

2019

PHYSICS

(Theory)

Full Marks : 70

Pass Marks : 21

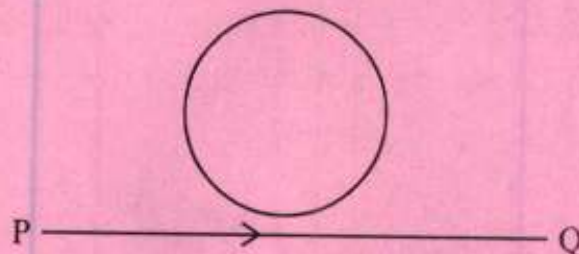
Time : Three hours

Attempt all Questions.

The figures in the right margin indicate full marks for the questions.

Question Nos. 1 to 10, are "Very Short Answer" type questions carrying 1 mark each.

1. Use the expression $\vec{F} = q(\vec{v} \times \vec{B})$ for the force experienced by a charge q moving with a velocity \vec{v} in a magnetic field \vec{B} to define the SI unit of magnetic field. 1
2. Where on the surface of the earth is the vertical component of earth's magnetic field zero? 1



3. The electric current flowing in a wire from P to Q is decreasing. Find out the direction of the induced current in the metallic loop kept above the wire as shown in the figure. 1

4. Find the reactance of a capacitor having a capacitance $\left(\frac{1}{\pi}\right) \mu F$ at 50 Hz. 1
5. The electric field vector of a plane electromagnetic wave oscillates sinusoidally at a frequency of 300 MHz. What is its wavelength? 1
6. Find the de-Broglie wavelength of an electron accelerated through a potential difference of 100 V. 1
7. Write the relation between average life and decay constant of a radioactive atom. 1
8. Identify the logic gate and write its Boolean expression. 1

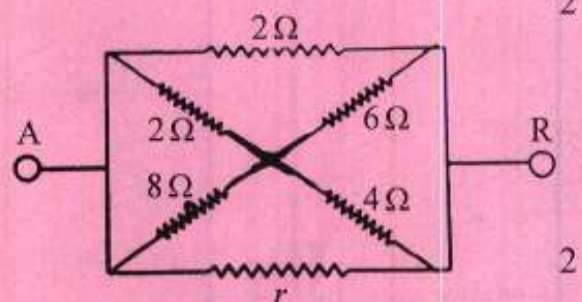


9. Draw a neat labelled circuit diagram showing the use of an n-p-n transistor as a common emitter amplifier. 1
10. What is sky wave propagation? Mention the frequency range used by this type of propagation. 1

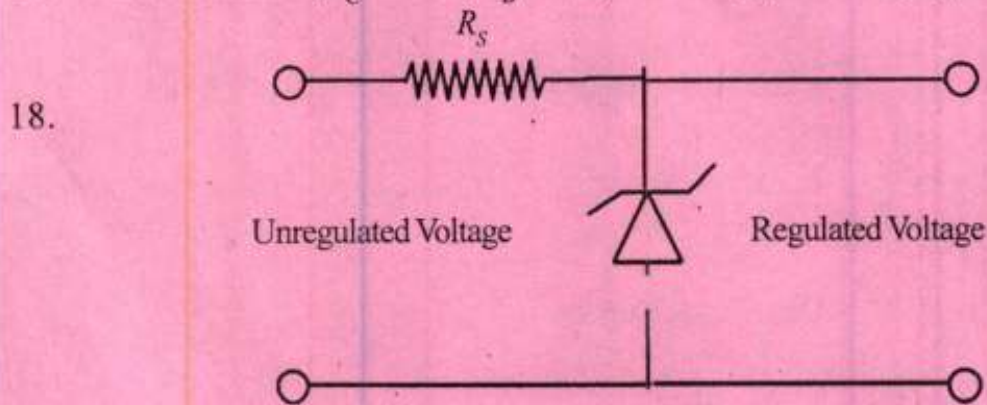
Question Nos. 11 to 20 are 'Short Answer Type-II' questions carrying 2 marks each.

11. Obtain the expression for the energy stored in a parallel plate capacitor of capacitance C charged to a potential V . 2
12. A point charge of $4.427 \mu C$ is at the centre of a cubic Gaussian surface 9.0 cm on the edge. Find the net electric flux through the surface. $(\epsilon_0 = 8.854 \times 10^{-12} C^2 N^{-1} m^{-2})$ 2

13. In the network shown, the equivalent resistance between A and B is $\frac{4}{3} \Omega$. Find the value of r .



14. A horizontal overhead power line carries a current of 30 A in the east to west direction. What is the magnitude and direction of the magnetic field due to the current at a point 1.5 m below the line. ($\mu_0 = 4\pi \times 10^{-7}\text{ T}\cdot\text{m}\cdot\text{A}^{-1}$) 2
15. What is displacement current and write the modified Ampere's circuital law. 2
16. The refractive index of plastic is $\sqrt{3}$. Calculate the angle of refraction for a ray of light incident at polarizing angle. 2
17. In a transistor, $I_C = 0.98$, $I_B = 20\ \mu\text{A}$. Find (i) α and (ii) β of the transistor. 2

