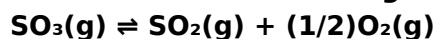


AIPMT 2012 Mains — Chemistry Question Paper with Solutions

21 Chemistry questions as set in the paper · answers checked by RankUp

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1. Given that the equilibrium constant for the reaction $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$ has a value of 278 at a particular temperature. What is the value of the equilibrium constant for the following reaction at the same temperature?



- (A) 1.8×10^{-3}
- (B) 3.6×10^{-3}
- (C) 6.0×10^{-2}
- (D) 1.3×10^{-5}

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2. Given the reaction between 2 gases represented by A_2 and B_2 to give the compound $\text{AB}(\text{g})$: $\text{A}_2(\text{g}) + \text{B}_2(\text{g}) \rightleftharpoons 2\text{AB}(\text{g})$. At equilibrium, the concentration of $\text{A}_2 = 3.0 \times 10^{-3} \text{ M}$, of $\text{B}_2 = 4.2 \times 10^{-3} \text{ M}$ and of $\text{AB} = 2.8 \times 10^{-3} \text{ M}$. If the reaction takes place in a sealed vessel at 527°C , then the value of K_c will be

- (A) 2.0
- (B) 1.9
- (C) 0.62
- (D) 4.5

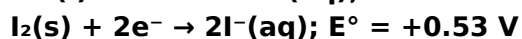
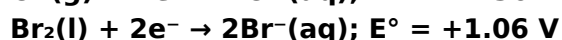
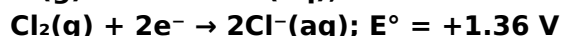
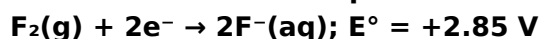
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3. During change of O_2 to O_2^- ion, the electron adds on which one of the following orbitals?

- (A) π^* orbital
- (B) π orbital
- (C) σ^* orbital
- (D) σ orbital

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4. Standard reduction potentials of the half reactions are given below:



The strongest oxidising and reducing agents respectively are

- (A) F_2 and I^-
- (B) Br_2 and Cl^-
- (C) Cl_2 and Br^-
- (D) Cl_2 and I_2

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5. The orbital angular momentum of a p-electron is given as :

- (A) $h/(\sqrt{2} \pi)$
- (B) $\sqrt{3} h/(2\pi)$
- (C) $\sqrt{(3/2)} h/\pi$
- (D) $\sqrt{6} h/(2\pi)$

6. Structure of a mixed oxide is cubic close-packed (c.c.p.). The cubic unit cell of mixed oxide is composed of oxide ions. One fourth of the tetrahedral voids are occupied by divalent metal A and the octahedral voids are occupied by a monovalent metal B. The formula of the oxide is

- (A) ABO_2
- (B) A_2BO_2
- (C) $\text{A}_2\text{B}_3\text{O}_4$
- (D) AB_2O_2

7. Molar conductivities ($\Lambda^\circ\text{m}$) at infinite dilution of NaCl, HCl and CH_3COONa are 126.4, 425.9 and 91.0 $\text{S cm}^2 \text{mol}^{-1}$ respectively. $\Lambda^\circ\text{m}$ for CH_3COOH will be

- (A) 425.5 $\text{S cm}^2 \text{mol}^{-1}$
- (B) 180.5 $\text{S cm}^2 \text{mol}^{-1}$
- (C) 290.8 $\text{S cm}^2 \text{mol}^{-1}$
- (D) 390.5 $\text{S cm}^2 \text{mol}^{-1}$

8. Equal volumes of two monoatomic gases, A and B, at same temperature and pressure are mixed. The ratio of specific heats (C_p/C_v) of the mixture will be

- (A) 0.83
- (B) 1.50
- (C) 3.3
- (D) 1.67

9. Which one of the following does not correctly represent the correct order of the property indicated against it?

- (A) $\text{Ti} < \text{V} < \text{Cr} < \text{Mn}$: increasing number of oxidation states
- (B) $\text{Ti}^{3+} < \text{V}^{3+} < \text{Cr}^{3+} < \text{Mn}^{3+}$: increasing magnetic moment
- (C) $\text{Ti} < \text{V} < \text{Cr} < \text{Mn}$: increasing melting points
- (D) $\text{Ti} < \text{V} < \text{Mn} < \text{Cr}$: increasing 2nd ionization enthalpy

