PART - III

PHYSICS / علم طبيعيات
(Urdu & English Versions / اردو اور انگریز ورژن)

Time Allowed : 3 Hours  
[Maximum Marks : 150]

Instructions:
(1) Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.

(2) Use Blue or Black ink to write and underline and pencil to draw diagrams.

PART - I/1

30x1=30

Note:
(i) Answer all the questions.
(ii) Choose the most suitable answer from the given four alternatives and write the option code and the corresponding answer.
1. A hollow metal ball carrying an electric charge produces no electric field at points:
(a) outside the sphere (b) on its surface (c) inside the sphere (d) at a distance more than twice.

2. The electric field at a point 2 cm from an infinite line charge of linear charge density $10^{-7}$ cm$^{-1}$ is:
(a) $4.5 \times 10^4$ NC$^{-1}$ (b) $9 \times 10^4$ NC$^{-1}$ (c) $18 \times 10^4$ NC$^{-1}$ (d) $9 \times 10^2$ NC$^{-1}$

3. Which of the following quantities is scalar?
(a) dipole moment (b) electric force (c) electric field intensity (d) electric potential

4. The ratio of the force on charge $q_1$ by charge $q_2$ and force on charge $q_2$ by charge $q_1$ is:
(a) $\frac{q_1}{q_2}$ (b) $\frac{q_2}{q_1}$ (c) 1 (d) $\left(\frac{q_1}{q_2}\right)^2$
The colour code of a carbon resistor is, Brown, Black, Brown and Red. The value of the resistor is:
(a) 10 Ω ± 5% (b) 1 kΩ ± 2% (c) 100 Ω ± 2% (d) 10 Ω ± 2%

Phosphor-bronze wire is used for suspension in a moving coil galvanometer, because it has:
(a) high conductivity (b) high resistivity (c) large couple per unit twist (d) small couple per unit twist

In a given thermocouple, the neutral temperature:
(a) is a constant (b) depends on the temperature of cold junction (c) depends upon the temperature of inversion (d) both (b) and (c)
Transformer works on:
(a) AC only  (b) DC only  (c) Both AC and DC  (d) AC more effectively than DC

The part of the AC generator that passes the current from the coil to the external circuit is:
(a) field magnet  (b) split rings  (c) slip rings  (d) brushes

An LCR series circuit is connected to 240 V A.C. supply. At resonance, the values of \( V_R \), \( V_L \) and \( V_C \) are respectively:
(a) 80 V, 80 V and 80 V  (b) 120 V, 60 V and 60 V  (c) 40 V, 180 V, 40 V

A DC of 5 A produces the same heating effect as an A.C. of:
(a) 50 A rms current  (b) 5 A peak current  (c) 5 A rms current  (d) none of these
In Raman effect, the wavelength of the incident radiation is 5890 Å. The wavelengths of Stokes’ and anti-Stokes’ lines are respectively:

(a) 5880 Å and 5900 Å  
(b) 5900 Å and 5880 Å  
(c) 5900 Å and 5910 Å  
(d) 5870 Å and 5880 Å

Light from a source is analysed by an analyser. When the analyser is rotated, the intensity of the emergent light:

(a) Does not vary  
(b) Remains uniformly dark  
(c) Varies between maximum and zero  
(d) Varies between maximum and minimum

The refractive index of the medium, for the polarising angle 60° is:

(a) 1.732  
(b) 1.414  
(c) 1.5  
(d) 1.468
15. In Newton’s ring experiment the radii of the \( m \)th and \( (m + 4) \)th dark rings are respectively \( \sqrt{7} \) mm and \( \sqrt{5} \) mm. What is the value of \( m \)?

(a) 2 (b) 4 (c) 8 (d) 10

16. In hydrogen atom, which of the following transitions produce a spectral line of maximum frequency?

(a) \( 6 \to 2 \) (b) \( 2 \to 1 \) (c) \( 4 \to 3 \) (d) \( 5 \to 2 \)

17. Arrange electron (e), proton (p) and deuteron (d) in the increasing order of their specific charge:

(a) e, p, d (b) d, p, e (c) p, e, d (d) d, e, p

18. The energy of a photon of characteristic X-ray from a Coolidge tube comes from:

(a) the kinetic energy of the free electrons of the target
(b) the kinetic energy of the ions of the target
(c) the kinetic energy of the striking electron
(d) an atomic transition in the target
The energy of electron in the first orbit of hydrogen atom is $-13.6 \text{ eV}$. Its potential energy is:

(a) $13.6 \text{ eV}$  
(b) $27.2 \text{ eV}$  
(c) $-27.2 \text{ eV}$  
(d) $-6.8 \text{ eV}$

The photoelectric effect can be explained on the basis of:

(a) corpuscular theory of light  
(b) wave theory of light  
(c) electromagnetic theory of light  
(d) quantum theory of light

The threshold frequency of a photosensitive surface is $5 \times 10^{14} \text{ Hz}$. Then which of the following will produce photoelectric effect from the same surface?

