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JEE (Advanced)
PAPER-1

2021

COMPUTER BASED TEST (CBT)
Questions

Date: 03 October, 2021

(Paper 1 - 9:00 am – 12:00 pm | Paper 2 – 2:30 pm to 5:30 pm)

Duration : 3 Hrs. | Total Marks : 180

SUBJECT: CHEMISTRY

SECTION 1

- This section contains **FOUR (04)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.
- For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated <u>according to the following marking scheme</u>:

  Full Marks   : $+3$ If ONLY the correct option is chosen;

  Zero Marks   :   0 If none of the options is chosen (i.e. the question is unanswered);

  Negative Marks : -1 In all other cases.

Q.1   The major product formed in the following reaction is

(A)

(B)

(C)

(D)
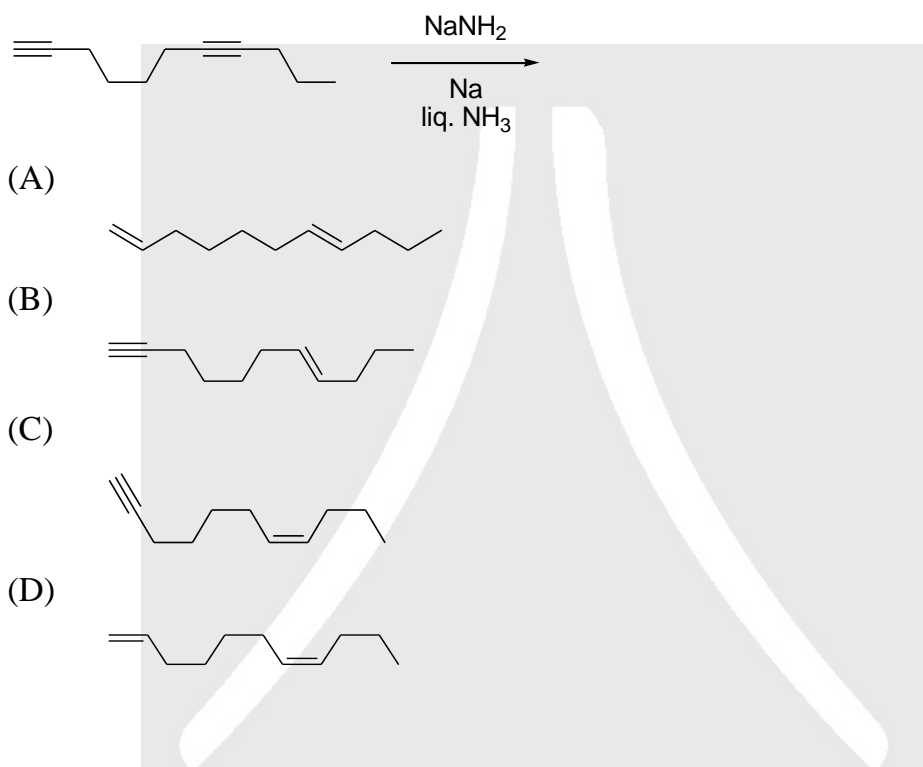
Q.2   Among the following, the conformation that corresponds to the most stable conformation of *meso*-butane-2,3-diol is

(A)

(B)

(C)

(D)
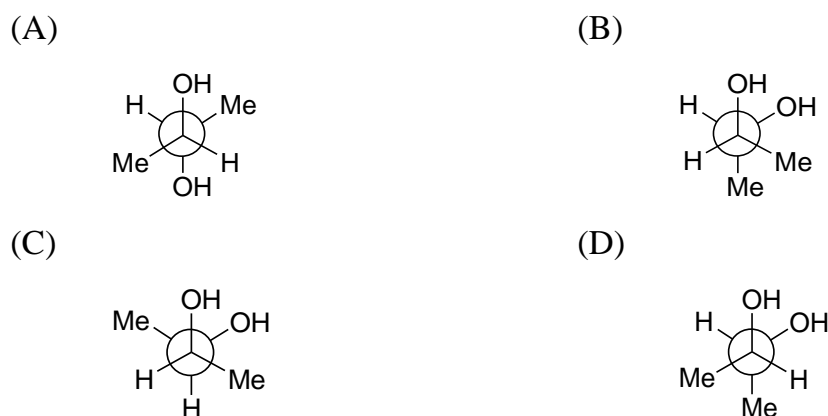
Q.3   For the given close packed structure of a salt made of cation **X** and anion **Y** shown below (ions of only one face are shown for clarity), the packing fraction is approximately (packing fraction $= \frac{\text{packing efficiency}}{100}$)
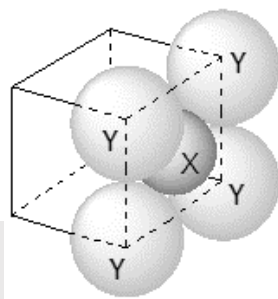
(A) 0.74   (B) 0.63   (C) 0.52   (D) 0.48

