PHYS 321 S 2022 Test #1 Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

A. The net potential energy between two adjacent ions, EN, may be represented by:



Calculate the equilibrium inter-ionic spacing, r0 and the bonding energy E0 in terms of the parameters A, B, and n.

B. Compute the percent ionic character of the inter-atomic bonds for the following compounds: MgO and GaAs. The electronegativity values are given below.


1. The unit cell for the face-centered cubic crystal structure is shown below.



1. Show that the cube edge length, *a* and the atomic radius, R are
related by: $ a=2R\sqrt{2}$

2. Show that the atomic packing factor is 0.74 for FCC.

3a. Calculate the atomic radius of a lead atom, given that Pb has a FCC crystal structure, a density of 11.35 g/cm3, and an atomic weight of 207.2 g/mol.

3b. Calculate the planar density for (110) planes in lead.

D. Determine the density of CaTiO2. Ionic radius: Ca = 0.100 nm, O = 0.140 nm, and Ti = 0.068 nm. Atomic masses: Ca = 40.08, O = 16, Ti = 47.87



E. 1. What are the indices for the directions shown, A and B within a cubic unit cell?
 2. Draw the direction [$\overbar{2}10].$



F. 1. Determine the 3-axis indices and then convert them to 4-axis indices for the directions shown.








'

*w*

*w*

*t*

*v*

*u*

)

*v*

*u*

(

+

-

)

'

*u*

'

*v*

2

(

3

1

-

)

'

*v*

'

*u*

2

(

3

1

-



]

*uvtw*

[

]

'

*w*

'

*v*

'

*u*

[



 2. Draw the direction [$2\overbar{4}26].$



G. What are the Miller indices for the planes shown below?


H. Hexagonal Closed Pack Structure

1. Show that the base area of the unit cell for HCP is given by, 6√3R2.

2. Show that the atomic packing factor for HCP is 0.74.

3. Magnesium (atomic weight = 24.31) has an HCP unit cell for which the ratio of the lattice parameters *c/a* is 1.624. If the density of Mg is 1.74 g/cm3, determine the radius of the Mg atom.

