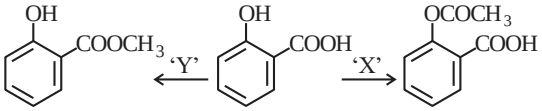
FINAL JEE–MAIN EXAMINATION – JANUARY, 2023

(Held On Wednesday 01st February, 2023) TIME : 3 : 00 PM to 6 : 00 PM

CHEMISTRY | TEST PAPER WITH SOLUTION

SECTION-A

31. In a reaction,



reagents 'X' and 'Y' respectively are :

(1) $(CH_3CO)_2O/H^+$ and CH_3OH/H^+, Δ

(2) $(CH_3CO)_2O/H^+$ and $(CH_3CO)_2O/H^+$

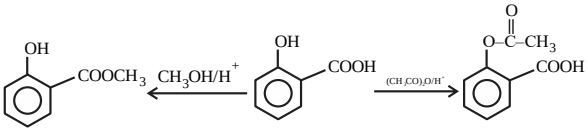
(3) CH_3OH/H^+, Δ and CH_3OH/H^+, Δ

(4) CH_3OH/H^+ Δ and $(CH_3CO)_2O/H^+$

Official Ans. by NTA (1)

Allen Ans. (1)

Sol.



32. The correct order of bond enthalpy (kJ mol^{-1}) is :

(1) Si – Si > C – C > Sn – Sn > Ge – Ge

(2) Si – Si > C – C > Ge – Ge > Sn – Sn

(3) C – C > Si – Si > Sn – Sn > Ge – Ge

(4) C – C > Si – Si > Ge – Ge > Sn – Sn

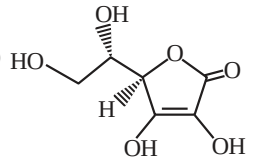
Official Ans. by NTA (4)

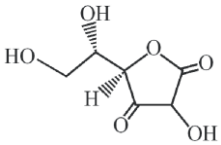
Allen Ans. (4)

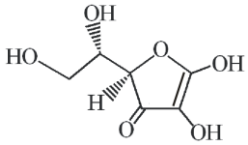
Sol. (Bond enthalpy order

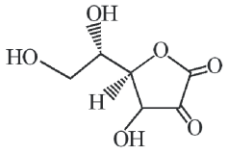
C – C > Si – Si > Ge – Ge > Sn – Sn)

33. All structures given below are of vitamin C. Most stable of them is :

(1) 

(2) 

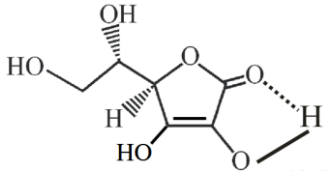
(3) 

(4) 

Official Ans. by NTA (1)

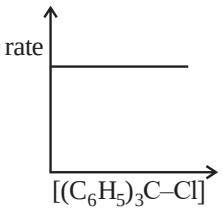
Allen Ans. (1)

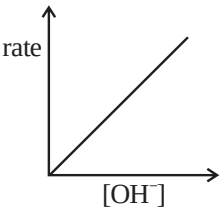
Sol. H-bonding stabilised vitamin C

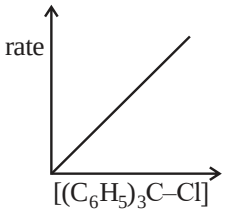


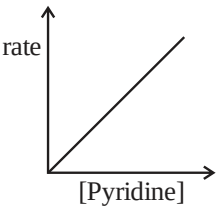
34. The graph which represents the following reaction is :

$$(C_6H_5)_3C-Cl \xrightarrow[\text{Pyridine}]{OH^-} (C_6H_5)_3C-OH$$

(1) 

(2) 

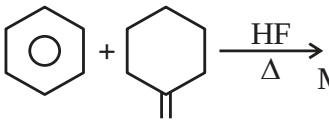
(3) 

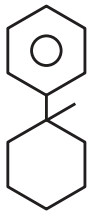
(4) 

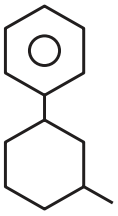
Official Ans. by NTA (3)

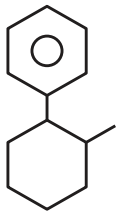
Allen Ans. (3)

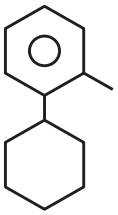
Sol. (It is SN1 reaction so rate of reaction depends on the concentration of alkyl halide only.

