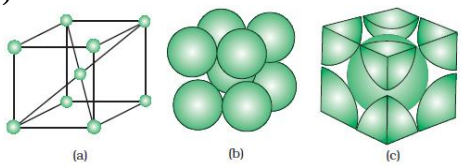
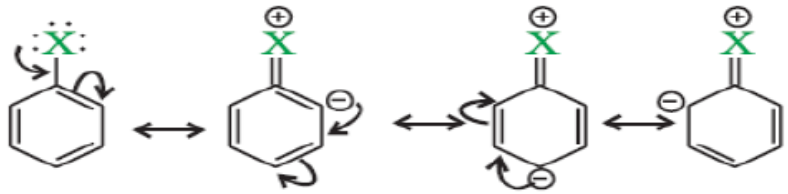
CHEMISTRY MODEL EXAMINATION, FEB-2020

KEY

Sl.No	Solution	Marks
1	a) HNO_3	**1**
2	b) Heroine	**1**
3	a) CH_3COONa, HCl, NaCl	**1**
4	c) MnO	**1**
5	d) polythene	**1**
6	Tollens reagent	**1**
7	Bredigs Arc Method	**1**
8	Freon	**1**
9	benzene sulphonyl chloride	**1**
10	Molecular solid- I_2 Ionic solid- CaF_2 Metallic solid-Mg Covalent solid- SiC	**2**
11	a)  b) Here the particles are present at the corners of the cube and also one atom at the body centre.The number of atoms at the corner = 8×1/8 = 1 The atom present at the centre of the body is not shared by other atoms. So the number of atoms at the body-centre = 1 Therefore, total number of atoms in the unit cell = 1+1=2	**1** **1**
12	a) our blood cells are **isotonic with 0.9%** (mass/volume) sodium chloride solution, called ***normal saline solution***. So it is safe to inject intravenously. If we place our blood cells in a solution containing more than 0.9% (mass/volume) sodium chloride solution, water will flow out of the cells and they would shrink. On the other hand, if they are placed in a solution containing less than 0.9% (mass/volume) NaCl, water will flow into the cells and they would swell b) Osmotic pressure measurement can be done at room temperature. Here molarity of the solution is used instead of molality, which can be determined easily. The magnitude of osmotic pressure is large even for very dilute solutions. This method can be used for the determination of molar masses of Biomolecules (which are generally not stable at higher temperatures) and for polymers (which have poor solubility	**1** **1**
13	a) $$\ln k = -\frac{E_a}{RT} + \ln A$$ ln K – rate constant Ea- activation energy T- temperature, R- gas constant A- Arrhenius factor b) Slope = -Ea/R	**1** **1**
14	a) Gold , silver etc b) ***Mond's process for Refining Nickel***: In this process, nickel is heated in a stream of carbon monoxide forming a volatile complex, nickel tetracarbonyl: $Ni + 4CO \xrightarrow{330 - 350K} Ni(CO)_4$ It is then decomposed to Ni and CO by heating at very high temperature. $Ni(CO)_4 \xrightarrow{450 - 470\ K} Ni + 4CO$	**1** **1**

