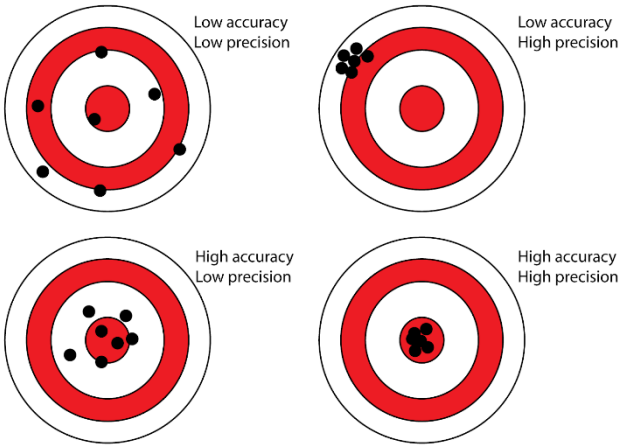
NTU/NUS Entrance Examination Practice – Set 3

1. Measurement: Accuracy vs Precision



An iron bar has a theoretical length of 15.0 cm. A student, Robyn, measures the length of the bar five times and gets the following results: 17.1 cm, 17.3 cm, 16.9 cm, 17.3 cm, 17.1 cm. Robyn's friend, Conrad, does another measurement five times and his results are, respectively, 13.0 cm, 14.0 cm, 15.0 cm, 16.0 cm, and 17.0 cm. What can we say about the accuracy and precision of Robyn's and Conrad's measurements?

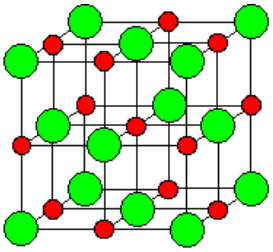
2. Relative abundance

Naturally occurring gallium, Ga, has two isotopes of mass numbers 69 and 71 respectively. Given that the relative atomic mass of Ga to be 69.7, calculate the percentage abundance of each isotopes of gallium.

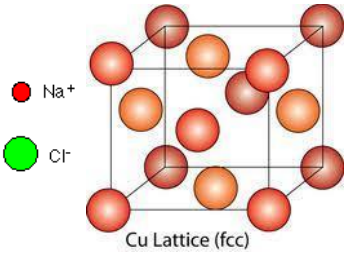
3. Calculation of empirical and molecular formulae

Chrysotile has the following percent composition: 28.03% Mg, 21.60% Si, 1.16% H, and 49.21% O. The molar mass for chrysotile is 520.8 g/mol. Determine the empirical and molecular formula for chrysotile. The molecular mass of magnesium, silicon, hydrogen, and oxygen are 24.3 g/mol, 28 g/mol, 1 g/mol, and 16 g/mol, respectively.

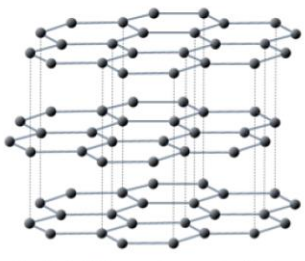
4. Lattice structure



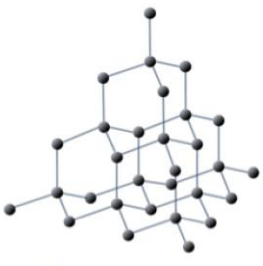
NaCl lattice (FCC)



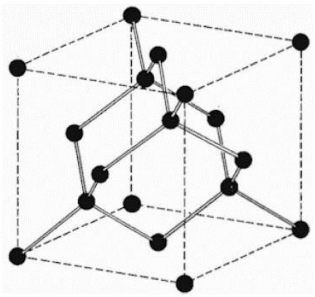
(CCP)

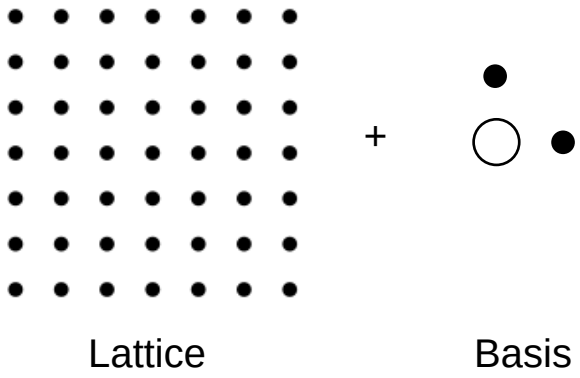


Graphite (solid lines are strong covalent bonds, dotted lines are weak inter-layer bonds)



Diamond (all bonds are strong covalent bonds)





Draw the crystal structure that the combination of lattice and basis above will produce.

5. Electrolysis

Consider the electrolysis of molten barium chloride, $BaCl_2$.

(a) Write the half-reactions.

(b) How many grams of barium metal can be produced by supplying 0.50 A for 30 mins?

