JEE (Main) 2020

COMPUTER BASED TEST (CBT)

Questions & Solutions

Date: 08 January, 2020 (SHIFT-1)  |  TIME : (9.30 am to 12.30 pm)

Duration: 3 Hours  |  Max. Marks: 300

SUBJECT : CHEMISTRY
HIGHEST number of CLASSROOM Students Qualified for JEE (Advanced) 2019 from any Institute of India*

12483* with 8 classroom students in top 100 in JEE Main 2019

(All are from Regular Classroom Program)

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Classroom student since class 9th
Roll No.: 1773285

AIR-100
Anandanand Nandi
Classroom student since class 9th
Roll No.: 1773289

AIR-77
Anubhav Kalyani
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Roll No.: 1770992

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AIR-30
Rajdeep Paul
Classroom student since class 9th
Roll No.: 1172006

AIR-82
Saptarshi Dasgupta
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AIR-45
Atrey Goswami
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Roll No.: 1177582

AIR-12
Shubhankar Gambhir
Classroom student since class 9th
Roll No.: 1177583

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Atin BalaNada, Raja, Kuldeep Meena

AIR-11 (SC)
Anshul Navphule

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4230 students from Freshers’ Batches

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Student Qualified for JEE (Advanced) 2019 from any Institute of India*
1510

HIGHEST CLASSROOM HINDI MEDIUM
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1. The first ionization energy (in kJ/mol) of Na, Mg, Al and Si respectively, are : 
Na, Mg, Al and Si की प्रथम आयान्त ऊर्जा (kJ/mol मी) क्रमशः है : 
(1) 496, 577, 737, 786 (2) 786, 737, 577, 496 (3) 496, 737, 577, 496 (4) 496, 737, 786, 776 
Ans. (4) 
Sol. Correct order of ionisation energy will be : Na < Al < Mg < Si 
आयान्त ऊर्जाओं का सही क्रम होगा : Na < Al < Mg < Si 

2. The stoichiometry and solubility product of a salt with the solubility curve given below is, respectively : 
तथा विलेयता गुणफल, क्रमशः है : 
(1) X₂Y, 2 × 10⁻⁶ M³ (2) XY, 2 × 10⁻⁶ M³ (3) XY₂, 4 × 10⁻⁶ M³ (4) XY₂, 1 × 10⁻⁶ M³ 
Ans. (3) 
Sol. 

\[
XY_2(s) \rightarrow X^+(aq) + 2Y^-(aq)
\]

\[
K_{sp} = [X^+][Y^2^-]^{2/3}
\]

or या, \(K_{sp} = 10^{-3} \times (2 \times 10^{-3})^2\) or या, \(K_{sp} = 4 \times 10^{-9} M^3\)

3. The third ionization enthalpy is minimum for : 
त्रितीय आयान्त ऊर्जा मिनिमम है, वह है : 
(1) Ni (2) Co (3) Mn (4) Fe 
Ans. (4) 
Sol. 

\[
_{26}^{4s}Fe = [Ar]3d^6 4s^2
\]
4. The complex that can show fac– and mer– isomers is:
   यह संकर जो fac- तथा mer- समावयवी प्रदर्शित करता है, है:
   (1) [CoCl₃(en)₂]   (2) [Pt(NH₃)₂Cl₂]   (3) [Co(NH₃)₄Cl₂]⁺   (4) [Co(NH₃)₃(NO₂)₃]
   **Ans.**
   (4)
   **Sol.**
   [M₆b₃] type complex shows facial and meridional isomerism
   [M₆b₃] प्रकार का संयुक्त फलकीय–रखरखाल व्यावहारिक समावयवता दर्शाता है।

5. The strength of an aqueous NaOH solution is most accurately determined by titrating:
   (Note: consider that an appropriate indicator is used)
   जलीय NaOH सैरणन की सामर्थ्य सरासरिक यथार्थता से इस तरह अनुमापन द्वारा निकाली जाती है:
   (नोट: विचार कीजिए कि एक उपयुक्त संयुक्त का उपयोग किया गया है)
   (1) Aq. NaOH in a volumetric flask and concentrated H₂SO₄ in a conical flask
   (2) Aq. NaOH in a burette and aqueous oxalic acid in a conical flask
   (3) Aq. NaOH in a pipette and aqueous oxalic acid in a burette
   (4) Aq. NaOH in a burette and concentrated H₂SO₄ oxalic in a conical flask
   **Ans.**
   (2)
   **Sol.**
   Oxalic acid is a primary standard solution while H₂SO₄ is a secondary standard solution.
   ऑक्सालिक अम्ल प्राथमिक मानक विलयन है जबकि H₂SO₄ द्वितीय मानक विलयन है।