(a) Sodium vapour lamp  
(b) Ruby laser  
(c) He - Ne laser  
(d) Both (b) and (c)

The nuclei $^{13}\text{Al}$ and $^{14}\text{Si}$ are examples of:

(a) isotopes  
(b) isobars  
(c) isotones  
(d) isomers
The mass defect of a certain nucleus is found to be 0.03 amu. Its binding energy is:
(a) 27.93 eV  (b) 27.93 keV  (c) 27.93 MeV  (d) 27.93 GeV

The radio-isotope used in agriculture is:
(a) $^{15}\text{P}_31$  (b) $^{15}\text{P}_32$  (c) $^{11}\text{Na}_23$  (d) $^{11}\text{Na}_24$

In a Bainbridge mass spectrometer positive rays of the same element produce different traces. The traces correspond to:
(a) isotopes  (b) isobars  (c) isotones  (d) none of the above

In a Colpitt’s oscillator circuit:
(a) capacitive feedback is used  (b) tapped coil is used  (c) no tuned LC circuit is used  (d) no capacitor is used
27. The emitter base junction of a given transistor is forward biased and its collector base junction is reverse biased. If the base current is increased, then its:

(a) $V_{CE}$ will increase
(b) $I_C$ will decrease
(c) $I_C$ will increase
(d) $V_{CC}$ will increase

28. Since the input impedance of an ideal operational amplifier is infinite:

(a) its input current is zero
(b) its output resistance is high
(c) its output voltage becomes independent of load resistance
(d) it becomes a current controlled device

29. The RF channel in a radio transmitter produces:

(a) audio signals
(b) high frequency carrier waves
(c) both audio signal and high frequency carrier waves
(d) low frequency carrier waves
The resting frequency of FM transmitter is 98.5 MHz. The allowed minimum and maximum frequency on either side of the centre frequency are respectively:

- (a) 98.400 MHz and 98.600 MHz
- (b) 98.450 MHz and 98.550 MHz
- (c) 98.425 MHz and 98.575 MHz
- (d) 98 MHz and 99 MHz

Note: Answer any fifteen questions.

What is an electric dipole? Define electric dipole moment.

Why is it safer to be inside a car than standing under a tree during lightning?

State Ohm’s law.

\[ [e = 1.6 \times 10^{-19} \text{ C}] \]

How much time \(10^{20}\) electrons will take to flow through a point in a conductor so that the current is 200 mA?
State Faraday’s laws of electrolysis.

What are the characteristics of heating element used in electric heating device?

State Fleming’s right hand rule.

An a.c. generator consists of a coil of 10,000 turns and of area 100 cm$^2$. The coil rotates at an angular speed of 140 rpm in a uniform magnetic field of 3.6 $\times 10^{-2}$ T. Find the maximum value of the emf induced.

Write any three uses of infrared radiations.

A 300 mm long tube containing 60 cc of sugar solution produces a rotation of $9^\circ$ when placed in a polarimeter. If the specific rotation is $60^\circ$, calculate the quantity of sugar contained in the solution.

Write any three medical applications of X-rays.
The Rydberg constant for Hydrogen is $1.097 \times 10^7$ m$^{-1}$. Calculate the short wavelength limit of Lyman series.

State the postulates of special theory of relativity.

Define curie.

Write any three properties of neutrons.

Define bandwidth of an amplifier.

What is an intrinsic semi conductor? Give two examples.
A galvanometer of resistance 100 Ω which can measure a maximum current of 1 mA is converted into an ohmmeter by connecting a battery of emf 1 V and a fixed resistance of 900 Ω in series. When an external resistance is measured the current reading is 0.1 mA. Calculate the value of the resistance.

What are the different types of radiowave propagation?

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Note:
(i) Answer question number 54 compulsorily.
(ii) Answer any six of the remaining 11 questions.
(iii) Draw diagrams wherever necessary.

Deduce an expression for the capacitance of a parallel plate capacitor.

Obtain the condition for bridge balance in Wheatstone’s bridge.

How can e.m.f. of two cells be compared using potentiometer?
A stream of deuterons is projected with a velocity of $10^4$ ms$^{-1}$ in XY-plane. A uniform magnetic field of induction $10^{-3}$ T acts along the Z-axis. Find the radius of the circular path of the particle. (Mass of deutron is $3.32 \times 10^{-27}$ kg and charge of deutron is $1.6 \times 10^{-19}$ C).

OR

A circular coil of radius 20 cm has 100 turns wire and it carries a current of 5 A. Find the magnetic induction at a point along its axis at a distance of 20 cm from the centre of the coil.

Obtain an expression for the self-inductance of a long solenoid.

State and explain Brewster’s law.

Write any five properties of cathode rays.

Derive an expression for de-Broglie’s wavelength of matter waves.

Write any five applications of photo electric cells.
A reactor is developing energy at the rate of 32 MW. Calculate the required number of fissions per second of $^{235}\text{U}$ assuming that energy per fission is 200 MeV.

State and prove De Morgan’s theorems.

A 10 MHz sinusoidal carrier wave of amplitude 10 mV is modulated by a 5 kHz sinusoidal audio signal wave of amplitude 6 mV. Find the frequency components of the resultant modulated wave and their amplitudes.

**PART - IV / IV**

4x10=40

Note:
(i) Answer any four questions in detail.
(ii) Draw diagrams wherever necessary.

State the principle and explain the construction and working of Van de Graaff generator.

Derive an expression for the magnetic induction at a point due to an infinitely long straight conductor carrying current. Write the expression for the magnetic induction when the conductor is placed in a medium of permeability ‘$\mu$’.
A source of alternating e.m.f. is connected to a series combination of a resistor $R$, an inductor $L$, and a capacitor $C$. Obtain with the help of a vector diagram and impedance diagram, an expression for (i) the effective voltage (ii) the impedance (iii) the phase relationship between the current and the voltage.

Derive an expression for bandwidth of interference fringes in Young’s double slit experiment.

Draw a neat sketch of Ruby Laser. Explain its working with the help of energy level diagram.

Explain the construction and working of a Geiger-Muller Counter.

What is meant by feedback? Derive an expression for voltage gain of an amplifier with negative feedback.

Explain the principle and working of RADAR with neat block diagram.