COMMON PRE-BOARD EXAMINATION 2022-23

Subject: PHYSICS (042)

MARKING SCHEME

SECTION A

1.	(d)The electric field over the Gaussian surface remains continuous and uniform at every point.	**1**
2.	(a) E=0, V≠0	**1**
3.	(a)	**1**
4.	(b)1.6 x 10^{-5} N towards the wire of infinite length	**1**
5.	(c) torsional constant K	**1**
6.	(c) Ferromagnetic domains become random.	**1**
7.	(d) Decreases in the first circuit and increases in the other	**1**
8.	(b) $\left(\frac{\varepsilon\mu}{\varepsilon_0\mu_0}\right)^{1/2}$	**1**
9.	(c) anticlockwise	**1**
10.	(a) 200μm	**1**
11.	(b) B and C	**1**
12.	(a) 5: 9	**1**
13.	(b) 1:2	**1**
14.	(c) 45^0	**1**
15.	(a) 15μF	**1**
16.	(c) A is true but R is false	**1**

17. (c) A is true but R is false **1**

18. (a) Both A and R are true and R is the correct explanation of A **1**

SECTION B

19.

(a) X-rays- any one use **1**

(b) Microwaves- any one use **1**

20. Intensity of Magnetization-It is defined as the magnetic moment per unit volume of the material. **1** The intensity of magnetization of a paramagnetic material varies inversely with its temperature. **1**

21.

(i) Energy of photon $= \frac{hc}{\lambda}$ **½**

$= \frac{6.64\times10^{-34}\times3\times10^{8}}{275\times10^{-9}\times1.6\times10^{-18}}$ eV **1**

$= 4.5$ eV

The corresponding transition is B **½**

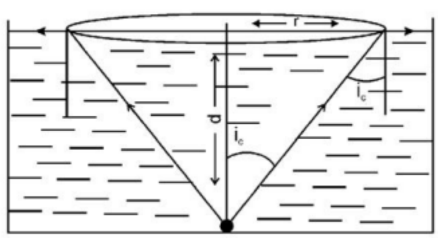
OR

(a) S, W, X

(b) For heavy nuclei, the protons on either side of the nucleus repel each other due to electrostatic repulsion. Hence the nuclear force becomes weak at this distance. Therefore, the average binding energy is very less.

1

22. **½**



For total internal reflection

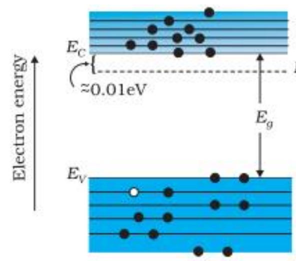
$\sin i_c = \frac{1}{\mu}$

also, from the figure,

$\tan i_c = \frac{r}{d}$ **1**

$\therefore \frac{\sin i_c}{\sqrt{1-\sin^2 i_c}} = \frac{r}{d}$

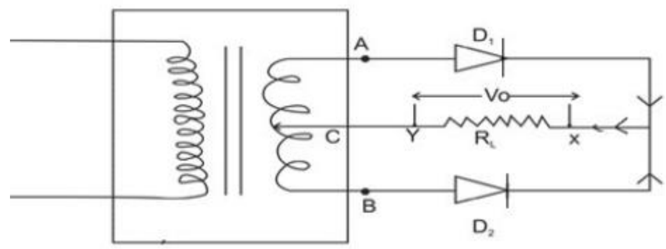
$\therefore r = \frac{d}{\sqrt{\mu^2 - 1}}$ **½**

23. 

