

MODEL TEST PAPER – 3 (Unsolved)

(Based on the latest CBSE Sample Paper)

Time: 3 hours

Maximum Marks: 80

General Instructions

- There are 33 questions in this question paper. All questions are compulsory.
- Section A: Q. No. 1 to 16 are objective type questions. Q. No. 1 and 2 are passage based questions carrying 4 marks each while Q. No. 3 to 16 carry 1 mark each.
- Section B: Q. No. 17 to 25 are short answer questions and carry 2 marks each.
- Section C: Q. No. 26 to 30 are short answer questions and carry 3 marks each.
- Section D: Q. No. 31 to 33 are long answer questions carrying 5 marks each.
- There is no overall choice. However, internal choices have been provided.
- Use of calculators and log tables is not permitted.

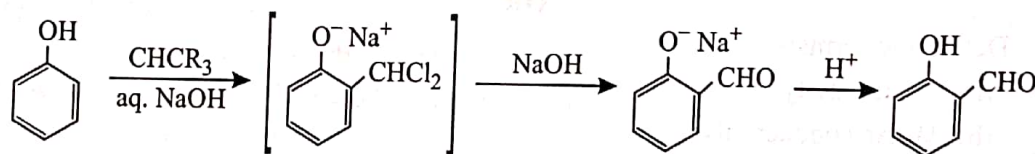
SECTION – A

Objective type

1. Read the passage given below and answer the following questions: [1×4=4]

On treating phenol with chloroform in the presence of sodium hydroxide, a $-CHO$ group is introduced at ortho-position of benzene ring.

The intermediate substitute benzal chloride is hydrolysed in the presence of alkali to produce 2-hydroxybenzaldehyde.



The following are multiple choice questions. Choose the most appropriate answer.

- The name of the above mentioned reaction is:
 - Cannizzaro Reaction
 - Kolbe's Reaction
 - Reiman – Tiemann Reaction
 - None of the above
- The product obtained when phenol is treated with sodium hydroxide, followed by carbon-dioxide gas and water is _____.
 - Salicylaldehyde
 - salicylic acid
 - Aspirin
 - Anisole

OR

Oxidation of phenol with chromic acid produces:

- Salicylaldehyde
 - Benzequinone
 - Salicylic acid
 - Aspirin
- Benzyl alcohol on treatment with NaOH produces 'A' which is very reactive. 'A' on treatment with CH_3Cl produces 'B'. This 'B' on treatment with bromine in ethanoic acid, produces 'C' & 'D', 'A', 'B', 'C' & 'D' respectively are:
 - Benzaldehyde, Anisole, *p*-bromoanisole, *o*-bromoanisole
 - Salicylaldehyde, Anisole, Salicylic acid, aspirin
 - Sodium phenoxide, Anisole, *p*-bromoanisole, *o*-bromoanisole
 - Benzaldehyde, Benzoic acid, Anisole, Benzoquinone

- (iv) When phenol is treated with bromine water, the product formed is
- (a) o-bromophenol (b) p-bromophenol
(c) m-bromophenol (d) 2, 4, 6 – tribromophenol

2. Read the passage given below and answer the following questions: [1 × 4 = 4]

Adsorption is the adhesion of atoms, ions or molecules from a gas, liquid or dissolved solid to a surface. This process creates a film of the adsorbate on the surface of the adsorbent. This process differs from absorption, in which a fluid (the absorbate) is dissolved by or permeates a liquid or solid (the absorbent), respectively. Adsorption is a surface phenomenon, while absorption involves the whole volume of the material, although adsorption does often precede absorption. The term sorption encompasses both processes, while desorption is the reverse of it.

Adsorption is present in many natural, physical, biological and chemical systems and is widely used in industrial applications such as heterogeneous catalysts, activated charcoal, capturing and using waste heat to provide cold water for air conditioning and other process requirements (adsorption chillers), synthetic resins, increasing storage capacity of carbide-derived carbons and water purification. Adsorption, ion exchange and chromatography are sorption processes in which certain adsorbates are selectively transferred from the fluid phase to the surface of insoluble, rigid particles suspended in a vessel or packed in a column. Pharmaceutical industry applications, which use adsorption as a means to prolong neurological exposure to specific drugs or parts thereof, are lesser known.

