683.

Problem 47.31 (RHK)

A beam of x rays of wavelength 29.3 pm *is incident on a calcite crystal of lattice spacing* 0.313 nm. *We have to find the smallest angle between the crystal planes and the beam that will result in constructive reflection of the x rays.*

Solution:

The Bragg' law for crystal diffraction is

$2d\sin\theta = m\lambda,\ m = 1, 2, 3, ...$

where d is the lattice spacing.

It is given that

$d = 0.313 \text{ nm},$

and

$\lambda = 29.3 \text{ pm} = 0.0293 \text{ nm}.$

Therefore, the smallest angle between the crystal planes and the beam that will result in constructive interference will be

$$\sin\theta = \frac{\lambda}{2d} = \frac{0.0293}{2\times 0.313} = 4.48\times 10^{-2},$$

and

$$\theta = \sin^{-1}\left(4.48\times 10^{-2}\right) = 4.68\times 10^{-2}\ \text{rad} = 2.68^{0}.$$