10. A certain gas takes three times as long to effuse out as helium. Its molecular mass will be :

- (A) 27 u
- (B) 36 u
- (C) 64 u
- (D) 9 u

11. Four successive members of the first series of the transition metals are listed below. For which one of them the standard potential $E^\circ(\text{M}^{2+}/\text{M})$ value has a positive sign?

- (A) Co ($Z = 27$)
- (B) Ni ($Z = 28$)
- (C) Cu ($Z = 29$)
- (D) Fe ($Z = 26$)

12. Four diatomic species are listed below. Identify the correct order in which the bond order is increasing in them:

- (A) $\text{NO} < \text{O}_2^- < \text{C}_2^{2-} < \text{He}_2^+$
- (B) $\text{O}_2^- < \text{NO} < \text{C}_2^{2-} < \text{He}_2^+$
- (C) $\text{C}_2^{2-} < \text{He}_2^+ < \text{O}_2^- < \text{NO}$
- (D) $\text{He}_2^+ < \text{O}_2^- < \text{NO} < \text{C}_2^{2-}$

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13. Which of the following exhibits only +3 oxidation state?

- (A) U
- (B) Th
- (C) Ac
- (D) Pa

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14. Consider the following reaction:



The product 'A' is

- (A) $\text{C}_6\text{H}_5\text{CHO}$
- (B) $\text{C}_6\text{H}_5\text{OH}$
- (C) $\text{C}_6\text{H}_5\text{COCH}_3$
- (D) $\text{C}_6\text{H}_5\text{Cl}$

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15. An organic compound $\text{C}_3\text{H}_9\text{N}$ (A), when treated with nitrous acid, gave an alcohol and N_2 gas was evolved. (A) on warming with CHCl_3 and caustic potash gave (C) which on reduction gave isopropylmethanamine. Predict the structure of (A).

- (A) $(\text{CH}_3)_2\text{CH}-\text{NH}_2$
- (B) $\text{CH}_3\text{CH}_2-\text{NH}-\text{CH}_3$
- (C) $(\text{CH}_3)_3\text{N}$
- (D) $\text{CH}_3\text{CH}_2\text{CH}_2-\text{NH}_2$

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16. Which of the following reagents will be able to distinguish between 1-butyne and 2-butyne?

- (A) NaNH_2
- (B) HCl
- (C) O_2
- (D) Br_2

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17. Consider the reaction: $\text{RCHO} + \text{NH}_2\text{NH}_2 \rightarrow \text{RCH}=\text{N}-\text{NH}_2$. What sort of reaction is it?

- (A) Electrophilic addition - elimination reaction
- (B) Free radical addition - elimination reaction
- (C) Electrophilic substitution - elimination reaction
- (D) Nucleophilic addition - elimination reaction

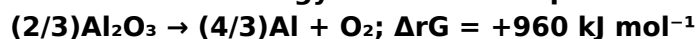
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18. Which of the following compounds can be used as antifreeze in automobile radiators ?

- (A) Methyl alcohol
- (B) Glycol
- (C) Nitrophenol
- (D) Ethyl alcohol

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19. The Gibbs energy for the decomposition of Al_2O_3 at 500°C is as follows:



The potential difference needed for the electrolytic reduction of aluminium oxide (Al_2O_3) at 500°C is at least

- (A) 4.5 V
- (B) 3.0 V
- (C) 2.5 V
- (D) 5.0 V

20. Chloramphenicol is an

- (A) antifertility drug
- (B) antihistaminic
- (C) antiseptic and disinfectant
- (D) antibiotic-broad spectrum