(Source: Atkins, P. W.; De Paula, Julio; Keeler, James (2018). *Atkins' Physical chemistry (Eleventh ed.)*. Oxford, United Kingdom. ISBN 978-0-19-876986-6. OCLC 1020028162.)

In these questions (i-iv), a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
(c) Assertion is correct statement but reason is wrong statement.
(d) Assertion is wrong statement but reason is correct statement.

(i) **Assertion:** Adsorption may increase or decrease with temperature.

Reason: Chemisorption decreases by increase in temperature due to decrease in rate of reaction while physisorption increases due to increase in physical forces.

(ii) **Assertion:** Adsorption is a unidirectional process.

Reason: Chalk chromatography is an example of adsorption.

(iii) **Assertion:** Adsorption of gases on activated charcoal is physisorption.

Reason: It is a multimolecular process and is accompanied by low enthalpies of adsorption.

(iv) **Assertion:** Extent of adsorption remains constant at high pressure.

Reason: There is no effect of change in pressure on extent of adsorption in any condition.

OR

Assertion: Adsorbates are selectively transferred from the fluid phase to the surface of insoluble during sorption processes.

Reason: Sorption technique is widely used in ion exchange and chromatography.

Following questions (No. 3 -11) are multiple choice questions carrying 1 mark each:

3. A conductivity cell has been calibrated with a 0.01 M 1:1 electrolyte solution (specific conductance $= 1.25 \times 10^{-3} \text{ S cm}^{-1}$) in the cell and the measured resistance was 800 ohms at 25°C . The cell constant will be [1]
- (a) 1.02 cm^{-1} (b) 0.102 cm^{-1}
 (c) 1.00 cm^{-1} (d) 0.5 cm^{-1}
4. In a nucleic acid, nucleotides are linked together by: [1]
- (a) Dative bond (b) Peptide bond
 (c) Glycosidic bond (d) Phosphodiester bond

OR

Which of the following reactions indicates that glucose contains 5 hydroxyl groups?

- (a) Reaction with dilute HNO_3 (b) Reaction with acetic anhydride
 (c) Reaction with HCN (d) Reaction with HI , red P
5. 1 kg of sea water contains $4.96 \times 10^{-3} \text{ gm}$ of dissolved oxygen. The concentration of oxygen in sea water in ppm is: [1]
- (a) 4.96×10^{-2} (b) 4.96
 (c) 49.6 (d) 0.496
6. One of the characteristics of transition metals to form the complex ion is: [1]
- (a) having unpaired electron in d-subshell (b) having paired electrons in d-subshell
 (c) providing empty d-orbitals (d) having small charge/size ratio

OR

The electronic configuration of a transition element in +3 oxidation state is $[\text{Ar}]3d^5$. The atomic number of the element is:

- (a) 25 (b) 26 (c) 27 (d) 28
7. Propanamide on reaction with bromine in aqueous NaOH gives: [1]
- (a) Phenol (b) Aniline
 (c) Acetanilide (d) Chlorobenzene

OR

IUPAC name of product formed by reduction of methyl amine with two moles of ethyl chloride

- (a) N,N-Dimethylethanamine (b) N,N-Diethylmethanamine
 (c) N-Methyl ethanamine (d) N-Ethyl ,N-methylethanamine
8. The CFSE for octahedral complex $[\text{CoCl}_6]^{2-}$ is 18000 cm^{-1} . The CFSE for tetrahedral $[\text{CoCl}_4]^{2-}$ is: [1]
- (a) 18000 cm^{-1} (b) 16000 cm^{-1}
 (c) 8000 cm^{-1} (d) 20000 cm^{-1}

