(2) $r = 1.2 \times 10^{-15} A^{\frac{1}{3}}$

$= 1.2 \times 10^{-15} \times 4^{\frac{1}{3}} = 1.905 \times 10^{-15}$ m

$= 1.905$ fermi

(37) $^{238}_{92}U$

a) decay constant $\Rightarrow \lambda$

$$\lambda = \frac{\ln 2}{t_{\frac{1}{2}}} = \frac{\ln 2}{(4.5 \times 10^{9})\, yr} = 1.54 \times 10^{-10} yr^{-1}$$

b) $$\lambda = \frac{\ln 2}{t_{\frac{1}{2}}} \Rightarrow t_{\frac{1}{2}} = \frac{\ln 2}{\lambda} = \frac{\ln 2}{(3.2 \times 10^{-5})\, s^{-1}} = 21,660.94\ s$$

(42) $^{131}_{53}I$

Iodine - 131

(1) Atomic Number Z	(2) Element	(3) Symbol	(4) Mass Number A	(5) Atomic Mass	(6) % Abundance (or Radioactive Decay Mode)	(7) Half-life (if radioactiv
52	Tellurium	Te	130	129.906223	34.08%; $\beta^-\beta^-$	>3.0 × 10
53	Iodine	I	127	126.904472	100%	
			131	130.906126	β^-, γ	8.0252 d
54	Xenon	Xe	132	131.904155	26.9086%	
			136	135.907214	8.8573%; $\beta^-\beta^-$	>2.4 × 10
55	Cesium	Cs	133	132.905452	100%	
56	Barium	Ba	137	136.905827	11.232%	
			138	137.905247	71.698%	
57	Lanthanum	La	139	138.906356	99.9119%	
58	Cerium	Ce	140	139.905443	88.450%	
59	Praseodymium	Pr	141	140.907658	100%	
60	Neodymium	Nd	142	141.907729	27.152%	
61	Promethium	Pm	145	144.912756	EC, α	17.7 yr
62	Samarium	Sm	152	151.919740	26.75%	
63	Europium	Eu	153	152.921238	52.19%	
64	Gadolinium	Gd	158	157.924112	24.84%	
65	Terbium	Tb	159	158.925355	100%	
66	Dysprosium	Dy	164	163.929182	28.260%	
67	Holmium	Ho	165	164.930329	100%	
68	Erbium	Er	166	165.930300	33.503%	
69	Thulium	Tm	169	168.934218	100%	
70	Ytterbium	Yb	174	173.938866	31.026%	
71	Lutetium	Lu	175	174.940775	97.401%	
72	Hafnium	Hf	180	179.946557	35.08%	
73	Tantalum	Ta	181	180.947996	99.98799%	
74	Tungsten (wolfram)	W	184	183.950931	30.64%; α	>8.9 × 10
75	Rhenium	Re	187	186.955750	62.60%; β^-	4.33 × 1
76	Osmium	Os	191	190.960926	β^-, γ	15.4 days
			192	191.961477	40.78%	
77	Iridium	Ir	191	190.960589	37.3%	
			193	192.962922	62.7%	
78	Platinum	Pt	195	194.964792	33.78%	
79	Gold	Au	197	196.966569	100%	
80	Mercury	Hg	199	198.968281	16.87%	
			202	201.970643	29.86%	
81	Thallium	Tl	205	204.974428	70.48%	
82	Lead	Pb	206	205.974466	24.1%	
			207	206.975897	22.1%	
			208	207.976652	52.4%	
			210	209.984189	β^-, γ, α	22.20 yr
			211	210.988737	β^-, γ	36.1 min
			212	211.991898	β^-, γ	10.64 h
			214	213.999806	β^-, γ	26.8 min
83	Bismuth	Bi	209	208.980399	100%	
			211	210.987270	α, γ, β^-	2.14 min
84	Polonium	Po	210	209.982874	α, γ, EC	138.376 da
			214	213.995202	α, γ	164.3 μs
85	Astatine	At	218	218.008695	α, β^-	1.5 s