35. 'X' is : 

(1) 

(2) 

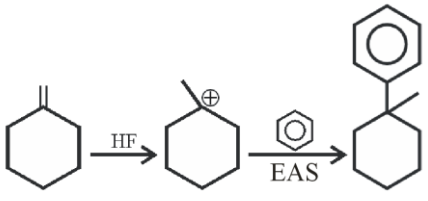
(3) 

(4) 

Official Ans. by NTA (1)

Allen Ans. (1)

Sol.



36. The complex cation which has two isomers is :

(1) $[Co(H_2O)_6]^{3+}$ (2) $[Co(NH_3)_5Cl]^{2+}$

(3) $[Co(NH_3)_5NO_2]^{2+}$ (4) $[Co(NH_3)_5Cl]^{+}$

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. $([Co(NH_3)_5NO_2]^{2+}$

Two linkage isomers possible

$NO_2 \rightarrow$ Ambidentate ligand

37. Given below are two statements :

Statement I : Sulphanilic acid gives esterification test for carboxyl group.

Statement II : Sulphanilic acid gives red colour in Lassigne's test for extra element detection.

In the light of the above statements, choose the **most appropriate** answer from the options given below :

(1) **Statement I** is correct but **Statement II** is incorrect.

(2) Both **Statement I** and **Statement II** are incorrect.

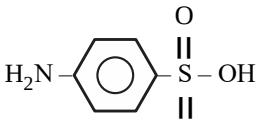
(3) Both **Statement I** and **Statement II** are correct.

(4) **Statement I** is incorrect but **Statement II** is correct.

Official Ans. by NTA (4)

Allen Ans. (4)

Sol.



Sulphanilic acid

Does not show esterification test.

Presence of both sulphur and nitrogen give red colour in Lassigne's test.

38. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A) : Gypsum is used for making fireproof wall boards.

Reason (R) : Gypsum is unstable at high temperatures.

In the light of the above statements, choose the **correct** answer from the options given below :

(1) Both **(A)** and **(R)** are correct but **(R)** is not the correct explanation of **(A)**.

(2) **(A)** is correct but **(R)** is not correct.

(3) **(A)** is not correct but **(R)** is correct.

(4) Both **(A)** and **(R)** are correct and **(R)** is the correct explanation of **(A)**.

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. (Gypsum is used for making fireproof wall boards.

39. Which element is not present in Nessler's reagent ?

(1) Mercury

(2) Potassium

(3) Iodine

(4) Oxygen

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. (Nessler's Reagent $\rightarrow K_2[HgI_4]$

40. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A) : α-halocarboxylic acid on reaction with dil. NH_3 gives good yield of α-amino carboxylic acid whereas the yield of amines is very low when prepared from alkyl halides.

Reason (R) : Amino acids exist in zwitter ion form in aqueous medium.

In the light of the above statements, choose the **correct** answer from the options given below :

(1) Both **(A)** and **(R)** are correct and **(R)** is the correct explanation of **(A)**.

(2) Both **(A)** and **(R)** are correct but **(R)** is **not** the correct explanation of **(A)**.

(3) **(A)** is correct but **(R)** is not correct.

(4) **(A)** is not correct but **(R)** is correct.

Official Ans. by NTA (1)

Allen Ans. (2)

41. The industrial activity held least responsible for global warming is :

(1) manufacturing of cement

(2) steel manufacturing

(3) Electricity generation in thermal power plants.

