

SECOND PUC PHYSICS MODEL QUESTION PAPER 2013

NEW SYLLABUS - SUBJECT CODE: 33

Time : 3 hours 15 min.

Max Marks : 70

**General instructions:**

- a) All parts are compulsory.
- b) Answers without relevant diagram / figure / circuit wherever necessary will not carry any marks.
- c) Direct answers to the Numerical problems without detailed solutions will not carry any marks.

**PART A**

**I Answer the following.**

**10 x 1 = 10**

1. Draw the electric lines of force in the case of two positive point charges separated by a small distance.
2. Name the charge carriers in metallic conductors.
3. A coil perpendicular to a uniform magnetic field is rotated by  $180^\circ$ . What is the change in the flux through it?
4. Write the expression for displacement current.
5. Mention one common method of generating X-rays.
6. Write the expression for magnifying power of a telescope in terms of focal lengths.
7. What is the outcome of Davisson Germer experiment?
8. How does nuclear radius of an atom depend on its mass number?
9. Who discovered the phenomenon of photoelectric effect?
10. What is demodulation?

**PART – B**

**II Answer any FIVE of the following questions.**

**5×2=10**

11. Write two properties of an electric charge.
12. What is electrostatic shielding? Mention its one application.
13. State Kirchhoff's rules of an electrical network.
14. Mention two properties of a diamagnetic material.

15. What are eddy currents? Mention one application of eddy currents.
16. Draw the ray diagram to construct an image when an object is placed between the principal focus and pole of a concave mirror.
17. Mention two necessary conditions for doping.
18. Draw the block diagram of a generalized communication system.

**PART – C**

**III Answer any FIVE of the following questions. 5×3=15**

19. Write the expression for electric potential at a point due to a dipole and hence arrive at the expression for electric potential at a point on the dipole axis.
20. Obtain the expression for effective capacitance of three capacitors connected in parallel.
21. What is a cyclotron? Draw its schematic labeled diagram.
22. Explain briefly the coil-magnet experiment to demonstrate the phenomenon of electromagnetic induction.
23. What is meant by alternating current? Define its amplitude and time period.
24. Using Huygen's wave theory of light, show that the angle of incidence is equal to angle of reflection in case of reflection of a plane wave by a plane surface.
25. Mention three experimental observations of photoelectric effect.
26. Classify metals, semiconductors and insulators based on the band theory of solids.

**PART – D**

**IV Answer any TWO of the following questions. 2×5=10**

27. Obtain the expressions for effective emf and effective internal resistance when 'n' different cells are connected in parallel.

28. State and explain Biot-Savart's law and write its mathematical equation in vector form.

29. Assuming the expression for magnetic field at a point on the axis of a circular current loop, show that a long current carrying solenoid acts as a bar magnet.

**V Answer any TWO of the following questions. 2×5=10**

30. Derive the expression for the refractive index of the material of a prism in terms of the angle of the prism and angle of minimum deviation.

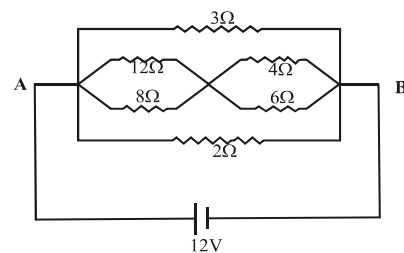
31. State radioactive decay law. Show that  $N = N_0 e^{-\lambda t}$  for a radioactive element with usual notations.

32. What is a solar cell? Explain its working with a diagram and draw the I-V characteristics.

**VI Answer any THREE of the following questions. 3×5=15**

33. The electrostatic force on a metal sphere of charge  $0.4 \mu\text{C}$  due to another identical metal sphere of charge  $-0.8 \mu\text{C}$  in air is  $0.2\text{N}$ . Find the distance between the two spheres and also the force between the same two spheres when they are brought into contact and then replaced in their initial positions.

34. In the given circuit, calculate the (i) effective resistance between A and B (ii) current through the circuit and (iii) current through  $3 \Omega$  resistor.



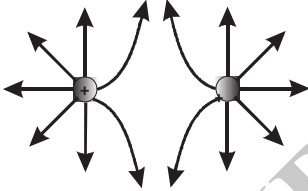
35. A resistor, an inductor and a capacitor are connected in series with a  $120\text{V}$ ,  $100\text{Hz}$  ac source. Voltage leads the current by  $35^\circ$  in the circuit. If the resistance of the resistor is  $10\Omega$  and the sum of inductive and capacitive reactances is  $17\Omega$ , calculate the self-inductance of the inductor.

36. A beam of light consisting of two wavelengths 500 nm and 400 nm is used to obtain interference fringes in Young's double slit experiment. The distance between the slits is 0.3 mm and the distance between the slits and the screen is 1.5 m. Compute the least distance of the point from the central maximum, where the bright fringes due to both the wavelengths coincide.

