Guru Nanak Vidyak Society's

GURU NANAK COLLEGE OF ARTS, SCIENCE & COMMERCE

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DBT- Star College Scheme

T. Y. B. Sc. Practical Manual

Department

of Physics

INDEX

EXPERIMENT NO. 1

Sextant

Aim: To find the vertical distance between two points using a sextant.

Apparatus: A sextant, chalk pieces of two different colours, a rigid clamp stand, a measuring tape, a pump line and a spirit level.

Theory: If h is the vertical distance between two points X and Y and θ is the angle subtended by XY at the index glass M_1 of the sextant at a distance d then,

$h/d = \tan \theta$

$h = d \tan \theta$
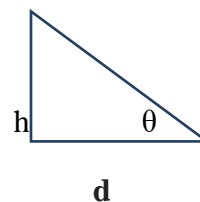
Theory: SEXTANT

Sextant is an instrument which enables us to determine the angle subtended by two distant point objects at the place of observation. It consists of a graduated circular arm AB supported by two fixed radial arms AC and BC which meet at point C which is the centre of the circle of which the arms form a part.

An index arm CD which is free to rotate round an axis passing through C carries a plane mirror M_1 called the index glass at the end C fixed in a plane perpendicular to the plane of the scale. At the other end of this arm at D there is a vernier scale V which can slide along the main scale. Ordinarily this vernier scale is fixed in position, but its motion can be made free by pressing the lever at L. A tangent screw S is provided for fine adjustments of the vernier.

A glass plate M_2 called the horizon glass is fixed on the arm AC with its plane perpendicular to the plane of the scale in such a manner that, When the index arm is at zero this is parallel to the mirror M_1. Lower half of this glass plate is silvered whereas the upper half is transparent. A telescope T is fixed to the arm BC with its axis parallel to the plane of the scale and passing through the centre of the horizon glass. A screw is provided at the side of the telescope (not shown) to move it in a plane perpendicular to the plane of the scale.

Procedure:
1. Find the vernier constant or the least count of the sextant.
2. Mark a horizontal arrow nearly 10 cm long on the wall with a coloured chalk at a height of about 1 metre from the floor. Mark another horizontal arrow vertically above it near the ceiling.
3. Place a rigid clamp stand at a distance of nearly 5 metre from the wall. Clamp the sextant in the stand with scale downwards and the objective of the telescope pointing horizontally towards the lower mark. Adjust the height of the sextant so that the axis of the telescope is horizontal and is at the same level as the lower mark Y from the ground. Test with a spirit level. With the help of a plump line adjust the plane of the scale to be vertical. Move the telescope sideways by

the screw at its side so that the line of demarcation of the silvered and unsilvered portions of the horizon glass M_2 slies in the centre of telescope objective.

4. Focus the telescope on the lower mark Y and adjust the position of the sextant so that the image of the horizontal arrow is in the centre of the field of view. This is the direct image as seen in the telescope. 5. Move the arm CD so that the image of the same horizontal arrow is also visibie in the telescope after reflection from the two mirrors. This will happen when the vernier reading is nearly zero and the instrument is in proper adjustment. If the reflected image is not in the field of view or does coincide with the direct image, the horizon glass is not perpendicular to the plane of the scale adjust this, work the small screw provided on the carriage of the horizon glass till the two image one above the other. If the two images seen are not of the same brightness, it can be adjusted by moving the telescope sideways with the help of the screw provided at the side of the telescope.

6. When the two images of the mark Y overlap, note the reading on the scale.

7. Keeping the eye in the same position move the arm CD. One half of the field of view will appear of slide past the other half and ultimately the image of the upper arrow will appear to approach the direct stationary image. Note the scale reading when two images again overlap.

8. measure the distance from the lower arrow to the index mirror by a measuring tape.

9. Repeat the experiment with three different distances of the sextant from the lower arrow.

Observations:

Least count of sextant =

Sr. No.	Scale reading		Difference Θ	tanθ	Distance d cm	Height h = dtanθ
	Initial	Final				

Mean height =   cm

Actual height by direct measurement =   cm

Result:

****

EXPERIMENT NO. 2

Diferential count of leucocytes (wbc)

Aim: To determine the differential count of leucocytes by staining the blood smear.

Principle: Blood is diluted with WBC diluting fluid(Turk's fluid) which lyses the red blood cell and mildly strains the WBC, which can be then counted. Turk's fluids act as a fixative while crystal /gentian violet stains the nuclei of the WBCs.

