Section A

INDIAN SCHOOL MUSCAT
SECOND PRELIMINARY EXAM
SUBJECT : PHYSICS

CLASS: XII | Answer Key :SET A | Time Allotted: 3 Hrs.

06.01.2019 | Max.Marks: 70

1. $\Phi_E = \frac{-2Q}{\epsilon_0}$ 1

2. The specific resistivity of copper (metal) will decrease but that of silicon (semi-conductor) will increase. 1

(OR)

Yes only during charging.

3. 60 degree 1

4. $\beta = \frac{\lambda D}{d}$ When light enters a denser medium, its wavelength decreases by a factor 4/3 and hence the fringe width also decreases by a factor 4/3. (1/2) 1

(OR)

No different colours have different refractive indices

5. A_c/A_m , no unit 1

Section B

6. Let, the drift velocities of the wires be v_d and v_d' respectively. 2
Area of cross- section of two wires be A and A'.

Then,
A : A' = 1:2

This implies,
A' = 2A

When the two wires are connected in series, the same amount of current flows through both the wires.
Implies,

$$n A v_d e = n A' v_d' e \quad (1)$$

where,
n is the number of electrons per unit volume and,
e is the charge on electron.
Therefore,

$$\frac{v_d}{v_d'} = \frac{A'}{A} = \frac{2A}{A} = 2:1 \quad (1)$$

7. $X_L = \omega L = 2\pi fL$ 2

$= 2\pi \times \frac{500}{\pi} \times 100 \times 10^{-3}$

$= 100\ \Omega$

Capacitive reactance,

$X_C = \frac{1}{\omega C} = \frac{1}{2\pi fC}$

$= \frac{1}{2\pi\left(\frac{500}{\pi}\right)\times 5\times 10^{-6}}$

$X_C = 200\ \Omega$

and,

$Z = \sqrt{(100)^2+(100-200)^2} = 141.4\ \Omega$

Current flowing across the circuit,

$\boxed{I = \frac{V}{Z}}$

$I = \frac{150\sqrt{2}}{100\sqrt{2}}$

$= 1.5$ A.

Now, average power dissipated across each component is,
(i) Across resistor is,
$I^2R = 1.5 \times 1.5 \times 100$
i.e., W = 225 W.

(OR)

(a)

$\boxed{\omega_r = \frac{1}{\sqrt{LC}}}$

$= \frac{1}{\sqrt{2.0\times 32\times 10^{-6}}}$

$= \frac{10^3}{8}$

$= 125\ \text{rad/s}$

(b)

$\boxed{Q = \frac{1}{R}\sqrt{\frac{L}{C}}}$

$= \frac{1}{10}\sqrt{\frac{2}{32\times 10^{-6}}}$

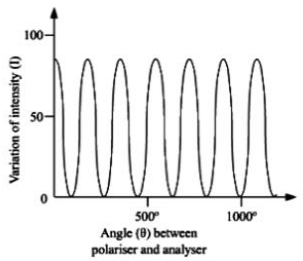
$= \frac{1000}{40}$

$= 25.$

8. Expression for mutual inductance of two longco-axial solenoids (2) 2

9. (a) Statement of Law of Malus. (1) 2

(b)



(OR)

(a) Definition of 'linearly polarised light.' (1)

(b) The light transmitted reaches a maximum when the intermediate sheet has its direction of polarization at a 45 degree angle to both the outside sheets.

10. If energy of photon = E (= hν), work function of metallic surface = $\phi = (h\nu_0)$ 2

kinetic energy of emitted electron = $1/2mv^2$

$E = \phi + 1/2mv^2$

$1/2mv^2 = h(v - v_0)$(1)

Any one characteristics of photons (1)

11. (a) Heavy water is basically used as a moderator in nuclear reactors to slow down the neutrons so that they are captured and become effective to bring about the fission reaction. The main reason why heavy water is used as a moderator is because it captures less neutrons than the normal water. 2

(1)

(b) cadmium that are capable of absorbing many neutrons without themselves fissioning. (1)

12. block diagram of communication system (1). function of transducer (1) 2

(OR)

No.as they penetrate the ionosphere.

