JEE (Main) 2020

COMPUTER BASED TEST (CBT)
Questions & Solutions

Date: 07 January, 2020 (SHIFT-1) | TIME : (9.30 am to 12.30 pm)
Duration: 3 Hours | Max. Marks: 300
SUBJECT : CHEMISTRY
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PART : CHEMISTRY

SECTION – 1 : (Maximum Marks : 80)
Straight Objective Type (सीधे व्यस्तसार प्रश्न)

This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) for its answer, out of which Only One is correct.

इस खंड में 20 सिधे-व्यस्तसार प्रश्न हैं। प्रत्येक प्रश्न के 4 विकल्प (1), (2), (3) तथा (4) हैं, जिनमे से एक सही है।

1. The dipole moments of CCl₄, CHCl₃ and CH₄ are in the order:
   CC₁₄, CHCl₃, CH₄ के दिष्टक आपूर्ति क्रम में हैं:
   (1) CH₄ < CCl₄ < CHCl₃ 
   (2) CC₁₄ < CH₄ < CHCl₃ 
   (3) CHCl₃ < CH₄ = CCl₄ 
   (4) CH₄ = CCl₄ < CHCl₃

   Ans. (4)
   Sol. $\mu_{\text{CCl}_4} = \mu_{\text{CH}_4} = 0$ but $\mu_{\text{CHCl}_3} \neq 0$

2. The theory that can completely/properly explain the nature of bonding in [Ni(CO)]₄ is:
   (1) Crystal field theory
   (2) Werner’s theory
   (3) Molecular orbital theory
   (4) Valence bond theory

   Ans. (3)
   Sol. जो [Ni(CO)]₄ में आपूर्ति की पूर्णता/समृद्धता बंग से व्यक्त कर सकता है, होगा—
   (1) क्रिस्टल फील्ड सिद्धांत
   (2) वर्नर के सिद्धांत
   (3) आविष्कारक कक्ष सिद्धांत
   (4) संयोजकता आविष्कार सिद्धांत

3. Consider the following reactions:
   (a) (CH₃)₂CCH(OH)CH₃ $\xrightarrow{\text{Conc. H}_2\text{SO}_4}$ (b) (CH₃)₂CHCH(CH(Br)CH₃ $\xrightarrow{\text{Alc. KOH}}$
   (c) (CH₃)₂CHCH(Br)CH₃ $\xrightarrow{(\text{CH}_3)_2\text{O}^+\text{K}^+}$ (d) (CH₃)₂C - CH₂ - CHO $\Delta$ OH

   Which of these reaction(s) will not produce Saytzeff product?
   (1) (b) and (d) 
   (2) (a), (c) and (d)
   (3) (d) only
   (4) (c) only

   Ans. (4)
   Sol. इन अभिक्रियाओं में से कौन सी सेटजेक्ट उत्पाद नहीं बनायेगी/बनायेगी?
   (1) (b) तथा (d) 
   (2) (a), (c) तथा (d)
   (3) (d) मात्र 
   (4) (c) मात्र

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4. Consider the following reaction:

\[ \text{Product 'X' is used:} \]
1. in laboratory test for phenols
2. in protein estimation as an alternative to ninhydrin
3. in acid base titration as an indicator
4. as food grade colourant

5. Given that the standard potentials (\( E^\circ \)) of Cu\(^{2+}/\text{Cu} \) and Cu\(^{+}/\text{Cu} \) are 0.34 V and 0.522 V respectively, the E\(^\circ \) of Cu\(^{2+}/\text{Cu} \) is:

- \( +0.158 \) V
- \( -0.182 \) V
- \( +0.182 \) V
- \( -0.158 \) V

6. 1-methyl-ethylene oxide when treated with an excess of HBr produces:

- Methyl orange is used as an indicator in acid base titration.

