

# Chem 151B, Spring 2018

## Problem Set #2

1. u.p.e. is on all three cobalts  $\Rightarrow$  A-couples to all three cobalts, not S

(i) All cobalts equivalent

$$2nI+1 = 2(3)\left(\frac{7}{2}\right)+1 = 22 \text{ lines}$$

(ii) Two cobalts equivalent (third is not)

$$2nI+1 = 2(2)\left(\frac{7}{2}\right)+1 = 15 \text{ lines}$$

$15 \times 8 = 120$  lines (though there will be overlap)

$$2(1)\left(\frac{7}{2}\right)+1 = 8 \text{ lines}$$

(iii) All cobalts non-equivalent

$$2nI+1 = 2(1)\left(\frac{7}{2}\right)+1 = 8 \text{ lines for each Co}$$

$$8^3 = 64 \times 8 = 512 \text{ lines}$$

5 marks each

2. Basics of instrument: 8 marks

-  $\gamma$  (or radioactive) source

- source moves

- Doppler shift to scan (or sweep)  $\lambda$  (or  $E$ )

- chemical (or center or isomer) shift

- shift due to change in s-electron density

Selection rules: 3 marks

$$\Delta M_{\pm} = 0, \pm 1$$

HF splitting: 4 marks

quadrupole  
magnetic

3. (i)  $\text{FeSO}_4$ , no magnetic field: (quadrupole) doublet  
(ii)  $\text{FeSO}_4$ , in " " " : (hf) hextet  
(iii)  $\text{KFeS}_2$  at RT: doublet  
(iv)  $\text{KFeS}_2$  at  $-145^\circ\text{C}$ : hextet

5 marks each

4.  $\text{ABX}_3$  perovskite

A at center

B at corners

X at edges

1 per unit cell

1 per unit cell

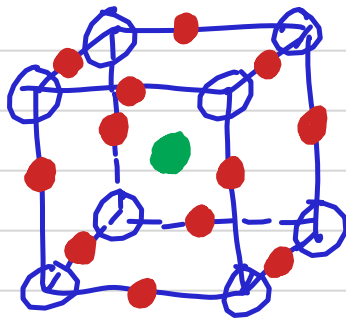
3 per unit cell

C.N. = 12

C.N. = 6

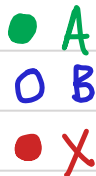
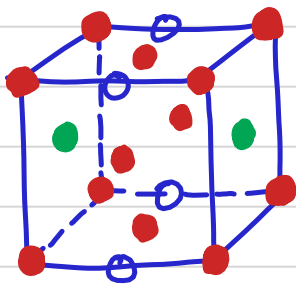
C.N. = 2

PC/SC corner-sharing  $\text{BX}_6$  octahedra



Drawings not needed  
in their answer.  
8 marks for above;  
7 marks for  
second description

Instead, B at center (translate  $\frac{1}{2}$  along any side):



A at two faces  
1 per unit cell  
C.N. = 12

B at four edges  
1 per unit cell  
C.N. = 6

X at corners & faces  
3 per unit cell  
C.N. = 2

Corner-sharing  $BX_6$  octahedra

5. Electrolyte has constant composition/formula/ion concentration/charge. Conducts ions only, impermeable to electrons.