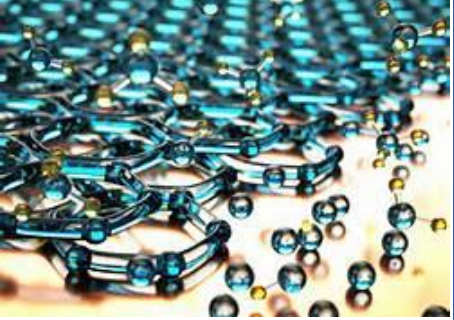

# Materials Science

**Lecture 8**

**Lebanese University - Faculty of Engineering – Branch 3**

**Fall 2022**

**Dr. Ali HARKOUS**

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## Lecture 8:

### Chap3: Crystalline Structure — Perfection

**Exercises**

## Chap 3

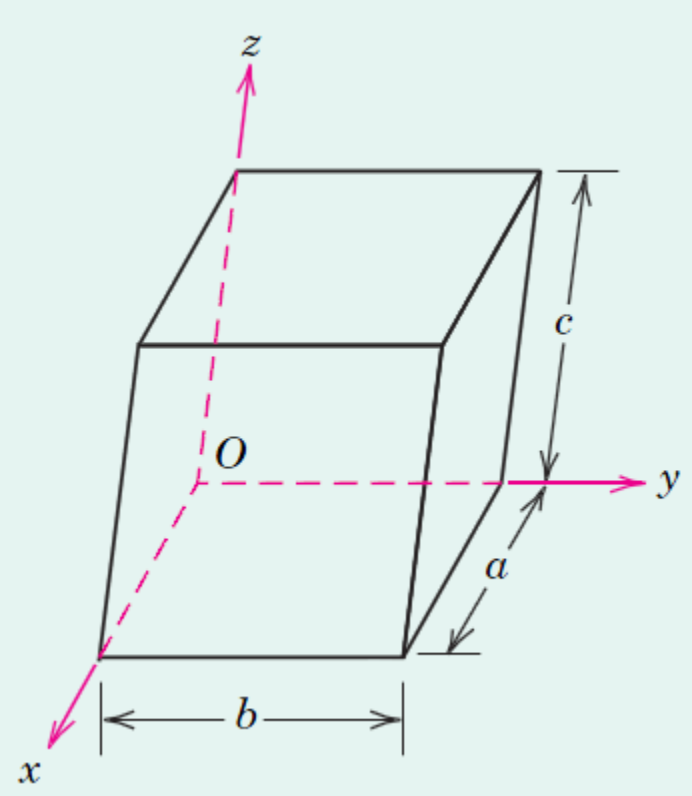
# Exercises

*(part 2)*

# Exercise 11

## Construction of a Specified Crystallographic Plane

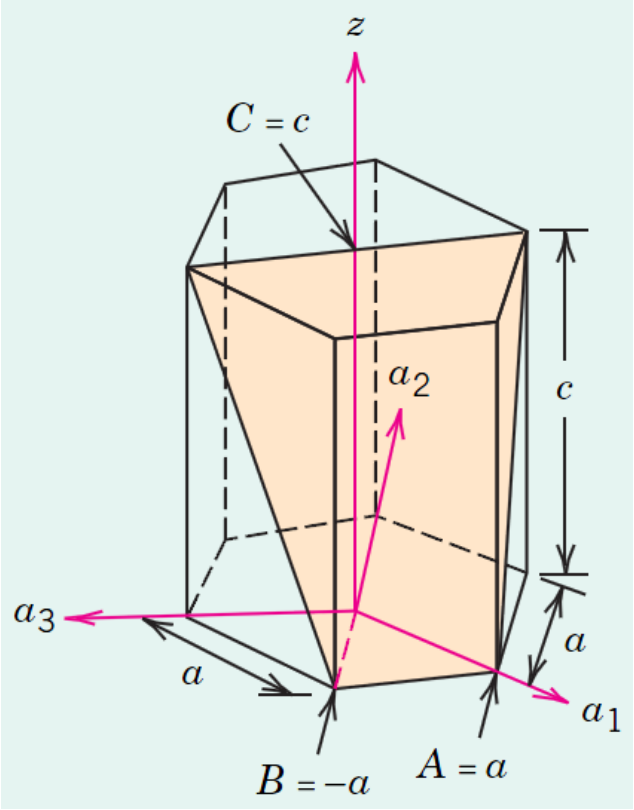
Construct a (101) plane within the following unit cell.



