HSC Maharashtra Board question paper: March 2013

Note:
i. All question are compulsory
ii. Neat diagrams must be drawn wherever necessary.
iii. Figure to the right indicate full marks.
iv. Use of logarithmic table is allowed.
v. All symbols have their usual meaning unless otherwise stated.

PHYSICS: SECTION – II

Q.1. Select and write the most appropriate answer from the given alternatives for each sub-question : [7]

i. In the diffraction pattern due to a single slit of width 'd' with incident light of wavelength 'λ', at an angle of diffraction 'θ', the condition for first minimum is _______.
(A) $\lambda \sin \theta = d$ (B) $d \cos \theta = \lambda$
(C) $d \sin \theta = \lambda$ (D) $\lambda \cos \theta = d$

ii. Kirchhoff's junction law is equivalent to _______.
(A) conservation of energy
(B) conservation of charge
(C) conservation of electric potential
(D) conservation of electric flux

iii. let 'p' and 'E' denote the linear momentum and energy of emitted photon respectively. If the wavelength of incident radiation is increased _______.
(A) both p and E increase
(B) p increases and E decreases
(C) p decreases and E increases
(D) both p and E decrease

iv. The nuclei having same number of protons but different number of neutrons are called _______.
(A) isobars (B) α - particles
(C) isotopes (D) γ - particles

v. In case of transistor oscillator, to obtain sustained oscillations, the product of voltage gain without feedback and feedback factor should be _______.
(A) zero (B) less than 1
(C) one (D) infinity

vi. The process of regaining of information from carrier wave at the receiver is called _____.
(A) modulation (B) transmission
(C) propagation (D) demodulation

vii. Reactance of a coil is 157 Ω. On connecting the coil across a source of frequency 100 Hz, the current lags behind e.m.f. by 45°. The inductance of the coil is _______.
(A) 0.25 H (B) 0.5 H
(C) 4 H (D) 314 H

Q.2. Attempt any SIX: **[12]**

i. Draw a neat labelled diagram of a parallel plate capacitor completely filled with dielectric.

ii. A point is situated at 7cm and 7.2 cm from two coherent sources. Find the nature of illumination at the point if wavelength of light is 4000Å.

iii. Obtain the expression for current sensitivity of moving coil galvanometer.

iv. In a cyclotron, magnetic field of 3.5 Wb/m^2 is used to accelerare protons. What should be the time interval in which the electric field between the Dees be reversed?
(Mass of proton = 1.67×10^{-27} Kg, Charge on proton = 1.6×10^{-19} C).

v. Define magnetization. State its formula and S.I. unit.

vi. Electrostatic energy of 3.5×10^{-4} J is stored in a capacitor at 700 V. What is the charge on the capacitor?

vii. What is space wave propagation? State its three components.

viii. Find the value of energy of electron in eV in the third Bohr orbit of hydrogen atom.
(Rydberg's constant (R) = 1.097×10^{7} m^{-1},
Planck's constant (h) = 6.63×10^{-34} J – s,
Velocity of light in air (c) = 3×10^{8} m/s.)

Q.3. Attempt any THREE: **[9]**

i. With the help of neat labelled circuit diagram explain the working of half wave rectifier using semiconductor diode. Draw the input and output waveforms.

ii. A cell balances against a length of 200 cm on a potentiometer wire, when it is shunted by a resistance of 8Ω. The balancing length reduces by 40 cm, when it is shunted by a resistance of 4Ω. Calculate the balancing length when the cell is in open circuit. Also calculate the internal resistance of the cell.

iii. State the law of radioactive decay. Hence derive the expression $N = Noe^{-\lambda t}$ where symbols have their usual meanings.

iv. The photoelectric work function for a metal is 4.2 eV. If the stopping potential is 3V, find the threshold wavelength and maximum kinetic energy of emitted electrons.
(Velocity of light in air = 3×10^{8} m/s,
Planck's constant = 6.63×10^{-34} J – s,
Charge on electron = 1.6×10^{-19} C)

Q.4. State Faraday's laws of electromagnetic induction and Lenz's law. **[7]**

Prove theoretically, the relation between e.m.f. induced and rate of change of magnetic flux in a coil moving in a uniform magnetic field.

A circular coil of 250 turns and diameter 18 cm carries a current of 12A. What is the magnitude of magnetic moment moment associated with the coil?

OR

On the basis of Huygens' wave theory of light prove that velocity of light in a rarer medium is greater that velocity of light in a denser medium.

In Young's experiment the ratio of intensity at the maxima and minima in the interference pattern is 36:16. What is the ratio of the widths of the two slits?