1a) $^{10}_{5}B_5 + ^{1}_{0}n \rightarrow ^{4}_{2}He_2 + ^{7}_{3}Li_4 + Q$

1b) $f_{raction} = \frac{N_{prod}}{N_{target}}$, note product is stable nuclide!

$N_{prod} = N_{Target}\,\sigma\phi$

$f = \frac{N_{prod}}{N_{target}} = \sigma\phi = 558\phi. \times 1\phi^{-24}\,cm^2 * \left(2 \times 1\phi^{+12}\,/cm^2/s * 36\phi\phi/s\right)$

$= 4.\phi 2 \times 1\phi^{-5}$

2) $^{35}_{17}Cl\ (n,\alpha)\ ^{32}_{15}P$ $\quad t_{1/2} = 14.26\,d$ radioactive product

$A = N\sigma\phi\,(1 - e^{-\lambda t}) \simeq N\sigma\phi\,(\lambda t) \qquad \lambda t < 1$

$A = \left[\frac{5.\phi\phi\,g\ NH_4Cl}{53.5\ g/mol} \frac{1\,Cl}{1\,NH_4Cl} \times \frac{\phi.7578\ ^{35}Cl}{1\,Cl}\right] N_A \left(8\phi \times 10^{-27}\,cm^2\right) 10^{14}\,/cm^2/s\,(\lambda t)$

$A = \left[4.266 \times 1\phi^{22}\right]\left(8 \times 1\phi^{-26}\,cm^2\right)\left(1\phi^{14}\,/cm^2/s\right)\left[\frac{ln2}{14.26 \times 24 \times 60} \times 3\phi\,min\right]$

$A = 3.41 \times 10^{11}/s\left[3.38 \times 10^{-5}/min \times 3\phi\,min\right]$

$A = 3.46 \times 10^{8}/s = Bq$ or $9.34 \times 10^{-3}\,Ci$

$9.34\,mCi$

3) $4\,(p^+) \rightarrow {}^4He^{2+} + 2e^+ + 2\nu + Q$

Notice that there are no $^{(-)}$ electrons in this reaction

if I use mass defects then I have to be careful about counting electrons:

$$4\,(^1H^0) \rightarrow {}^4He^0 + 2e^+ + 2\nu + 2e^- + Q_{pp}$$

$$Q_{pp} = 4\Delta(^1H) - \Delta(^4He) - 4m_e c^2$$

$$Q_{pp} = 4[7.289] - 2.425 - 4[0.511] \text{ MeV}$$

$$Q_{pp} = 24.687 \text{ MeV}$$

4) $3\,(^4He^{2+}) \rightarrow {}^{12}C^{6+} + Q$

add electrons → 6 on each side

$$3\,(^4He^0) \rightarrow {}^{12}C^0 + Q_\alpha$$

$$Q_\alpha = 3[2.425] - \phi \text{ MeV}$$

$$= 7.275 \text{ MeV}$$