21. Which one of the following sets forms the biodegradable polymer?

- (A) $\text{CH}_2=\text{CH}-\text{CN}$ and $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2$
- (B) $\text{H}_2\text{N}-\text{CH}_2-\text{COOH}$ and $\text{H}_2\text{N}-(\text{CH}_2)_5-\text{COOH}$
- (C) $\text{HO}-\text{CH}_2-\text{CH}_2-\text{OH}$ and $\text{HOOC}-\text{C}_6\text{H}_4-\text{COOH}$ (terephthalic acid)
- (D) $\text{C}_6\text{H}_5-\text{CH}=\text{CH}_2$ and $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2$

Answer key and explanations**1. Answer: (C) 6.0×10^{-2}**

The required reaction is the given one reversed and halved, so $K' = (1/278)^{(1/2)} = 1/16.7 \approx 6.0 \times 10^{-2}$. Reversing without taking the square root gives 3.6×10^{-3} .

2. Answer: (C) 0.62

$K_c = [\text{AB}]^2/([\text{A}_2][\text{B}_2]) = (2.8 \times 10^{-3})^2/(3.0 \times 10^{-3} \times 4.2 \times 10^{-3}) = 7.84 \times 10^{-6}/1.26 \times 10^{-5} \approx 0.62$. The temperature is not needed, since K_c is computed directly from concentrations.

3. Answer: (A) π^* orbital

In O_2 the two π^*2p orbitals each hold one electron, and they are the lowest vacant-capacity orbitals, so the extra electron of O_2^- enters a π^* orbital. The bonding π and σ orbitals are already full.

4. Answer: (A) F_2 and I^-

The highest reduction potential (F_2 , +2.85 V) marks the strongest oxidising agent. The lowest reduction potential (I_2/I^- , +0.53 V) means I^- is most easily oxidised, so I^- is the strongest reducing agent; I_2 itself is an oxidant, not a reductant.

5. Answer: (A) $h/(\sqrt{2} \pi)$

Orbital angular momentum = $\sqrt{l(l+1)} \cdot h/2\pi$. For a p-electron $l = 1$, giving $\sqrt{2} \cdot h/2\pi = h/(\sqrt{2} \pi)$. $\sqrt{6} \cdot h/2\pi$ would be for a d-electron ($l = 2$).

6. Answer: (D) AB_2O_2

A ccp unit cell has 4 oxide ions, 8 tetrahedral voids and 4 octahedral voids. A occupies 1/4 of the tetrahedral voids (2 per cell) and B all octahedral voids (4 per cell), giving $\text{A}_2\text{B}_4\text{O}_4 = \text{AB}_2\text{O}_2$; the charges balance ($2 \times 2 + 4 \times 1 = 8 = 4 \times 2$).

7. Answer: (D) $390.5 \text{ S cm}^2 \text{ mol}^{-1}$

By Kohlrausch's law, $\Lambda^\circ(\text{CH}_3\text{COOH}) = \Lambda^\circ(\text{CH}_3\text{COONa}) + \Lambda^\circ(\text{HCl}) - \Lambda^\circ(\text{NaCl}) = 91.0 + 425.9 - 126.4 = 390.5 \text{ S cm}^2 \text{ mol}^{-1}$.

8. Answer: (D) 1.67

For any monoatomic ideal gas $C_v = (3/2)R$ and $C_p = (5/2)R$, so a mixture of two monoatomic gases still has $C_p/C_v = 5/3 \approx 1.67$. 1.50 is not the value for any simple ideal gas, and values below 1 are impossible.

9. Answer: (C) $\text{Ti} < \text{V} < \text{Cr} < \text{Mn}$: increasing melting points

Manganese has a much lower melting point (about 1246 °C) than chromium (about 1907 °C) because its stable $3d^5 4s^2$ configuration weakens metallic bonding, so $\text{Ti} < \text{V} < \text{Cr} < \text{Mn}$ for melting point is wrong. The other orders are right: Cr has the highest 2nd ionisation enthalpy (removing an electron from stable $3d^5$), and unpaired electrons rise from d^1 to d^4 across Ti^{3+} to Mn^{3+} .