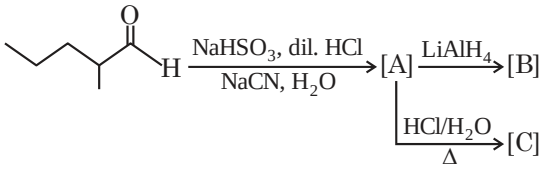
(4) Industrial production of urea

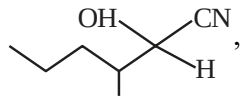
Official Ans. by NTA (4)

Allen Ans. (4)

Sol. In urea production NH_3 and CO_2 consumed so least responsible for global warming.

42. The structures of major products A, B and C in the following reaction are sequence.



(1) A = 

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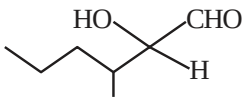
B = 

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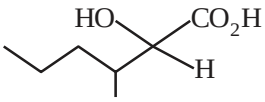
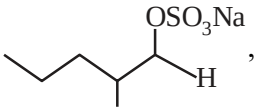
C = 

(2) A = 

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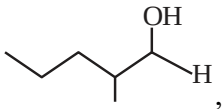
B = 

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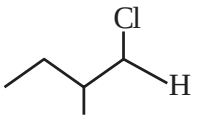
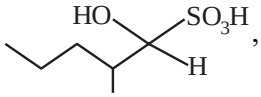
C = 

(3) A = 

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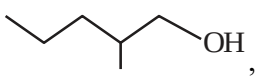
B = 

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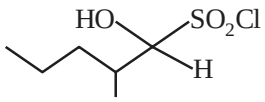
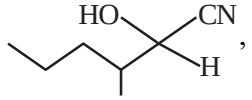
C = 

(4) A = 

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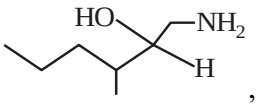
B = 

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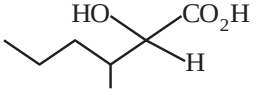
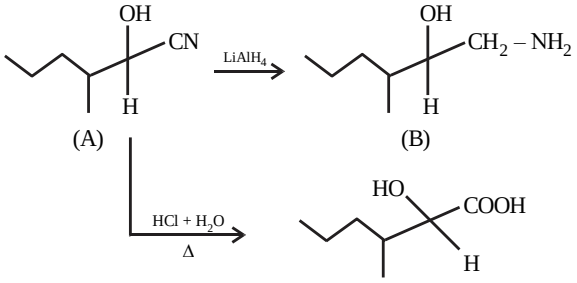
C = 

Official Ans. by NTA (4)

Allen Ans. (4)

Sol.



43. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A) : Cu^{2+} in water is more stable than Cu^{+}.

Reason (R) : Enthalpy of hydration for Cu^{2+} is much less than that of Cu^{+}.

In the light of the above statements, choose the **correct** answer from the options given below :

(1) Both **(A)** and **(R)** are correct and **(R)** is the correct explanation of **(A)**.

(2) **(A)** is correct but **(R)** is not correct.

(3) **(1)** is not correct but **(R)** is correct.

(4) Both **(A)** and **(R)** are correct but **(R)** is **not** the correct explanation of **(A)**.

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. $2Cu^{+} \rightarrow Cu^{2+} + Cu$

The stability of $Cu^{2+}(aq)$ rather than $Cu^{+}(aq)$, is due to the much more negative $\Delta_{hyd}H$ of $Cu^{2+}(aq)$ than $Cu^{+}(aq)$, which more than compensates for the second ionisation enthalpy of Cu.

44. The starting material for convenient preparation of deuterated hydrogen peroxide (D_2O_2) in laboratory is:

(1) $K_2S_2O_8$ (2) 2-ethylanthraquinol

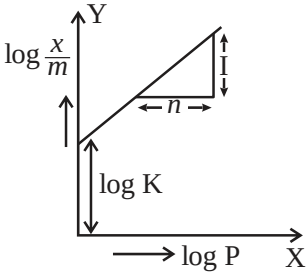
(3) BaO_2 (4) BaO

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. $(K_2S_2O_8(s) + 2D_2O(l) \rightarrow 2KDSO_4(aq.) + D_2O_2$

45. In figure, a straight line is given for Freundrich Adsorption ($y = 3x + 2.505$). The value of $\frac{1}{n}$ and log K are respectively.



