Mark scheme for Extension Worksheet – Option I, Worksheet 2

1 **a** Biological half-life is the time that must go by for the activity of radioactive material in the body to be reduced to half by natural bodily functions such as sweating urinating etc; whereas physical half-life is the time for the activity to be reduced to half by the process of radioactive decay. [2]

b The effective half-life is $\frac{1}{T} = \frac{1}{3.0} + \frac{1}{4.0} \Rightarrow T = 1.71\ \text{d}$; so $0.80A = A\left(\frac{1}{2}\right)^{t/1.71}$;

hence $t = \frac{\ln 0.50}{\ln 0.80} \times 1.71 = 5.3$ days [3]

2 Energy released in 30 min is
$8.2 \times 10^{8} \times 30 \times 60 \times 25 \times 10^{3} \times 1.6 \times 10^{-19} = 6.38 \times 10^{-9}$ J; so absorbed dose is
$\frac{6.38 \times 10^{-9}}{25 \times 10^{-3}} = 2.55 \times 10^{-7}$ Gy; since the quality factor is 1 the dose equivalent is then
2.55×10^{-7} Sv [3]

3 Let V be the volume blood of the patient, and A the initial activity in the sample of 10 cm^3 of albumen. Then $110 = A\frac{5}{V+10}$; and $105 = A\frac{5}{5000+10}$; forgetting about the 10 in the denominators, and dividing side by side we get

$$\frac{110}{105} = \frac{A\frac{5}{V}}{A\frac{5}{5000}} = \frac{5000}{V} \Rightarrow V = 4773 \approx 4800\ \text{cm}^3$$ [3]