10. Answer: (B) 36 u

By Graham's law, effusion time $\propto \sqrt{M}$, so $t/t_{\text{He}} = \sqrt{M/4} = 3$, giving $M = 36 \text{ u}$. Assuming time is proportional to M itself would give 12 u, and squaring wrongly gives 9 u.

11. Answer: (C) Cu ($Z = 29$)

Copper is the only one of these with a positive $E^\circ(\text{M}^{2+}/\text{M})$, about +0.34 V, because its high atomisation enthalpy and low hydration enthalpy are not compensated. Fe, Co and Ni all have negative values.

12. Answer: (D) $\text{He}_2^+ < \text{O}_2^- < \text{NO} < \text{C}_2^{2-}$

Bond orders from MO theory: $\text{He}_2^+ = 0.5$, $\text{O}_2^- = 1.5$, $\text{NO} = 2.5$ and $\text{C}_2^{2-} = 3$ (isoelectronic with N_2). So the increasing order is $\text{He}_2^+ < \text{O}_2^- < \text{NO} < \text{C}_2^{2-}$.

13. Answer: (C) Ac

Actinium ($5f^0$) shows only the +3 oxidation state. Thorium is mainly +4, protactinium up to +5 and uranium shows +3 to +6.

14. Answer: (A) C_6H_5CHO

This is the Rosenmund reduction: hydrogen over poisoned Pd-BaSO₄ reduces an acid chloride only as far as the aldehyde, so benzoyl chloride gives benzaldehyde, C_6H_5CHO . The poisoned catalyst prevents further reduction to the alcohol.

15. Answer: (A) $(CH_3)_2CH-NH_2$

Evolving N_2 with nitrous acid and giving a carbylamine (isocyanide) with $CHCl_3/KOH$ both show A is a primary amine. Reducing $(CH_3)_2CH-NC$ gives $(CH_3)_2CH-NH-CH_3$ (isopropylmethylamine), so A is isopropylamine, $(CH_3)_2CH-NH_2$. n-Propylamine would give n-propylmethylamine instead.

16. Answer: (A) $NaNH_2$

1-Butyne is a terminal alkyne with an acidic $\equiv C-H$ and reacts with $NaNH_2$ to form a sodium acetylide; 2-butyne has no such hydrogen. Br_2 and HCl add to both alkynes, so they cannot tell them apart.

17. Answer: (D) Nucleophilic addition - elimination reaction

The nucleophilic nitrogen of hydrazine adds to the electrophilic carbonyl carbon, and the intermediate then loses water to form the hydrazone $C=N$ bond. This is nucleophilic addition followed by elimination, not an electrophilic or free-radical process.

18. Answer: (B) Glycol

Ethylene glycol (ethane-1,2-diol) is the standard radiator antifreeze: it lowers the freezing point of water and, unlike methyl or ethyl alcohol, has a high boiling point so it does not evaporate away.

19. Answer: (C) 2.5 V

Making $4/3$ mol Al from Al^{3+} needs $(4/3) \times 3 = 4$ mol electrons per mol O_2 . $E = \Delta G/(nF) = 960000/(4 \times 96500) \approx 2.5$ V. Taking $n = 3$ instead would give about 3.3 V.

20. Answer: (D) antibiotic-broad spectrum

Chloramphenicol is a broad-spectrum antibiotic, effective against a wide range of Gram-positive and Gram-negative bacteria (used, for example, in typhoid). It is not an antiseptic applied to skin or an antihistamine.

21. Answer: (B) H_2N-CH_2-COOH and $H_2N-(CH_2)_5-COOH$

Glycine (H_2N-CH_2-COOH) and 6-aminohexanoic acid ($H_2N-(CH_2)_5-COOH$) condense to form nylon-2-nylon-6, a biodegradable polyamide. Ethylene glycol with terephthalic acid gives non-biodegradable polyester (Dacron/PET), and the other pairs give synthetic rubbers.

Questions as set in the AIPMT/NEET papers conducted by CBSE and NTA. Answers checked and explanations written by the RankUp team. RankUp is not affiliated with CBSE or NTA.