**Ans.**

**Sol.**

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7. The increasing order of pK_a for the following compounds will be:

(A) NH_2–CH=NH, (B) \( \text{NH}_2 \text{C} = \text{NH} \), (C) CH_3–NH–CH_3

(1) (A) < (B) < (C)  (2) (B) < (C) < (A)  (3) (B) < (A) < (C)  (4) (C) < (A) < (B)

Ans. (3)

Sol. Option "B" represents Guanadine, the conjugate acid of which is resonance stabilised. The option 'C' is an aliphatic amine, here the 'N' is sp^3 whereas in option 'A', the 'N' is sp^2, hence C is more basic than A. Both options (B) and (C) are resonance stabilised. Option 'C' is an aliphatic amine, here the 'N' is sp^3 whereas in option 'A', the 'N' is sp^2, hence C is more basic than A.

8. Oxidation number of potassium in K_2O, K_2O_2 and KO_2, respectively, is:

(1) +1, +2 and +4  (2) +1, +4 and +2  (3) +1, +1 and +1  (4) +2, +1 and +\( \frac{1}{2} \)

K_2O, K_2O_2, and KO_2 are oxides of potassium. Oxidation number of potassium in K_2O is +1, in K_2O_2 is +1, and in KO_2 is +1.

Ans. (3)

9. What is the product of the following reaction?

Hex-3-ynal

(i) \( \text{NaBH}_4 \)  
(ii) \( \text{PBr}_3 \)  
(iii) \( \text{Mg/ether} \)  
(iv) \( \text{CO}_2/\text{H}_2\text{O} \)

Ans. (1)

Sol. 

\[
\begin{align*}
\text{(1) } & \quad \text{CHO} \\
\text{(2) } & \quad \text{OH} \\
\text{(3) } & \quad \text{OH} \\
\text{(4) } & \quad \text{OH}
\end{align*}
\]

\[
\begin{align*}
\text{(1) } & \quad \text{CHO} \\
\text{(2) } & \quad \text{OH} \\
\text{(3) } & \quad \text{OH} \\
\text{(4) } & \quad \text{OH}
\end{align*}
\]
10. At 35°C, the vapour pressure of CS₂ is 512 mm Hg and that of acetone is 344 mm Hg. A solution of CS₂ in acetone has a total vapour pressure of 600 mm Hg. The false statement amongst the following is:
   (1) heat must be absorbed in order to produce the solution at 35°C
   (2) Raoult's law is not obeyed by this system
   (3) a mixture of 100 mL CS₂ and 100 mL acetone has a volume < 200 mL
   (4) CS₂ and acetone are less attracted to each other than to themselves.

   35°C पर, CS₂ का वाष्प दबा 512 mm Hg है तथा ऐसीटोन का 344 mm Hg है। ऐसीटोन में CS₂ के विलयन का कुल वाष्प दबा 600 mm Hg है। निम्न में से गलत कथन है:
   (1) 35°C पर, विलयन बनाने के लिए ऊष्मा अवशोषित होनी चाहिए।
   (2) तंत्र द्वारा राउल्ट सिद्धान्त का पालन नहीं हो रहा है।
   (3) 100 mL CS₂ तथा 100 mL ऐसीटोन मिश्रण का आयतन < 200 mL होगा।
   (4) CS₂ तथा ऐसीटोन के बीच आकर्षण उनके अंतर से बीच जो आकर्षण से कम होगा।

   Ans. (3)

   Sol. Above mixture of liquids show positive deviation from Raoul't's Law
   उपरोक्त मिश्रण राउल्ट नियम से धनात्मक विचलन दर्शाता है।

11. A solution of m-chloroaniline, m-chlorophenol and m-chlorobenzoic acid in ethyl acetate was extracted initially with a saturated solution of NaHCO₃ to give fraction A. The left over organic phase was extracted with dilute NaOH solution to give fraction B. The final organic layer was labelled as fraction C. Fraction A, B and C, contain respectively:
   (1) m-chlorobenzoic acid, m-chlorophenol and m-chloroaniline
   (2) m-chlorophenol, m-chlorobenzoic acid and m-chloroaniline
   (3) m-chloroaniline, m-chlorobenzoic acid and m-chlorophenol
   (4) m-chlorobenzoic acid, m-chloroaniline and m-chlorophenol