# Exercise 12

## Determination of the Miller–Bravais Indices for a Plane within a Hexagonal Unit Cell

Determine the Miller–Bravais indices for the plane shown in the hexagonal unit cell.

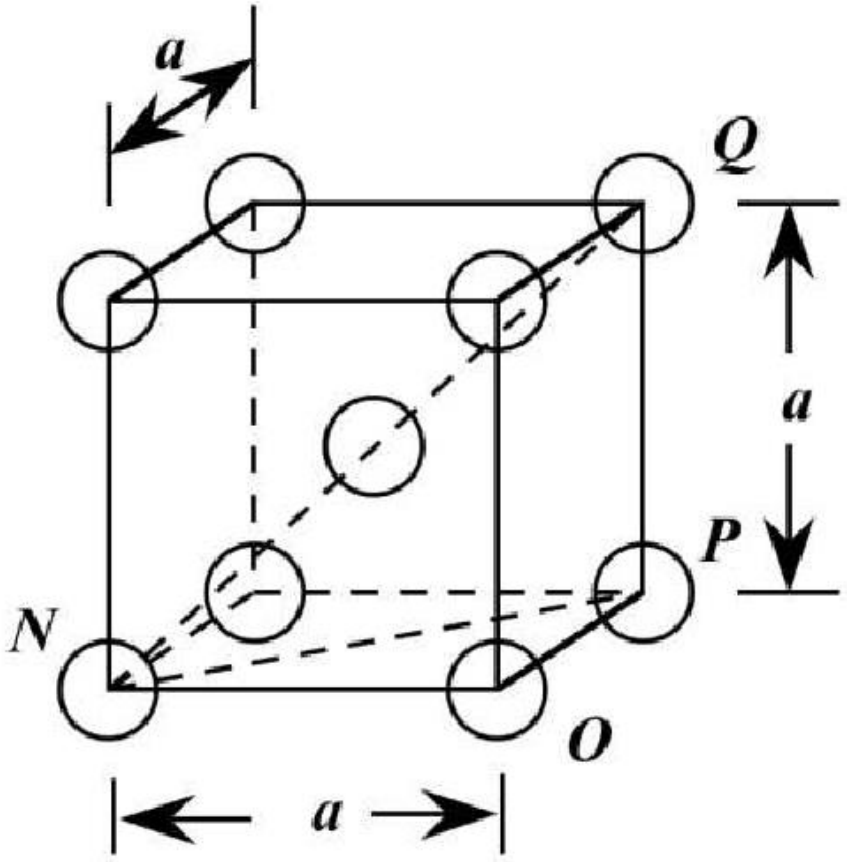


# Exercise 13

If the atomic radius of aluminum is 0.143 nm, calculate the volume of its unit cell in cubic meters. Note that Aluminum has a FCC structure.

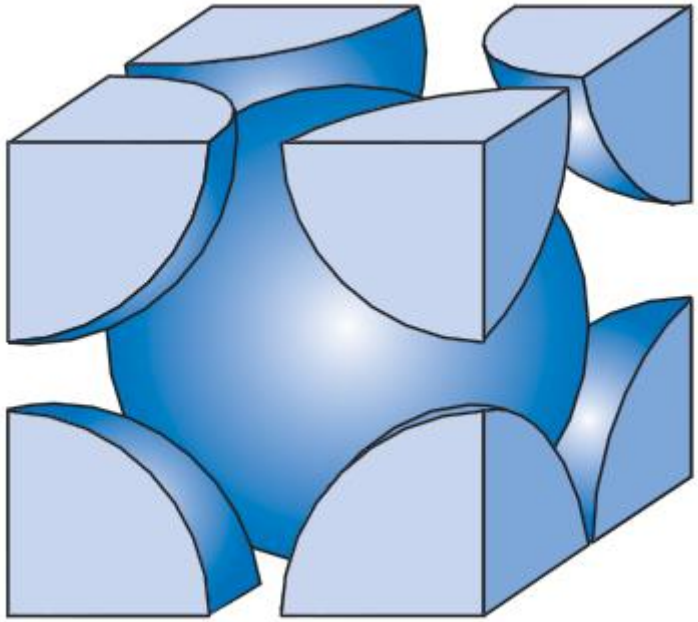
# Exercise 14

Show for the body-centered cubic crystal structure that the unit cell edge length $a$ and the atomic radius $R$ are related through $a = 4R/\sqrt{3}$.