Requirements: WBC diluting pipette, Hemocytometer, Cover slip, Sterile lancets, Absorbent cotton, blotting paper.

Chemical and Reagents: 70% alcohol, Turk's fluid(8ml glacial acetic acid, 1ml of 1% of gentian violet and make the volume upto 100 ml with distilled water)

Theory: Differential count is percent distribution of various white cells in peripheral blood. It is determined from blood smear stained with polychromatic stain & after observation of smear under oil immersion objective. The no. of each type of white cells is then expressed as percent of total no. of cells. The stained blood smear helps us in determination of total no. of cells. The stained blood smear helps us in determination of abnormalities in leucocytes &also detection of blood parasites.

There are three major steps involved in differential count:

1) Preparation of blood smear.
2) Staining the smear.
3) Stained smear examination under microscope.

Procedure:
1. Take a clean glass slide.
2. With proper aseptic precautions prick a finger & discard the 1st drop.
3. Drop the second drop at the edge of slide.
4. Place another slide at 45° angle to slide.
5. Pull back the spreader slide till it touches the drop & the push it forward smoothly but swiftly.
6. Dry the smear in room temp. & fix this in methanol for 1-2 min
7. Dip the slide in field stain B for about 5sec & then wash it under tap water.
8. Then dip the slide in field stain A for 5 sec 7 then allow it to dry.
9. Observe the slide under oil immersion lens & determine the percentage of each type of WBC.
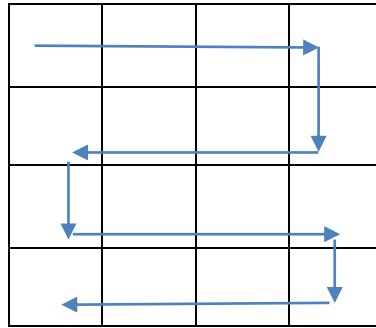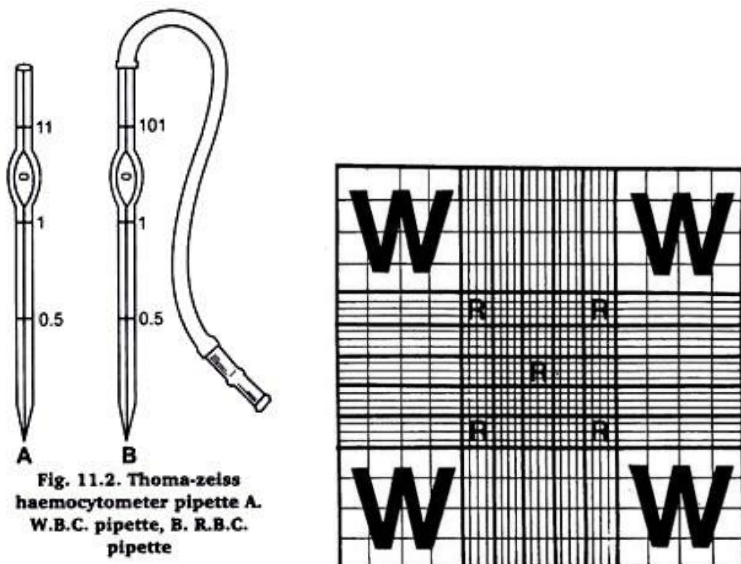
Observations:

Fig: WBC counting pattern

N1

N3

N4

N5

Fig. 11.2. Thoma-zeiss haemocytometer pipette A. W.B.C. pipette, B. R.B.C. pipette

Calculations:

Number of WBCs/cu mm(µl)of whole blood= Number of white cell counted *Dilution / Area counted *Depth of fluid

Where: Dilution = 20
Area counted = 4* l sq.mm = 4sq.mm
Depth of fluid = 0.1mm (constant)
Hence no. of white cell per cu.mm (µl) of whole blood
= Dilution factor * 1/ volume * Number of cells counted(N)
= 20*N
   4*0.1
=50 *N/cu.mm.

Normal values:
Adults:- 4000- 10000 cell/mm^3

Result: The total number of WBCs in the blood is _____ cell \ mm^3

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EXPERIMENT NO. 3

RESISTIVITY OF IONIC COMPOUNDS

Aim : To find resistivity of Given ionic compounds

Apparatus: Resistivity cell, digital micro / nano ammeter, digital Vernier calipers, and regulated power supply 0 – 30V

Theory : The electrical resistance of a metallic wire expressed as the ratio of voltage produced across a metallic wire to the amount of current passing through it, is given by Equation -1 $R = \frac{V}{I}$ ………..1

The resistance of the wire is also expressed in terms of its physical dimensions as

$R = \frac{\rho L}{A}$ ………..2

Where ρ = resistivity

A = cross sectional area of the wire;

L = lenght of the wire ; and

R = The resistance of the wire.