$D = (2Rh)^{1/2} = 800$ km

Section C

13. (i) The capacitance of capacitor increases to K times (since $C = (K\varepsilon_0 A)/d \propto K$) (1) 3

(ii) The potential difference between the plates becomes 1/K times.

Reason: V = Q/C;Q same, increases to K times

$\therefore V' = V/K$

As E = V/d = and V is decreased; therefore, electric field decreases to 1/K times. (1)

(iii) Energy stored by the capacitor, u =Q2/2C. (1)

As Q = constant, C is increased, and so energy stored by capacitor decreases to 1/K times. (1)

14. circuit diagram of a potentiometer (1) 3

the method to find the internal resistance of the cell (2)

15. Describing Young's double slit experiment (1). 3

Deducing the expression for the fringe width (2).

16. Derivation of expression for v=E/B (2) 3

Trajectory (1/2) justification (1/2)

OR

expression for force per unit length (2)

define one ampere (1).

17. (a) 3

Electromagnetic waves are produced by accelerating charged particle. When the charge moves with acceleration, both the magnetic and electric fields change continuously. This change produces electromagnetic waves. (1)

Accelerated charge is the source of energy of these waves. (1)

(b) (i) in remote switches of house hold electronic device: IR (ii) as a diagnostic tool in medicine X rays (1/2+1/2)

18. Magnetic field at O due to loop 1. 3

$$B_1 = \frac{\mu_0 i R^2}{2(x^2+R^2)^{3/2}}$$, acting towards left. 1/2

Magnetic field at O due to loop 2.

$$B_2 = \frac{\mu_0 i R^2}{2(x^2+R^2)^{3/2}}$$,acting vertically upwards . 1/2

where, R is the radius of each loop.

Therefore,
Resultant magnetic field at O will be

$$B = \sqrt{B_1^2+B_2^2} \quad (\because B_1 = B_2)$$
$$= \sqrt{2B_1}$$
$$= \frac{\mu_0}{\sqrt{2}} \frac{i R^2}{(x^2+R^2)^{3/2}}$$ (2)

This resultant field acts at an angle of 45° with the axis of loop 1.

19. Statement ofHuygen's principle.(1) 3

To verify the laws of refraction when light travels from denser to rarer medium. (2)

20. 3

$\therefore$ By de-Broglied equation

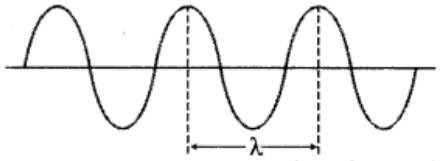
$$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2meV}}$$

Here, $h = 6.63 \times 10^{-34}$ J-s

$e = 1.6 \times 10^{-19}$ C

$m = 9.1 \times 10^{-31}$ kg

$$\Rightarrow \quad \lambda = \frac{12.27}{\sqrt{V}} \text{ Å}$$ (1)



A matter wave associated with an electron of definite momentum has single wavelength and extends all over space. (1)

(OR)

The de Broglie wavelength is given by

$$\lambda = \frac{h}{mv} .$$

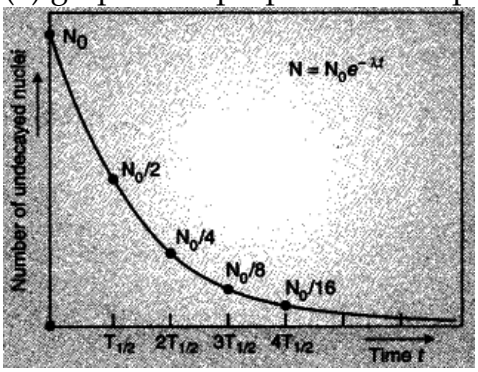
So the kinetic energy is $K = \frac{1}{2} mv^2$ and $v = \sqrt{\frac{2K}{m}}$

$$p = mv = m\sqrt{\frac{2K}{m}} = \sqrt{2mK} = \sqrt{2meV} \quad \text{since } K = eV$$

$$\lambda = \frac{h}{\sqrt{2meV}}$$

(1+2)

21. (a) Statement of the law of radioactive decay (1) 3
(b) graph with proper axes and points (2)



(OR)

(a) Derivation of the expression $N = N_0 e^{\lambda t}$ (1).
(b)

The β^+ decay for is given below:

$^{22}_{11}Na \rightarrow {}^{22}_{10}Ne + \beta^+ + \nu$

A proton is converted into neutron if, the unstable nucleus has excess protons than required for stability.