   एथिल ऐसीटेट में बना m-क्लोरोआनिलिन, m-क्लोरोफिनोल तथा m-क्लोरोबेंजोइड ऐसिड का विलयन प्रारम्भ में NaHCO₃ के संचालित विलयन के साथ निकास्तित किया गया जिससे प्रभाज A मिला। बचा हुआ कार्बनिक अंश तुर्क NaOH विलयन के साथ निकास्तित किया गया जिससे प्रभाज B मिला। अंतिम कार्बनिक परत को प्रभाज C के रूप में अंकित किया गया। प्रभाज A, B तथा C में क्रमः हैं:
   (1) m-क्लोरोबेंजोइड ऐसिड, m-क्लोरोफिनोल तथा m-क्लोरोआनिलिन
   (2) m-क्लोरोफिनोल, m-क्लोरोबेंजोइड ऐसिड तथा m-क्लोरोआनिलिन
   (3) m-क्लोरोआनिलिन, m-क्लोरोबेंजोइड ऐसिड तथा m-क्लोरोफिनोल
   (4) m-क्लोरोबेंजोइड ऐसिड, m-क्लोरोआनिलिन तथा m-क्लोरोफिनोल

   Ans. (1)
12. In comparison to the zeolite process for the removal of permanent hardness, the synthesis resins method is:
   (1) more efficient as it can exchange both cations as well as anions
   (2) less efficient as it exchanges only anions
   (3) more efficient as it can exchange only cations
   (4) less efficient as the resins cannot be regenerated

   Ans. (1)

13. The atomic radius of Ag is closest to:
   Ag की परमाणु विद्युत त्रिशत्त किशर निकटतम है वह है:
   (1) Au (2) Hg (3) Ni (4) Cu

   Ans. (1)

14. The IUPAC name of the complex [Pt(NH$_3$)$_2$Cl(NH$_2$CH$_3$)]Cl is:
   (1) Bisammine(methanamine)chloridoplatinum(II)chloride
   (2) Diammine(methanamine)chloridoplatinum(II)chloride.
   (3) Diamminechlorido(methanamine)platinum(II)chloride.
   (4) Diamminechlorido(amminomethane)platinum(II)chloride

   Ans. (3)
15. The electron gain enthalpy (in kJ/mol) of fluorine, chloride, bromine and iodine, respectively are :
   (1) –296, –325, –333 and –349
   (2) –333, –349, –325 and –296
   (3) –349, –333, –325 and –296
   (4) –333, –349, –325 and –296

   फ्लॉरिन, च्लोरिड, ब्रोमीड और आयडीड की इलेक्ट्रॉन ग्राह्मी तकनीकी (kJ/mol में) क्रम हैं :
   (1) –296, –325, –333 तथा –349
   (2) –333, –349, –325 तथा –296
   (3) –349, –333, –325 तथा –296
   (4) –333, –349, –325 तथा –296

   Ans. (2)

16. Match the following
   (i) Riboflavin (a) Beriberi
   (ii) Thiamine (b) Scurvy
   (iii) Pyridoxine (c) Cheilosis
   (iv) Ascorbic acid (d) Convulsions

   (1) (i) - (c); (ii) - (a); (iii) - (d); (iv) - (b)
   (2) (i) - (c); (ii) - (d); (iii) - (a); (iv) - (b)
   (3) (i) - (a); (ii) - (d); (iii) - (c); (iv) - (b)
   (4) (i) - (d); (ii) - (b); (iii) - (a); (iv) - (c)

   निम्न को सुसंगत करिए :
   (i) मिरिक्सिन (a) बेरिबेरी
   (ii) भैमीन (b) स्कररी
   (iii) पाइरिक्सिसन (c) फिलोसिस (ओट्न विशेषता)
   (iv) एसक्सर्सिक एसिड (d) गुलाम (आक्षण)

   Ans. (1)

Sol.

