

**CAREERS360**  
*A Career is a Life*

**ISC 12<sup>th</sup>  
PHYSICS PAPER-1  
2018**

**QUESTION PAPER**

**PHYSICS**  
**PAPER – 1**  
**(THEORY)**

**(Maximum Marks: 70)**

**(Time allowed: Three hours)**

*(Candidates are allowed additional 15 minutes for only reading the paper.*

*They must NOT start writing during this time.)*

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***All questions are compulsory.***

***This question paper is divided in 4 Sections A, B, C and D as follows.***

***Section A***

*Question number 1 is of twelve marks. All parts of this question are compulsory.*

***Section B***

*Question numbers 2 to 12 carry 2 marks each with two questions having internal choice.*

***Section C***

*Question numbers 13 to 19 carry 3 marks each with two questions having internal choice.*

***Section D***

*Question numbers 20 to 22 are long-answer type questions and carry 5 marks each. Each question has an internal choice.*

*The intended marks for questions are given in brackets [ ].*

*All working, including rough work, should be done on the same sheet as and adjacent to the rest of the answer.*

*Answers to sub parts of the same question must be given in one place only. A list of useful physical constants is given at the end of this paper.*

*A simple scientific calculator without a programmable memory may be used for calculations.*

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***Section A***

*Answer all questions.*

**Question 1**

(A) Choose the correct alternative (a), (b), (c) or (d) for each of the questions given below: [5×1]

(i) Ohm's law in **vector** form is:

- (a)  $\mathbf{V} = \mathbf{I.R}$
- (b)  $\vec{J} = \sigma \vec{E}$
- (c)  $\vec{J} = \rho \vec{E}$
- (d)  $\vec{E} = \sigma \vec{J}$

(ii) Current flowing through a long solenoid is varied. Then, magnetic flux density of the magnetic field inside it varies:

- (a) inversely with I
- (b) inversely with  $I^2$
- (c) directly with I
- (d) directly with  $I^2$

(iii) A convex lens, made of glass, is immersed in water. As a result, its focal length will:

- (a) increase
- (b) decrease
- (c) double
- (d) remain same

(iv) de Broglie wavelength of a moving particle is  $\lambda$ . Its momentum is given by:

- (a)  $\frac{h\lambda}{c}$
- (b)  $\frac{h}{\lambda}$
- (c)  $\frac{hc}{\lambda}$
- (d) Zero

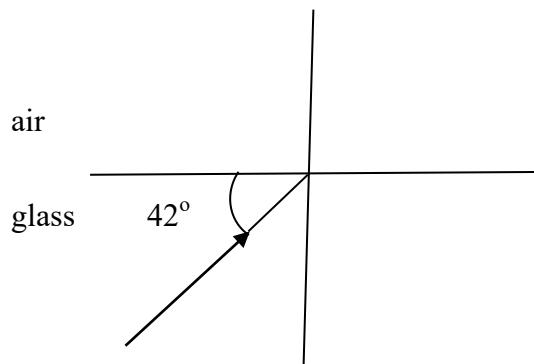
(v) Half Life of a certain radioactive substance is 69.3 days. Its disintegration constant is:

- (a)  $0.010 \text{ day}^{-1}$
- (b)  $0.100 \text{ day}^{-1}$
- (c)  $0.001 \text{ day}^{-1}$
- (d)  $1.00 \text{ day}^{-1}$

(B) Answer the following questions briefly and to the point [7×1]

- (i) How will the **sensitivity** of a potentiometer change with increase in current flowing through its wire?
- (ii) Which of the two; an ammeter or a voltmeter, has a greater resistance?
- (iii) Why is soft iron preferred to steel in making the **core** of a transformer?
- (iv) When would a moving charged particle travel undeviated in a uniform magnetic field?

(v) Complete the ray diagram shown in **Figure 1**, given that the critical angle for air-glass pair is  $i_c=42^\circ$ .



**Figure 1**

(vi) State the Law of Malus.  
 (vii) Name *any one* material used as a moderator in a nuclear reactor.

## Section B

*Answer all questions.*

**Question 2**

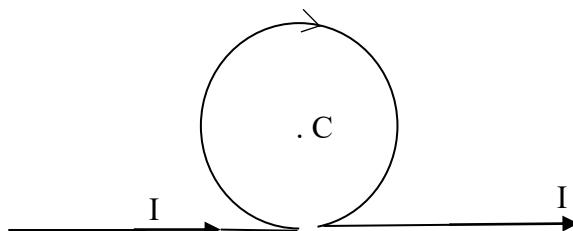
[2]

Define **drift velocity** and **relaxation time**, with reference to the free electron theory of conductors.