$t_{\frac{1}{2}} = 8.0252$ days

$m = 782\ \mu g = 782 \times 10^{-6}$ g

from m, we can find number of moles and then N_o

Avogadro number

$$782 \times 10^{-6}\ g \times \frac{1\ mol}{131\ g} \times \frac{6.02 \times 10^{23}\ nuclei}{1\ mol}$$

$$N_o = 3.59 \times 10^{18}\ nuclei$$

$$\lambda = \frac{\ln 2}{t_{\frac{1}{2}}} = \frac{\ln 2}{8.0252\ days} = 0.08637\ days^{-1}$$

from table

Standard units of λ is s^{-1}, so we need to convert $day^{-1} \longrightarrow s^{-1}$

$$\frac{0.08637}{1\ day} \times \frac{1\ day}{24\ h} \times \frac{1\ h}{60\ min} \times \frac{1\ min}{60\ s}$$

$$\lambda(s^{-1}) = 9.99668 \times 10^{-7}\ s^{-1}$$

$A_o = \lambda N$

$= 9.99668 \times 10^{-7}\ s^{-1} \times 3.59 \times 10^{18}$ nuclei

$$= \boxed{3.59 \times 10^{12}\ \frac{decays}{s}}$$

b) $A = A_0 e^{-\lambda t}$

$t = 1.5h \Rightarrow (1.5 \times 60 \times 60)s = 5400\,s$, $A = ?$, $\lambda = 9.99668 \times 10^{-7}$

$A_0 = 3.59 \times 10^{12}$ (previous Q)

$A = (3.59 \times 10^{12}) e^{-(9.99668 \times 10^{-7})(1.5 \times 60 \times 60)}$

$= \boxed{3.573 \times 10^{12} \frac{\text{decays}}{1s}}$

c) 3 months:

$3 \text{ months} \times \frac{30 \text{ days}}{1 \text{ month}} \times \frac{24 \text{ h}}{1 \text{ day}} \times \frac{60 \text{ min}}{1 \text{ h}} \times \frac{60 \text{ s}}{1 \text{ min}}$

$t \text{ (s)} = 7,776,000$

$A = A_0 e^{-\lambda t}$

$A = (3.59 \times 10^{12}) e^{-(9.99668 \times 10^{-7})(7,776,000)}$

$A = 1,511,592,067 \frac{\text{decays}}{s}$

$= \boxed{1.51 \times 10^{9} \frac{\text{decays}}{s}}$

(43) $^{238}_{92}U \Rightarrow$ Uranium - 238

$$\lambda = \frac{\ln 2}{t_{\frac{1}{2}}} = \frac{\ln 2}{4.468 \times 10^{9}\ yr}$$

$$\lambda = 1.55135 \times 10^{-10}\ yr^{-1}$$

$$\lambda = \frac{1.55135 \times 10^{-10}}{1\ \cancel{yr}} \times \frac{1\ \cancel{yr}}{365\ \cancel{days}} \times \frac{1\ \cancel{day}}{24 \times 60 \times 60\,s}$$

$$= 4.919 \times 10^{-18}\ s^{-1}$$

$$A = \lambda N$$

$$\Rightarrow N = \frac{A}{\lambda} = \frac{420}{4.919 \times 10^{-18}} = 8.537 \times 10^{19}$$