Q.4   The calculated spin only magnetic moments of $[Cr(NH_3)_6]^{3+}$ and $[CuF_6]^{3-}$ in BM, respectively, are

(Atomic numbers of Cr and Cu are 24 and 29, respectively)

(A) 3.87 and 2.84   (B) 4.90 and 1.73

(C) 3.87 and 1.73   (D) 4.90 and 2.84

Question Stem for Question Nos. 5 and 6

Question Stem

For the following reaction scheme, percentage yields are given along the arrow:
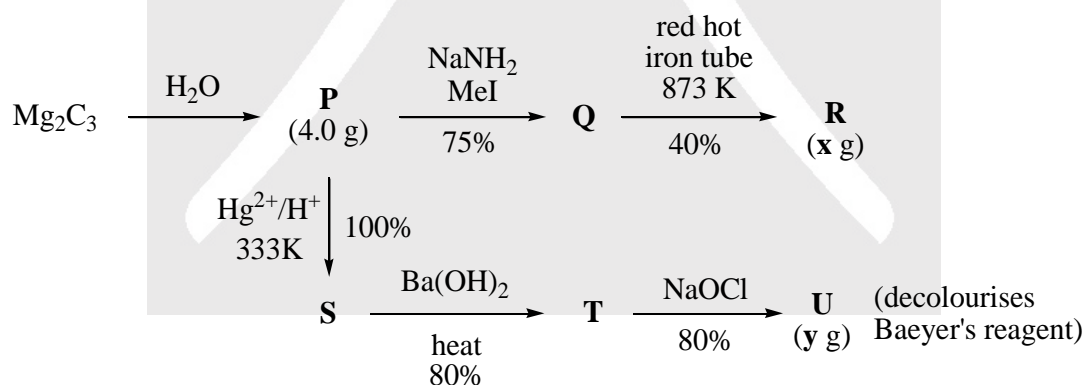
x g and y g are mass of **R** and **U**, respectively.
(Use: Molar mass (in g mol^{-1}) of H, C and O as 1, 12 and 16, respectively)

Q.5   The value of **x** is ___.

Q.6   The value of **y** is ___.

Question Stem for Question Nos. 7 and 8

Question Stem

For the reaction, $\mathbf{X}(s) \rightleftharpoons \mathbf{Y}(s) + \mathbf{Z}(g)$, the plot of $\ln \frac{p_Z}{p^{\ominus}}$ versus $\frac{10^4}{T}$ is given below (in solid line), where p_Z is the pressure (in bar) of the gas $\mathbf{Z}$ at temperature T and $p^{\ominus} = 1$ bar.

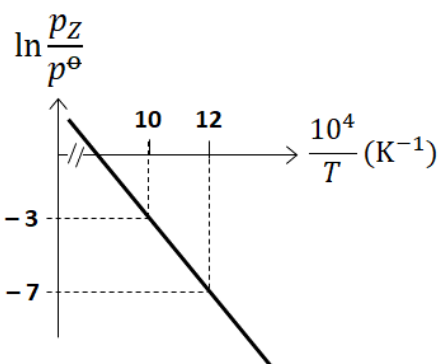(Given, $\dfrac{d\,(\ln K)}{d\left(\frac{1}{T}\right)} = -\dfrac{\Delta H^{\ominus}}{R}$, where the equilibrium constant, $K = \dfrac{p_Z}{p^{\ominus}}$ and the gas constant, R $= 8.314$ J K^{-1} mol^{-1})

Q.7   The value of standard enthalpy, $\Delta H^{\ominus}$ (in kJ mol^{-1}) for the given reaction is ___.

Q.8   The value of $\Delta S^{\ominus}$ (in J K^{-1} mol^{-1}) for the given reaction, at 1000 K is ___.

Question Stem for Question Nos. 9 and 10

Question Stem

The boiling point of water in a 0.1 molal silver nitrate solution (solution **A**) is **x** °C. To this solution **A**, an equal volume of 0.1 molal aqueous barium chloride solution is added to make a new solution **B**. The difference in the boiling points of water in the two solutions **A** and **B** is **y** $\times 10^{-2}$ °C.