6. A graph of vapour pressure and temperature for three different liquids X, Y and Z is shown below:
   तीन अलग-अलग रास्ते X, Y एवं Z के लिए धार्म दब तथा ताप के बीच एक ग्राफ नीचे लिया गया है:

   ![Graph](image)

   The following inferences are made:
   (1) X has higher intermolecular interactions compared to Y.
   (2) X has lower intermolecular interactions compared to Y.
   (3) Z has lower intermolecular interactions compared to Y.
   The correct inference(s) is/are:
   (1) (C)   (2) (B)   (3) (A) and (C)   (4) A
   **Ans.**
   (2)
   **Sol.**
   At a particular temperature as intermolecular force of attraction increases vapour pressure decreases.
   एक निश्चित ताप पर अतिरिक्त अंतराल्युक्त आकर्षण बल में व्याप्ति के साथ धार्म दब में कमी आती है।
7. The rate of a certain biochemical reaction at physiological temperature (T) occurs 10^6 times faster with enzyme than without. The change in the activation energy upon adding enzyme is:

\[ \text{K} = Ae^{-E_a/RT} \]

According to hardy-schultz rule, coagulation value or flocculation value for ferric hydroxide sol are in the order:

**Ans.** (1) (a), (c), (d), and (e)

8. Among the gases (a) – (e), the gases that cause greenhouse effect are:

(a) CO2  (b) O3 (c) CFCs  (d) O2  (e) O3

**Ans.** (2) (a), (b), (c), and (e)

9. When gypsum is heated to 393 K, it forms:

(1) Anhydrous CaSO4  (2) CaSO4 · 0.5 H2O

**Ans.** (1)

10. As per Hardy–Schulze formulation, the flocculation values of the following for ferric hydroxide sol are in the order:

**Ans.** (1) 1

\[ \frac{1}{\text{Coagulation power}} \]
11. Which of the following statement is not true for glucose?
   - Glucose exists in two crystalline forms α and β.
   - Glucose reacts with hydroxylamine to form oxime.
   - Glucose gives Schiff’s test for aldehyde.
   - The pentaacetate of glucose does not react with hydroxylamine to give oxime.
   - The pentaacetate of glucose does not react with hydroxylamine to give oxime.

   Ans. (3)
   Sol. Open chain form of glucose is very very small, hence does not gives Schiff’s test.

12. Arrange the following compounds in increasing order of C–OH bond length:
   - Methanol, phenol, p-ethoxyphenol
   - Methanol < phenol < p-ethoxyphenol
   - Phenol < methanol < p-ethoxyphenol
   - Phenol < p-ethoxyphenol < methanol

   Ans. (3)
   Sol. There is not any resonance in CH₃–OH. Resonance is poor in p-Ethoxyphenol than phenol. So C–OH bond length order is: CH₃–OH > p-ethoxyphenol (p-HO–C₆H₄–OH) Ph–OH
   - CH₃–OH in C–OH of methanol
   - Phenol < p-ethoxyphenol < CH₃–OH

13. For the Balmer series in the spectrum of H atom, \( \bar{\nu} = R_{\infty} \left( \frac{1}{n_1^2} - \frac{1}{n_2^2} \right) \), the correct statements among (I) to

   (IV) are:
   - (I) As wavelength decreases, the lines in the series converge
   - (II) The integer \( n_1 \) is equal to 2
   - (III) The lines of longest wavelength corresponds to \( n_2 = 3 \)
   - (IV) The ionization energy of hydrogen can be calculated from wave number of these lines

   Ans. (4)
   Sol. Theory based.
   Sol. सैद्धांतिक
14. The predominant intermolecular forces present in ethyl acetate, a liquid, are:

(1) Dipole-dipole and hydrogen bonding
(2) London dispersion, dipole-dipole and hydrogen bonding
(3) London dispersion and dipole-dipole
(4) Hydrogen bonding and London dispersion

(1) Dipole-dipole and hydrogen bonding
(2) London dispersion, dipole-dipole and hydrogen bonding
(3) London dispersion and dipole-dipole
(4) Hydrogen bonding and London dispersion

Ans. (3)

Sol. Ethyl acetate is polar molecule so dipole-dipole interaction will be present in it.