1

The semiconductor obtained is N-type semiconductor and the majority charge carriers are electrons. 1

OR



1

Change the connection of R from point C to point B. Now No Current flowing through D2 in the second half. 1

24. As width of central maxima = width of 10 maxima

$$\therefore \frac{2D\lambda}{a} = 10\left(\frac{\lambda D}{d}\right)$$ 1

$$\Rightarrow a = \frac{d}{5} = \frac{10^{-3}}{5} = 0.2 \times 10^{-3} m$$ ½

$a = 0.2$ mm ½

25. At point A, electric field $= \vec{E}_A$

$$= \frac{2\sigma}{2\varepsilon_0}(-\hat{i}) + \frac{2\sigma}{2\varepsilon_0}(\hat{i}) + \frac{\sigma}{2\varepsilon_0}(-\hat{i})$$ 1

$$= \frac{\sigma}{2\varepsilon_0}(-\hat{i})$$

At point B, electric filed $= \vec{E}_B$

$$= \frac{\sigma}{2\varepsilon_0}(\hat{i}) + \frac{2\sigma}{2\varepsilon_0}(-\hat{i}) + \frac{2\sigma}{2\varepsilon_0}(\hat{i})$$ 1

$$= \frac{\sigma}{2\varepsilon_0}(\hat{i})$$

So, net electric field to the left of the sheet having charge density 2σ is $\frac{\sigma}{2\varepsilon_0}$ towards left.

Similarly net electric field to the right of the sheet having charge density σ is $\frac{\sigma}{2\varepsilon_0}$ towards right.

SECTION C

26.	Introduction	½
	Figure	½
	Steps and explanation	1½
	Final answer	½

27. **Solution** The angle θ made by the area vector of the coil with the magnetic field is 45°. From Eq. (6.1), the initial magnetic flux is **1**

$$\Phi = BA\cos\theta$$

$$= \frac{0.1 \times 10^{-2}}{\sqrt{2}}\,\text{Wb}$$

Final flux, $\Phi_{min} = 0$

The change in flux is brought about in 0.70 s. From Eq. (6.3), the magnitude of the induced emf is given by **1**

$$\varepsilon = \frac{|\Delta\Phi_B|}{\Delta t} = \frac{|(\Phi - 0)|}{\Delta t} = \frac{10^{-3}}{\sqrt{2} \times 0.7} = 1.0\,\text{mV}$$

And the magnitude of the current is **1**

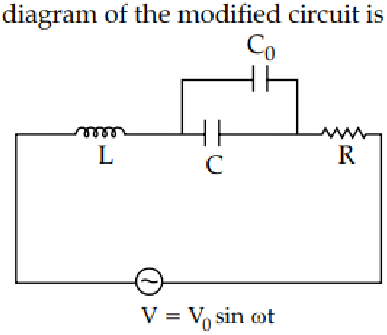
$$I = \frac{\varepsilon}{R} = \frac{10^{-3}\,\text{V}}{0.5\Omega} = 2\,\text{mA}$$

28. Device X- capacitor. **1**

Expression for power (introduction+ steps+ explanation+ final answer) **2**

OR

The diagram of the modified circuit is as shown. **1**



For resonance, we have **2**

$$\frac{1}{\omega(C + C_0)} = \omega L$$

$$\therefore \qquad C_0 = \left[\frac{1}{\omega^2 L} - C\right]$$

29. (a) Intensity: The total energy falling (or going through) a surface/region per unit area, per unit time. **1**

(b)

$E_{photon} = \Phi_o + \frac{1}{2}mV_{max}^2 \rightarrow$ for fastest electron ½

$\frac{1}{2}mV_{max}^2 = \frac{hc}{\lambda} - \Phi_o$ ½

$= \left[\frac{6.63x10^{-34} x3x10^8}{2000x10^{-10}x1.6x10^{-19}} - 4.2\right]eV$ ½

= 1.99 eV

The K.E of the slowest emitted electron is zero ½

OR

(i) It is the minimum frequency below which no photoemission occurs. **1**

(ii)

$K_{max} = h\nu - W_0$

$\frac{1}{2}mv_1^2 = 2hf - hf = hf$ **1**

$\frac{1}{2}mv_2^2 = 5hf - hf = 4hf$

$\frac{v_1^2}{v_2^2} = \frac{1}{4}$ **1**

$\frac{v_1}{v_2} = \frac{1}{2}$

30.

For a transition from n=3 to n =1 state, the energy of the emitted photon, **1**

$h\upsilon = E_2 - E_1 = 13.6\ [\frac{1}{1^2} - \frac{1}{3^2}]$ eV = 12.1 eV.