Combining Equation – 1 and 2, one gets

$R = \frac{V}{I} = \frac{\rho L}{A}$, from which resistivity , ρ,

$\rho = \frac{AV}{IL} = \frac{RA}{L}$ ……..3Ω

Procedure :

1. NaCL is filled up to 2-3cms of length in the conductivity cell. The upper electrode is then pressed so that the contents of the tube spread evenly without any air gap. The inner diameter of the cell is noted and the exact length of the substance filled in the cell is measured using a digital calliper.
    Inner diameter of the cell d = 7.7 mm = 7.7×10^{-3} m
    Inner radius of cell = 3.85×10^{-3} m
    Cross sectional area of the substance, A = $\pi r^2 = 4.656 \times 10^{-5}$ m^2 .
2. The lengh 'L' of the sample inside the tube, is measure using a digital Vernier callipers L =2.9cm = 2.9×10^{-2}m
3. The circuit connections are made.
4. The power is switched on and the values of current and voltage are noted and recorded in Table – 1, the resistance of NaCL inside the cell is calculated

I = 39.5μA; V = 30.0V; and hence
R = 759.49KΩ

5. Resistivity is calculated using Equation – 1 as
6. The NaCL sample is now removed from the cell, and the cell is cleaned thoroughly with cotton ear – bud and another sample KCL is loaded and its resistance is determined by noting the current passing through it. The readings obtained are tabulated in Table – 1
7. The experiment is repeated for $ZnSO_4$, $NaNO_3$, NH_4CL and table salt.

Figure: Resistivity cell and Resistivity measurement setup

Table – 1: Resistance and resistivity of different ionic samples

Compound	Current (1)	Resistance (R)Ω	Resistivity(ρ) Ω m	Conductivity σ = 1/ ρ (S)

V = 30V kept constant in all the trials

Result: Resistivity of given compound found to be

Sr.No	Compound	Resistivity

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EXPERMENT No. 4

STEPPER MOTOR

Aim: Interfacing stepper motor to 8051 microcontroller.

Theory:

BASICS OF STEPPER MOTOR:

Stepper motor is brushless which take digital signals. It converts digital pulses into mechanical shaft rotation. Rotation is divided into steps and a separate pulse is sent for each step. For each pulse motor rotates a few degrees which is mostly 1.8 degree angle. As we interface it with controller, so when digital pulses increase in frequency, the stepping movement of motor converts to continuous rotation of motor. So we can say that speed of rotation is directly proportional to the frequency of pulses given by controller.

WINDING ARRANGEMENT:
For a two phase stepper motor, there are two winding arrangements of electromagnetic coils.
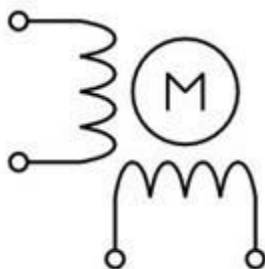
- Unipolar
- Bipolar

UNIPOLAR MOTOR:
- Only one winding with center tap per phase
- Each winding section is switched on for each direction of magnetic field
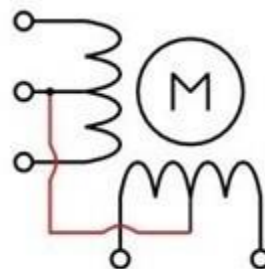- Center tap of each winding is made common.

BIPOLAR MOTOR:
- A single winding per phase
- Current in winding must be reversed to reverse a magnetic pole
  Two leads per phase, none are common.
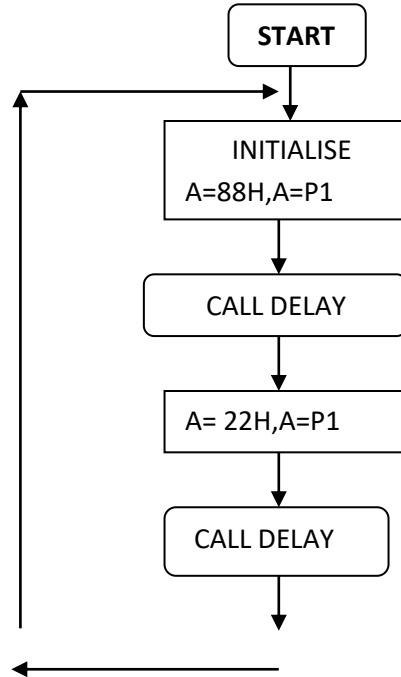
Circuit diagram:

