MECH 221 Session #3

MECH 221 **Fall 2008** **QUIZ #1**

Student _____ I.D. _____

1. Many ionic compounds under normal conditions are in the gaseous state. *(1 mark)*

T (F)

Most ionic compounds are solid under normal conditions

2. FCC and BCC unit cells have different numbers of atoms in the unit cell and different atomic packing factors. *(1 mark)*

(T) F

FCC : $n = 4$ $APF = 0,74$

BCC : $n = 2$ $APF = 0,68$

3. To calculate the theoretical density of a metal, it is enough to know the volume of the unit cell and its type. *(1 mark)*

T (F)

You must know atomic weight of metal, too.

4. Electronegativity of an element determines the type of unit cell of this element. *(1 mark)*

T (F)

5. The electron shell of Ti^{4+} ion is similar to that of: *(1 mark)*

A. Kr B. Xe C. Ne D. Ca (E) Correct answer is not listed

$Ti : [Ar]3d^2 4s^2$ $Ti^{4+} : [Ar]$

6. In which of the following compounds would the bond have the highest percentage of ionic character? *(1 mark)*

A. SiO_2 B. $CaBr_2$ C. ZnS D. Al_2O_3 (E) ~~KBr~~ KCl

$\%\ ionic\ character = \{1 - exp[-(0.25)(X_A - X_B)^2]\} \cdot 100$

$\Delta X = 1,7$ $1,8$ $0,9$ $2,0$ $2,2$

7. The atoms of two different isotopes of the same element differ by: *(1 mark)*

(A) number of neutrons; B. number of protons; C. electron's subshells sequence; D. number of electron shells

8. The effect of van der Waals forces can be observed in which of following phenomenon (more than one answer): *(2 marks)*

A. High thermal conductivity of pure gold; B. Brittleness of crystalline table salt, NaCl;

C. Hardness of diamond; (D) Liquefaction of the neon, Ne;

(E) High boiling temperature of water; (F) Softness of graphite

E – hydrogen bonding
D – fluctuating induced dipole bonds
F – Van der Waals forces bond layers of covalently bonded carbon atoms

9. Which of the following statements is true for the (111) plane in the cubic unit cell? (Consider BCC and FCC unit cells with equal lattice parameters). *(3 marks)*

A. The Planar density of this plane is higher for BCC than FCC

(B) The Planar density of this plane is higher for FCC than BCC

C. The Planar density of this plane is the same for both BCC and FCC since the area of the plane is the same in both cases

D. Planar densities can not be compared in this plane as it would also depend on the atomic weights of the elements

FCC:  BCC: 

For the same area:
FCC contains 2 atoms and
BCC contains 1,5 atoms

10. Which of the following planes of FCC nickel (atomic radius R=0.125 nm) unit cell would have the highest diffraction angle, if all other conditions of X-ray diffraction are the same? *(3 marks)*

A. (212) (B.) (133) C. (010) D. (231) E. There is not enough information to answer this question.

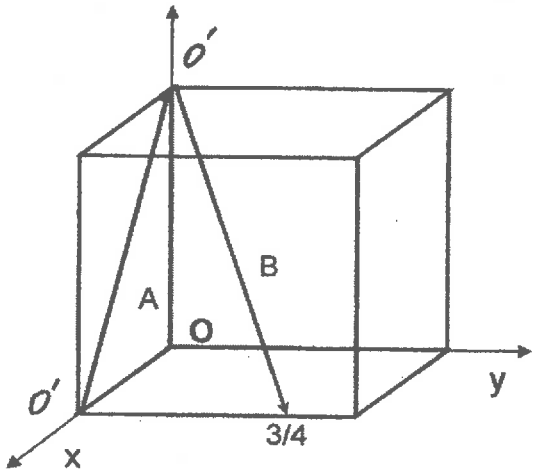
$n\lambda = 2d_{hkl} \cdot \sin\theta$

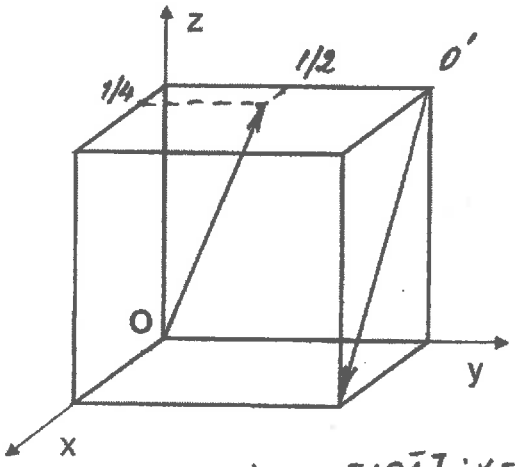
$d_{hkl} = a/\sqrt{h^2+k^2+l^2}$

$n\lambda$ = const. then for highest θ we should have highest $\sin\theta$ and lowest value d_{hkl}
Thus d_{hkl} lowest for highest $(h^2+k^2+l^2)$

