

Chapter 23 Example Problems

1. A powder diffraction photograph of the element polonium gave lines at the following values of 2θ (in degrees) when the sample was exposed to 71.0-pm radiation: 12.1, 17.1, 21.0, 24.3, 27.2, 29.9, 34.7, 36.9, 38.9, 40.9, and 42.8.
- Confirm that Po crystallizes as a primitive cubic (cubic P) lattice.
 - Determine the unit cell's dimensions (in good old-fashioned chemical units of Å).
 - Po is the only metal known to form cubic P lattices. Most other metals form either cubic I (body-centered cubic) or cubic F (face-centered cubic) lattices. Why is cubic P so rare?

Answer:

2θ (deg)	θ (deg)	θ (rad)	$\sin \theta$	$\sin^2 \theta$	$h^2 + k^2 + l^2$	Common Factor (Å)	
12.1	6.05	0.1056	0.1054	0.0111	1	0.011108	
17.1	8.55	0.1492	0.1487	0.0221	2	0.011052	
21.0	10.5	0.1833	0.1822	0.0332	3	0.011070	
24.3	12.15	0.2121	0.2105	0.0443	4	0.011075	
27.2	13.6	0.2374	0.2351	0.0553	5	0.011058	
29.9	14.95	0.2609	0.2580	0.0666	6	0.011092	
34.7	17.35	0.3028	0.2982	0.0889	8	0.011116	
						0.011082	mean
						0.000025	standard dev
						0.2218	rel stdev (%)