FLOW CHART: MAIN PROGRAM

```
                    ┌─────────┐
                    │  START  │
                    └─────────┘
                         │
        ┌────────────────┤
        │         ┌──────────────┐
        │         │  INITIALISE  │
        │         │  A=88H,A=P1  │
        │         └──────────────┘
        │                │
        │         ┌──────────────┐
        │         │  CALL DELAY  │
        │         └──────────────┘
        │                │
        │         ┌──────────────┐
        │         │  A= 22H,A=P1 │
        │         └──────────────┘
        │                │
        │         ┌──────────────┐
        │         │  CALL DELAY  │
        │         └──────────────┘
        │                │
        └────────────────┘
```

FLOW CHART : DELAY

```
                 ┌─────────┐
                 │  START  │
                 └─────────┘
                      │
              ┌───────────────┐
              │  INITIALISE   │
              │   R1= FFH ,   │
              │   R2=FFH      │
              └───────────────┘
                      │
                      │        N
                   ╱─────╲
                  ╱  IS   ╲
                 ╱  R1=0   ╲────────
                 ╲   ?     ╱
                  ╲───────╱
                      │
                   ╱─────╲
                  ╱  IS   ╲
                 ╱  R2=0   ╲──────────
                 ╲   ?     ╱
                  ╲───────╱
                      │
                 ┌─────────┐
                 │   RET   │
                 └─────────┘
```

Program:
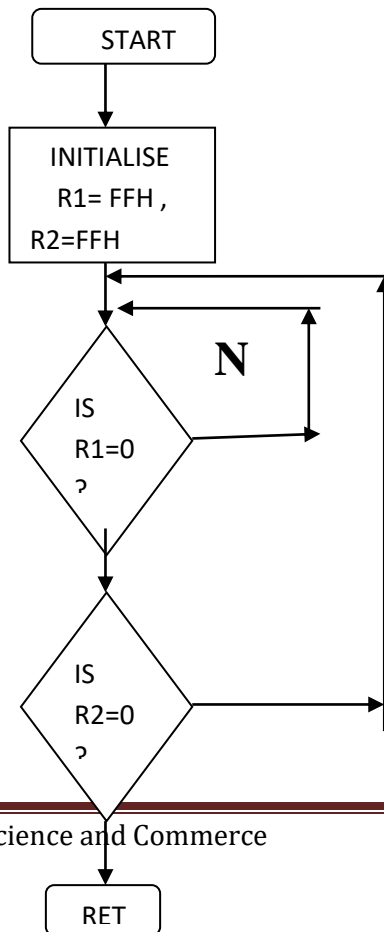
```
                ORG 0000H

                LJMP MAIN

                ORG 0100

 MAIN:      MOV A1,#88H

                MOV P1,A

                CALL DELAY

                MOV A,#44H

                MOV P1,A

                CALL DELAY

                MOV A,#22H

                MOV P1,A

                CALL DELAY

                MOV A,,#11H

                MOV P1,A

                CALL DELAY

                SJMP MAIN

 DELAY:        MOV R1,#00FH

 LOOP2:        MOV R2,#00FH

 LOOP1:        DJNZ R1,# LOOP1

                DJNZ R2, #LOOP2

                 RET
```
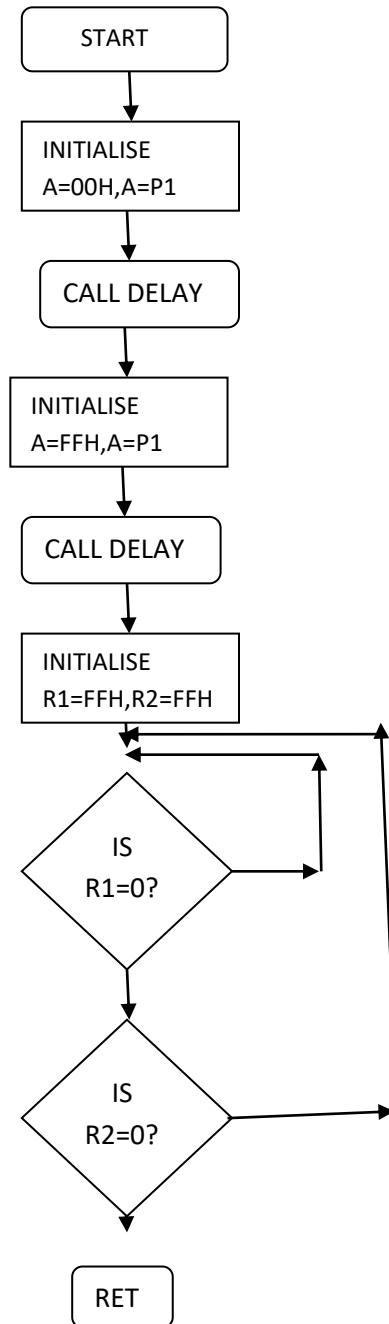
<center>*******************</center>

