Q1: (2000 S) Two radioactive materials X_1 and X_2 have decay constants 10λ and λ respectively. If initially they have the same number of nuclei, then the ratio of the number of nuclei of X_1 to that of X_2 will be $1/e$ after a time

a) $\frac{1}{10\lambda}$ b) $\frac{1}{11\lambda}$

c) $\frac{11}{10\lambda}$ d) $\frac{1}{9\lambda}$

[Ans = d]

Q2: (2004 S) A 280 days old radioactive substance shows an activity of 6000 dps, 140 days later its activity becomes 3000 dps. What was its initial activity?

a) 2000 dps b) 24000 dps

c) 12000 dps d) 6000 dps

[Ans = b]

Q3. (1999 S) The half-life period of a radioactive element X is same as the mean-life time of another radioactive element Y. Initially both of them have the same number of atoms. Then,

a) X and Y have the same decay rate initially

b) X and Y decay at the same rate always

c) Y will decay at a faster rate than X.

d) X will decay at a faster rate than Y.

[Ans = c]

(Hint: Compare λ_x and λ_y)

Q4. (2003) A radioactive sample emits n β- particles in 2 sec. In next 2 secs it emits 0.75 n β- particles, what is the mean life of the sample ?

[Ans = $\frac{2}{\ln(4/3)}$]

Q 5. (JEEA 2015) Match the nuclear processes given in column I with the appropriate option(s) in column II

Column I	Column II
(A) Nuclear fusion	(p) Absorption of thermal neutrons by $^{235}_{92}U$
(B) Fission in a nuclear reactor	(q) $^{60}_{27}Co$ nucleus
(C) β- decay	(r) Energy production in stars via hydrogen
(D) γ- ray emission	(s) Heavy water
	(t) Neutrino emission

[Ans: A → r
B → p, s
C → q, t
D → r]

Q6. (JEEA 2015) For a radioactive material, its activity A and rate of change of its activity R are defined as $A = -\frac{dN}{dt}$ and $R = -\frac{dA}{dt}$ where N(t) is the number of nuclei at time t

Two radioactive sources P (mean life τ) and Q (mean life 2τ) have the same activity at t = 0. Their rates of change of activities

at $t = 2\tau$ are R_P and R_Q respectively. If $\frac{R_P}{R_Q} = \frac{n}{e}$, then the value of n is

[Ans = 2]

Q7. (2011) The activity of a freshly prepared radioactive sample is 10^{10} disintegrations per second, whose mean life is 10^9 s. The mass of an atom of this radioisotope is 10^{-25} kg. The mass (in mg) of the radioactive sample is

[Ans = 1]

Q8: (JEEA 2017) ^{131}I is an isotope of Iodine that β decays to an isotope of Xenon with a half-life of 8 days. A small amount of a serum labelled with ^{131}I is injected into the blood of a person. The activity of the amount of ^{131}I injected was 2.4×10^5 Becquerel (Bq). It is known that the injected serum will get distributed uniformly in the blood stream in less than half an hour. After 11.5 hours, 2.5 ml of blood is drawn from the person's body, and gives an activity of 115 Bq. The total volume of blood in the person's body, in litres is approximately ____.
(you may use $e^x \approx 1+x$ for $|x| << 1$ and $\ln 2 \approx 0.7$)

[Ans = 5]

Hint: find total activity after 11.5 hours and use unitary method

Q9. (JEEA 2021) A heavy nucleus Q of half-life 20 minutes undergoes alpha-decay with probability of 60% and beta decay with probability of 40%. Initially, the no. of Q nuclei is 1000. The number of alpha-decays of Q in the first one hour is

a) 50 c) 350
b) 75 d) 525

[Ans = d]