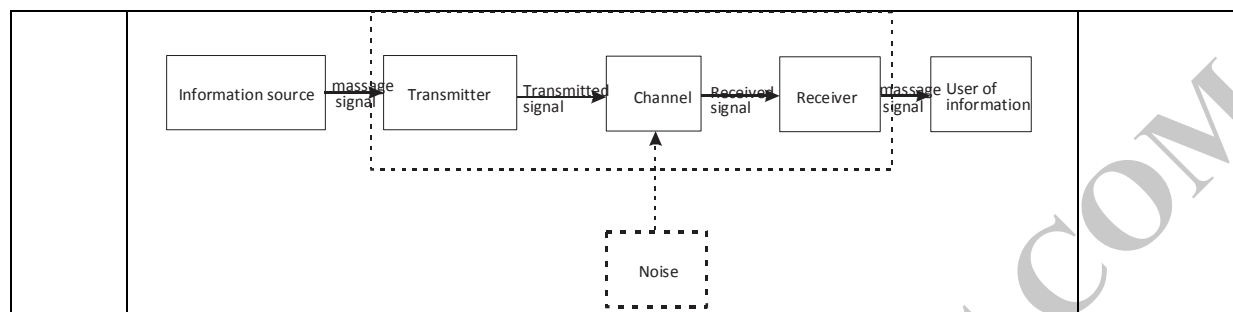
37. The first member of the Balmer series of hydrogen atom has wavelength of 656.3nm. Calculate the wavelength and frequency of the second member of the same series. Given,  $C = 3 \times 10^8$  m/s.

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## MODEL ANSWER PAPER

Q.NO	ANSWERS	MARKS
<b>I PART-A</b>		
1		1 mark
2	Free electrons or electrons	1 mark
3	The flux becomes double.	1 mark
4	Expression	1 mark
5	Bombarding a heavy metal target with high speed electrons	1 mark
6	$m = \frac{f_o}{f_e}$	1 mark
7	It confirms the wave nature of electrons.	1 mark
8	$R = R_0 A^{1/3}$ or R is directly proportional to A to the power of 1/3	1 mark
9	Heinrich Hertz.	1 mark
10	The process of retrieval of information from the carrier wave at the receiver is called demodulation.	1 mark
<b>II PART-B</b>		
11	1. Charge is quantized. 2. Charge is conserved. 3. Charge is always associated with mass. 4. Charge is a scalar. 5. Like charges repel each other and unlike charges attract each other. <b>any two properties</b>	2 marks

12	<p>The phenomenon of making a region free from any electric field is called electrostatic shielding.</p> <p>Sensitive electronic devices are protected</p>	<p>1 mark</p> <p>1mark</p>
13	<p>(1) <b>Junction rule:</b> At any junction, the sum of the currents entering the junction is equal to the sum of the currents leaving the junction.</p> <p>(2) <b>Loop rule:</b> The algebraic sum of changes in potential around any closed loop involving resistors and cells in the loop is zero.</p>	<p>1 mark each</p>
14	<ol style="list-style-type: none"> <li>1. These substances are feebly repelled by a powerful magnet.</li> <li>2. The magnetic lines of force tend to avoid passing through a diamagnetic material.</li> <li>3. Relative permeability of these substances is slightly less than one.</li> <li>4. Diamagnetics have a low negative susceptibility of the order of <math>10^{-6}</math> to <math>10^{-7}</math></li> <li>5. Susceptibility of diamagnetic is independent of temperature.</li> </ol> <p><b>Any two properties</b></p>	<p>1 mark each</p>
15	<p>The induced circulating currents produced in a metal itself due to change in magnetic flux linked with the metal are called eddy currents.</p> <p><b>Applications of eddy currents:</b> Eddy current are used in</p> <ol style="list-style-type: none"> <li>1. Induction furnace.</li> <li>2. Speedometer.</li> <li>3. Dead beat galvanometer.</li> <li>4. Electromagnetic Breaks.(any one)</li> </ol>	<p>1 mark</p> <p>1 mark</p>
16	<p>Diagram</p> <p>Arrow mark</p>	<p>1 mark</p> <p>1 mark</p>
17	<ol style="list-style-type: none"> <li>1. The size of the dopant atom should be almost the same as that of the semiconductor atom.</li> <li>2. The dopant atoms should not distort the crystal lattice.</li> </ol>	<p>1 mark each</p>
18		<p>2 marks</p>



**III PART-C**

19	Writing Expression $\Theta = 0$ or $\pi$ Arriving at final Expression	1mark 1mark 1mark
20	<p style="text-align: center;"><b>Circuit diagram</b></p> $q = q_1 + q_2 + q_3$ <p style="text-align: center;">Charge on the capacitor <math>C_1</math>,  <math>q_1 = C_1 V</math>, Similarly, <math>q_2 = C_2 V</math> and <math>q_3 = C_3 V</math></p> <p style="text-align: center;"><b>Arriving at the final equation</b> <math>C_p = C_1 + C_2 + C_3</math></p>	1mark  1 mark  1 mark
21	It is a device used to accelerate charged particles. Diagram Labeling	1 mark 1 mark 1 mark
22	Figure Brief procedure Conclusion-Changing magnetic flux linking the coil induces emf	1 mark 1 mark 1 mark
23	An alternating current is that current whose magnitude and direction change periodically. The maximum value attained by an ac in either direction is called its amplitude. The time taken by an ac to complete one cycle of its variations is called its time period.	1mark each
24	Ray diagram Arriving at $i=r$	1 mark 2 mark
25	Any three observations,	1mark each
26	Metals overlapping of CB and VB	1 mark