15	the powdered ore is treated with a concentrated solution of NaOH at 473 – 523 K and 35 – 36 bar pressure. Alumina (Al_2O_3) dissolves in NaOH to form sodium aluminate [Silica (SiO_2) also dissolves in NaOH to form sodium silicate] leaving behind the impurities. Al_2O_3 (s) + 2NaOH(aq) + $3H_2O$(l) → 2Na[Al(OH)$_4$](aq) The aluminate in solution is neutralised by passing CO_2 gas and hydrated Al_2O_3 is precipitated. The solution is seeded with freshly prepared hydrated Al2O3 which induces the precipitation. 2Na[Al(OH)$_4$](aq) + CO_2(g) → $Al_2O_3.xH_2O$(s) + 2$NaHCO_3$ (aq) The sodium silicate remains in the solution and hydrated alumina is filtered, dried and heated to give back pure alumina (Al_2O_3). $Al_2O_3.xH_2O$(s) 1470 K Al_2O_3 (s) + xH_2O(g)	**2**
16	Transition elements can be defined as elements which contain partially filled d orbitals in their atomic state or in any of their oxidation state. This definition does not include Zn, Cd and Hg. So, they are not regarded as transition elements. Or, they are called pseudo transition elements.	**2**
17	Central atom -Co Ligands – Cl, NH_3 Primary valency – 1(only one ionisable chlorine) (**question is confusing**) Secondary valency- 6	½ ½ ½ ½
18	a) PCl_3 react with moisture to form fumes PCl_3 + $3H_2O$ → H_3PO_3 + 3HCl (white ppt) b) Any two structures	**1** **1**
19	a) Reaction with thionyl chloride ($SOCl_2$) b) CH_3- CH_2-OH CH_3- O- CH_3 Ethanol methoxy methane	**1** **1**
20	a) ***Rosenmund's Reduction*** b) ***Clemmensen reduction***	**1** **1**
21	***Resonance effect***:  the C—X bond acquires a partial double bond character. Since it is difficult to break a C=C bond, the replacement of halogen atom by other atoms is not easy. So haloarenes are less reactive towards nucleophilic substitution reactions. ***Difference in hybridisation of carbon atom in C—X bond*** ***Instability of phenyl cation*** ***Repulsion between nucleophile and electron rich benzene ring*** ***(any two reasons)***	**2**
22	The range of bacteria or other microorganisms that are affected by a certain antibiotic is expressed as its spectrum of action. Antibiotics which kill or inhibit a wide range of Gram-positive and Gram-negative bacteria are said to be broad spectrum antibiotics. Those effective mainly against Gram-positive or Gram-negative bacteria are narrow spectrum antibiotics. If effective against a single organism or disease, they are referred to as limited spectrum antibiotics. Penicillin G has a narrow spectrum. Ampicillin and Amoxycillin are synthetic modifications of penicillins. These have broad spectrum	**2**
23	a) **Henry's law**. "*The law states that at a constant temperature, the solubility of a gas in a liquid is directly proportional to the pressure of the gas".* b) Molar mass of urea = 2(1×14 + 2×1)+ 12+16 = 60gmol^{-1} 0.25 molar solution of urea means in 1000g of water contains 0.25 mol = 0.25 ×60 = 15g of urea in 1000g Mass of urea required = $\frac{(15\times2500)}{(1000+15)}$= 36.95g ≈ 37 g of urea required	**1** **2**

24

a) It is necessary to remove CO when ammonia is prepared by Haber's process because CO act as a poison and adversely affects the activity of iron catalyst, used in the process — 1

b)

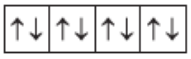
Properties	Physisorption	Chemisorption
Force of attraction	Weak van der Waals force	Strong chemical bond
Specificity	Not specific in nature	Highly specific
Reversibility	Reversible	Irreversible
Extend of adsorption and nature of gas	Easily liquefiable gases (e.g. CO_2, HCl, NH_3 etc) are easily adsorbed than permanent gases (e.g. H_2, N_2, O_2 etc)	Gases which can react with the adsorbent show chemisorption
Heat of adsorption	Low (20-40 kJ/mol)	High (80-240kJ/mol)
Temperature	Low temperature is favourable. It decreases with increase in temperature	High temperature is favourable. It increases with increase in temperature
Activation energy	No appreciable activation energy is needed	High activation energy is required
Nature of layer	Multimolecular layer of adsorption occurs	Only unimolecular layer of adsorption occurs

(any four differences) — 2

25

In tetrahedral complexes one *s* and three *p* orbitals are hybridised to form four equivalent orbitals oriented tetrahedrally. This is illustrated below for $[NiCl_4]^{2-}$. Here nickel is in +2 oxidation state and the ion has the electronic configuration $3d^8$. The hybridisation scheme is as shown in diagram. — 1 ½

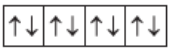
$[NiCl_4]^{2-}$ (high spin complex)