(Assume: Densities of the solutions **A** and **B** are the same as that of water and the soluble salts dissociate completely.
Use: Molal elevation constant (Ebullioscopic Constant), $K_b = 0.5$ K kg mol^{-1};
Boiling point of pure water as 100 °C.)

Q.9   The value of **x** is ___.

Q.10   The value of |**y**| is ___.
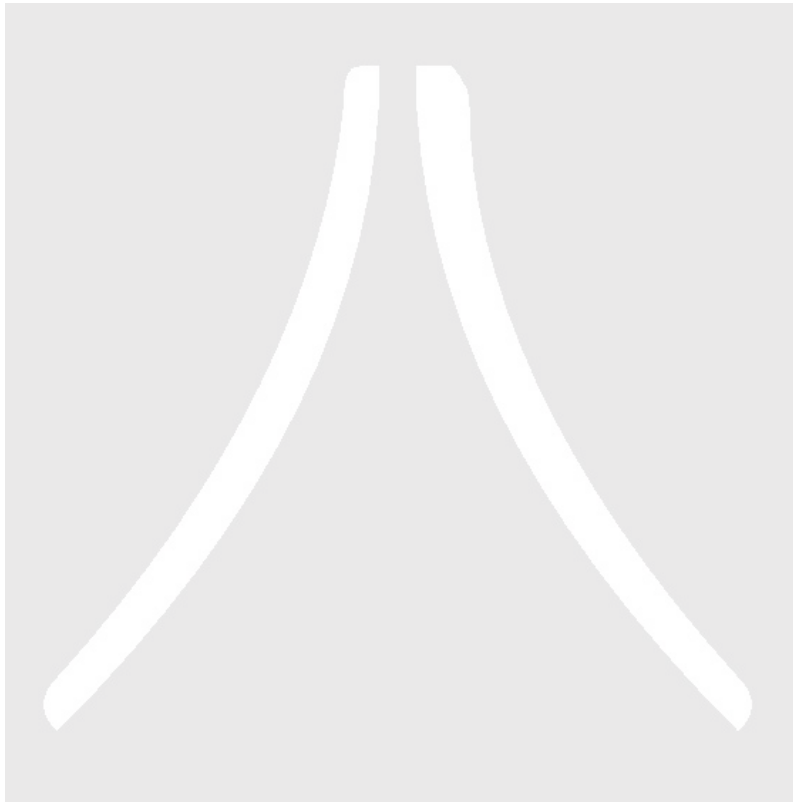
SECTION 3

- This section contains **SIX (06)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
- Answer to each question will be evaluated <u>according to the following marking scheme</u>:

  Full Marks   : $+4$ If only (all) the correct option(s) is(are) chosen;
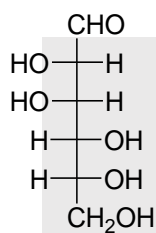 *Partial Marks*   : $+3$ If all the four options are correct but ONLY three options are chosen;
  Partial Marks   : $+2$ If three or more options are correct but ONLY two options are chosen, both of which are correct;
  Partial Marks   : $+1$ If two or more options are correct but ONLY one option is chosen and it is a correct option;
  Zero Marks   : 0 If unanswered;
  Negative Marks : -2 In all other cases.

- For example, in a question, if (A), (B) and (D) are the ONLY three options corresponding to correct answers, then
  choosing ONLY (A), (B) and (D) will get $+4$ marks;
  choosing ONLY (A) and (B) will get $+2$ marks;
  choosing ONLY (A) and (D) will get $+2$marks;
  choosing ONLY (B) and (D) will get $+2$ marks;
  choosing ONLY (A) will get $+1$ mark;
  choosing ONLY (B) will get $+1$ mark;
  choosing ONLY (D) will get $+1$ mark;
  choosing no option(s) (i.e. the question is unanswered) will get 0 marks and
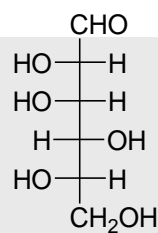 choosing any other option(s) will get -2 marks.