# Exercise 15

Show that the atomic packing factor for BCC is 0.68.



# Exercise 16

Calculate the radius of a vanadium atom, given that V has a BCC crystal structure, a density of 5.96 g/cm$^3$, and an atomic weight of 50.9 g/mol.

# Exercise 17

Zirconium has an HCP crystal structure and a density of 6.51 g/cm$^3$.

**(a)** What is the volume of its unit cell in cubic meters?

**(b)** If the $c/a$ ratio is 1.593, compute the values of $c$ and $a$.

**Use the answers of Exercise 3**

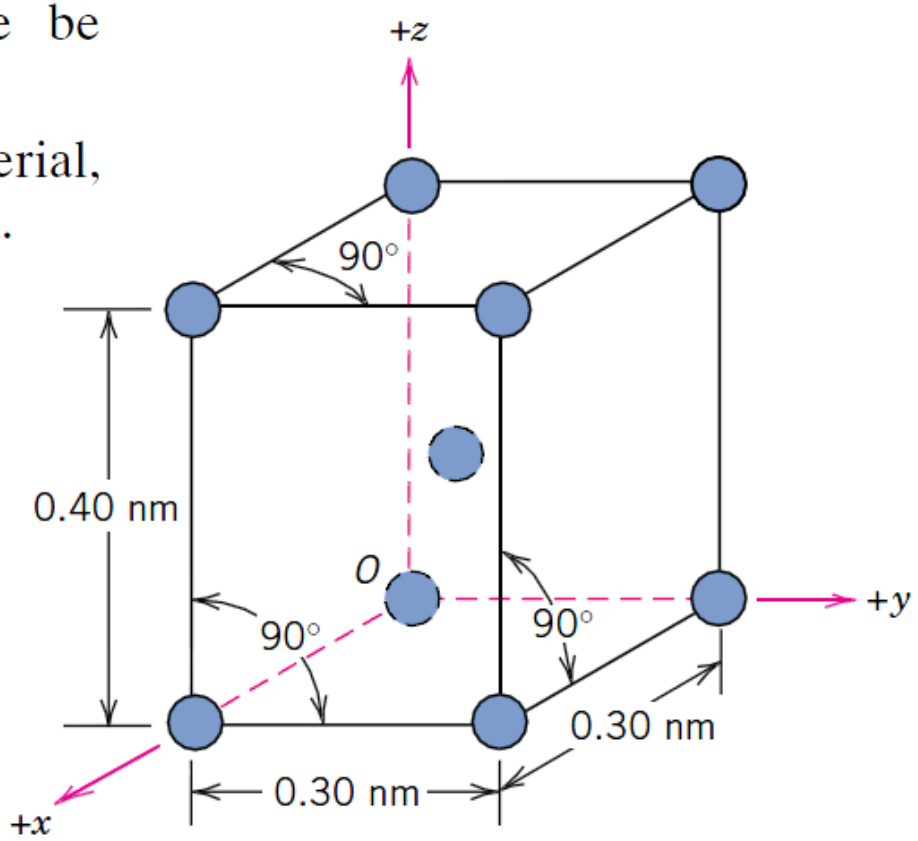
# Exercise 18

The accompanying figure shows a unit cell for a hypothetical metal.

