

**MSE 235**  
**2023-2024 FALL SEMESTER**  
**RECITATION-01**

1) (a) Give the electron configurations of Cl, Cl<sup>-</sup>, Al, Al<sup>3+</sup> and determine number of valence electrons

(b) Calcium oxide(CaO) exhibits predominantly ionic bonding. The Ca<sup>2+</sup> and O<sup>2-</sup> ions have electron structures that are identical to which inert gases?

1 H																	2 He	
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne	
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar	
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr	
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe	
55 Cs	56 Ba	57-70 *	71 Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89-102 **	103 Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun	111 Uuu	112 Uub	114 Uuq					

\* Lanthanide series

57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb
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\*\* Actinide series

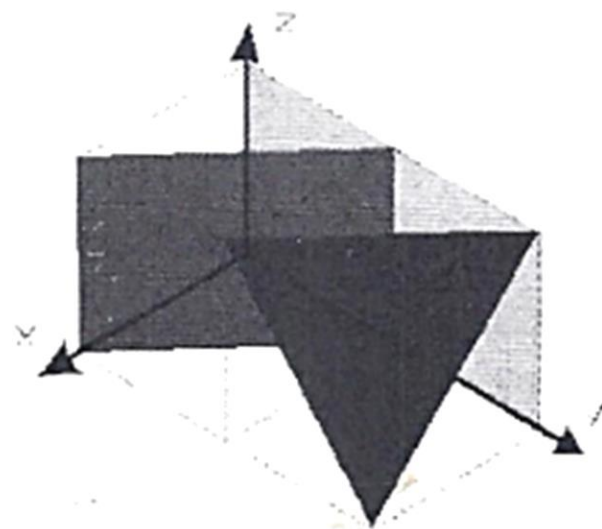
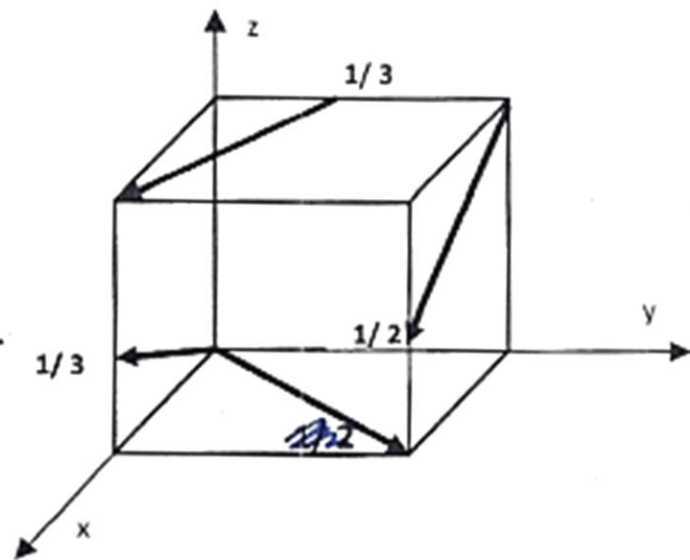
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No
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2) (a) Within a cubic unit cell, sketch the following planes and directions;

i) (202),

ii) [102],

(b) Determine the indices for the directions and planes shown in the following cubic unit cells:



(c) Calculate the planar density of (111) plane in an FCC crystal.

**3)**

**(a)** Calculate the radius of potassium (K) atom, given that K has a BCC crystal structure, density of  $0.862 \text{ g/cm}^3$ , and an atomic weight of  $39.1 \text{ g/mol}$

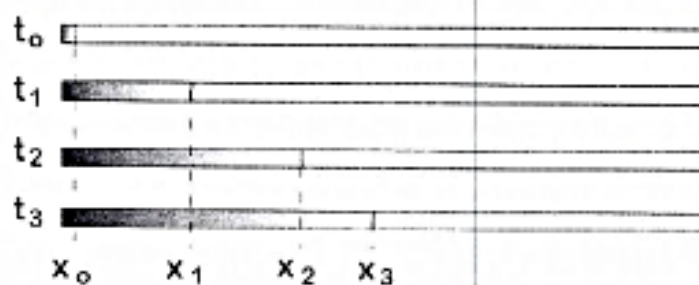
**(b)** Calculate the unit cell parameter (a) of K unit cell.

**(c)** What is the size of interstitial site?

- 4) Methylene chloride is a common ingredient of paint removers. Besides being an irritant, it also may be absorbed through skin. When using this paint remover, protective gloves should be worn.

If butyl rubber gloves (0.04 cm thick) are used, what is the diffusive flux of methylene chloride through the glove?

- 5) An FCC iron-carbon alloy initially containing 0.20 wt% C is carburized at an elevated temperature and in an atmosphere that gives a surface carbon concentration constant at 1.0 wt%. If after 49.5 h the concentration of carbon is 0.35 wt% at a position 4.0 mm below the surface, determine the temperature at which the treatment was carried out.



$$\frac{C(x_i, t_i) - C_0}{C_s - C_0} = 1 - \operatorname{erf}\left(\frac{x_i}{2\sqrt{Dt_i}}\right)$$

Tabulation of Error Function Values

$z$	$\operatorname{erf}(z)$	$z$	$\operatorname{erf}(z)$	$z$	$\operatorname{erf}(z)$
0	0	0.55	0.5633	1.3	0.9340
0.025	0.0282	0.60	0.6039	1.4	0.9523
0.05	0.0564	0.65	0.6420	1.5	0.9661
0.10	0.1125	0.70	0.6778	1.6	0.9763
0.15	0.1680	0.75	0.7112	1.7	0.9838
0.20	0.2227	0.80	0.7421	1.8	0.9891
0.25	0.2763	0.85	0.7707	1.9	0.9928
0.30	0.3286	0.90	0.7970	2.0	0.9953
0.35	0.3794	0.95	0.8209	2.2	0.9981
0.40	0.4284	1.0	0.8427	2.4	0.9993
0.45	0.4755	1.1	0.8802	2.6	0.9998
0.50	0.5205	1.2	0.9103	2.8	0.9999