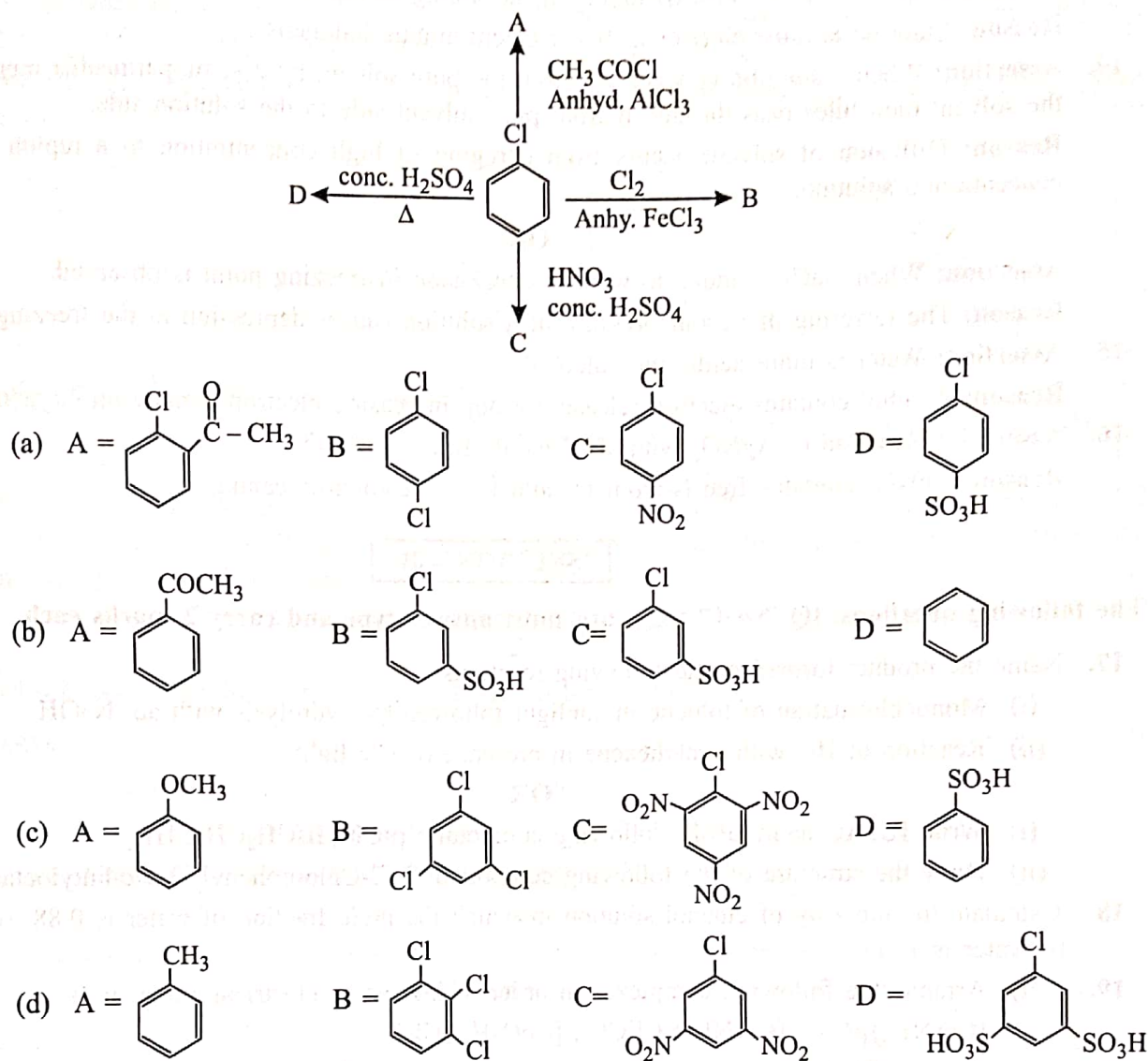
OR

Which of the following is the most stable complex?

- (a) $[\text{Fe}(\text{CO})_5]$ (b) $[\text{Fe}(\text{CN})_6]^{3-}$
 (c) $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3+}$ (d) $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$
9. Which of the following ions show higher spin only magnetic moment value? [1]
- (a) Ti^{3+} (b) Cr^{3+} (c) Fe^{2+} (d) Co^{2+}

10. Identify A, B, C and D.

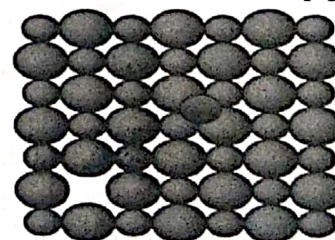
[1]



11. Identify the defect, select the property which is not true about the given solid:

[1]

- It is shown by compounds having low coordination number.
- It is shown by the compounds containing similar sizes of cation and anion.
- It is shown by ZnS.
- Both vacancy and interstitial defect arise in this defect.