(1) 0.3 and log 2.505 (2) 0.3 and 0.7033

(3) 3 and 2.505 (4) 3 and 0.7033

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. $\frac{x}{m} = Kp^{1/n}$

$\log\frac{x}{m} = \log k + \frac{1}{n}\log P$

$Y = 3x + 2.505,\ \frac{1}{n} = 3$, $\log K = 2.505$)

46. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A) : An aqueous solution of KOH when for volumetric analysis, its concentration should be checked before the use.

Reason (R) : On aging, KOH solution absorbs atmospheric CO_2.

In the light of the above statements, choose the correct answer from the options given below.

(1) **(A)** is not correct but **(R)** is correct

(2) Both **(A)** and **(R)** are correct but **(R)** is **not** the correct explanation of **(A)**

(3) Both **(A)** and **(R)** are correct and **(R)** is the correct explanation of **(A)**

(4) **(A)** is correct but **(R)** is not correct

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. KOH absorb CO_2

So its concentration should be checked.

47. Which one of the following sets of ions represents a collection of isoelectronic species?

(Given : Atomic Number : F :9 , Cl : 17, Na = 11, Mg = 12, Al = 13, K = 19, Ca = 20, Sc = 21)

(1) (Li^+ , Na^+ , Mg^{2+} , Ca^{2+}

(2) (Ba^{2+} , Sr^{2+} , K+ , Ca^{2+}

(3) (N^{3-} , O^{2-} , F^- , S^{2-}

(4) (K^+ , Cl^- , Ca^{2+} , Sc^{3+}

Official Ans. by NTA (4)

Allen Ans. (4)

Sol.

K^+	Cl^1	Ca^{2+}	Sc^{3+}
18	18	18	18

48. The effect of addition of helium gas to the following reaction in equilibrium state, is :

$PCI_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

(1) the equilibrium will shift in the forward direction and more of Cl_2 and PCl_3 gases will be produced.

(2) the equilibrium will go backward due to suppression of dissociation of PCl_5.

(3) helium will deactivate PCl_5 and reaction will stop.

(4) addition of helium will not affect the equilibrium.

Official Ans. by NTA (1)

Allen Ans. (A & D)

Sol. $PCI_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

(**Case 1 :** At constant P – volume will increase so reaction will shift in forward direction then answer will be A

Case 2 : At constant volume no change in active mass so reaction will not shift in any direction then answer will be D.

49. For electron gain enthalpies of the elements denoted as $\Delta_{eg}H$, the incorrect option is :

(1) $\Delta_{eg}H$ (Cl) < $\Delta_{eg}H$ (F)

(2) $\Delta_{eg}H$ (Se) < $\Delta_{eg}H$ (S)

(3) $\Delta_{eg}H$ (I) < $\Delta_{eg}H$ (At)

(4) $\Delta_{eg}H$ (Te) < $\Delta_{eg}H$ (Po)

Official Ans. by NTA (2)

Allen Ans. (2)

Sol. (1) $\Delta_{eg}H$ (Cl) < $\Delta_{eg}H$ (F)

(–345) (– 328) Correct

(2) $\Delta_{eg}H$ (Se) < $\Delta_{eg}H$ (S)

(–195) (– 200) Incorrect

(3) $\Delta_{eg}H$ (I) < $\Delta_{eg}H$ (At)

(–295) (– 270) Correct

(4) $\Delta_{eg}H$ (Te) < $\Delta_{eg}H$ (Po)

(–190) (– 183) Correct

50. O–O bond length in H_2O_2 is X than the O–O bond length in F_2O_2. The O – H bond length in H_2O_2 is Y than that of the O–F bond in F_2O_2.

Choose the correct option for X and Y from the given below.

