

# MATE 201

Fall 2019

## Homework #1

Due date: October 10<sup>th</sup>, 2019

(lecture time)

**No late submissions!**

Group submission (up to 4 students per group) is allowed.

Your homework submission should have a cover page which contains the following information;  
your name, student number, course name, homework number and date of submission.

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### Question 1.

Aluminum foil used for storing food weighs about 55 g/m<sup>2</sup>.

- How many aluminum atoms are present in one square centimeter of this foil?
- What is the thickness of this foil in microns?

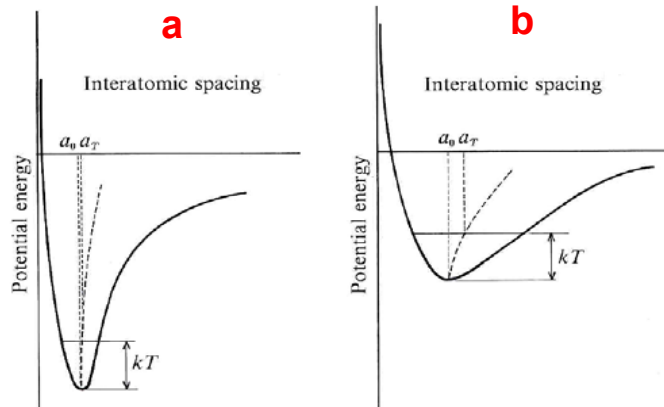
### Question 2.

What are the main differences between ionic, covalent, and metallic bonding?

### Question 3.

The interatomic spacing versus potential energy curves of two different hypothetical elements, **a** and **b**, are described in the figure below.

- Which element has the higher melting temperature?
- Which has the larger interatomic spacing at 0 Kelvin?
- Which element has the higher coefficient of thermal expansion? Briefly justify your answers.



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### Question 4.

Compute the percentage ionic character of the interatomic bond for each of the following compounds: CsF, CdS, and FeO.

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

### Question 5.

Metal M has a density of 8.57 g/cm<sup>3</sup> with an atomic radius of 0.143 nm. Find out if M has FCC or BCC crystal structure.

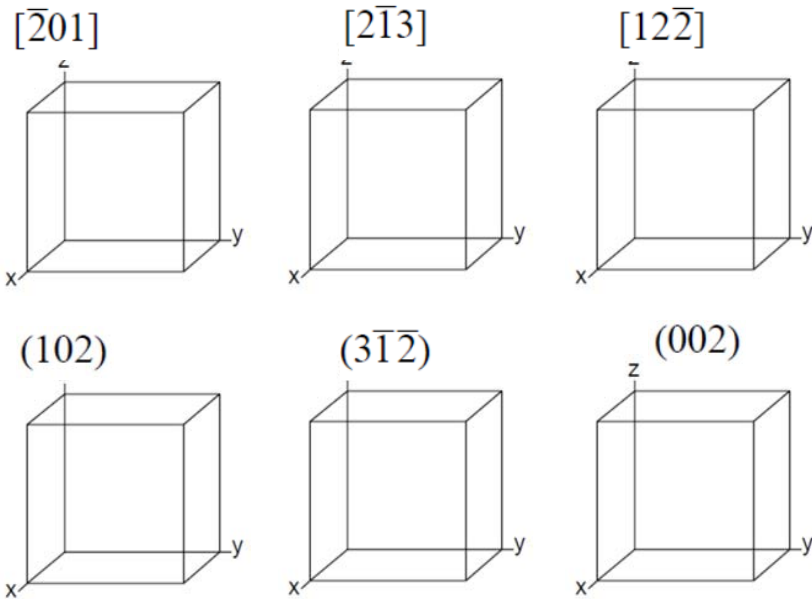
### Question 6.

Show that the ideal *c/a ratio* is 1.633 for the HCP crystal structure.

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**Question 7.**

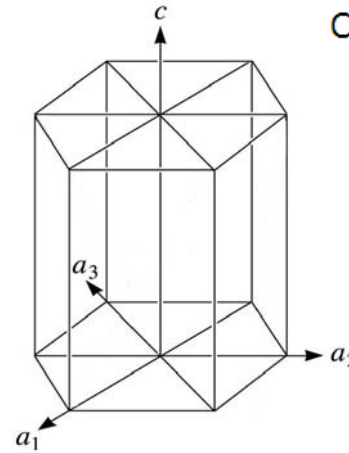
Draw the following within a cubic unit cell. Indicate your choice of origin in each cell.



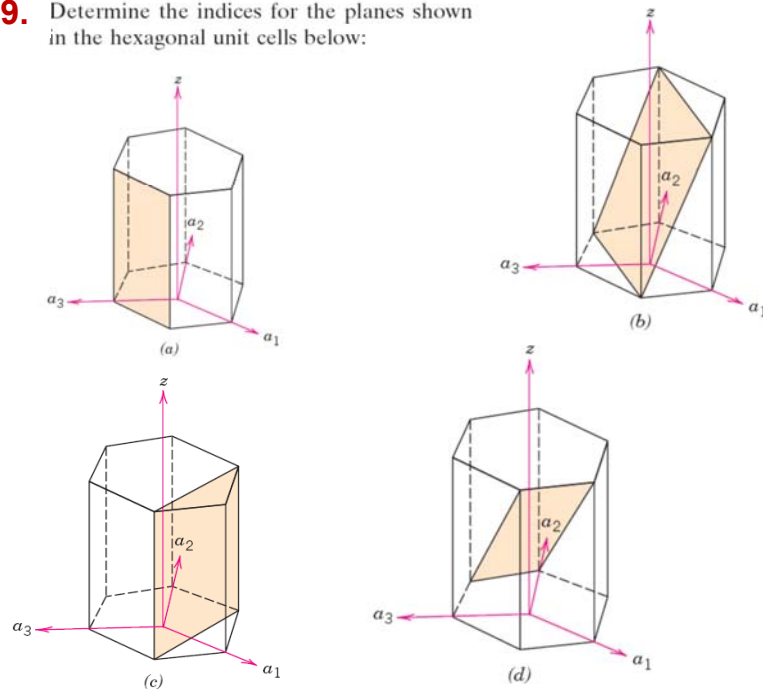
**Question 8.**

Within a hexagonal unit cell, sketch the following directions

- A:  $[\bar{1}02]$
- B:  $[0\bar{1}\bar{1}]$
- C:  $[01\bar{1}]$



**Question 9.** Determine the indices for the planes shown in the hexagonal unit cells below:



**Question 10.**

The figure below shows the atomic arrangements in (111) plane of a FCC crystal. Show the following directions on this figure:

- $[\bar{1}10]$
- $[\bar{1}01]$
- $[0\bar{1}1]$

