Q. P. Code: 59327

SET – VI

ANSWER KEY

Q 1	**A**	**Select the correct alternative**	
	(i)	(d) All of these.	(2)
	(ii)	(d) None of these.	(2)
	(iii)	(c) approximately 1000V	(2)
	(iv)	(d) 30-40 eV	(2)
	(v)	(d) all of the above	(2)
	(vi)	(d) frequency	(2)
Q 1	**B**	**Answer in one sentence**	
	(i)	3.700×10^{10} disintegrations / second.	(1)
	(ii)	A nuclear reaction in which a heavy nucleus splits up into two or more nuclei of comparable masses with release of energy is called as nuclear fission.	(1)
	(iii)	As the temperature of black body is raised, the maximum intensity of radiation emitted is displaced towards the shorter wavelength side $\lambda_m T$ = constant	(1)
Q 1	**C**	**Fill in the blanks.**	
	(i)	138, 88	(1)
	(ii)	$_{n-2}Z^{m-4}$	(1)
	(iii)	ionization	(1)
	(iv)	Entire length	(1)
	(v)	Pair production	(1)
Q 2	**A**	**Attempt ANY ONE**	
	(i)	Sketch of Segre chart Characteristics of stable and unstable nuclei	(2) (6)
	(ii)	Statement of law of successive disintegration -------	(1)
		<u>Ideal equilibrium</u>: $\frac{dN_2}{dt} = 0 \quad at\ t = tm$ $\lambda_1 N_1 = \lambda_2 N_2$ discussion ---------	(2)
		<u>Secular equilibrium</u>: $T_1 >> T_2$ i.e. $\lambda_1 << \lambda_2$ $N_2 = \frac{\lambda_1 N_0}{\lambda_2}\left[1 - e^{-\lambda_2 t}\right]$ --------	(1)
		$N_2 = \frac{\lambda_1 N_0}{\lambda_2}$ --------	(2)
		$\therefore \frac{N_{2C}}{N_1} = \frac{\lambda_1}{\lambda_2} = \frac{T_2}{T_1} = constant$ --------	(2)
Q 2	**B**	**Attempt ANY ONE**	
	(i)	Explanation on experimental set up	(2)
		Size: momentum $\Delta P = F.\ \Delta t$ $\therefore \Delta P = \frac{1}{4\pi\epsilon_0}\frac{2e.Ze}{b.v}$	(2)
		$\theta \sim \frac{\Delta P}{P} = \frac{1}{4\pi\epsilon_0}\frac{2e.Ze}{b.v} \times \frac{1}{mv}$ $b = \frac{1}{4\pi\epsilon_0}\frac{2Ze^2}{mv^2}\frac{1}{\theta}$	(2)

		$\therefore R = \frac{1}{4\pi\epsilon_0}\frac{2Ze^2}{mv^2}$	(2)
	(ii)	Isotopes: - same atomic number (Z), different Mass number (A) Isobars: - Same mass number (A), different atomic number (Z) Isotones: - Same neutron number (N), different (A) and (Z) Carbon dating: - $^{14}_{7}N + ^{1}_{0}n \rightarrow (^{15}_{7}N) \rightarrow ^{14}_{6}C + ^{1}_{1}H$ $^{14}_{6}C \rightarrow ^{14}_{7}N + \beta^- + antineutrino$ ------ $X = X_0 e^{-\lambda_C t}$ $\therefore t = \frac{1}{\lambda_C} ln\frac{X_0}{X}$ -------	(1) (1) (1) (2) (3)
Q 2	C	**Attempt ANY ONE**	
	(i)	$\left\|\frac{dN}{dt}\right\| = N\lambda = 1\ Curie = 3.7\times10^{10} disintegrations/sec$ $\therefore N = \frac{3.7\times10^{10}}{\lambda} = \frac{3.7\times10^{10}\times T}{0.693}$ N = 8.585×10^{13} atoms Mass of RaB = $\frac{214\times8.585\times10^{13}}{6.023\times10^{26}} = 3.050\times10^{-11}kg$	(1) (1) (1) (1)
	(ii)	$b = \frac{1}{4\pi\epsilon_0}\frac{2Ze^2}{mv^2}$ $(\theta = 1)$ $b = \frac{9\times10^9\times2\times79\times(1.6\times10^{-19})^2}{5\times1.6\times10^{-13}} = 4.14\times10^{-14}\ m$	(1) (3)
Q 3	A	**Attempt ANY ONE**	
	(i)	Nuclear reaction definition: 2 marks Explaining different types of nuclear reactions: 3 marks each.	(2) (3)
	(ii)	Diagram: 2 marks Construction: 2 marks Working: 4 marks	(2) (2) (4)
Q 3	B	**Attempt ANY ONE**	
	(i)	Use of momentum conservation laws or momentum triangle seen Diagram of momentum conservation or momentum triangle Define $Q = E_y + E_Y - E_x$ Rest of the derivation leading to $Q = E_y\left(1+\frac{m_y}{M_Y}\right) - E_x\left(1-\frac{m_x}{M_Y}\right) - \frac{2}{M_Y}\sqrt{m_x m_y E_x E_y}\cos\theta$	(2) (2) (1) (3)
	(ii)	Conservation law of atomic number, atomic mass, linear and angular momentum, energy etc. stated and explained: 8 marks	(8)
Q 3	C	**Attempt ANY ONE**	
	(i)	1 mole of U^{238} (i.e.238 gm) contains 6.023×10^{23}nuclei Therefore 476 gm contains $2 \times 6.023 \times 10^{23}$nuclei Energy released = $2 \times 6.023 \times 10^{23} \times 200MeV = 2 \times 1204.6MeV = 2409.2MeV$ Formula : 1 mark Working : 2 marks Final answer with proper unit : 1 mark	 (1) (2) (1)
	(ii)	$Q = [(m_x + M_X) - (m_y + M_Y)] \times 931.5MeV$:1mark Q= -1.15506 MeV : 1 mark	(1) (1) (1)

