Problems from 30.2 - Nuclear Reactions - (you will get a table of neutral atom masses)

Binding Energy: m_n | $1.675 \times 10^{-27}\,\text{kg} = 1.008665\,\text{u} = 940\,\text{MeV}\,c^{-2}$ u | $1.661 \times 10^{-27}\,\text{kg} = 931.5\,\text{MeV}\,c^{-2}$ $^{1}_{1}H$ = 1.007825 u

1. Find the binding energy and the binding energy per nucleon of Helium-4 (28.30 MeV, 7.074 MeV)
2. Find the binding energy and binding energy per nucleon of Fluorine-19. (147.8 MeV, 7.779 MeV)
3. Find the binding energy and binding energy per nucleon of Silicone-28. (236.5 MeV, 8.448 MeV)
4. Find the binding energy and binding energy per nucleon of Argon-36. (306.7 MeV, 8.520 MeV)
5. Find the binding energy and binding energy per nucleon of Chromium-52. (456.3 MeV, 8.776 MeV)

6. Balancing Nuclear Reactions: Find the missing nucleus: d = deuterium, t = tritium

a.	b.	c.	d.
? (t,p) $^{40}_{17}Cl$ $^{38}_{17}Cl$	$^{52}_{23}V$ (n,?) $^{51}_{22}Ti$ $^{2}_{1}H$ or d	$^{65}_{28}Ni$ (?,n) $^{68}_{30}Zn$ $^{4}_{2}He$ or α	$^{81}_{37}Rb(p,\gamma)?$ $^{82}_{38}Sr$
$?(\alpha,p)\ ^{44}_{22}Ti$ $^{41}_{21}Sc$	$^{51}_{24}Cr\ (\alpha,?)\ ^{55}_{26}Fe$ $^{0}_{0}\gamma$	$^{22}_{10}Ne(d,?)^{23}_{11}Na$ $^{1}_{0}n$	$^{28}_{14}Si(\alpha,n)?$ $^{31}_{16}S$
$?(d,\alpha)^{10}_{5}B$ $^{12}_{6}C$	$^{145}_{66}Dy\ (d,n)?$ $^{146}_{67}Ho$	$?(t,n)^{11}_{5}B$ $^{9}_{4}Be$	$^{7}_{3}Li(?,p)^{8}_{3}Li$ $^{2}_{1}H$ or d

Finding the Q value: Find the Q value for the following reactions. Label the reaction as either energy requiring, (endoergic) or energy releasing (exoergic). You will need to look up the masses in a table.

7. $^{7}_{3}Li(p,\alpha)\ ^{4}_{2}He.$ (Exo, Q = 17.35 MeV)
8. $^{6}_{3}Li(n,\alpha)^{3}_{1}H.$ (Exo, Q = +4.783 MeV)
9. $^{7}_{3}Li\ (\alpha,\ n)\ ^{10}_{5}B.$ (Endo, Q = -2.790 MeV)
10. $^{12}_{6}C(t,n)^{14}_{7}N.$ (Exo, Q = 4.015 MeV)
11. $^{14}_{7}N(\alpha,p)^{17}_{8}O.$ (Endo, Q = -1.192 MeV)

Fission Reactions: For each of the following (fictitious) fission reactions, determine the number of free neutrons liberated, and the Q value of the reaction as a whole:

12. $^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{141}_{56}Ba + {}^{90}_{36}Kr$ + some neutrons.
    U-235 = 235.043923 u, Ba-141 = 140.914406 u, Kr-90 = 89.919524 u (5 neutrons, Q = +163.3 MeV)
13. $^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{138}_{55}Cs + {}^{92}_{37}Rb$ + some neutrons.
    U-235 = 235.043923 u, Cs-138 = 137.911011 u, Rb-92 = 91.919725 u (6 neutrons, Q = +158.2 MeV)
14. $^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{137}_{54}Xe + {}^{95}_{38}Sr$ + some neutrons.
    U-235 = 235.043923 u, Xe-137 = 136.911563 u, Sr-95 = 94.919358 u (4 neutrons, Q = +174.2 MeV)
15. $^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{126}_{48}Cd + {}^{107}_{44}Ru$ + some neutrons.
    U-235 = 235.043923 u, Cd-126 = 125.922354 u, Ru-107 = 106.909907 u (3 neutrons, Q = +181.0 MeV)
16. $^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{126}_{49}In + {}^{108}_{43}Tc$ + some neutrons.
    U-235 = 235.043923 u, In-126 = 125.916465 u, Tc-108 = 107.918480 u (2 neutrons, Q = +186.6 MeV)