Q1)

This question will be solved by applying the conservation of mass and atomic numbers:

a) ${}^{27}_{14}Si$

b) ${}^{36}_{18}Ar$

c) $3{}^{1}_{0}n$

d) ${}^{2}_{1}H$

Q2)

$$Q_{\beta+} = \left[m_N\left({}^{A}_{Z}X\right) - m_N\left({}^{A}_{Z+1}X'\right) - m_e\right]c^2$$
$$Q_{Reaction} = \left[m_N\left({}^{A}_{Z}X\right) + m_n - m_N\left({}^{A}_{Z+1}X'\right) - m_p\right]c^2$$

$$\therefore Q_{Reaction} - Q_{\beta+} = \left[m_n - m_p + m_e\right]c^2$$
$$= \left[1.00866501 - 1.00727647 + 5.485803 \times 10^{-4}\right] * 931.5\ MeV = 1.804\ MeV$$

From https://www.nndc.bnl.gov/qcalc/:

- ${}^{95}Tc$:
  $Q_{Reaction} - Q_{\beta+} = 2473\ keV - 669\ keV = 1.804\ MeV$
- ${}^{196}Au$:
  $Q_{Reaction} - Q_{\beta+} = 2288\ keV - 484\ keV = 1.804\ MeV$

Q3)

$$Q = \left[m\left({}^{9}Be\right) + m\left({}^{1}H\right) - m\left({}^{8}Be\right) - m\left({}^{2}H\right)\right]c^2$$

$$\therefore m\left({}^{8}Be\right) = \left[m\left({}^{9}Be\right) + m\left({}^{1}H\right) - m\left({}^{8}Be\right) - m\left({}^{2}H\right)\right] - Q/c^2$$
$$= 8.005905\ u - \frac{559.5 \pm 0.4\ keV}{931.5\ MeV/u}$$
$$= 8.005905\ u - 0.000601 \pm 0.000000\ u = 8.005304\ u$$

Q4)

a)

$$Q = \left[m\left({}^{1}H\right) + m\left({}^{4}He\right) - m\left({}^{2}H\right) - m\left({}^{3}He\right)\right]c^2$$
$$= [1.007825 + 4.002603 - 2.014102 - 3.016029] * 931.5\ MeV = -18.35\ MeV$$

b)

$$T_{th} = (-Q)\frac{m\left({}^{2}H\right) + m\left({}^{3}He\right)}{m\left({}^{2}H\right) + m\left({}^{3}He\right) - m\left({}^{4}He\right)}$$
$$= 18.3534\ MeV \times \frac{2.014102\ u + 3.016029\ u}{2.014102\ u + 3.016029\ u - 4.002603\ u} = 89.8467\ MeV$$