In the following questions (Q. No. 12 - 16) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- Assertion and reason both are correct statements and reason is correct explanation for assertion.
- Assertion and reason both are correct statements but reason is not correct explanation for assertion.
- Assertion is correct statement but reason is wrong statement.
- Assertion is wrong statement but reason is correct statement.

12. Assertion: Fructose does not contain aldehydic group but still reduces Tollens' reagent.

[1]

Reason: In the presence of base, fructose undergoes rearrangement to form glucose and mannose.

13. **Assertion:** Fluorine is the best oxidizing agent among halogens. [1]
Reason: Fluorine is most electronegative element among halogens.
14. **Assertion:** When a solution is separated from the pure solvent by a semi-permeable membrane, the solvent molecules pass through it from pure solvent side to the solution side. [1]
Reason: Diffusion of solvent occurs from a region of high concentration to a region of low concentration solution.

OR

- Assertion:** When NaCl is added to water a depression in freezing point is observed.
Reason: The lowering of vapour pressure of a solution causes depression in the freezing point.
15. **Assertion:** Water is more acidic than alcohol. [1]
Reason: Alcohol contains electron releasing group increasing electron density on oxygen atom.
16. **Assertion:** Reaction of AgNO_2 with alkyl halide forms R-ONO . [1]
Reason: AgNO_2 contains free N-atom for attack as nucleophilic centre.

SECTION - B

The following questions, (Q. No 17 – 25) are short answer type and carry 2 marks each.

17. Name the product formed in the following reactions: [2]
 (i) Monochlorination of toluene in sunlight followed by hydrolysis with aq. NaOH.
 (ii) Reaction of Br_2 with cyclohexene in presence of UV light.

OR

- (i) Write IUPAC name of the following compound: $\text{p-ClC}_6\text{H}_4\text{CH}_2\text{CH}(\text{CH}_3)_2$
 (ii) Draw the structure of the following compound: 2-(2-Chlorophenyl)-3-sec-butyloctane.
18. Calculate the molarity of ethanol solution in which the mole fraction of water is 0.88. (density of water is 1g/ml) [2]
19. (i) Arrange the following complexes in order of increasing electrical conductivity: [2]
 $[\text{Co}(\text{NH}_3)_4]\text{Cl}_3$, $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$, $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]$
 (ii) Write IUPAC name of the following complex: $[\text{Fe}(\text{NH}_3)_4\text{Cl}_2] [\text{Ag}(\text{CN})_2]$

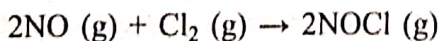
OR

For the complex ion $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$

- (i) Find electronic configuration of central metal atom (in terms of t_{2g} and e_g)
 (ii) Calculate magnetic moment of the metal atom.
20. (i) State a condition under which a bi-molecular reaction is kinetically first order reaction. [2]
 (ii) What is the unit of rate and rate constant for the reaction having rate law: $\text{Rate} = k(\text{PCH}_3\text{OH}_3)^{3/2}$ if the pressure is measured in bar and time in minutes?

OR

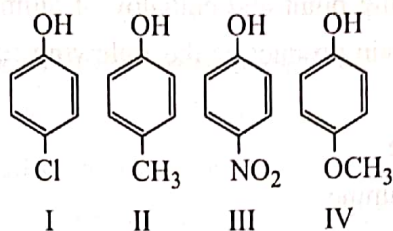
The following results have been obtained during the kinetic studies of the reaction:



Exp.	Initial P(mol/L)	Initial Q (mol/L)	Init. Rate of Formation of R (M min ⁻¹)
1	0.15	0.15	0.60
2	0.15	0.30	1.20
3	0.30	0.15	2.40
4.	0.25	0.25	?