In the process, a positron e^+ (or a β^+) and a neutrino v are created and emitted from the nucleus.

$p \rightarrow n + \beta^+ + \nu$

This process is called beta plus decay.

(2)

22. circuit diagram of a full wave rectifier (1) 3
explaining its working (1).
Drawing the input and output waveforms.(1)

OR

circuit diagram of Zener diode as a DC voltage regulator (1).
its I-V characteristics with correct axes (2)

23. Circuit of *npn* transistor in CE configuration (1). 3
Explation (1)
Plotting of the output characteristic (1)

24. (a) any two reasons for need of modulating a signal (1/2+1/2). 3
(b) labelled block diagram of a simple modulator for obtaining an AM signal. (1)

Section C

25. (a) Definition of the capacitance of a capacitor (1). 5
expression for the capacitance of a parallel plate (2).
(b)

Capacitance having a dielectric of thickness 't' is given by,

$$C = \frac{\epsilon_o A}{d - t + \frac{t}{K}}$$

When the thickness of the plates is reduced to half, t = d/2 then,

Capacitance becomes,

$$C = \frac{\epsilon_o A}{d - \frac{d}{2} + \frac{d}{2K}}$$

$$= \frac{\epsilon_o A}{\frac{d}{2} + \frac{d}{2K}}$$

$$= \frac{\epsilon_o A}{\frac{d}{2}\left(1 + \frac{1}{K}\right)}$$

$$= \frac{2\epsilon_o AK}{d\,(K + 1)}$$

(OR)

Torque experienced by the electric dipole of dipole moment $\vec{p}$ in a uniform electric field $\vec{E}$ is given by $\vec{\tau} = \vec{p} \times \vec{E}$ The pairs of perpendicular vectors are: $\vec{p}$, $\vec{E}$

(i) When $\theta = 90^\circ$, torque is maximum [Fig. (a)]. $\tau_{max} = pE \sin 90^\circ = pE$ (ii)

When $\theta = 30^\circ 150^\circ$ torque is half the maximum value [Fig. (b)]. $\tau = pE \sin(30^\circ \text{or } 150^\circ) = \frac{1}{2}pE = \frac{1}{2}\tau_{max}$

(iii) When $\theta = 0^\circ$ or 180°, torque is minimum [Fig. (c)] $\tau_{min} = pE \sin(0^\circ or 180^\circ) = 0$

26. (a) labelled diagram of ac gen: 1 5

principle (1)

working (1).

expression for the *emf* generated (1)

No(1)

(b) Maximum e.m.f (E_o) = BANω= BAN(2 π ν)= 3.14 V

(OR)

Def. of eddy currents(1)

Producing eddy current (1)

considered undesirable in a transformer because loss of energy(1)

Ways to minimise any one (1)

Any two applications of eddy currents.(1)

27. (a) Ray diagram (1) 5

Relation between u v and R (2)

(b)

$$f_l = \frac{{}_a n_g - 1}{\frac{{}_a n_g}{{}_a n_l} - 1} \times f_a$$

$$= \frac{1 \cdot 6 - 1}{\left(\frac{1 \cdot 6}{1 \cdot 3} - 1\right)} \times 20 \text{ cm cm}$$

$$= \frac{0 \cdot 6 \times 1 \cdot 3}{0 \cdot 3} \times 20 \text{ cm}$$

$$= 52 \text{ cm}$$ (2)

(OR)

(a) ray diagram glass prism (1)

Derivation of relation between the refractive index of the prism, angle of prism and angle of minimum deviation. (2)

(b) $i = \sin^{-1}(n_2/n_1)$ (1m)

$i=45^o$(1m)

End of the Question Paper