

# Chemistry 2720 Fall 2005 Quiz 6

Name: \_\_\_\_\_

## Marks for this quiz: 13

In neutron diffraction, we use neutrons with an appropriate de Broglie wavelength in exactly the same way as we would X-rays to determine the structure of a solid. Neutrons can be monochromated the same way X-rays are using diffraction from a known crystal. Ge(311) reflects 2.079 Å neutrons at 75°.

1. What is the distance between the (311) planes in germanium? [2 marks]

Note: When using the Miller index system without further comment, it is assumed that the order of refraction is 1.

2. What is the momentum of the neutrons which emerge from the monochromator? [2 marks]
3. Suppose that you passed these neutrons through a 10 nm-wide slit in an effort to obtain a narrow beam. What uncertainty in the wavelength would result? [9 marks]

Hint: You can't calculate the uncertainty in the wavelength directly, unless you've had more error analysis than most students at your level. Instead, calculate the minimum and maximum wavelengths which you would expect from your calculation of the uncertainty in another quantity, then take half the difference to give an uncertainty in wavelength.

## Data

Neutron mass:  $1.674\,927\,16 \times 10^{-27}$  kg

$c = 2.997\,924\,58 \times 10^8$  m/s

$h = 6.626\,068\,8 \times 10^{-34}$  J/Hz

$1 \text{ \AA} = 10^{-10}$  m