EXPERIMENT NO. 5

FLASHING OF LED

AIM: study of flashing of LED by using microcontroller 8051.

FLOWCHART FOR FLASHING OF LED'S

```
                    ┌─────────────┐
                    │   START     │
                    └─────────────┘
                           │
                    ┌─────────────┐
                    │ INITIALISE  │
                    │ A=00H,A=P1  │
                    └─────────────┘
                           │
                    ┌─────────────┐
                    │ CALL DELAY  │
                    └─────────────┘
                           │
                    ┌─────────────┐
                    │ INITIALISE  │
                    │ A=FFH,A=P1  │
                    └─────────────┘
                           │
                    ┌─────────────┐
                    │ CALL DELAY  │
                    └─────────────┘
                           │
                    ┌──────────────┐
                    │ INITIALISE   │
                    │ R1=FFH,R2=FFH│
                    └──────────────┘
                           │
                        ◇ IS
                          R1=0?
                           │
                        ◇ IS
                          R2=0?
                           │
                    ┌─────────────┐
                    │    RET      │
                    └─────────────┘
```

PROGRAM FOR LED'S FLASHING:

```
            ORG 0000H

            LJMP MAIN

            ORG 0100

MAIN:      MOV A1,#00H

            MOV P1,A

            CALL DELAY

            MOV A,#0FFH

            MOV P1,A

            CALL DELAY

            SJMP  MAIN

DELAY:       MOV R1,#0FFH

LOOP2:      MOV R2,#0FFH

LOOP1:       DJNZ R1,# LOOP1

            DJNZ R2, #LOOP2

             RET
```

****

EXPERIMENT NO. 6

MILLER INDICES

Aim: To find miller indices of a given plane.

Apparatus: Given crystal structure

Theory: Miller indices are group of three numbers that indicate the orientation of a plane or set of parallel planes of atoms in a crystal. Following are the rules to determine the miller indices of a plane.

- Determine the intercepts of the face along the crystallographic axes, *in terms of unit cell dimensions.*
- Take the Reduce to lowest terms
- For example, if x , y, and z intercepts of a plane are 2,1 & 3 respectively.Take reciprocals: 1/2, 1/1, 1/3
- If reciprocals of the intercepts are in fractions, multiply them to clear fractions (multiply by 6): 3, 6, 2. Reduce to lowest terms

- Thus the miller indices of the given plane are denoted by (h,k,l) as (3,6,2)
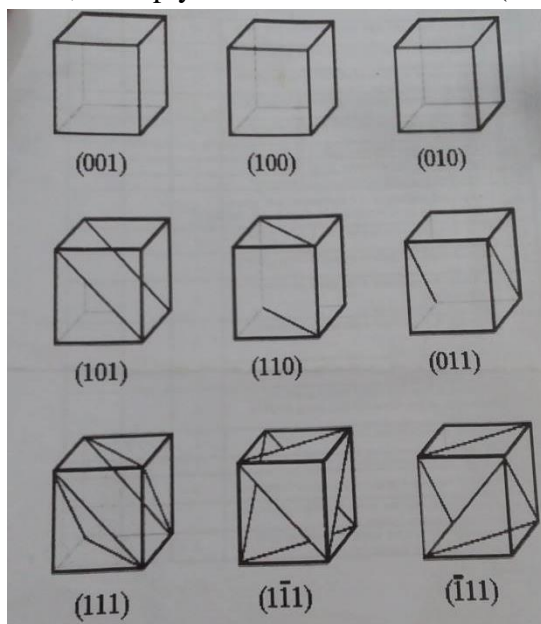
Procedure:

- Observe the given crystal.
- Calculate the intercepts.
- Take reciprocal
- Find the miller indices

Observation Table:
Draw the plane in a crystal system from given crystal and identify it's miller indices

Sr. No.	Plane in a crystal system	Miller indices
1		
2		

3		
4		
5		
6		
7		
8		
9		

Result: The miller indices of a given plane is identified.