Q.11   Given:

CHO
H —— OH
HO —— H $\xrightarrow{\text{HNO}_3}$ **P**
H —— OH $[\alpha]_D = +52.7°$
H —— OH
CH$_2$OH
D-Glucose
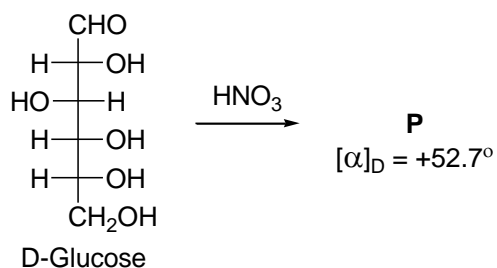
The compound(s), which on reaction with HNO$_3$ will give the product having degree of rotation, $[\alpha]_D = -52.7°$ is(are)
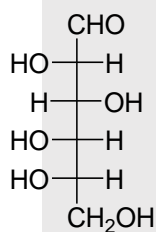
(A)   (B)

CHO   CHO
HO —— H   HO —— H
HO —— H   HO —— H
H —— OH   H —— OH
H —— OH   HO —— H
CH$_2$OH   CH$_2$OH

(C)   (D)

CHO   CHO
HO —— H   H —— OH
H —— OH   H —— OH
HO —— H   HO —— H
HO —— H   H —— OH
CH$_2$OH   CH$_2$OH
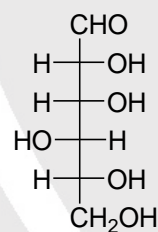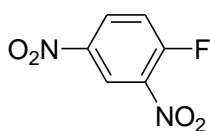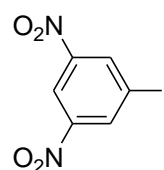
Q.12   The reaction of **Q** with PhSNa yields an organic compound (major product) that gives positive Carius test on treatment with Na$_2$O$_2$ followed by addition of BaCl$_2$. The correct option(s) for **Q** is(are)

(A)   (B)

O$_2$N——⬡——F   O$_2$N
           | \
          NO$_2$ ⬡——I
                                                     /
                                                 O$_2$N

(C)   (D)

MeS   O$_2$N——⬡
  \   \
   ⬡——Br   CH$_2$—Cl
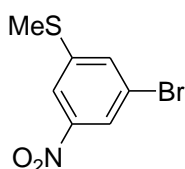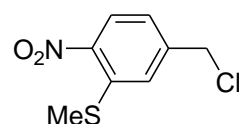 /   MeS
O$_2$N

Q.13   The correct statement(s) related to colloids is(are)

   (A) The process of precipitating colloidal sol by an electrolyte is called peptization.

   (B) Colloidal solution freezes at higher temperature than the true solution at the
        same concentration.

   (C) Surfactants form micelle above critical micelle concentration (CMC). CMC
        depends on temperature.

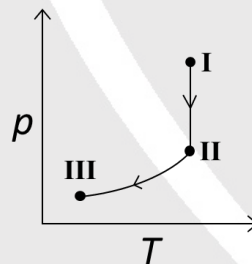   (D) Micelles are macromolecular colloids.

Q.14   An ideal gas undergoes a reversible isothermal expansion from state **I** to state **II**
        followed by a reversible adiabatic expansion from state **II** to state **III**. The correct
        plot(s) representing the changes from state **I** to state **III** is(are)

   (p: pressure, V: volume, T: temperature, H: enthalpy, S: entropy)
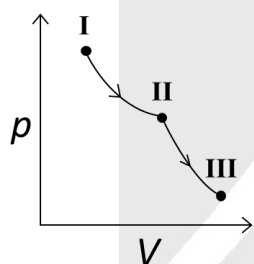
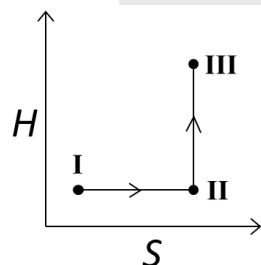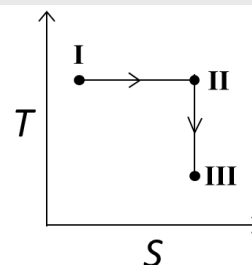   (A)   (B)

   (C)   (D)

Q.15 The correct statement(s) related to the metal extraction processes is(are)

(A) A mixture of PbS and PbO undergoes self-reduction to produce Pb and SO_2.

(B) In the extraction process of copper from copper pyrites, silica is added to produce copper silicate.

(C) Partial oxidation of sulphide ore of copper by roasting, followed by self-reduction produces blister copper.

(D) In cyanide process, zinc powder is utilized to precipitate gold from $Na[Au(CN)_2]$.

