1. Solve the differential equation

\[ \frac{dN_d}{dt} = \lambda_p N_0 e^{-\lambda_p t} - \lambda_d N_d \]

given the initial \( t=0 \) conditions \( N_p = N_0 \) and \( N_d = 0 \).

2. (J & C 3-20) A source of \(^{99m}\text{Tc}\) arrives in the department at 10 am on Monday, at which time the daughter is separated. The parent is found to have an activity of \( 5.0 \times 10^9 \) Bq. Determine the activity of the parent after 3.0 d and determine the activity of daughter that may be eluted.

3. (J & C 3-22) One g of \(^{23}\text{Na}\) is placed in a reactor at a flux density of \( 5 \times 10^{12} \) cm\(^{-2}\) s\(^{-1}\) for 30 h. Estimate the activity produced.

4. (J & C 3-24) 15 g of gold is to be activated in a flux of \( 5 \times 10^{12} \) cm\(^{-2}\) s\(^{-1}\). Find the saturation activity. Determine the activity after 4.0 d. What fraction of the gold atoms has been activated in 4.0 d?

5. (J & C 3-26) Derive an expression for \( t_m \), the time at which the activity of the radioactive daughter attains its maximum value.

6. If the half-life of \(^{99}\text{Mo}\) is 66.7 hr and the half-life of \(^{99m}\text{Tc}\) is 6.03 hr, show that daily “milking” of the Mo “cow” is nearly optimum utilization of the yield.