -1; \ f = zero$
4. $m = -1; \ f = \infty$

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

Q.42

In the given figure, a diode D is connected to an external resistance R = 100 Ω and an emf of 2.5 V. During forward bias, if the barrier potential developed across the diode is 0.6 V, the current in the circuit will be

1. 19 mA
2. 190 mA
3. 6 mA
4. 25 mA

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

Q.43 The force of attraction between two charges separated by a distance in air is F.

If the medium air is replaced by a dielectric medium of dielectric constant K, the force of attraction between the charges will become:

1. KF
2. $\dfrac{F}{K}$
3. FK^2
4. F

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

Q.44 Two wires with resistances R_1 and R_2 are stretched n times their original length.

After stretching, the two wires are connected in parallel. The equivalent resistance of the combination will be:

1. $\dfrac{n^2 R_1 R_2}{R_1 + R_2}$

2. $\dfrac{n R_1 R_2}{R_1 + n R_2}$

3. $\dfrac{R_1 R_2}{n^2 (R_1 + R_2)}$

4. $\dfrac{n R_1 R_2}{n R_1 + R_2}$

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

Q.45 Match List-I with List-II

List-I	List-II
Physical Quantity	**Formula**
(A) j (current density)	(I) $\dfrac{e\tau}{m}$
(B) v_d (drift velocity)	(II) $\dfrac{ne^2}{m}\tau$
(C) σ (conductivity)	(III) $\dfrac{e}{m}\tau E$
(D) μ (mobility)	(IV) $\dfrac{ne^2}{m}\tau E$

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

3. (A) - (11), (B) - (111), (C) - (IV), (D) - (I))
4. (A) - (IV), (B) - (III), (C) - (I), (D) - (II)

Options 1. 1

2. 2

3. 3

4. 4

Q.46 If the angular velocity of coil in an AC generator is doubled while keeping other parameters
constant, the maximum
induced emf
1. remains the same
2. is halved
3. is doubled
4. is quadrupled

Options 1. 1

2. 2

3. 3

4. 4

Q.47 Match List-I with List-II (here symbols have their usual meanings)

List-I   List-II

(Physical Quantity / Law) (Formula)

(A) Snell's law $\dfrac{t}{\mu}$

(B) Apparent Shift $\dfrac{c}{v}$

(C) Refractive Index $\dfrac{\mu_2}{\mu_1}$

(D) Apparent depth $t\left(1-\dfrac{1}{\mu}\right)$

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

Options 1. 1

2. 2

3. 3

4. 4

Q.48 The wavelength of light coming from a sodium source is 589 nm. Its wavelength in crown glass
having refractive index
1.52 is
1. 387.5 nm
2. 589 nm
3. 447 nm
4. 895 nm

Options 1. 1

2. 2

3. 3

4. 4

Q.49 Match List-I with List-II

List-I   List-II

Electric Field   Expression

(A) Field due to an infinitely long straight uniformly charged wire   (I) $\sigma(2\varepsilon_0)^{-1}$

(B) Field due to a uniformly charged thin spherical shell (inside the shell)   (II) $q(4\pi\varepsilon_0 r^2)^{-1}$

(C) Field due to a uniformly charged infinite plane sheet   (III) $\lambda(2\pi\varepsilon_0 r)^{-1}$

(D) Field due to a uniformly charged thin spherical shell (outside the shell) (IV) zero

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

Options 1. 1

2. 2

3. 3

4. 4

Q.50 A 10 cm long air-core solenoid of cross-sectional area 1.0 cm^2 contains 300 turns. Its inductance is:

1. $36\pi \times 10^{-6}$ H
2. $4\pi \times 10^{-6}$ H
3. $4\pi \times 10^{-5}$ H
4. 36×10^{-6} H

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