(1) Atomic Number Z	(2) Element	(3) Symbol	(4) Mass Number A	(5) Atomic Mass	(6) % Abundance (or Radioactive Decay Mode)	(7) Half-life (if radioactive)
86	Radon	Rn	222	222.017578	α, γ	3.8235 day
87	Francium	Fr	223	223.019736	β^-, γ, α	22.00 min
88	Radium	Ra	226	226.025410	α, γ	1600 yr
89	Actinium	Ac	227	227.027752	β^-, γ, α	21.772 yr
90	Thorium	Th	228	228.028741	α, γ	1.9116 yr
			232	232.038056	100%; α, γ	1.40 × 10
91	Protactinium	Pa	231	231.035884	α, γ	3.276 × 10
92	Uranium	U	232	232.037156	α, γ	68.9 yr
			233	233.039636	α, γ	1.592 × 10
			235	235.043930	0.7204%; α, γ	7.04 × 10
			236	236.045568	α, γ	2.342 × 10
			238	238.050788	99.2742%; α, γ	4.468 × 10
			239	239.054294	β^-, γ	23.45 min
93	Neptunium	Np	237	237.048174	α, γ	2.144 × 10
			239	239.052939	β^-, γ	2.356 days
94	Plutonium	Pu	239	239.052164	α, γ	24,110 yr
			244	244.064205	α	8.00 × 10
95	Americium	Am	243	243.061381	α, γ	7370 yr
96	Curium	Cm	247	247.070354	α, γ	1.56 × 10
97	Berkelium	Bk	247	247.070307	α, γ	1380 yr
98	Californium	Cf	251	251.079589	α, γ	898 yr
99	Einsteinium	Es	252	252.082980	α, EC, γ	471.7 days
100	Fermium	Fm	257	257.095106	α, γ	100.5 days
101	Mendelevium	Md	258	258.098431	α, γ	51.5 days
102	Nobelium	No	259	259.101030	α, EC	58 min
103	Lawrencium	Lr	262	262.109610	α, EC, fission	≈ 4 h
104	Rutherfordium	Rf	263	263.112500	fission	10 min
105	Dubnium	Db	268	268.125670	fission	32 h
106	Seaborgium	Sg	271	271.133930	α, fission	2.4 min
107	Bohrium	Bh	274	274.143550	α, fission	0.9 min
108	Hassium	Hs	270	270.134290	α	22 s
109	Meitnerium	Mt	278	278.156310	α, fission	8 s
110	Darmstadtium	Ds	281	281.164510	α, fission	20 s
111	Roentgenium	Rg	281	281.166360	α, fission	26 s
112	Copernicium	Cn	285	285.177120	α	30 s
113†			286	286.18210	α, fission	20 s
114	Flerovium	Fl	289	289.190420	α	2.7 s
115†			289	289.193630	α, fission	0.22 s
116	Livermorium	Lv	293	293.204490	α	53 ms
117†			294	294.210460	α	0.08 s
118†			294	294.213920	α, fission	0.9 ms

(46) $^{40}_{19}K$

$$\lambda = \frac{\ln 2}{t_{\frac{1}{2}}}$$

$$\lambda = \frac{\ln 2}{1.248 \times 10^{9}\ yr}$$

$$\lambda = 5.55 \times 10^{-10}\ yr^{-1}$$

$\lambda\ (yr^{-1}) \longrightarrow \lambda\ (s^{-1})$:

$$\frac{5.55 \times 10^{-10}}{1\ \cancel{yr}} \times \frac{1\ \cancel{yr}}{365\ \cancel{days}} \times \frac{1\ \cancel{day}}{24\ \cancel{h}} \times \frac{1\ \cancel{h}}{60\ \cancel{min}} \times \frac{1\ \cancel{min}}{60\ s}$$

$$\lambda = 1.761182 \times 10^{-17}\ s^{-1}$$

$$A_0 = \lambda N_0 \rightarrow N_0 = \frac{A_0}{\lambda} = \frac{2.4\times10^5 \ \frac{\text{decays}}{1s}}{1.761182\times10^{-17}\ \frac{1}{s}} = \boxed{1.3627\times10^{22}\ \text{particles.}}$$

decay Rate (A_0)

decay constant (λ)

(49)

$$A = A_0 e^{-\lambda t}$$

$$t = 9.4\text{ min} \longrightarrow A = \frac{1}{6}A_0$$

$$\frac{1}{6}\cancel{A_0} = \cancel{A_0}e^{-\lambda(9.4)}$$

$$\frac{1}{6} = e^{-9.4\lambda}$$

$$\ln\left(\frac{1}{6}\right) = e^{-9.4\lambda}$$

$$\ln(6^{-1}) = \ln(e^{-9.4\lambda})$$

$$-\ln 6 = -9.4\lambda(\cancel{\ln e})$$

$$\frac{\ln 6}{9.4} = \lambda$$

$$0.1906\text{ min}^{-1} = \lambda$$

$$\lambda = \frac{\ln 2}{t_{\frac{1}{2}}} \Rightarrow t_{\frac{1}{2}} = \frac{\ln 2}{\lambda} = \frac{\ln 2}{0.1906} = \boxed{3.64\text{ min}}$$