**(a)** To which crystal system does this unit cell belong?

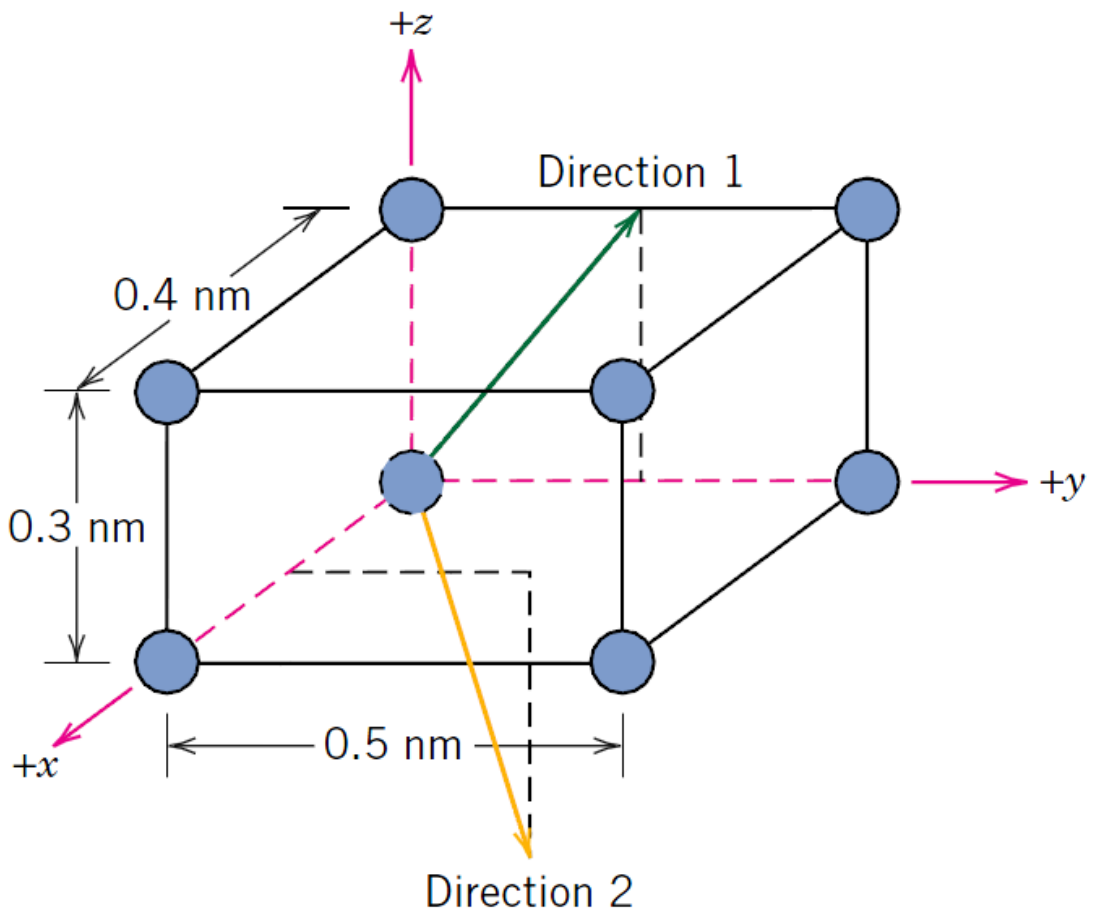
**(b)** What would this crystal structure be called?

**(c)** Calculate the density of the material, given that its atomic weight is 141 g/mol.



# Exercise 19

What are the indices for the directions indicated by the two vectors in the following sketch?



# Exercise 20

Cite the indices of the direction that results from the intersection of each of the following pairs of planes within a cubic crystal: **(a)** the (100) and (010) planes, **(b)** the (111) and $(11\bar{1})$ planes, and **(c)** the $(10\bar{1})$ and (001) planes.