(1) X – shorter, Y – shorter

(2) X – shorter, Y – longer

(3) X – longer, Y – longer

(4) X – longer, Y - shorter

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. According to bent rule more electronegative atom occupy less s-characters so bond length increases.

O – H bond will be short than O – F bond due to small size of H than F.

SECTION-B

51. 0.3 g of ethane undergoes combustion at 27°C in a bomb calorimeter. The temperature of calorimeter system (including the water) is found to rise by 0.5°C. The heat evolved during combustion of ethane at constant pressure is _____kJ mol^{-1}.

(Nearest integer)

[Given : The heat capacity of the calorimeter system is 20 kJ K^{-1}, R = 8.3 JK^{-1} mol^{-1}.

Assume ideal gas behaviour.

Atomic mass of C and H are 12 and 1 g mol^{-1} respectively]

Official Ans. by NTA (1006)

Allen Ans. (1006)

Sol. (Bomb calorimeter → const volume

Heat released

By combustion of 1 mole

$$C_2H_6\ (\Delta U) = -\frac{20\times0.5}{0.3}\times30 = -1000\ kJ$$

$C_2H_6(g) + 7/2\ O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$

$\Delta ng = 2 - (2 + 7/2) = -(7/2)$

$\Delta H = \Delta U + \Delta nRT$

$= -1000 - 7/2 \times 8.3 \times 300$ kJ

$= -1000 - 6.225$

$= -1006$ kJ

So heat released = 1006 kJ mol^{-1}

52. Among following compounds, the number of those present in copper matte is_____.

A. $CuCO_3$

B. Cu_2S

C. Cu_2O

D. FeO

Official Ans. by NTA (3)

Allen Ans. (1)

Sol. FeS and Cu_2S, present in copper matte.

53. Among the following, the number of tranquilizer/s is/are_____.

A. Chloroliazepoxide

B. Veronal

C. Valium

D. Salvarsan

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. (chlorodiazepoxide, Veronal, Valium is tranquilizer where as salvarsan is antibiotic.

54. $A \rightarrow B$

The above reaction is of zero order. Half life of this reaction is 50 min. The time taken for the concentration of A to reduce to one-fourth of its initial value is_____min.

(Nearest integer)

Official Ans. by NTA (75)

Allen Ans. (75)

Sol. Assume reaction starts with 1 mole A

$$(t_{1/2} = \frac{a}{2k}, K = \frac{1}{2\times50}$$

For 75% completion

$$a - \frac{a}{4} = kt$$

$$t = \frac{3}{4}\frac{a}{k} = \frac{3}{4}\times\frac{100}{a} = 75$$

55. 20% of acetic acid is dissociated when its 5 g is added to 500 mL of water. The depression in freezing point of such water is _____ $\times 10^{-3}$ °C. Atomic mass of C, H and O are 12, 1 and 16 a.m.u. respectively.

[Given : Molal depression constant and density of water are 1.86 K kg mol^{-1} and 1 g cm^{-3} respectively.

Official Ans. by NTA (372)

Allen Ans. (372)

Sol. $i = 1 + (n - 1)\alpha$

$(i = 1 + 0.2\ (2 - 1) = 1.2$

$\Delta T_f = i\, K_f m$

$$\Delta T_f = 1.2 \times 1.86 \times \frac{5 \times 1000}{60 \times 500}$$

$\Delta t_f = 3.72$

$\Delta T_f = 372 \times 10^{-2}$

56. The molality of a 10% (v/v) solution of di-bromine solution in CCl_4 (carbon tetrachloride) is 'x'. x = _____ $\times 10^{-2}$ M. (Nearest integer)

[Given : molar mass of Br_2 = 160 g mol^{-1}

atomic mass of C = 12 g mol^{-1}

atomic mass of Cl = 35.5 g mol^{-1}

density of dibromine = 3.2 g cm^{-3}

density of CCl_4 = 1.6 g cm^{-3}]

Official Ans. by NTA (139)

Allen Ans. (139)

Sol. (10 ml solute in 90 ml solvent

mass of solute = 10 × 3.2 = 32g

mass of solvent = 90 × 1.6g

$$m = \frac{32 \times 1000}{160 \times 90 \times 1.6} = 1.388$$

$m = 138.8 \times 10^{-2} = 139$

57. 1×10^{-5} M $AgNO_3$ is added to 1 L of saturated solution of AgBr. The conductivity of this solution at 298 K is _____$\times 10^{-8}$ S m^{-1}.