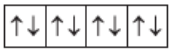
Four pairs of electrons from 4 Cl^- — 1 ½

In the square planar complexes, the hybridisation involved is dsp^2. An example is $[Ni(CN)_4]^{2-}$. Here nickel is in +2 oxidation state and has the electronic configuration $3d^8$. The hybridisation scheme is as shown in diagram:

$[Ni(CN)_4]^{2-}$ (low spin complex)



3*d*



Four pairs of electrons from 4 CN^- groups

4*p*

26

a) Order , n = ½ + 3/2 =4/4 = 1 — 1

b) For first order reaction — 2

$$k = 2.303 \log \frac{[R_0]}{[R]} \Big/ t$$

R = 100-80= 20, t = 10 min

k = 2.303 log (100/20)/ 10
= 2.303 log (5)/10
= 0.160 min^{-1}

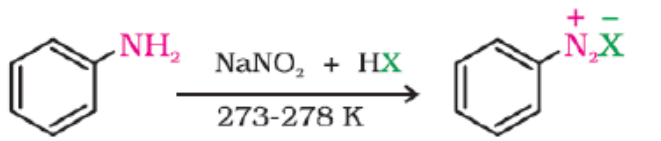
27

a) Order of basic strength — 1

$(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3$
2^0 1^0 3^0

b) By diazotisation — 2

Aromatic primary amines when treated with mineral acids like HCl and sodium nitrite ($NaNO_2$) at cold condition ($0 - 5^0C$), an aromatic diazonium salt is formed. This reaction is called *Diazotisation*



Benzene diazonium halide

28

A	B
Polysaccharide	cellulose
Zwitter ion	Isoelectric P^H
Vitamin A	Night
RNA	Ribose
Maltose	Maltase
Hormone	Testosterone

3

29

a) $CH_3Cl < CH_3\text{-}CH_2\text{-}Cl < (CH)_2\text{-}CH\text{-}Cl < (CH_3)_3CCl$ 1

b) Any two differences 2

30

1. ***Elastomers***: These are rubber – like solids with elastic properties. In these polymers, the polymer chains are held together by the weakest intermolecular forces (van der Waal's force). So they can be stretched. A few 'cross links' are formed in between the chains, which help the polymer to regain to its original position after the force is released. E.g. buna-S, buna-N, neoprene, etc.
2. ***Fibres***: Fibres are the thread forming solids which possess high tensile strength and high modulus. Here the different polymer chains are held together by strong intermolecular force they have close packed structure and are crystalline in nature Nylon 6,6, Nylon-6, terylene etc.
3. ***Thermoplastic polymers***: These are the linear or slightly branched long chain molecules repeatedly softening on heating and hardening on cooling On heating a physical change occurs these polymers possess intermolecular forces of attraction in between that of elastomers and fibres some examples are polythene, polystyrene, polyvinyls, etc.
4. ***Thermosetting polymers***: These polymers are cross linked or heavily branched molecules they undergo extensive cross links and become infusible. These cannot be reused. There occurs a chemical change on heating. Some common examples are bakelite, urea-formaldelyde resins, glyptal, terylene etc.

3

31

Potassium dichromate is generally prepared from chromite ore ($FeCr_2O_4$). The preparation involves
three steps.

1

1. Conversion of chromite ore to sodium chromate

Chromite ore is first fused with sodium carbonate in presence of air to form sodium chromate.

$4\ FeCr_2O_4 + 8\ Na_2CO_3 + 7\ O_2 \rightarrow 8\ Na_2CrO_4 + 2\ Fe_2O_3 + 8\ CO_2$

2. Acidification of sodium chromate to sodium dichromate 1

The yellow solution of sodium chromate is filtered and acidified with sulphuric acid to orange
sodium dichromate.

$2Na_2CrO_4 + 2\ H^+ \rightarrow Na_2Cr_2O_7 + 2\ Na^+ + H_2O$ 1

3. Conversion of sodium dichromate to potassium dichromate

The solution of sodium dichromate is treated with potassium chloride so that orange crystals of potassium dichromate crystallise out.