		$E_{th} \cong -\frac{Q(M_X+m_x)}{M_X}$:1 mark $E_{th} = 1.485218MeV$:1 mark	(1)
Q 4	A	**Attempt ANY ONE**	
	(i)	Diagram of Davisson-Germer Experiment Construction Polar graph explanation to get λ Finding λ using Bragg's law	(2) (2) (2) (2)
	(ii)	Explanation of Bragg's law Obtaining 2d sin θ = nλ Diagram and construction of Bragg's X-rays spectrometer Observations	(2) (2) (2) (2)
Q 4	B	**Attempt ANY ONE**	
	(i)	Understanding energy using HUP Explaining the uncertainty in time and energy Taking Uncertainty in position 10^{-14} m and finding uncertainty in momentum Calculating energy (124 MeV) and explaining it contadiction	(2) (2) (2) (2)
	(ii)	Compton effect explanation Diagram of scattering of electron Applying law of conservation of momentum Simplifying equations Obtaining $\Delta\lambda = \frac{h}{m_0 c}(1 - \cos\theta)$	(2) (1) (1) (2) (2)
Q 4	C	**Attempt ANY ONE**	
	(i)	n = 1, θ = 12° d = 1 A° = 10^{-10} m From Bragg's law, 2d sin θ = 2λ λ = 0.416 A°	(1) (1) (2)
	(ii)	T_1 = 75°C = 348 K $\lambda_{m1} = 2.5\times10^{-5}$ m T_2 = 100°C=373 K λ_{m2} = ? From Wien's displacement law, $\lambda_m T$ = constant $\lambda_{m2} = (\lambda_{m1}T_1) / T_2 = 2.37\times10^{-5}$ m	(1) (1) (2)
Q 5		**Attempt ANY FOUR**	
	(i)	Statement -------- $N = N_0 e^{-\lambda t}$ -------- Definition of Half-life -------- Definition of Mean life --------	(2) (1) (1) (1)
	(ii)	Radius of nucleus $R = R_0 A^{1/3}$ R_0 = 1.27 fermi ------- Nuclear density $=10^{17}$kg/m³ --------- $\frac{number\ of\ nucleons}{m^3} = \frac{density}{Mass\ of\ a\ nucleon} \approx 10^{44}\ nucleon/m^3$ -------	(2) (2) (1)
	(iii)	1 mole of Po^{239} (i.e.239 gm) contains 6.023×10^{23}nuclei Energy released = $6.023 \times 10^{23} \times 205MeV = 1234.715MeV$ Formula : 1 mark Working : 3 marks	(1) (3) (1)

		Final answer with proper unit : 1 mark	
	(iv)	Definition: 2marks	(2)
		Properties, examples or energy released etc. : 3 marks	(3)
	(v)	Bragg's interpretation of Laue's pattern	(3)
		Diagram of crystal planes and formation of diffraction pattern	(2)
	(vi)	Graph showing wavelength and temperature relation with intensity of radiation	(2)
		Explanation of black body spectrum	(3)