From Einstein's photoelectric equation,

$h\upsilon = K_{max} + W_0$ **1**

$$\therefore W_0 = h\upsilon - K_{max} \quad = 12.1 - 9 = 3.1\ eV$$

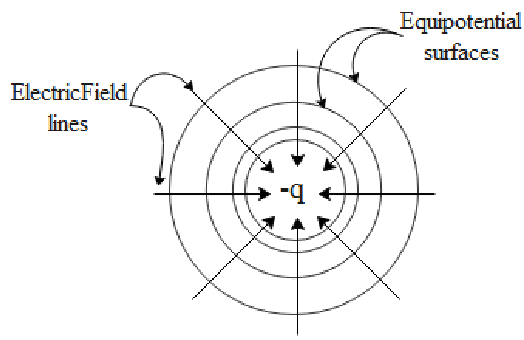
Threshold wavelength,

$\lambda_{th} = \frac{hc}{W_0} = \frac{6.62x10^{-34}x3x10^8}{3.1x1.6x10^{-19}} = 4x10^{-7}$ m **1**

SECTION D

31. (a) The work done in moving a charge from one point to another on an equipotential surface is zero. If the field is not normal to the surface, then it would have a non-zero component along the surface. This imply that work have to be done to move a charge which is contradictory to the definition of equipotential surface. **2**

1



(b) Work done to dissociate the system= 1

$$U = \sum_{i \neq j = 1}^{n} \frac{k q_i q_j}{r_{ij}}$$ 1

$=10kq^2/a$

OR

(*i*)

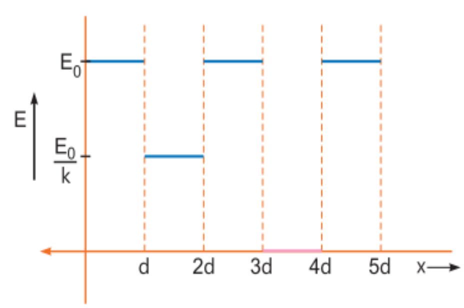
	Non-Polar (O_2)	Polar (H_2O)
(a) Absence of electric field		
Individual	No dipole moment exists	Dipole moment exists
Specimen	No dipole moment exists	Dipole are randomly oriented. Net P = 0
(b) Presence of electric field		
Individual	Dipole moment exists (molecules become polarised)	Torque acts on the molecules to align them parallel to $\vec{E}$
Specimen	Dipole moment exists	Net dipole moment exists parallel to $\vec{E}$

3

(*ii*) (*a*) The potential difference between the plates is given by

$$V = E_0 d + \frac{E_0}{K} d + E_0 d + 0 + E_0 d \quad \Rightarrow \quad V = 3E_0 d + \frac{E_0}{K} d$$ 1

(*b*) *E* versus *x* graph



1

32. **2**

(i) Kirchhoff's laws ½

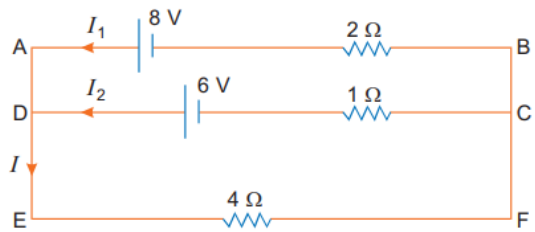
(ii) ½

$$I = I_1 + I_2 \qquad ...(i)$$

In loop *ABCDA*

$$-8 + 2I_1 - 1 \times I_2 + 6 = 0 \qquad ...(ii)$$ ½

In loop *DEFCD* ½



$$-4I - 1 \times I_2 + 6 = 0$$ ½

$$4I + I_2 = 6$$

$$4(I_1 + I_2) + I_2 = 6$$

$$4I_1 + 5I_2 = 6 \qquad ...(iii)$$ ½

From equations (*i*), (*ii*) and (*iii*) we get

$$I_1 = \frac{8}{7}\text{A},\ I_2 = \frac{2}{7}\text{A},\ I = \frac{10}{7}\text{A}$$