15. The most suitable reagent for the given conversion is:

(2) H₂/Pd
(3) NaBH₄
(4) LiAlH₄
(5) B₂H₆

B₂H₆ is very selective reducing agent and usually used to reduce acid to alcohol.

16. The number of bonds between sulphur and oxygen atoms in S₂O₈²⁻ and the number of bonds between sulphur and sulphur atoms in rhombic sulphur, respectively, are:

(1) 8 and 8
(2) 8 and 6
(3) 4 and 6
(4) 4 and 8

S₈ in rhombic sulphur and S₂O₈²⁻ in sodium persulphate both have 8-membered rings. However, S₂O₈²⁻ has additional bonds between oxygen and sulphur atoms as well.

Ans. (1)
17. The major product of the following reaction is:

![Chemical structure](image)

**Ans. (3)**

**Sol.**

18. The decreasing order of reactivity towards dehydrohalogenation (E₁) reaction of the following compounds is:

![Chemical structures](image)

**Ans. (2)**

**Sol.**

E₁ reaction proceeds via carbocation formation, therefore, greater the stability of carbocation, faster the E₁ reaction.

E₁ अभिक्रिया कार्बोक्यासन के निर्माण से सम्पन्न होती है इस प्रकार कार्बोक्यासन का अधिक स्थायित्व, E₁ अभिक्रिया को तीव्र करता है।
19. The major products A and B in the following reactions are:

\[ \text{CN} \xrightarrow{\text{Peroxide, heat}} \text{[A]} \]

\[ \text{[A]} + \text{CN} \xrightarrow{\text{heat}} \text{[B]} \]

(1) \( A = \text{CN} \quad \text{and} \quad B = \text{CN} \)

(2) \( A = \text{CN} \quad \text{and} \quad B = \text{CN} \)

(3) \( A = \text{CN} \quad \text{and} \quad B = \text{CN} \)

(4) \( A = \text{CN} \quad \text{and} \quad B = \text{CN} \)

Ans. (2)

Sol.

\[ \text{CN} \xrightarrow{\text{Peroxide, heat}} \text{[A]} \]

\[ \text{[A]} + \text{CN} \xrightarrow{\text{heat}} \text{[B]} \]

\[ \text{[A]} \] would be more stable radical and undergoes radical addition to form \([B]\). \([A]\) undergoes radical addition to form \([B]\).

20. A flask contains a mixture of isohexane and 3-methylpentane. One of the liquids boils at 63°C while the other boils at 60°C. What is the best way to separate the two liquids and which one will be distilled out first?

(1) simple distillation, isohexane
(2) simple distillation, 3-methylpentane
(3) fractional distillation, 3-methylpentane
(4) fractional distillation, isohexane

Ans. (4)

Sol.

Liquid having lower boiling point comes out first in fractional distillation. Fractional distillation is generally used if boiling point difference is small. (Boiling point of 3-methylpentane = 63°C, isohexane = 60°C)

The major products A and B in the following reactions are:

\[ \text{CN} \xrightarrow{\text{Peroxide, heat}} \text{[A]} \]

\[ \text{[A]} + \text{CN} \xrightarrow{\text{heat}} \text{[B]} \]

(1) \( A = \text{CN} \quad \text{and} \quad B = \text{CN} \)

(2) \( A = \text{CN} \quad \text{and} \quad B = \text{CN} \)

(3) \( A = \text{CN} \quad \text{and} \quad B = \text{CN} \)

(4) \( A = \text{CN} \quad \text{and} \quad B = \text{CN} \)

Ans. (2)

Sol.

\[ \text{CN} \xrightarrow{\text{Peroxide, heat}} \text{[A]} \]

\[ \text{[A]} + \text{CN} \xrightarrow{\text{heat}} \text{[B]} \]

\[ \text{[A]} \] would be more stable radical and undergoes radical addition to form \([B]\). \([A]\) undergoes radical addition to form \([B]\).
21. The magnitude of work done by a gas that undergoes a reversible expansion along the path ABC shown in the figure is

