

CHU 3237/Industrial Chemistry
Answer Guide for Assignment Test 01

1. (a) i. That is because the free energy change decreases (less negative) with an increase of temperatures

$$\Delta G = \Delta H - T\Delta S$$

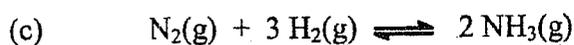
Here the S decreases and hence ΔS is negative. Thus if the T is raised, then $T\Delta S$ becomes more negative so ΔG less negative.

ii. The free energy changes all follow a straight line unless the materials melt or vaporize. When the material melt or vaporizes, there is a large change in entropy associated with the change of state, which changes the slope of the line.

(b) i. 'C' can reduce ZnO, Al₂O₃, MgO
ZnO can reduce by 'C' at 1000 °C
Al₂O₃ can reduce by 'C' at 2100 °C
MgO can reduce by 'C' at 1750 °C

ii. Yes, one metal can be used to reduce the oxide of other metals

iii. around 500 °C



$$K_c = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3}$$

$$K_c = \frac{(0.0027)^2}{(0.0402)(0.1207)^3}$$

$$= 0.103 \text{ mol}^{-2}\text{dm}^6$$

$$Q = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3}$$

$$Q = \frac{(1.0)^2}{(2.0)(2.0)^3}$$

$$= 0.0625 \text{ mol}^{-2}\text{dm}^6$$

Here the quotient $\frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3}$ will need to change from 0.0625 to 0.103 for the

system to achieve equilibrium. This can achieve only if $[\text{NH}_3]$ increases and $[\text{H}_2]$ and $[\text{N}_2]$ decreases. Thus reaction proceeds towards equilibrium with the formation of NH_3 from N_2 and H_2 .

Or When $Q < K_c$ reaction move to forward direction.

Yes. N_2 and H_2 react to form more NH_3 .

2. (a) i. Mineral sands

They are called 'mineral' because of their high industrial and economic values and the term 'sands' is used because the minerals are in the form of sand in the range 50-200 μ m in particle size.

ii. ilmenite ($\text{FeO} \cdot \text{Fe}_2\text{O}_3$) TiO_2

rutile (TiO_2)

zircon (ZrSiO_4)

garnet (complex Ca, Mg, Fe, Mn silicate)

sillimanite ($\text{Al}_2\text{O}_3 \cdot \text{SiO}_2$)

monazite (Ce, La, Th) PO_4

(b) latex based industries

products: Balloons, Gloves, Elastic thread, Cushions, Carpet backings, rubberized coir, baby teets

additives: surface active agents, viscosity modifier, vulcanizing agents, fillers, Accelerator and secondary gelling agent, Antioxidants

dry rubber based industries

products: Tyre re-thredings, Garden hoses, Sleeves for rubber band, Rubber mats, Solid rubber sheets, Solid tyres, Automobile spare parts(busses), footwear

additives: accelerators, Activators, Anti-degradants, Fillers, Cross-linking agents, Processing acids, Specific additives

(c)

Extraction of iron

raw material: iron oxides or iron sulphides

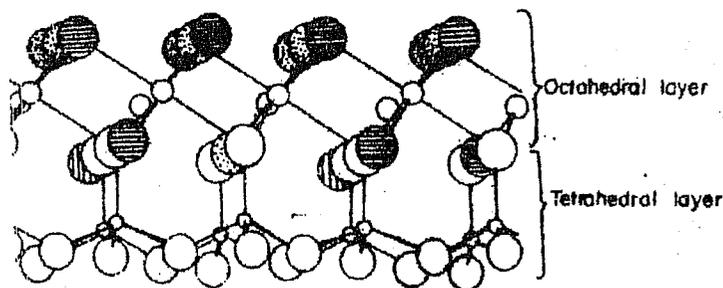
method: reductive extractive metallurgy

Extraction of Aluminium

purified bauxite (Al_2O_3)

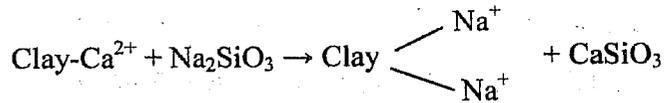
non-ferrous metallurgy or a typical electrolytic process

(d) i.



ii. In clay minerals, Because of the substitution of Al^{3+} and Si^{4+} it gives negative charge to the structure. In such situations the negative charges are balanced in the clay minerals by loosely holding positive ions on the surface of the particles or

between the layers. Since these are loosely bound they are more or less readily exchanged with other ions in the surrounding. It is this fact that is responsible for the *ion exchange capacity* of clays.