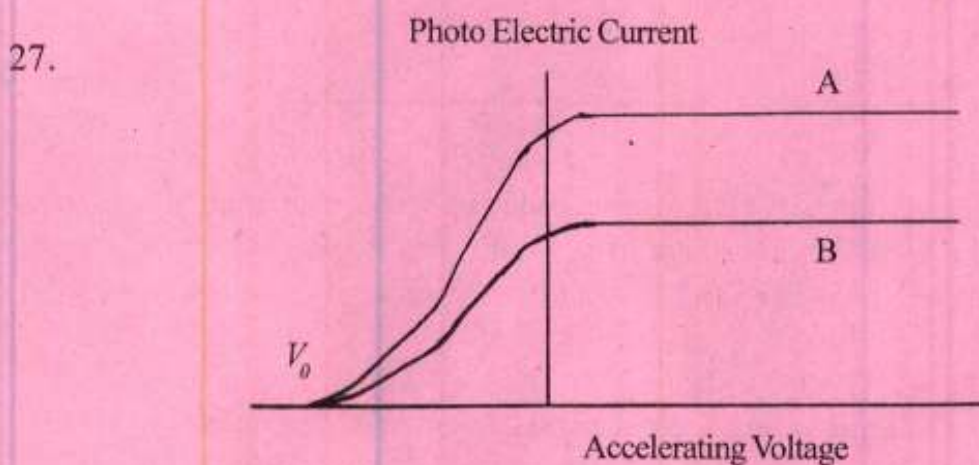


A zener diode of rating 100 mW is to be used as a voltage regulator. If the zener diode has the breakdown voltage of 5 V and it has to regulate voltage which fluctuate between 3 V and 7 V , what should be the value of R_s for safe operation. 2

19. Using block diagrams, name the segments of general communication system. 2
20. Write two points of advantages of FM broadcasting over AM broadcasting. 2
- Question Nos. 21 to 27 are 'Short Answer Type-I' questions carrying 3 marks each.*

21. Three charges of 1 nC , 2 nC and 3 nC are placed at the corners of an equilateral triangle of side $\sqrt{3}$. Calculate electrostatic potential at a point equidistant from the three corners of the triangle. 3

22. Describe how a galvanometer can be converted into an ammeter. 3
23. Define self inductance and write its SI unit. Derive an expression for self inductance of a long solenoid of length l , cross sectional area A having N number of turns. 3
24. A series LCR circuit with $R = 1k\Omega$, $L = 1.0\text{ mH}$, $C = 0.001\ \mu\text{F}$ is connected to a sinusoidal voltage of peak value $200\sqrt{2}V$. When the frequency of the supply equals the natural frequency of the circuit, what is the average power transferred to the circuit in one cycle. 3
25. Write three points of difference between interference and diffraction. 3
26. Draw ray diagrams to show how a right angled prism can be used to deviate a ray of light through (i) 90° and (ii) 180° 3



In the fig. shown, two monochromatic radiations of intensities I_1 and I_2 ($I_1 > I_2$) having the same frequency are in turn incident on a photo sensitive surface causing photo electric emission. Curve A and B show the variation of photo electric current with accelerating potential. Identify the curves representing radiation with intensity I_1 and I_2 giving reason. Also give reason why the two curves have the same stopping potential V_0 . 3

Question Nos. 28 to 30 are 'Long Answer Type' questions carrying 5 marks each.

28. State Kirchhoff's laws for a electric network. Using Kirchhoff's laws obtain the balance condition in terms of resistances of four arms of a Wheatstone's bridge. 5

OR

Describe with the help of necessary circuit diagram how to determine the specific resistance of the material of a wire by using a metre bridge. 5

29. Deduce Lens Makers formular for a double convex lens 5

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

where the symbols have their usual meanings.

OR

Deduce the mirror formula 5

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

(where the symbols have their usual meanings) for a concave mirror forming real image.

30. Write the nuclear reaction of ${}_{92}^{235}\text{U}$ bombarded with a slow neutron. Calculate the energy released in KWh in the fission of 50 kg of ${}_{92}^{235}\text{U}$. 5

OR

Using Bohr's quantization condition for angular momentum of an electron revolving around the hydrogen nucleus, establish the expression of the radius of the stationary orbits of hydrogen atom. 5

Question Nos. 31 to 34 are 'Multiple Choice Type' questions carrying 1 mark each. Choose the correct answer out of the four alternatives and rewrite the correct answer.

31. If a charge q is placed at the centre of the line joining two equal charges Q such that the system is in equilibrium, then value of q is 1

A. $\frac{Q}{2}$

B. $-\frac{Q}{2}$

C. $\frac{Q}{4}$

D. $-\frac{Q}{4}$

32. A charged particle of mass m and charge q moves along a circular path of radius r that is perpendicular to a magnetic field B . The time taken by the particle to complete one revolution is 1

A. $\frac{2\pi m q}{B}$

B. $\frac{2\pi q^2 B}{m}$

C. $\frac{2\pi q B}{m}$

D. $\frac{2\pi m}{q B}$

33. A laser operating at 3×10^{14} Hz passes through an aperture of 10^{-2} m. The angular spread in radians is

1

A. 10^{-2}

B. 10^{-4}

C. 10^{-6}

D. 10^{-8}

34. Pure Silicon at 300 K has equal number of electrons and holes concentration of $1.5 \times 10^{16} \text{ m}^{-3}$. Doping by indium increases the hole concentration (n_h) to $4.5 \times 10^{22} \text{ m}^{-3}$. The number of electrons concentration (n_e) in doped Silicon is

1

A. 9×10^5

B. 9×10^9

C. 2.25×10^{11}

D. 3×10^{19}