MCQ 6.1.1 A perfect conducting sphere of radius r is such that it's net charge resides on the surface. At any time t, magnetic field $\boldsymbol{B}(r, t)$ inside the sphere will be

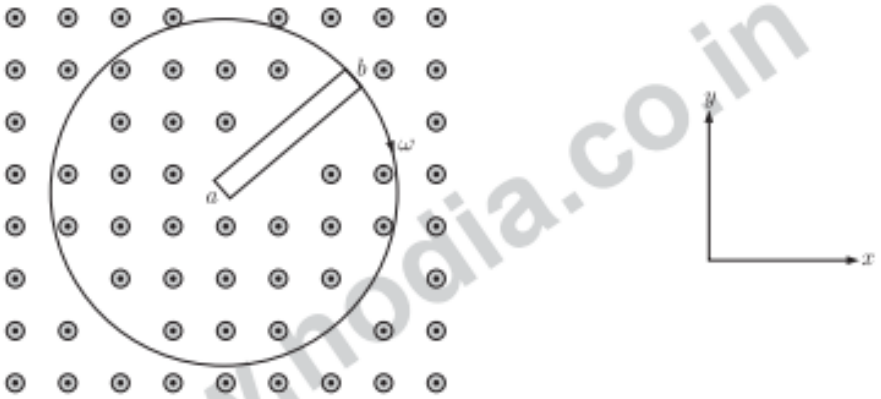
(A) 0

(B) uniform, independent of r

(C) uniform, independent of t

(D) uniform, independent of both r and t

MCQ 6.1.2 A straight conductor ab of length l lying in the xy plane is rotating about the centre a at an angular velocity ω as shown in the figure.



If a magnetic field $\boldsymbol{B}$ is present in the space directed along $\boldsymbol{a}_z$ then which of the following statement is correct ?

(A) V_{ab} is positive

(B) V_{ab} is negative

(C) V_{ba} is positive

(D) V_{ba} is zero

MCQ 6.1.3 **Assertion (A)** : A small piece of bar magnet takes several seconds to emerge at bottom when it is dropped down a vertical aluminum pipe where as an identical unmagnetized piece takes a fraction of second to reach the bottom.
Reason (R) : When the bar magnet is dropped inside a conducting pipe, force exerted on the magnet by induced eddy current is in upward direction.

(A) Both A and R are true and R is correct explanation of A.

(B) Both A and R are true but R is not the correct explanation of A.

(C) A is true but R is false.

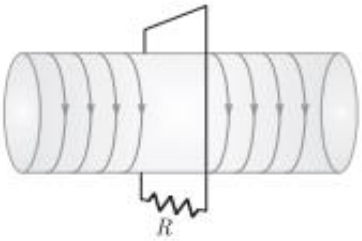
(D) A is false but R is true.

MCQ 6.1.4 Self inductance of a long solenoid having n turns per unit length will be proportional to

(A) n (B) $1/n$

(C) n^2 (D) $1/n^2$

MCQ 6.1.5 A wire with resistance R is looped on a solenoid as shown in figure.

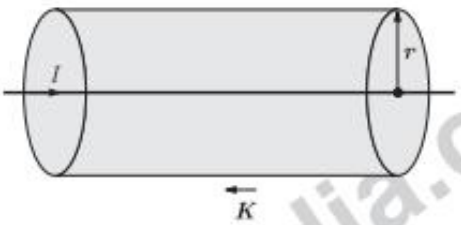


If a constant current is flowing in the solenoid then the induced current flowing in the loop with resistance R will be

(A) non uniform (B) constant

(C) zero (D) none of these

MCQ 6.1.6 A long straight wire carries a current $I = I_0 \cos(\omega t)$. If the current returns along a coaxial conducting tube of radius r as shown in figure then magnetic field and electric field inside the tube will be respectively.

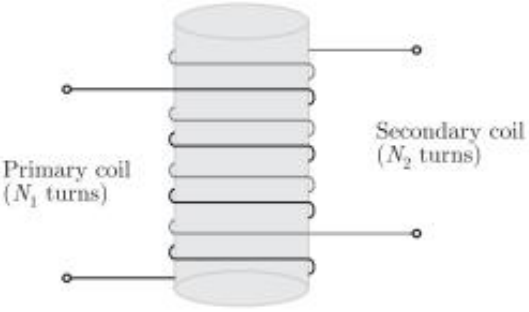


(A) radial, longitudinal (B) circumferential, longitudinal

(C) circumferential, radial (D) longitudinal, circumferential

MCQ 6.1.7 Assertion (A) : Two coils are wound around a cylindrical core such that the primary coil has N_1 turns and the secondary coils has N_2 turns as shown in figure. If the same flux passes through every turn of both coils then the ratio of emf induced in the two coils is

$$\frac{V_{emf\,2}}{V_{emf\,1}} = \frac{N_2}{N_1}$$



Reason (R) : In a primitive transformer, by choosing the appropriate no. of turns, any desired secondary emf can be obtained.

(A) Both A and R are true and R is correct explanation of A.

(B) Both A and R are true but R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.