(e) Clay- plasticity, give the necessary shape we require
Silica-give hardness to the ceramic body

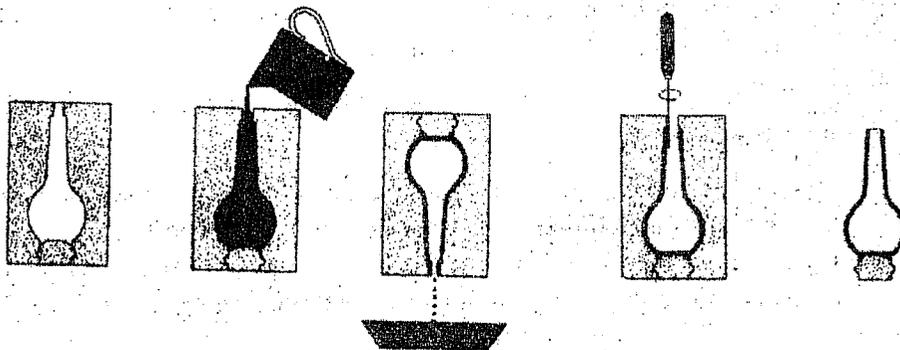
Fluxes- Fusion of raw materials and giving a glossy appearance

3. (a) i. Basic principals in the slip casting

- This is one of the method used in shaping of ceramic
- Clay mixture is in a suspension form(slip)
- clay mixture is cast into a plaster of paris mould
- the mould sucks the liquid from the contact area
- Suction make hard lay on the surface

ii. Drain casting

- assemble mould
- The mould is filled with slip completely
- Excess liquid is poured out after suitable wall thickness is formed.
- Trimming
- Removing mould



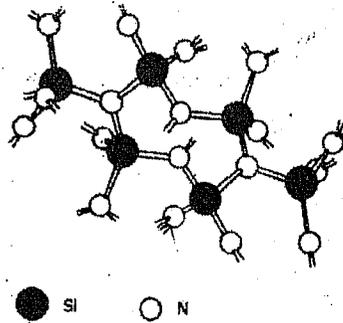
iii. comparison

Solid casting	drain casting
Product is complete solid	product contains only thin wall with inside hole
Whole slip solidify inside mould	Part of the slip solidify rest drain out of mould
No trimming	Trimming must be done
Used a mould (similarity)	Used a mould

iv.

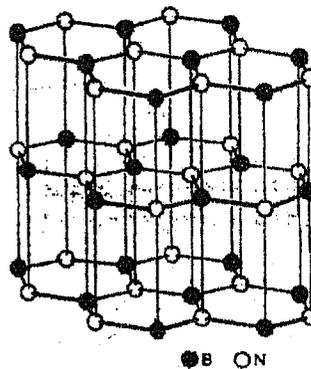
Products of dry pressing	Products of drain casting
tiles	Goblet jars
refractories	vase

(b) .i. Each Si-atom is bonded to 4 N-atoms at the corner of tetrahedral structure and each N-atom is bonded to 3 Si-atoms. Si_3N_4 is a strong network. And Si_3N_4 is a solid.



ii. Boron nitride Structure

BN structure is hexagonal. B and N atoms takes alternate places in a sheet. Sheets are stacked in a way that each boron atom has a N-atom directly above and below it.



ii. Applications

BN	Si_3N_4
Abrasive material	-do-
Refractive material	-do-
In high-temp applications	As components for high temp applications

(c) oxide ceramics , BaTiO_3

synthesis

heat equimolar amounts of BaTiO_3 and TiO_2



Structure: same structure as mineral perovskite (CaTiO_3)

Properties: superconducting material