11. Determine the Miller indices for the directions A and B in the left figure, and, in the empty cubic cell (right figure) draw directions [124] and [redacted]. *(2+2+2+2 = 8 marks)*

[10$\bar{1}$]





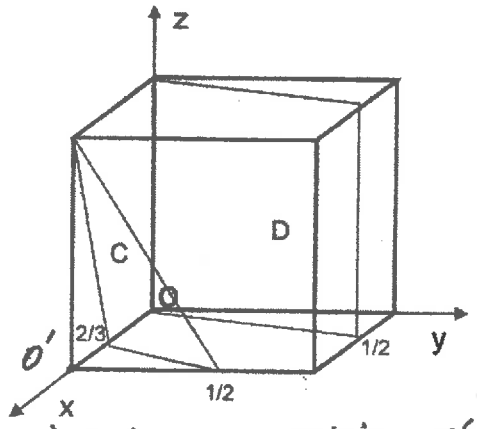
A: $x = -1$, $y = 0$, $z = 1$ → $[\bar{1}01]$

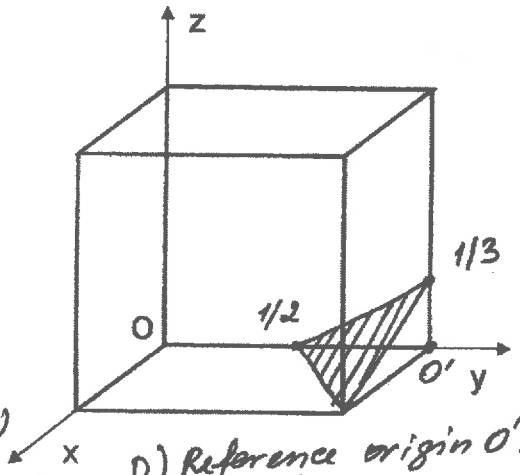
B: $x = 1$, $y = 3/4 \times 4$, $z = -1$ → $[43\bar{4}]$

[124]: $x = \frac{1}{4}$, $y = \frac{1}{2}$, $z = 1$

$[10\bar{1}]$: $x = 1$, $y = 0$, $z = -1$

12. Determine the Miller indices for the planes C and D in the left figure, and, in the empty cubic cell (right figure) draw the plane $(1\bar{2}3)$. *(3+3+4 =10 marks)*





c) Reference origin: O' = (1;0;0)

$x = -1/3$ → -3

$y = 1/2 \Rightarrow 2$ → $(\bar{3}21)$

$z = 1$ → 1

D) Reference origin O'' = (0;1;0)

$x = 1/2$ → 2

$y = -1$ → -1 → $(2\bar{1}0)$

$z = \infty$ → 0

13. Determine the force of attraction between Al^{3+} and O^{2-} ions separated by 0.442 nm distance. *(3 marks)*

$$F_A = \frac{1}{4\pi\varepsilon_0}(z_1 e)(z_2 e)\cdot\frac{1}{r^2}$$

$$F_A = \frac{1}{4\pi\cdot 8{,}85\cdot 10^{-12}\,F/m}\cdot(3\cdot 1{,}6\cdot 10^{-19}C)\cdot(2\cdot 1{,}6\cdot 10^{-19}C)\times$$

$$\times\frac{1}{(0{,}442\cdot 10^{-9}m)^2} = \frac{2{,}828\cdot 10^{-8}N}{4}$$

= 7.07 x 10E-9 N

14. Calculate the number of atoms per cubic centimeter in sodium and tungsten (ρ_{Na} = 0.968 g/cm^3 and ρ_W = 19.25 g/cm^3) *(2 + 2 = 4 marks)*

Atomic weight of Na = 22,99

$$n_{At} = \frac{0{,}968\,g}{22{,}99}\cdot N_A = \frac{0{,}968\,g}{22{,}99}\cdot 6{,}023\cdot 10^{23} = 2{,}536\cdot 10^{22}\ atoms$$

Atomic weight of W = 183,85

$$n_{At} = \frac{19{,}25\,g}{183{,}85}\cdot N_A = \frac{19{,}25\,g}{183{,}85}\cdot 6{,}023\cdot 10^{23} = 6{,}306\cdot 10^{22}\ atoms$$

Mech221 midterm Feb 28 up to ch. 7

ENGR 251 midterm Feb 28 upto ch. 5
March 5 ~~th~~

ENGR 251 quiz Feb 14 ch. 4