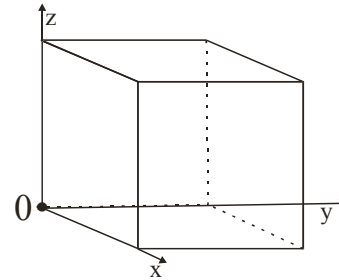


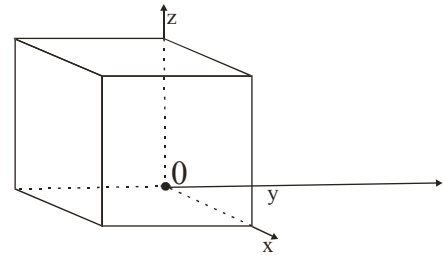
LAST NAME, FIRST NAME

1.

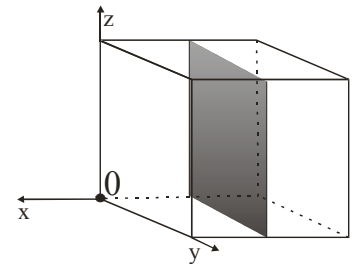
(a) (6 points) Sketch the (002) plane in the picture.



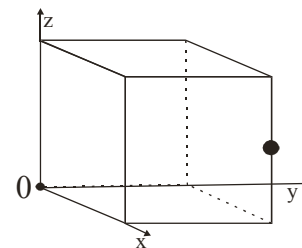
(b) (6 points) Sketch the vector  $[1 \bar{1} 0]$ .



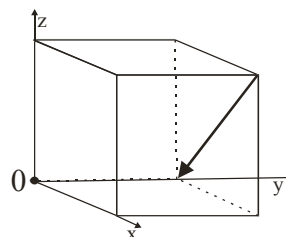
(c) (6 points) Identify the plane in the sketch by stating the Miller Indices.



(d) (6 points) Give the coordinates of the point in the sketch.



(e) (6 points) Identify the vector in the sketch.

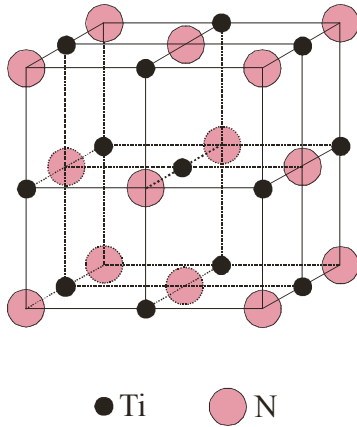


(Print)

LAST NAME, FIRST NAME

2. TiN has a rock-salt crystal structure (NaCl-structure), as shown in the schematic below, with a lattice constant  $a = 0.4242$  nm.

- (a) (4 points) How many Ti and how many N belong to one unit cell?
- (b) (4 points) What is the coordination number for the Ti-ions?
- (c) (4 points) What is the coordination number for the N-ions?
- (d) (6 points) What is the smallest distance between a Ti and N ion?
- (e) (6 points) What is the smallest distance between two Ti ions?
- (f) (16 points) Calculate the density of TiN. ( $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$ , Ti: 47.92 g/mol, N 14.01 g/mol)



- (a) 4 Ti; 4 N
- (b) 6
- (c) 6
- (d)  $a/2 = 0.4242/2 \text{ nm} = 0.2121 \text{ nm}$
- (e)  $(a/2)\sqrt{2} = 0.3000 \text{ nm}$
- (f)  $d = 4(47.92 + 14.01) / (a^3 N_A) = 247.72 \text{ g} / 45.9677 \text{ cm}^3 = 5.389 \text{ g/cm}^3$

3.

Explain

(a) (10) Thermoplastic polymers

Polymers which soften when heated. Usually they consist of linear chain structure.

(b) (10) Thermosetting polymers

Polymers which harden (and eventually burn) when heated. Usually they consist of cross-linked three dimensional structure.

(b) (10) Isotactic polymer

A chain polymer in which all side groups are positioned on the same side of the chain molecule.