1. Mo k-series radiation has an absorption edge corresponding to a wavelength of 0.61977 Å. The kα₁ line has a wavelength of 0.70926 Å and the kβ₁, a wavelength of 0.63225 Å.

A. What is the minimum potential in KV that can be used to produce Mo k-series radiation from a Mo-target X-ray tube?

Convert the energy of the absorption edge to eV.

\[ E = \frac{hc}{\lambda} \]
\[ E = \frac{6.6 \times 10^{-34} \times 3.0 \times 10^9}{0.61977 \times 10^{-10}} \]
\[ E = 3.1047 \times 10^{-15} \text{ joules} \]
\[ E = 3.1047 \times 10^{-15} / 1.602 \times 10^{-19} \]
\[ E = 19,947 \text{ eV} \]

Voltage = 19.947 KV

B. What is the frequency of Mo kβ radiation?

\[ \nu = \frac{c}{\lambda} \]
\[ \nu = \frac{3 \times 10^8}{0.63225 \times 10^{-10}} \]
\[ \nu = 4.745 \times 10^{18} \text{ hz} \]

C. Nb has an absorption edge corresponding to a wavelength of 0.65291 Å. Can Nb be used as a β-filter for Mo radiation? Why?

Kβ (Mo) = 0.63225 Å Is this energetic enough to remove inner K-shell electrons from Nb?
Yes
Kα (Mo) = 0.70926 Å Is this energetic enough to remove inner K-shell electrons from Nb?
No
Then the Kβ of Mo will be absorbed strongly but the Kα will not. So it can be used as a β-filter.

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Planck’s Constant = 6.6 x 10⁻³⁴ joule-sec
1 ev = 1.6016 x 10⁻¹⁹ joule
\[ c = 3.0 \times 10^8 \text{ m/sec} \]
2. Barite (BaSO$_4$) has orthorhombic cell edges $a = 7.157$ Å, $b = 8.884$ Å, and $c = 5.457$ Å. Calculate $2\theta$ for CuK$_{\alpha}$ radiation $\lambda = 1.5405$ Å for the following X-ray diffractions:

a. (002)

\[
d = \frac{1}{h^2/a^2 + k^2/b^2 + l^2/c^2}^{1/2}
\]
\[
d = c/2
\]
\[
d = 2.728\text{Å}
\]

\[
\lambda = 2d \sin \theta
\]
\[
2\theta = 2\sin^{-1}(\lambda/2d)
\]
\[
2\theta = 2\sin^{-1}(1.5405/5.457)
\]
\[
2\theta = 32.79^\circ
\]

b. (110)

\[
d = \frac{1}{(1/7.157)^2 + (1/8.884)^2}^{1/2}
\]
\[
d = 5.574\text{Å}
\]

\[
\lambda = 2d \sin \theta
\]
\[
2\theta = 2\sin^{-1}(\lambda/2d)
\]
\[
2\theta = 2\sin^{-1}(1.5405/2*5.574)
\]
\[
2\theta = 15.88^\circ
\]

c. (021)

\[
d = \frac{1}{(2/8.884)^2 + (1/5.457)^2}^{1/2}
\]
\[
d = 3.445\text{Å}
\]

\[
\lambda = 2d \sin \theta
\]
\[
2\theta = 2\sin^{-1}(\lambda/2d)
\]
\[
2\theta = 2\sin^{-1}(1.5405/2*3.445)
\]
\[
2\theta = 25.84^\circ
\]

d. (111)

\[
d = \frac{1}{(1/7.157)^2 + (1/8.884)^2 + (1/5.457)^2}^{1/2}
\]
\[
d = 3.899\text{Å}
\]

\[
\lambda = 2d \sin \theta
\]
\[
2\theta = 2\sin^{-1}(\lambda/2d)
\]
\[
2\theta = 2\sin^{-1}(1.5405/2*3.899)
\]
\[
2\theta = 22.79^\circ
\]

e. (301)

\[
d = \frac{1}{(3/7.157)^2 + (1/5.457)^2}^{1/2}
\]
\[
d = 2.262\text{Å}
\]

\[
\lambda = 2d \sin \theta
\]
\[
2\theta = 2\sin^{-1}(\lambda/2d)
\]
\[
2\theta = 2\sin^{-1}(1.5405/2*2.262)
\]
\[
2\theta = 39.82^\circ
\]