Problems from 30.1 - Radioactive Decay (Use your Isotope reference for this)

1. Find the missing particle or nucleus in these decays: (ignore neutrinos for this)

a.	b.	c.	d.
$^{55}_{24}Cr \rightarrow {}^{51}_{22}Ti + ??$ α	$^{55}_{24}Cr \rightarrow {}^{55}_{23}V + ??$ β^+	$^{55}_{24}Cr \rightarrow {}^{55}_{25}Mn + ??$ β^-	$^{55}_{24}Cr \rightarrow {}^{55}_{24}Cr + ??$ γ
$^{43}_{19}K \rightarrow ?? + \gamma$ $^{43}_{19}K$	$^{43}_{19}K \rightarrow ?? + \alpha$ $^{39}_{17}Cl$	$^{43}_{19}K \rightarrow ?? + \beta^-$ $^{43}_{20}Ca$	$^{43}_{19}K \rightarrow ?? + \beta^+$ $^{43}_{18}Ar$
$?? \rightarrow {}^{27}_{13}Al + \beta^+$ $^{27}_{14}Si$	$?? \rightarrow {}^{27}_{13}Al + \alpha$ $^{31}_{15}P$	$?? \rightarrow {}^{27}_{13}Al + \gamma$ $^{27}_{13}Al$	$?? \rightarrow {}^{27}_{13}Al + \beta^-$ $^{27}_{12}Mg$

Alpha Decay - Find the energy released in MeV of these alpha decays:

2. ^{208}Po (m = 207.981222 u) → ^{204}Pb (m = 203.973020) + α (5.216 MeV)
3. ^{152}Dy (m = 151.9247139 u) → ^{148}Gd (m = 147.9181098) + α (3.728 MeV)
4. No-257 (m = 257.0968528 u) → Fm-253 (m = 253.0851763) + α (8.452 MeV)
5. Pa-226 (m = 226.0279327 u) → Ac-222 (m = 222.0178289) + α (6.987 MeV)
6. Am-234 (m = 234.0477940 u) → Np-230 (m = 230.0378126) + α (6.873 MeV)

Balanced Beta decays

7. Imagine it is possible for the following nuclei to undergo both β^- and β^+ decay. Write the complete decay equation for each:

a. $^{19}_{9}F$	b. $^{23}_{11}Na$	c. $^{44}_{20}Ca$	d. $^{55}_{24}Cr$
$^{19}_{9}F \rightarrow {}^{19}_{10}Ne + \beta^- + \overline{\upsilon_e}$ $^{19}_{9}F \rightarrow {}^{19}_{8}O + \beta^+ + \upsilon_e$	$^{23}_{11}Na \rightarrow {}^{23}_{12}Mg + \beta^- + \overline{\upsilon_e}$ $^{23}_{11}Na \rightarrow {}^{23}_{10}Ne + \beta^+ + \upsilon_e$	$^{44}_{20}Ca \rightarrow {}^{44}_{21}Sc + \beta^- + \overline{\upsilon_e}$ $^{44}_{20}Ca \rightarrow {}^{44}_{19}K + \beta^+ + \upsilon_e$	$^{55}_{24}Cr \rightarrow {}^{55}_{25}Mn + \beta^- + \overline{\upsilon_e}$ $^{55}_{24}Cr \rightarrow {}^{55}_{23}V + \beta^+ + \upsilon_e$

Half Life and Decay Rates - Integer number of half life

8. A radioactive substance has a half life of 13.0 s. If you have an activity of 480. counts per second initially, what is the activity in 65.0 s? (15.0 counts/s)
9. A radioactive substance has a half life of 2.50 years. If you have 128. g initially, after what time do you have only 2.00 grams left? (15.0 years)
10. A radioactive substance starts off with 3240 atoms, and in 48.0 minutes, is down to 405 atoms. What is its half life? (16.0 minutes)
11. A radioactive substance has a half life of 47.0 s. If you have 1920 g initially, how much is left after 329 s? (15.0 grams)
12. A radioactive substance has a half life of 12.0 minutes. If you have an activity of 5.12×10^4 counts/sec initially, after what time do you have an activity of 1.28×10^4 counts/sec? (24.0 minutes)
13. A radioactive substance starts off with 3.20×10^{20} atoms, and in 85.0 minutes, is down to 1.00×10^{19} atoms. What is its half life? (17.0 minutes)

Half life and Decay Rates:

14. You have 45.0 grams initially of a sample with a half-life of 178 seconds. In what time will there be only 13.0 grams left? (319 s)
15. You have 78.0 grams of undecayed nuclei initially, and in 68.0 hours you have only 45.0 grams left. What is the half-life in hours? (85.7 hours)
16. A sample has a half-life of 13.7 seconds. If its activity is initially 196 counts per second, what will it be in 60.0 seconds? (9.42 counts/sec)
17. A sample has a half-life of 34.0 minutes. If after 87.0 minutes the activity is 137 counts per second, what was the activity initially? (807 counts/sec)
18. At first the activity of a radioactive sample is 278 counts per minute, and after 17.0 hours the activity is 171 counts per minute. What is the half-life of the sample in hours? (24.2 hours)
19. What is the activity of 13.0 g of Co-60 (m = 59.934 u) if it has a half life of 5.2708 years? (5.44×10^{14} counts/sec)
20. You have 0.150 g of S-35 (m = 34.969 u), and the activity is 2.37×10^{14} counts/s. What is the half life of S-35? (87.4 days)
21. A sample of P-32 (m = 31.974 u) has a half life of 14.262 days. How many grams do you have if it has an activity of 4.20×10^{15} counts/sec? (0.397 g)
22. What is the activity of 1.20 μg of Sr-90 (m = 89.908 u) if it has a half life of 28.79 years? (6.13×10^6 counts/s)
23. If you have 0.0340 g of O-15 (m = 15.003) and the activity is 7.736×10^{18} counts/sec. What is its half life? (122 s)
24. A sample of C-11 (m = 11.0114 u) has a half life of 20.39 minutes. How many grams do you have if it has an activity of 3.10×10^{13} counts/sec? (1.00 μg)