Potential difference across resistor 4Ω is:

$$V = \frac{10}{7} \times 4 = \frac{40}{7}\text{ volt}$$

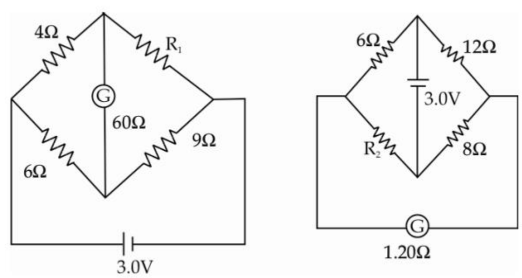
OR

(i) (a) curved path (b) straight lines. **1**

(ii) v=eEτ/m. No, there is a variation in the velocities of electrons. **1**

(iii) As the temperature of a conductor increases, the thermal speed of the electrons increases and also the amplitude of vibration of the metal atoms/ions increases. As a result, relaxation time decreases and drift velocity decreases. **1**

(iv)



For circuit 1

$$\frac{R_1}{9} = \frac{4}{6}$$ ½

$\therefore R_1 = 6\Omega$

For circuit 2 ½

$$\frac{R_2}{8} = \frac{6}{12}$$ ½

½

or $R_2 = 4\Omega$

$\therefore \frac{R_1}{R_2} = \frac{6}{4} = \frac{3}{2}$

33. (a) Statement Huygens principle and reason for absence of back wave **2**

(b) Refraction using Huygens principle-

Introduction **½**

Diagram **½**

Explanation **1**

Final answer **1**

OR

(a) Ray diagram of an astronomical telescope for the final image formed at infinity and labelling **2 ½**

(b) $m = -fo / fe$ **½**

$fo = 5\,fe$ **½**

$L = fo + fe$ **½**

$fe = 36/6 = 6\text{ cm}$ **½**

$fo = 30\text{ cm}$ **½**

SECTION E

34.

(a) n = 1.47 **1**

(b) Increases **1**

(c)

$$\frac{1}{f} = (\mu - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$$

$$\frac{1}{20} = (1.55 - 1)\left[\frac{1}{R} + \frac{1}{R}\right]$$

$$\frac{1}{20} = 0.55 \times \frac{2}{R}$$

$$\therefore R = 0.55 \times 2 \times 20 = 22\text{ cm}$$

½
½
½
½

OR

$$\frac{1}{f}=(n-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$$ ½

$$\frac{1}{12}=(n-1)\left(\frac{1}{10}+\frac{1}{15}\right)$$ ½

$$=(n-1)\times\frac{5}{30}$$ ½

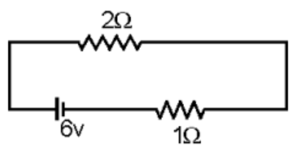
$$n-1=\frac{30}{5}\times\frac{1}{12} \quad \text{or} \quad n=1+\frac{30}{60} \Rightarrow n=1+0{\cdot}5=1{\cdot}5$$ ½

35.

(a) (i) forward biased- decreases (ii) reverse biased- increases **1**

(b) Diffusion and drift. **1**

(c) Diode D1 is forward biased while Diode D2 is reverse biased Hence the resistances, of (ideal) diodes, D1 and D2, can be taken as zero and infinity, respectively. The given circuit can, therefore, be redrawn as shown in the figure. **1**



½

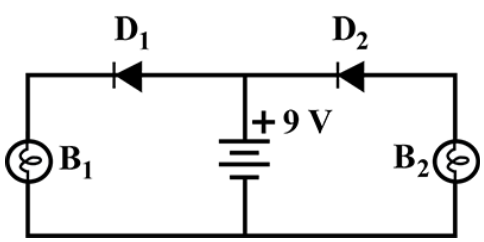
∴ Using ohm's law, ½

$I = \frac{6}{(2+1)} A = 2A$

∴ current flowing in the 1Ω resistor, is 2A.

OR

(c)



Bulb B_1 will glow. **1**

As D_1 is forward biased. **1**

Bulb B_2 will not glow as D_2 is reverse biased.