What is the initial rate of disappearance of Cl_2 in experiment 4?

21. In the reaction, $2\text{N}_2\text{O}_5 \rightarrow 4\text{NO}_2 + \text{O}_2$, initial pressure and rate constant, k are 500 atm and $3.38 \times 10^{-5} \text{ sec}^{-1}$ respectively. Calculate final pressure of N_2O_5 after 10 minutes. [2]
22. Arrange the following compounds in decreasing order of acidic character and justify your answer. [2]



23. Explain the difference in oxidizing action of Cl_2 and SO_2 . [2]
24. An optically active compound having molecular formula $\text{C}_7\text{H}_{15}\text{Br}$ reacts with aqueous KOH to give a racemic mixture of products. Write the mechanism involved in this reaction. [2]
25. In a cubic unit cell, atoms 'A' occupy all corners and atoms 'B' occupy center of each face. If 2 atoms of each 'A' and 'B' are missing from their lattice sites, find the formula of the substance having this type of structure. [2]

SECTION - C

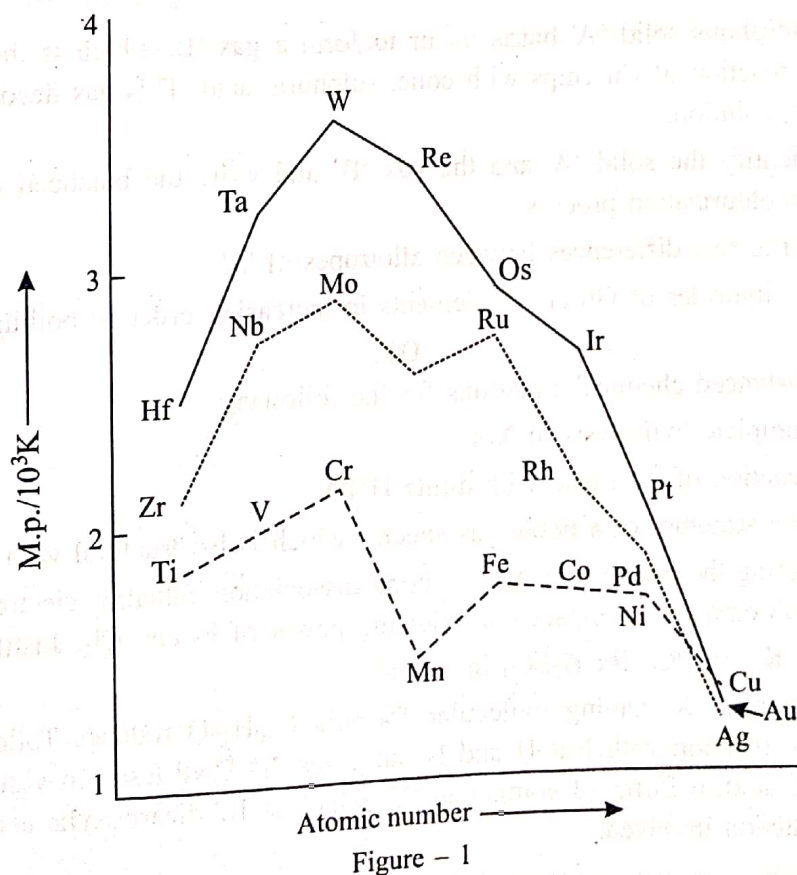
Q.No 26 -30 are Short Answer Type II carrying 3 marks each.

26. Give reasons for the following: [3]

- i. Transition elements are used to make alloys.
- ii. Cr^{2+} act as reducing agent and Mn^{3+} act as an oxidizing agent.
- iii. Transition metals exhibit variable oxidation state.