*******************

EXPERIMENT NO. 7

CUBIC CRYSTAL SYSTEM

**Aim:** To identify the given type of cubic structure, find its number of atoms and packing fraction.

Theory:
Unit cell can be considered as the building block of a crystal. It has the same symmetry as the entire crystal. When we arrange the unit cell in 3D, we get the bulk crystal. In other words it can be described as the smallest volume which when repeated in all direction gives the crystal. The three edges a, b, c along the axis and angle between them α, β and γ is termed as lattice parameters. In 3D it is better to consider a parallelepiped as unit cell.

Unit cell can be of primitive as well as non primitive type. A primitive cell is a minimum volume unit cell and has only one lattice point in it and the latter contains more than one.
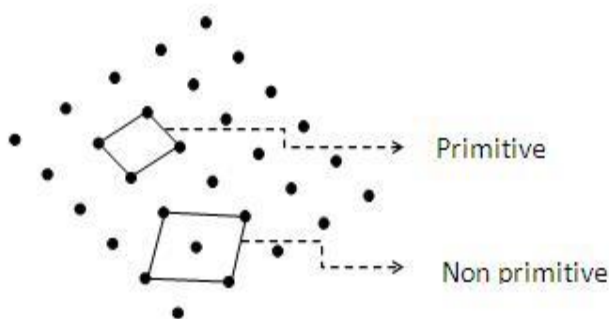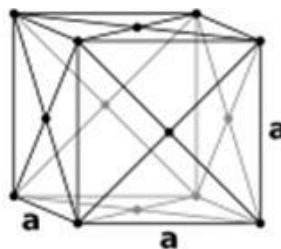

In the given figure below, simple cube is a primitive cell. No.of atoms per unit cell is one for it. The rest two is non primitive. No.of atoms per unit cell is 2 and 4 respectively.
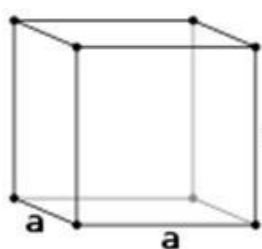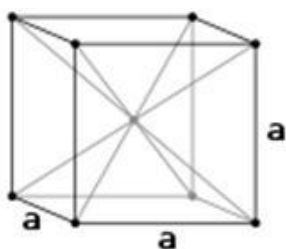
Simple cubic (P)   **Body- centred cubic (I)**   **Face centered cubic (F)**

Procedure:
1. Observe the given crystal.
2. Identify the type of crystal.
3. Find the number of atoms in the given crystal depending on its type.
4. Calculate the packing fraction by the formula
5.

$$\textbf{Packing fraction} = \frac{\left(\textbf{No. of }\frac{\textbf{atoms}}{\textbf{unitcell}}\right)(\textbf{volume of each atom})}{\textbf{volume of a unit cell}}$$

APF FOR SIMPLE CUBIC

APF = 0.52 for simple cubic

$$APF = \frac{1 \cdot \frac{4}{3}\pi(0.5a)^3}{a^3}$$

atom / unit cell → volume / atom

volume / unit cell

contains 8 x 1/8 = 1atom/unit cell

R=0.5a

close-packed directions

APF FOR BCC / BODY CENTERED CUBIC

1 unit cell

close-packed directions: length = 4R = $\sqrt{3}a$

Coordination Number = 8

One of 4 close-packed directions

contains 1 + 8 x 1/8 = 2atoms/unit cell

$$APF = \frac{2 \cdot \frac{4}{3}\pi(\sqrt{3}a/4)^3}{a^3}$$

atoms / unit cell → volume / atom

volume / unit cell

APF = 0.68 for BCC

Face-Centered Cubic Structure (FCC)

close-packed directions: length = 4R = $\sqrt{2}a$

Coordination Number = 12

contains 6 x 1/2 + 8 x 1/8 = 4atoms/unit cell

$$APF = \frac{4 \cdot \frac{4}{3}\pi(\sqrt{2}a/4)^3}{a^3}$$

atoms / unit cell → volume / atom

volume / unit cell

Courtesy of Materials Science: A Multimedia Approach, by John C. Russ

APF = 0.74 for FCC

Result:

Type of cubic structure	No. of Atoms	Packing Fraction