[Given : $K_{sp}(AgBr) = 4.9 \times 10^{-13}$ at 298K

$\lambda^0_{Ag^+} = 6 \times 10^{-3}\, S m^2\, mol^{-1}$

$\lambda^0_{Br^-} = 8 \times 10^{-3}\, S m^2\, mol^{-1}$

$\lambda^0_{NO_3^-} = 7 \times 10^{-3}\, S m^2\, mol^{-1}$]

Official Ans. by NTA (14)

Allen Ans. (Bonus)

Sol. $[Ag^+] = 10^{-5}$

$\left[NO_3^-\right] = 10^{-5}$

$$\left[Br^-\right] = \frac{Ksp}{\left[Ag^+\right]} = 4.9 \times 10^{-8}$$

$$\Lambda_m = \frac{k}{1000 \times M}$$

For Ag^+

$$6 \times 10^{-3} = \frac{K_{Ag^+}}{1000 \times 10^{-5}}$$

$K_{Ag^+} = 6 \times 10^{-5}$

$\Rightarrow 6000 \times 10^{-8}$

for Br^-

$$8 \times 10^{-3} = \frac{K_{Br^-}}{1000 \times 4.9 \times 10^{-8}}$$

$K_{Br^-} = 39.2 \times 10^{-8}$

for NO_3^-

$$7 \times 10^{-3} = \frac{K_{NO_3^-}}{1000 \times 10^{-5}}$$

$K_{NO_3^-} = 7 \times 10^{-5}$

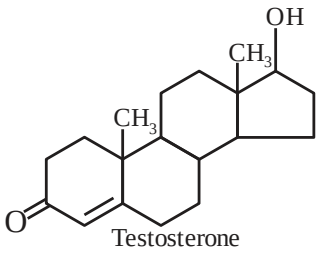
$= 7000 \times 10^{-8}$

Conductivity of solution

$\Rightarrow (6000 + 7000 + 39.2) \times 10^{-8}$

$\Rightarrow 13039.2 \times 10^{-8}$ S m^{-1}

58. Testosterone, which is a steroidal hormone, has the following structure.



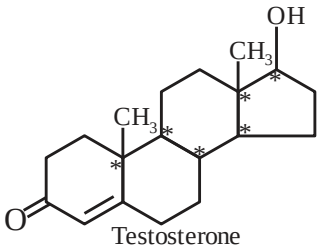
Testosterone

The total number of asymmetric carbon atom/s in testosterone is _____

Official Ans. by NTA (6)

Allen Ans. (6)

Sol.



Testosterone

59. The spin only magnetic moment of $[Mn(H_2O)_6]^{2+}$ complexes is _____B.M. (Nearest integer)

(Given : Atomic no. of Mn is 25)

Official Ans. by NTA (6)

Allen Ans. (6)

Sol. $([Mn(H_2O)_6]^{2+}$

$Mn^{2+} = 3d^5$

$\mu = \sqrt{5(5+2)} = 5.91BM$

60. A metal M crystallizes into two lattices :- face centred cubic (fcc) and body centred cubic (bcc) with unit cell edge length of 2.0 and 2.5 Å respectively. The ratio of densities of lattices fcc to bcc for the metal M is _____.

(Nearest integer)

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. $d = \frac{Z \times M}{N_A a^3}$

$$\frac{d_{FCC}}{d_{BCC}} = \frac{\frac{4 \times M_w}{N_A \times (2)^3}}{\frac{2 \times M_w}{N_A \times (2.5)^3}} = 3.90$$