	Semiconductors small energy gap between CB and VB Insulators very large energy gap between CB and VB	1 mark 1 mark
<b>IV</b>	<b>PART-D</b>	
<b>27</b>	Circuit diagram for two cells Pd across the first cell = $\varepsilon_1 - I_1 r_1$ similarly pd across second cell = $\varepsilon_2 - I_2 r_2$ But $I = I_1 + I_2$ $I_1 = \frac{\varepsilon_1 - V}{r_1}$ $I_2 = \frac{\varepsilon_2 - V}{r_2}$ $\varepsilon_{eq} = \left( \frac{\varepsilon_1 r_2 + \varepsilon_2 r_1}{r_1 r_2} \right) \text{ or for n cells } \frac{\varepsilon_{eq}}{r_{eq}} = \frac{\varepsilon_1}{r_1} + \frac{\varepsilon_2}{r_2} + \dots + \frac{\varepsilon_n}{r_n}$ $r_{eq} = \left( \frac{r_1 r_2}{r_1 + r_2} \right) \text{ or for n cells } \frac{1}{r_{eq}} = \frac{1}{r_1} + \frac{1}{r_2} + \dots + \frac{1}{r_n}$	1 mark 1 mark 1 mark 1 mark 1 mark
<b>28</b>	The magnetic field dB at a point P is directly proportional to (1) the strength of the current (I) (2) the length of the current element (dl) (3) the sine of the angle between the element and the line joining the point to it (sinθ) and (4) inversely proportional to the square of the distance of point from the current element ( $r^2$ ) Equation in vector form	1 mark 1 mark 1 mark 1 mark 1 mark
<b>29</b>	Figure Assuming the expression $dB = \frac{\mu_0 n I a^2 dx}{2 \left[ (r-x)^2 + a^2 \right]^{3/2}}$ After integration obtaining the equation $B = \frac{\mu_0 n I}{2} \frac{2la^2}{r^3}$ Arriving at final equation $B = \frac{\mu_0}{4\pi} \frac{2m}{r^3}$ and comparing with the bar magnet	1 mark 1 mark 2 marks 1 mark



V		
30	Ray diagram with necessary arrow marks $d = i_1 + i_2 - A$ At minimum deviation, $d = D$ and $i = i_1 = i_2$ , $r_1 = r_2 = r$ , The value of $r$ and $i$  Arriving at final expression $n = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin\left(\frac{A}{2}\right)}$	1 mark 1 mark 1 mark 1 mark 1 mark
31	Decay law statement  $\frac{dN}{dt} = -\lambda N$ Arriving at $\text{Log}_e N = -\lambda t + C$ Finding the value of $C$ and arriving at $N = N_0 e^{-\lambda t}$	1 mark  1 mark  1 mark 1+1 marks
32	It is a p-n junction which generates emf when solar radiation falls on the p-n junction. Diagram Working I-V characteristic graph	1 mark 1 mark 2 marks 1 mark
VI		
33	$f = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2}$ $0.2 = \frac{9 \times 10^9 \cdot 0.4 \times 10^{-6} \cdot 0.8 \times 10^{-6}}{r^2}$ $r = 0.12m$ after contact $f = \frac{9 \times 10^9 \cdot 0.2 \times 10^{-6} \cdot 0.2 \times 10^{-6}}{0.12^2} = 0.025N(\text{repulsive})$ Final answer with unit $f=0.025N$	1 mark  1 mark  1 mark  1 mark  1mark
34	$R_p = \frac{R_1 R_2}{R_1 + R_2}$ and $V = IR$ Finding the effective resistance of the circuit Finding current through the circuit $I = 11.66A$ Finding current through $3\Omega$ resistor $I = 4A$ with unit	1 mark  2 marks 1 mark 1 mark
35	$\tan\phi = \frac{X_L - X_C}{R}$ or $\cos\phi = \frac{R}{Z}$ and $X_L = 2\pi fL$ $X_L - X_C = 7$ $X_L = 12\Omega$	1 mark 1 mark 1 mark

	Calculation of $L = 19mH$ with unit	<b>2 marks</b>
<b>36</b>	$X_{n_1} = X_{n_2}$	<b>1 mark</b>
	$\frac{n_1 \lambda_1 D}{d} = \frac{n_2 \lambda_2 D}{d}$	<b>1 mark</b>
	Substitution and getting the values $n_1$ and $n_2$	<b>2 mark</b>
	Calculation of Final answer with unit $X_{n_1} = 0.01 \text{ m}$	<b>1 mark</b>
<b>37</b>	$\frac{1}{\lambda} = R \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$	<b>1 mark</b>
	Substitution, simplification and $\lambda_2 = 4861 \text{ \AA}$	<b>1+1 marks</b>
	Using $c = f\lambda$ , getting the value of $f = 6.1715 \times 10^{14} \text{ Hz}$ (with unit)	<b>1+1 marks</b>

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