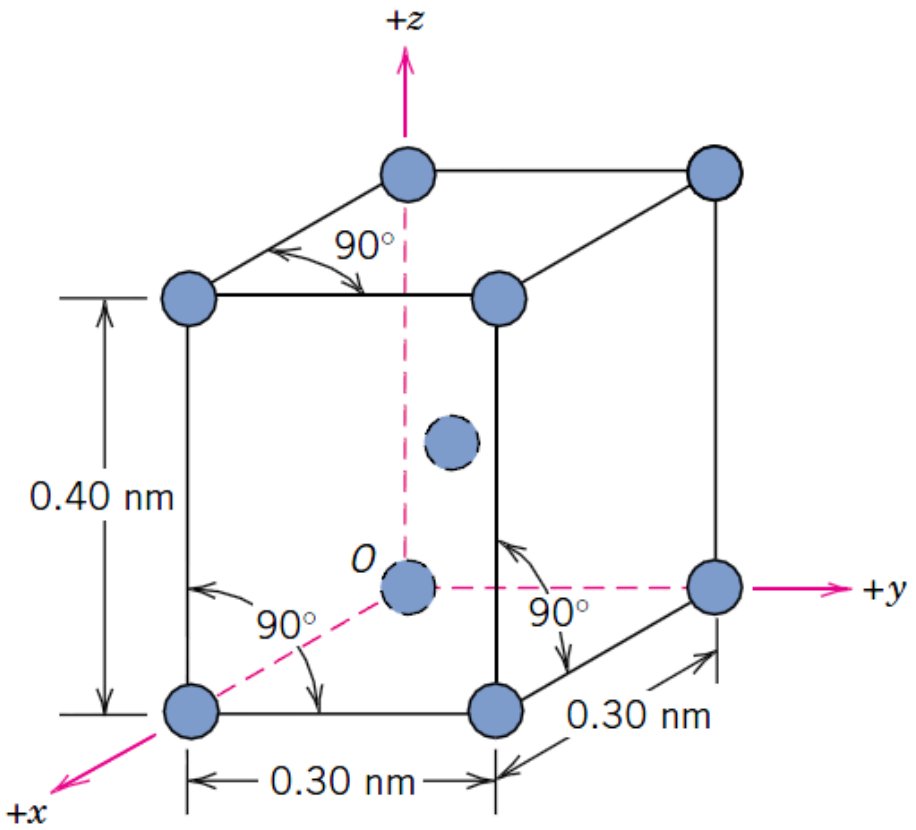
# Exercise 21

Consider the reduced-sphere unit cell shown in Problem 3.20, having an origin of the coordinate system positioned at the atom labeled *O*. For the following sets of planes, determine which are equivalent:

**(a)** $(00\bar{1})$, $(010)$, and, $(\bar{1}00)$

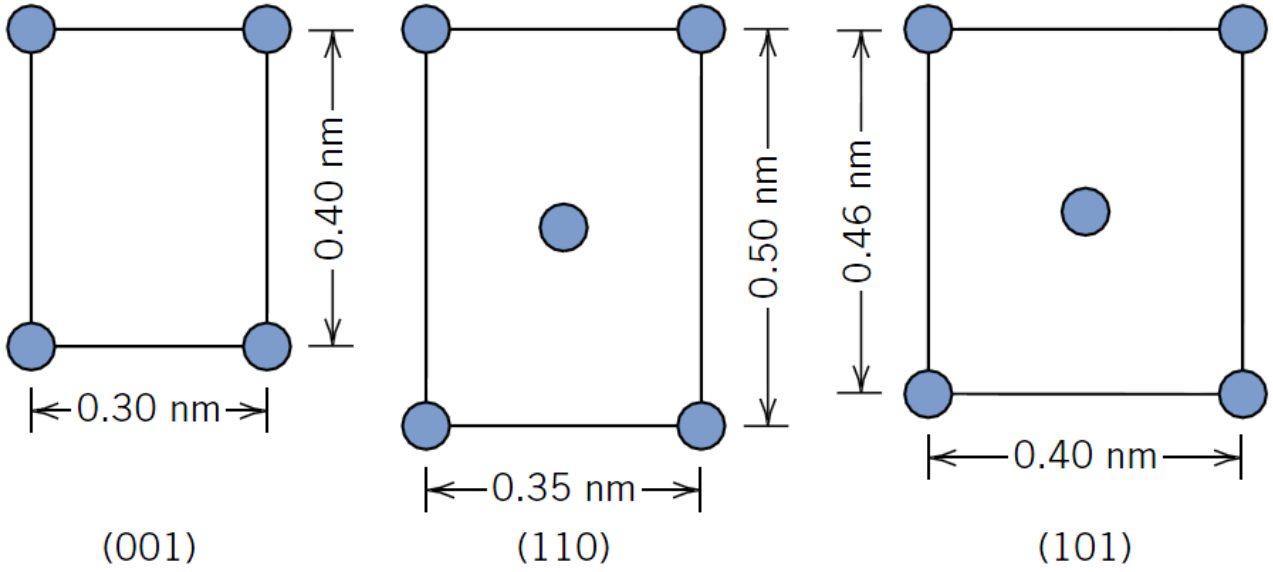
**(b)** $(1\bar{1}0)$, $(10\bar{1})$, $(0\bar{1}1)$, and $(\bar{1}\bar{1}0)$

**(c)** $(\bar{1}\bar{1}\bar{1})$, $(\bar{1}1\bar{1})$, $(\bar{1}\bar{1}1)$, and $(1\bar{1}1)$



# Exercise 22

The accompanying figure shows three different crystallographic planes for a unit cell of a hypothetical metal. The circles represent atoms.




**(a)** To what crystal system does the unit cell belong?

**(b)** What would this crystal structure be called?

**(c)** If the density of this metal is 8.95 g/cm$^3$, determine its atomic weight.