OR

Melting point trends among transition series are depicted in figure (1):



Explain the following observations:

- (i) The general trend towards change in order of melting point across the series
 - (ii) Unique behaviour of group 6 elements.
 - (iii) Relation between melting point and enthalpy of atomization.
27. Write the structures of the main product of the following reactions: [3]
- (i) Acetylation of aniline
 - (ii) Sulphonation of aniline
 - (iii) Diazotization of ethanamine

OR

- (i) How will you distinguish between secondary and tertiary amine? Show reactions involved.
 - (ii) How will you form N, N-dimethylaniline from benzene? Show steps.
28. (i) Name the non-stoichiometric point defect responsible for colour in alkali metal halides. [3]
- (ii) Calculate number of cation vacancies created when 0.1 mole % of CdCl_2 is doped in AgCl lattice. What type of defect is exhibited in it?
29. (i) Draw a Haworth projection of $\alpha\text{-D}(+)\text{glucopyranose}$. [3]
- (ii) Write two structural differences between nucleic acids.
30. Account for the following: [3]
- (i) On addition of O_3 gas to KI solution, violet vapours are formed.
 - (ii) Two S-O bonds in SO_2 are identical.
 - (iii) Dioxygen is a gas while sulphur (S_8) is a solid.

SECTION - D

Q. No 31 to 33 are long answer type carrying 5 marks each.

31. (i) An amorphous solid 'A' burns in air to form a gas 'B' which is the by-product formed during reaction of Cu chips with conc. sulphuric acid. This gas decolourises acidified aq. KMnO_4 solution. [5]
- (a) Identify the solid 'A' and the gas 'B' and write the balanced equation involved in decolourization process.
 - (b) Write two differences between allotropes of 'A'.
- (ii) Arrange hydrides of Group 15 elements in increasing order of boiling point
- OR
- (i) Write balanced chemical equations for the following:
- (a) Complete hydrolysis of XeF_6
 - (b) Reaction of Cu metal with dilute HNO_3 .
- (ii) Draw the structure of a noble gas species which is isostructural with BrO_3^- .
- (iii) Considering the parameters such as bond dissociation enthalpy, electron gain enthalpy and hydration enthalpy, compare the oxidising power of F_2 and Cl_2 . Justify.
- (iv) Why is $K_{a2} \ll K_{a1}$ for H_2SO_4 in water?
32. (i) A compound 'X' having molecular formula $\text{C}_{10}\text{H}_{12}\text{O}$ reduces Tollens reagent. It does not give reaction with NaOH and I_2 but gives 2,4-DNP test. On vigorous oxidation with chromic acid, it forms of compound 'Y' which is 1,2-dicarboxylic acid. Identify X and Y with reaction involved. [5]

(ii) Distinguish between the following by giving suitable chemical test:

(a) Phenol and Benzoic acid

(b) Acetophenone and benzophenone.

OR

[2+3]

(i) Draw structures of the following derivatives—

(a) Cyclobutane oxime.

(b) The ethylene ketal of pentan-3-one.

(ii) How will you carry out the following conversions?

(a) Benzaldehyde to α -Hydroxyphenyl acetic acid.

(b) Benzaldehyde to 3-Phenylpropanol.

(c) Ethanol to 3-oxobutanoic acid.

33. (i) A galvanic cell consists of a metallic zinc plate immersed in 0.1M $\text{Zn}(\text{NO}_3)_2$ solution and metallic plate of Aluminium in 0.02M $\text{Al}(\text{NO}_3)_3$ solution. Calculate the emf of the cell. Write the chemical equation for the electrode reactions and represent the cell.

(Given: $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ V}$; $E^\circ_{\text{Al}^{3+}/\text{Al}} = -1.33 \text{ V}$)

(ii) Predict product of electrolysis for aqueous CuCl_2 with Pt electrodes. [5]

OR

(i) Given the reduction potentials of Na^+ , Mg^{2+} , Al^{3+} , Ag^+ as

$E^\circ_{\text{Na}^+/\text{Na}} = -2.71 \text{ V}$, $E^\circ_{\text{Mg}^{2+}/\text{Mg}} = -2.37 \text{ V}$, $E^\circ_{\text{Al}^{3+}/\text{Al}} = -1.66 \text{ V}$, $E^\circ_{\text{Ag}^+/\text{Ag}} = +0.80 \text{ V}$

Which one of these will form least stable oxide?

(ii) Write products of electrolysis for (i) aqueous H_2SO_4 (ii) Conc. H_2SO_4 with Pt electrodes. [5]

(iii) Derive the relation between standard electrode potential and equilibrium constant. [5]

□□□