![Pressure-Volume Graph](image)

\[\text{Volume} \ (\text{m}^3)\]

\[\text{Pressure} \ (\text{Pa})\]

\[A \quad B\]

\[10 \quad 8 \quad 6 \quad 4\]

\[(2, 2)\]

\[\text{Find the value of } W.\]

**Ans.** 48.00 to 48.00

**Sol.**

\[|W| = \frac{1}{2} (6 + 10) \times 6 = 48 \text{ J}\]

22. The volume (in mL) of 0.125 M AgNO_3 required to quantitatively precipitate chloride ions in 0.3 g of [Co(NH_3)_6]Cl_3 is ___________.

\[-\text{M}[\text{Co(NH}_3)_6]\text{Cl}_3 = 267.46 \text{ g/mol}\]

\[-\text{MAgNO}_3 = 169.87 \text{ g/mol}\]

\[-\text{[Co(NH}_3)_6]\text{Cl}_3 \text{ of } 0.3 \text{ g } \text{ of } \text{Cl}^- \text{ ions}\]

\[-\text{Vol. of } \text{AgNO}_3 \text{ required} = \frac{0.3 \times 10^{-3} \times 267.46}{0.125} = 6.29 \text{ mL}\]

**Ans.** 26.80 to 27.00

**Sol.**

\[\text{[ML}_3]\text{Cl}_3 + 3\text{AgNO}_3 \rightarrow 3\text{AgCl}\]

\[0.3 \text{ g} \quad \text{v mL, } 0.125 \text{ M}\]

\[\frac{0.3}{267.46} \times 3 = 0.125 \times V \times 10^{-3} \quad \text{or, } V = \frac{0.3 \times 3 \times 1000}{267.46 \times 0.125} = 26.92 \text{ mL}\]
23. Ferrous sulphate heptahydrate is used to fortify foods with iron. The amount (in grams) of the salt required to achieve 10 ppm of iron in 100 kg of wheat is ___________.
Atomic weight : Fe = 55.85 ; S = 32.00 ; O = 16.00
Mass of Fe(ing) = 1 g
\[ \text{Mass of Fe(ing)} = \frac{1 \text{ g}}{55.85 \text{ g in 1 mole}} \times 1000 \]
\[ = \frac{1}{55.85} \times 1000 \text{ g} \]
\[ = 4.97 \text{ g} \]

\[ \text{Ans. 4.95 to 4.97} \]

24. The number of chiral centres in penicillin is ___________.
Star marked atoms are chiral centres.

\[ \text{Ans. 3.00 to 3.00} \]

25. What would be the electrode potential for the given half cell reaction at pH = 5 ?
\[ 2\text{H}_2\text{O} \rightarrow \text{O}_2 + 4\text{H}^+ + 4e^- ; E^o_{\text{red}} = 1.23 \text{ V} (R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1} ; \text{Temp} = 298 \text{ K} ; \text{oxygen under std. pressure of 1 bar}) \]
\[ \text{pH} = 5 \text{ पर, दी गई अर्ध सेल अभिक्रिया के लिए इलेक्ट्रोड विषय का होगा होगा} ? \]
\[ 2\text{H}_2\text{O} \rightarrow \text{O}_2 + 4\text{H}^+ + 4e^- ; E^o_{\text{red}} = 1.23 \text{ V} (R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1} ; \text{Temp} = 298 \text{ K} ; \text{ऑक्सीजन मानक वायुमण्डलीय} \]
\[ \text{दाब 1 bar पर}) \]

\[ \text{Ans. 1.52 to 1.53} \]

\[ \text{Sol. From the given data} \]
\[ E_{\text{ap}} = E^o_{\text{ap}} - \frac{0.0591}{4} \log [\text{H}^+]^4 \]
\[ E_{\text{ap}} = 1.23 - \frac{0.0591}{4} \log [\text{H}^+]^4 \]
\[ = -1.23 + 0.0591 \times \text{pH} = -1.23 + 0.0591 \times 5 \]
\[ = -1.23 + 0.2955 = -0.9345 \text{ V} = -0.93 \text{ V} \]
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