$Na_2Cr_2O_7 + 2\ KCl \rightarrow K_2Cr_2O_7 + 2\ NaCl$

32

a) $Mg(s) / Mg^{2+}(aq) // Ag^+(aq) / Ag(s)$ 1

b) At anode 2

$Mg(s) \longrightarrow Mg^{2+}(aq) + 2e^-$

At cathode

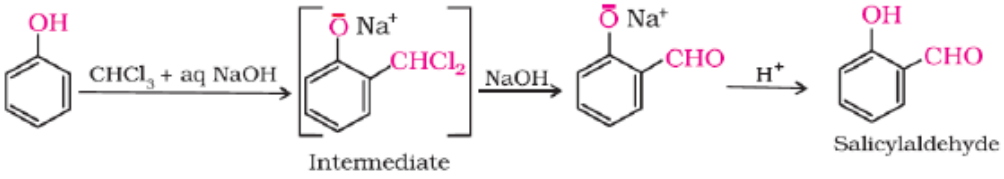
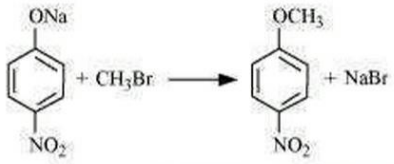
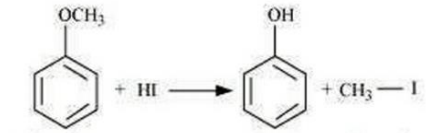
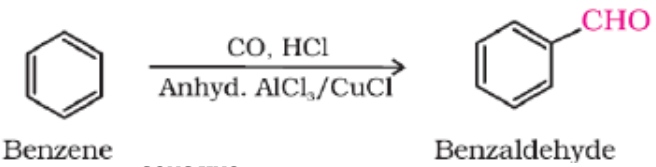
$2Ag^+(aq) + 2e^- \longrightarrow 2Ag(s)$

c) NaCl solution is electrolysed, we get H_2 gas at the cathode and Cl_2 gas at the anode. NaCl solution contains 4 ions – Na^+, Cl^-, H^+ and OH^- 1

Cathode reaction: $H^+ + e^- \rightarrow . H_2$

Anode reaction: $Cl^- \rightarrow . Cl_2 + e^-$

NaOH is formed in the solution.

33	a) ***Reimer-Tiemann reaction***  Intermediate Salicylaldehyde b)  1 – Methoxy – 4 – nitrobenzene  Methoxybenzone Phenol Iodomethane	2 1 1
34	a) **White phosphorus, Red phosphorus, Black phosphorus** b) When two different halogens react with each other, interhalogen compounds are formed. They can be assigned general compositions as AX, AX_3, AX_5 and AX_7, e.g ClF, BrF, IF, BrCl, BrI , ClF3, BrF3, IF3, ICl3, IBr3 , ClF5, BrF5, IF5 IF7 c) Noble gases have very low boiling points. Why? *Example 7.21* Noble gases being monoatomic have no interatomic forces except weak dispersion forces and therefore, they are liquefied at very low temperatures. Hence, they have low boiling points. *Solution*	1 2 1
35	**a)** Aldehydes are generally more reactive than ketones in nucleophilic addition reactions due to steric and electronic reasons. Sterically, the presence of two bulky alkyl groups in ketones hinders the approach of nucleophile to carbonyl carbon than in aldehydes. Electronically, ketones are less reactive because of the electron releasing nature of the two alkyl groups reduces the electrophilicity of the carbonyl carbon. **b)** **i.**  Benzene Benzaldehyde **ii.** **$2HCHO \xrightarrow{CONC.HNO_3} CH_3\text{-}OH + HCOONa$** **Methanol** **iii.** $CH_3\text{-}CH_2\text{-}COOH \xrightarrow{i)\ Cl_2/\ Red\ P\ ii)\ H_2O} CH_3\text{-}CHCl\text{-}COOH + HCl$ Propanoic acid 2-chloropropanoic acid	1 1 1 1