**Question 3**

[2]

A long straight wire is bent as shown in **Figure 2** below. Find the resultant magnetic field „B“ at the centre C of the circular path of radius 2 cm if a current I of 5 A is passed through the wire as shown:



**Figure 2**

**Question 4**

[2]

(i) Explain the meaning of the statement:  
 “Angle of dip at a certain place on earth is  $60^\circ$ .”

(ii) If the horizontal component of earth’s magnetic field at this place is  $3 \times 10^{-5}$  T, calculate the earth’s **total** magnetic field at that place.

**Question 5****[2]**

(a) Briefly explain the following terms:

- Curie temperature
- Self-induction

**OR**

(b) Name *any two* types of energy losses in a transformer. State how *any one* of them can be minimized.

**Question 6****[2]**

- What is **displacement current**?
- Which electromagnetic radiation is used to study the crystal structure?

**Question 7****[2]**

A thin convex lens of focal length 20 cm is kept in contact with a thin concave lens of focal length 15 cm. Find the focal length and the nature of the combination.

**Question 8****[2]**

What is meant by **dispersive power**? Write an expression of dispersive power in terms of refractive indices.

**Question 9****[2]**

(a) For *each* of the following, state *one* phenomenon in which:

- particles behave like waves.
- waves behave like particles.

**OR**

(b) Plot a labelled graph of maximum kinetic energy of photo electrons versus frequency of incident radiation. State how you will obtain the value of Planck's constant „h“ from the graph.

**[2]****Question 10**

Draw energy level diagram for Hydrogen atom showing at least four lowest energy levels. Show the transitions responsible for emission of **Balmer series**.

**Question 11****[2]**

What is meant by '**binding energy per nucleon**' of a nucleus? State its physical significance.

**Question 12****[2]**

Name essential components of a communication system. Draw its block diagram.

## Section C

*Answer all questions.*

### Question 13

[3]

Using **Gauss' theorem**, obtain an expression for **intensity of electric field 'E'** at a point, which is at a distance „r“ ( $r > R$ ) from the centre „C“ of a thin spherical shell (of radius  $R$ ) carrying charge „Q“.

### Question 14

[3]

(a) Obtain an expression for **electric potential 'V'** due to a point charge 'Q' at a distance  $r$ .

**OR**

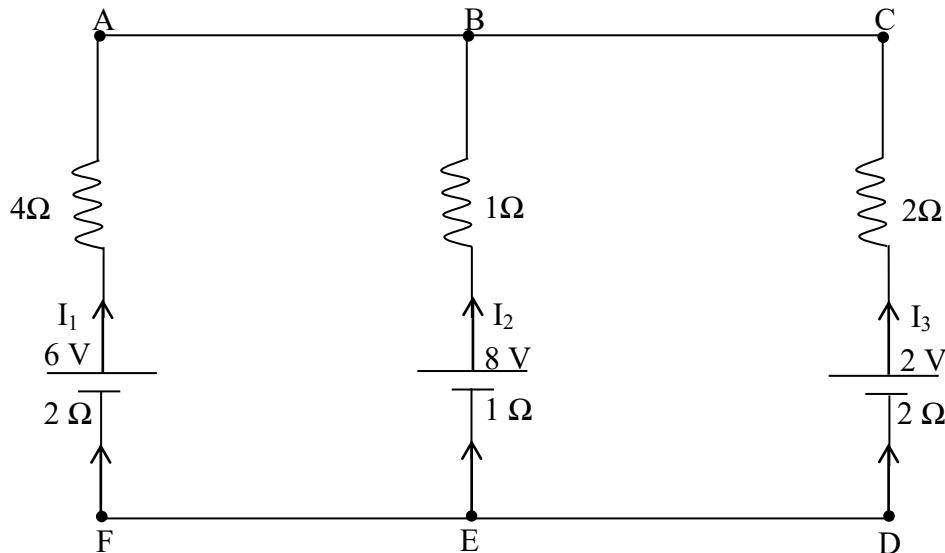
(b) A parallel plate capacitor is charged by a battery; which is then disconnected. A dielectric slab is now introduced between the two plates to occupy the space completely. State the effect on the following:

- (i) the capacitance of the capacitor.
- (ii) potential difference between the plates.
- (iii) the energy stored in the capacitor.

### Question 15

[3]

Using **Kirchhoff's laws** of electrical networks, calculate the currents  $I_1$ ,  $I_2$  and  $I_3$  in the circuit shown below (*Figure 3*).