Q.16 A mixture of two salts is used to prepare a solution **S**, which gives the following results:
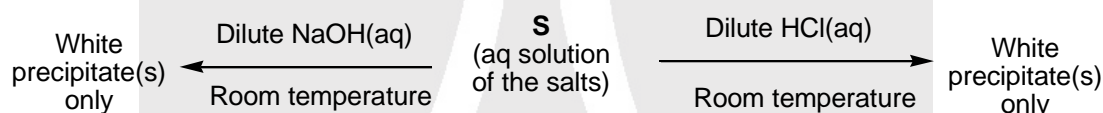
The correct option(s) for the salt mixture is(are)

(A) $Pb(NO_3)_2$ and $Zn(NO_3)_2$ (B) $Pb(NO_3)_2$ and $Bi(NO_3)_3$

(C) $AgNO_3$ and $Bi(NO_3)_3$ (D) $Pb(NO_3)_2$ and $Hg(NO_3)_2$
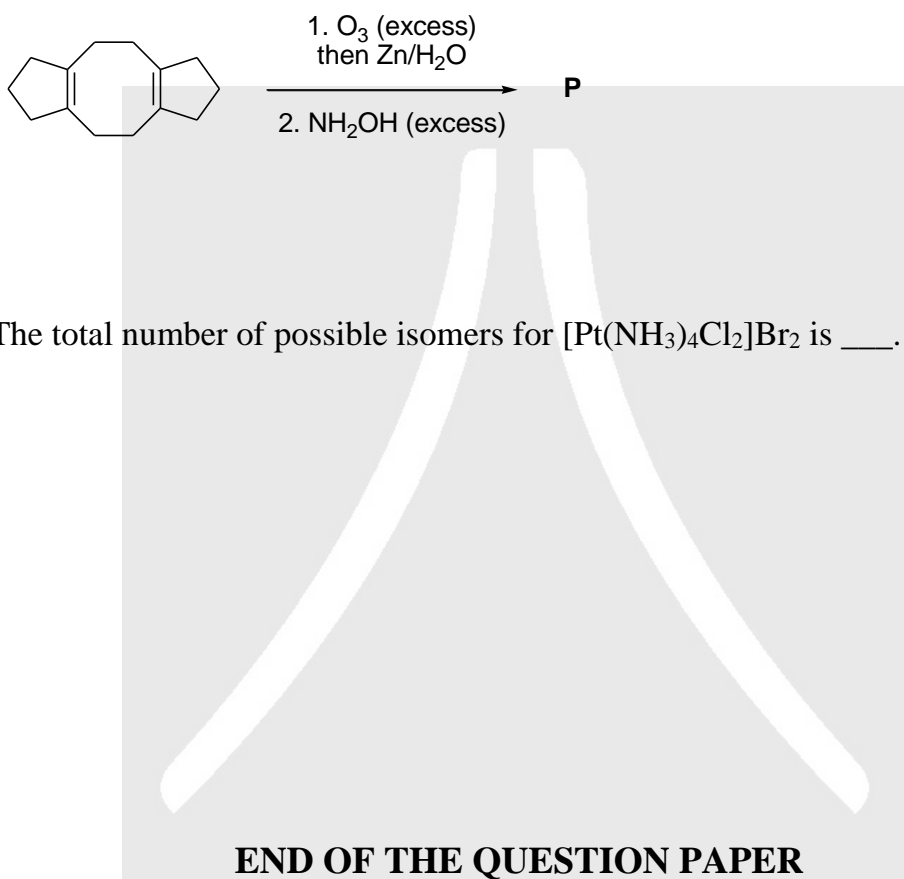

SECTION 4

- This section contains **THREE (03)** questions.
- The answer to each question is a **NON-NEGATIVE INTEGER.**
- For each question, enter the correct integer corresponding to the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.
- Answer to each question will be evaluated <u>according to the following marking scheme</u>:

  Full Marks   : $+4$ If ONLY the correct integer is entered;

  Zero Marks   :   0   In all other cases.

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Q.17   The maximum number of possible isomers (including stereoisomers) which may be
       formed on *mono*-bromination of 1-methylcyclohex-1-ene using Br$_2$ and UV light
       is ___.

Q.18   In the reaction given below, the total number of atoms having *sp^2* hybridization in
       the major product **P** is ___.

Q.19   The total number of possible isomers for [Pt(NH$_3$)$_4$Cl$_2$]Br$_2$ is ___.

END OF THE QUESTION PAPER

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