

**MINOR - PYL302: [Total marks: 30]**

**EXAM ETHICS: Open book, No cross talk, No discussion**

*[From Q 1 to 5, upload answers in pdf in the google sheet. Show detailed calculation and mathematical formulation]*

**Q1.** What is the effective dose when 1 Roentgen of gamma rays fall on skin. Assume that the gamma photon energy to create an electron-hole pair is 33.7 eV. **[4]**

**Q2.** A large amount of radioactive material of half life 20 days got spread in a room making the level of radiation 40 times the permission level of normal occupancy. After how many days, the room would be safe for occupation? **[4]**

**Q3.** Calculate the half life of  $\text{RaC}'$  which emits alpha particle that can penetrate 6.97 cm in air. Use following data: (i) alpha particle from Na (half life= 1622 years) and (ii) alpha particles from Po (half life =138 days) can penetrate 3.36 cm and 3.85 cm in air respectively. **[4]**

**Q4.** For  $A = 43$ , which isobar is most stable?  ${}_{20}\text{Ca}^{43}$ ,  ${}_{19}\text{K}^{43}$  and  ${}_{21}\text{Sc}^{43}$ . Justify with appropriate formulation. **[4]**

**Q5.** A log of wood weighs 50 gms and shows 320 C-14 atoms disintegrate in one minute. Estimate the length of time which has elapsed since this wood was part of a living tree, assuming that in living plants 12 C-14 atoms disintegrate per minute. **[4]**

*[From Q 6 to 15: 1 mark for correct answer, -1 for wrong attempt]*

**Q6.** The g factor of  ${}^{19}\text{F}$  is same as proton while  ${}^7\text{Li}$  is different. This is because

(i) Li has higher nuclear radii, (ii) due to spin-orbit interaction (iii) Li is like a spin 1/2 particle, (iv) None of these.

**Q7.** In PET

(i) two fermions are detected, (ii) two Bosons are detected, (iii) 1 gamma ray photon is detected, (iv) only imaged through resonance

**Q8.** A positive nuclear charge distribution situated at the nuclear radius along body axis ( $x, y = 0$ ), the shape is expected to be

(i) Perfectly spherical, (ii) elongated along minor axis, (iii) prolate, (iv) oblate

**Q9.** One gm of natural samarium shows an activity 135 (with appropriate units). The isotope  ${}^{247}\text{Sm}$  (abundance 15%) is responsible for the activity. The decay constant (in appropriate unit) is of the order of

(i)  $10^{-15}$ , (ii)  $10^{-23}$ , (iii)  $10^{-21}$ , (iv)  $10^{-19}$

**Q10.** For Rb-Sr dating both of these elements are to be in transient equilibrium

(i) Only an ideal statement, (ii) important necessity, (iii) relevant only at time  $t = t_0$ , (iv) incorrect statement

**Q11.** In MRI scan the contrast is obtained by the following process

(i) electron-phonon coupling, (ii) electron-proton scattering, (iii) nuclear resonance, (iv) none of these

**Q12.** 100 keV neutron is much less damaging to colon as compared to 100 MeV neutron. True/False

**Q13.** In U-Pb time is possible as Pb (daughter) achieves a decay constant same as its parent. Yes/No

**Q14.** C-14 time scale can determine the history of earth's creation. True/False

**Q15.**  $^{62}\text{Ni}$  has highest BE but not most abundant element as its proton no. is less as compared to the most abundant one.

**[1 x 10 = 10]**