*Figure 3*

### Question 16

[3]

(a) Obtain an expression for refraction at a single convex spherical surface separating the two media having refractive indices „ $n_1$ “ (rarer medium) and „ $n_2$ “ (denser medium) i.e. a relation between  $u$ ,  $v$ ,  $n_1$ ,  $n_2$  and  $R$ .

**OR**

(b) Derive  $R = 2f$  for a spherical mirror, where the symbols have their usual meaning.

**Question 17****[3]**

When a ray of ordinary light is incident on the surface of separation of two media at **polarizing angle**, show with the help of a **labelled diagram** that reflected ray and the refracted ray are mutually perpendicular to each other.

**Question 18****[3]**

For **radioactive disintegration** of a radioactive substance, show that

$$N = N_0 e^{-\lambda t}$$

where the terms have their usual meaning.

**Question 19****[3]**

With reference to a semiconductor diode, define the terms '**depletion region**' and '**potential barrier**'. How will the width of depletion region change during reverse biasing?

**Section D**

*Answer all questions.*

**Question 20****[5]**

(a) An 8 H inductor, a  $2 \mu\text{F}$  capacitor and a  $100 \Omega$  resistor are connected in **series** to an A.C. supply of 220 V and 50 Hz. Calculate:

- Impedance of the circuit.
- Current flowing through the circuit.
- Phase difference between the current and the supply voltage.
- Average power consumed by the circuit.

**OR**

(b) An A.C. generator generating an emf „E“ given by  $E = 311 \sin(10 \pi t)$  is connected to a  $44 \Omega$  resistor. Calculate:

- rms value of A.C. flowing through the resistor.
- frequency of the current.
- mean value of emf generated by the generator in time interval 0.06s to 0.08s.

**Question 21****[5]**

(a) Draw a labelled ray diagram of an image formed by a **compound microscope** with final image formed at the least distance of distinct vision (D). Derive an expression for its magnifying power (in terms of  $V_o$ ,  $U_o$ ,  $f_e$  and D).

**OR**

(b) Draw a neat and labelled diagram of an experimental setup of **Young's double slit experiment** to study the interference of light and show that:

$$\beta = \frac{\lambda D}{d}$$

where the terms have their usual meaning. Show intensity variation in the interference

pattern graphically.

### Question 22

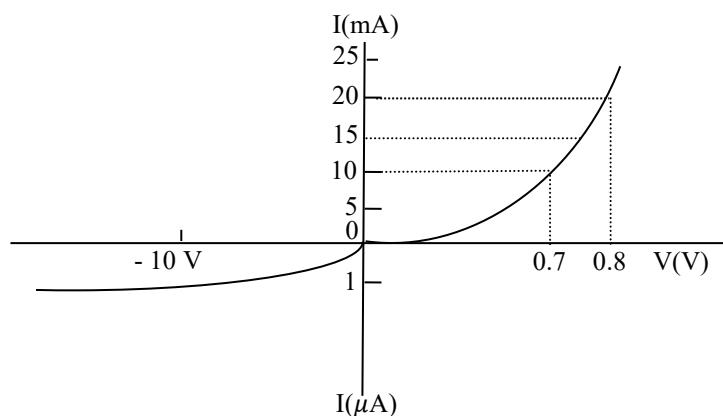
[5]

(a) (i) For a transistor in a **common emitter** mode, draw labelled graph to show:

- (1) Input characteristic curve.
- (2) Output characteristic curve.
- (3) Transfer characteristic curve.

*(Circuit diagram of the arrangement is **not** required.)*

(ii) The characteristic curve of a silicon diode is shown in **Figure 5** below:



**Figure 5**

Calculate the resistance of the diode at:

- (1)  $I = 15 \text{ mA}$  and
- (2)  $V = -10 \text{ V}$

**OR**

(b) (i) Show how you will obtain an **AND** gate using only **NOR** gates. Draw the **truth table** for this arrangement of gates.

(ii) For a **common emitter transistor amplifier**, the audio signal voltage across the collector resistance ( $r_c$ ) of  $2 \text{ k}\Omega$  is  $2 \text{ V}$ . If the current amplification factor ( $\beta$ ) of the transistor is 100, calculate the input signal voltage ( $V_{BE}$ ) and base current ( $I_B$ ) for base resistance of  $1 \text{ k}\Omega$ .

### Useful Constants and Relations:

1.	Permeability of vacuum	$(\mu_0)$	$= 4\pi \times 10^{-7} \text{ H m}^{-1}$
2.		$\ln 2$	$= 0.693$