

BOWEN UNIVERSITY, IWO, OSUN STATE
COLLEGE OF AGRICULTURE, ENGINEERING AND SCIENCE
INDUSTRIAL CHEMISTRY PROGRAMME
2022/2023 B.SC. DEGREE SECOND SEMESTER EXAMINATION

Course Code: CHM 318

Course Title: Introductory Material Science

Date: 26/06/2023

Time Allowed: 2 hours

Credit: 2

INSTRUCTIONS: Answer All questions in section A and any two (2) questions in section B.

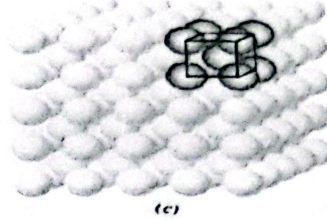
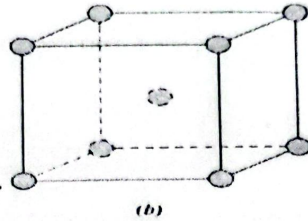
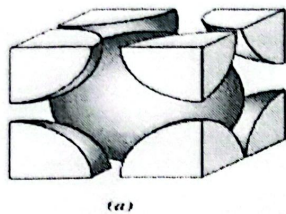
Answer each question on a fresh page of your booklet.

SECTION A (Fill in the gap with correct answers in this section (20 marks))

1. Materials science is a part of engineering that involves discovering and designing new materials and analyzing their properties and _____
2. Different materials have different _____ and weaknesses and are better for different purposes.
3. Materials are generally classified into four main groups: Three of them are
i _____ ii _____ iii _____
4. Metallic materials have large numbers of _____ electrons
5. _____ can be defined as inorganic crystalline materials
6. _____ is an amorphous material, often, but not always, derived from a molten liquid.
7. _____ polymers are stronger but more brittle because the molecular chains are tightly linked.
8. Thermal conductivity (K) is the amount of heat conducted per unit time through a unit area perpendicular to the direction of heat conduction when the temperature gradient across the heat conducting element is one unit. Hence, its mathematical formular is _____
9. Permanent dipole moments exist in some molecules by virtue of an asymmetrical arrangement of positively and negatively charged regions; such molecules are termed _____
10. In the schematic diagram of the dependence of repulsive, attractive, and net potential energies on interatomic separation for two isolated atoms, the materials having _____ typically also have high melting temperatures; at room temperature, _____ are formed

for large bonding energies, whereas for _____ the gaseous state is favored; liquids prevail when the energies are of _____

11. The calculated volume of an FCC unit cell in terms of the atomic radius R is _____



12. The above diagram represent a crystal structure of _____

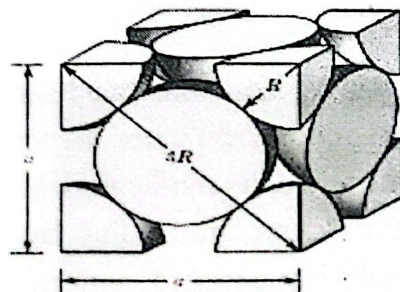
13. The coordination number for the FCC crystal structure is _____

14. Two metals that assumed an hexagonal closed-packed crystal structures are _____ and _____

SECTION B (Answer any TWO questions)

QUESTION ONE

- (a) What do you understand by material science? 5 marks
- (b) Highlight **four** factors affecting selection of materials in the industry? 4 marks
- (c) List **two** primary and **one** secondary bonding system that can affect the structure and properties of materials in the industry. 3 marks
- (d) Modern polymers, being molecular materials that are composed of extremely large molecules, exist as solids. Explain the nature of the bonds that exist in them. 3 marks
- (e) Given the Face-Centered Cubic unit cell as illustrated below:



- (i) Calculate the volume of an FCC unit cell in terms of the atomic radius R .
- (ii) Hence, Show that the atomic packing factor (APF) for the FCC crystal structure is 0.74.

10 marks

QUESTION TWO

(a) With the aid of a **well labelled schematic diagram only**, explain the dependence of repulsive, attractive, and net forces on the interatomic separation for two isolated atoms. **5 marks**

(b) Mechanical properties is one of the major general properties of materials in the industry. hence, **list and briefly describe five** important mechanical properties affecting the selection of a material? **10 marks**

(c) Copper has an atomic radius of 0.128 nm, an FCC crystal structure, and an atomic weight of 63.5 g/mol. Compute its theoretical density, and compare the answer with its measured density (i.e. literature value of 8.94 g/cm³). (Given that the unit cell volume V_c for FCC was determined as $16R^3\sqrt{2}$ and $N_A = 6.022 \times 10^{23}$). **5 marks**

(d) Enumerate any **five** classes of metallic materials you know. **5 marks**

QUESTION THREE

Write short note on the following, giving examples and illustrations where applicable:

- | | | |
|-------|----------------------------|----------------|
| (i) | Polymorphism and Allotropy | 5 marks |
| (ii) | Whiskers | 5 marks |
| (iii) | Space lattice and Basis | 5 marks |
| (iv) | Advanced materials | 5 marks |
| (v) | Composite materials | 5 marks |