<table>
<thead>
<tr>
<th>Vitamins</th>
<th>Deficiency Diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin B&lt;sub&gt;1&lt;/sub&gt; (Thiamine)</td>
<td>Beri Beri</td>
</tr>
<tr>
<td>Vitamin B&lt;sub&gt;2&lt;/sub&gt; (Riboflavin)</td>
<td>Cheilosis</td>
</tr>
<tr>
<td>Vitamin B&lt;sub&gt;3&lt;/sub&gt; (Pyridoxine)</td>
<td>Convulsions</td>
</tr>
<tr>
<td>Vitamin C (Ascorbic acid)</td>
<td>Scurvy</td>
</tr>
</tbody>
</table>

17. Amongst the following statements, that which was not proposed by Dalton was :
   (1) When gases combine or reproduced in a chemical reaction they do so in a simple ratio by volume
   provided all gases are at the same T & P.
   (2) Matter consists of indivisible atoms
   (3) Chemical reactions involve reorganization of atoms. These are neither created nor destroyed in a
   chemical reaction.
   (4) All the atoms of a given element have identical properties including identical mass. Atoms of different
   elements differ in mass.
If the numerical value has more than two decimal places truncate/round-off the value up to TWO decimal places.

- Full Marks: +4 If ONLY the correct option is chosen.
- Zero Marks: 0 In all other cases

SECTION – 2 : (Maximum Marks : 20)

This section contains FIVE (05) questions. The answer to each question is NUMERICAL VALUE with two digit integer and decimal up to one digit.

If the numerical value has more than two decimal places truncate/round-off the value up to TWO decimal places.
21. Two solutions, A and B, each of 100 L was made by dissolving 4g of NaOH and 9.8 g of H$_2$SO$_4$ in water, respectively. The pH of the resultant solution obtained from mixing 40 L of solution A and 10 L of solution B is _______.

**Ans. 10.60 to 10.60**

**Sol.**

\[
M_{H_2SO_4} = \frac{9.8}{98 \times 100} = 10^{-3}
\]

\[
M_{NaOH} = \frac{4}{40 \times 100} = 10^{-3}
\]

\[
= \frac{40 \times 10^{-3} - 10 \times 10^{-3} \times 2}{50} = \frac{20 \times 10^{-3}}{50} = \frac{2}{5} \times 10^{-3}
\]

\[
[OH^-] = \frac{2}{5} \times 10^{-3}
\]

pOH = 3.397

pH = 10.603

22. For the reaction:

\[
A(l) \rightarrow 2B(g)
\]

\[
\Delta U = 2.1 \text{ kcal}, \Delta S = 20 \text{ cal K}^{-1} \text{ at 300 K}.
\]

Hence \(\Delta G\) in K.cal is _______.

**Ans. \(-2.70\) to \(-2.70\)**

**Sol.**

\[
\Delta H = \Delta U + \Delta RT
\]

\[
= 2.1 \times 10^2 + 2(2)(300)
\]

\[
= 2100 + 1200
\]

\[
= 3300 \text{ cal}
\]

\[
\Delta G = \Delta H - T \Delta S = 3300 - (300)(20) = 3300 - 6000 = -2700 \text{ cal} = -2.7 \text{ kcal}
\]

23. The number of chiral carbons in chloramphenicol is_____.

**Ans. 2.00 to 2.00**
24. Chlorine reacts with hot and concentrated NaOH and produces compounds (X) and (Y). Compound (X) gives white precipitate with silver nitrate solution. The average bond order between Cl and O atoms in (Y) is __________.

Ans. 1.66 to 1.67

Sol. 3Cl₂ + 6NaOH → 5NaCl - NaClO₃ + 3H₂O

NaCl + AgNO₃ → AgCl + NaNO₃ ppt.

Y is NaClO₃  
ClO₅⁻ (bond order) = \( \frac{5}{3} = 1.67 \)

Sol. 3Cl₂ + 6NaOH → 5NaCl - NaClO₃ + 3H₂O

NaCl + AgNO₃ → AgCl + NaNO₃ ppt.

Y is NaClO₃  
ClO₅⁻ (bond order) = \( \frac{5}{3} = 1.67 \)

25. During the nuclear explosion, one of the products is \(^{90}\text{Sr}\) with half life of 6.93 years. If 1 µg of \(^{90}\text{Sr}\) was absorbed in the bones of a newly born baby in place of Ca, how much time, in years, is required to reduce it by 90% if it is not lost metabolically.

Ans. 23.00 to 23.03

Sol. \( t_{90\%} = \frac{\ln 100}{\ln 2} = \frac{m10}{m2} = 0.693 \)

\( t_{90\%} = \frac{6.93}{0.693} \times \frac{m10}{m10} = 10/10 = 23.03 \text{Years} \)
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