

**PUMDET-2017**

**Subject : Chemistry**

*Time Allowed : 1Hour 30 Minutes*

*Maximum Marks : 100*

**20201003**

Booklet No. ....

**INSTRUCTIONS**

Candidates should read the following instructions carefully before answering the questions:

1. This question paper contains 50 MCQ type objective questions. Each question has four answer options given, viz. A, B, C and D.
2. Only one answer is correct. Correct answer will fetch full marks 2. Incorrect answer or any combinations of more than one answer will fetch – ½ marks. No answer will fetch 0 marks.
3. Questions must be answered on OMR sheet by darkening the appropriate bubble marked A, B, C or D.
4. Use only **Black/Blue ball point pen** to mark the answer by complete filling up of the respective bubbles.
5. Mark the answers only in the space provided. Do not make any stray mark on the OMR.
6. Write question booklet number and your roll number carefully in the specified locations of the OMR. Also fill appropriate bubbles.
7. Write your name (in block letter), name of the examination centre and put your full signature in appropriate boxes in the OMR.
8. The OMRs will be processed by electronic means. Hence it is liable to become invalid if there is any mistake in the question booklet number or roll number entered or if there is any mistake in filling corresponding bubbles. Also it may become invalid if there is any discrepancy in the name of the candidate, name of the examination centre of signature of the candidate vis-a-vis what is given in the candidate's admit card. The OMR may also become invalid due to folding or putting stray marks on it or any damage to it. The consequence of such invalidation due to incorrect marking or careless handling by the candidate will be sole responsibility of candidate.
9. Rough work must be done on the question paper itself. Additional blank pages are given in the question paper for rough work.
10. Hand over the OMR to the invigilator before leaving the Examination Hall.

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1. Which one is true for an adiabatic expansion of a van der Waals' gas against vacuum?

- (A) The process is isentropic
- (B) The process is isothermal
- (C) The process results cooling
- (D) The process results heating

2. A molecule AX, has a vibrational energy of  $1000\text{ cm}^{-1}$  and rotational energy of  $10\text{ cm}^{-1}$ . Another molecule, BX, has a vibrational energy of  $400\text{ cm}^{-1}$  and rotational energy of  $40\text{ cm}^{-1}$ . Which one of the following statements about the coupling of vibrational and rotational motion is true?

- (A) The coupling is stronger in BX.
- (B) The coupling is stronger in AX.
- (C) Magnitude of coupling is same in both AX and BX.
- (D) There is no coupling in both AX and BX.

3. If the separation between the most intense lines of P branch and R branch in the vibrational-rotational spectra of CO at 300 K is  $55\text{ cm}^{-1}$ , what will be the value of rotational constant?

- (A)  $5.5\text{ cm}^{-1}$
- (B)  $1.8\text{ cm}^{-1}$
- (C)  $2\text{ cm}^{-1}$
- (D)  $2.7\text{ cm}^{-1}$

4. Degree of dissociation of  $\text{AB}_2(\text{g})$  is  $x$  ( $x \ll 1$ ) for the equilibrium  $2\text{AB}_2(\text{g}) = 2\text{AB}(\text{g}) + \text{B}_2(\text{g})$  and the total pressure is  $P$ . The equilibrium constant  $K_p$  is

- (A)  $Px$
- (B)  $Px/2$
- (C)  $Px^3/2$
- (D)  $Px^2/2$

5. The rate of an acid-catalyzed reaction in aqueous solution follows the rate equation:  $\text{Rate} = k[\text{X}^+][\text{Y}^{2-}][\text{H}^+]$ . If  $k_{16}$  and  $k_4$  are rate constants for the reaction at ionic strengths of  $16\text{ mol L}^{-1}$  and  $4\text{ mol L}^{-1}$ , respectively,  $\ln(k_4/k_{16})$ , in terms of Debye-Hückel constant ( $B = 0.51$ ), is

- (A)  $4B$
- (B)  $8B$
- (C)  $10B$
- (D)  $12B$

6. If the radius of a gas molecule is decreased by a factor of 2, then its mean free path

- (A) remains unchanged.
- (B) increases by four times.
- (C) increases by two times.
- (D) decreases by a factor of 2.

7. As per Stokes-Einstein equation of diffusion, which of the following statement is not correct?

- (A) Ionic diffusivity is proportional to temperature.
- (B) Ionic diffusivity is inversely proportional to the size of the ion.
- (C) Ionic diffusivity is inversely proportional to the mass of the ion.
- (D) Ionic diffusivity is inversely proportional to the viscosity coefficient of the medium.

8. Which of the following statement is correct about free particle?

- (A) There is no restriction on the energy.
- (B) Both energy and momentum are quantized.
- (C) Both energy and momentum are always positive.
- (D) Energy is always positive but momentum may be positive or negative.

9. A system with just two energy levels (spacing = 0.1 eV) is in thermal equilibrium with a heat reservoir at 600 K. The probability of finding the system in the higher energy level is

- (A) 0.126
- (B) 0.162
- (C) 1
- (D) 0

10. At 298 K, with a  $Zn^{2+}$  ion solution of activity,  $a_{Zn^{2+}} = 0.1$ , the experimental emf of the cell :  $Zn | Zn^{2+} (a_{Zn^{2+}}) || H^+ (a_{H^+} = 1) | H_2 (Pt) (1 atm)$ , is 0.7914 volt. The standard oxidation potential of the left electrode is

- (A) +0.7618 volt
- (B) -0.7618 volt
- (C) +0.8210 volt
- (D) -0.8210 volt

11. The ratio of the average kinetic energy of hydrogen molecules to that of oxygen molecules at the same temperature and pressure is

- (A) 1:1
- (B) 1:2
- (C) 2:1
- (D) 4:1

12. The potential of an electrode  $M^{+n} + ne \rightarrow M$  changes by 0.03 V when there is tenfold increase in the concentration of  $M^n$ . The value of  $n$  is

- (A) 1
- (B) 2
- (C) 3
- (D) 4

13. A 0.04 molar aqueous solution of a coloured compound has a molar absorptivity of  $3.76 \text{ L mol}^{-1} \text{ cm}^{-1}$  at 525 nm in a cell 2 cm thickness. The per cent transmission is

- (A) 30
- (B) 40
- (C) 50
- (D) 60

14. The relation  $dq - pdV = 0$  is valid for (the symbols have their usual significance)

- (A) an isothermal process
- (B) any cyclic process
- (C) a reversible process
- (D) a reversible cyclic process

15. The value of  $i^i [i = \sqrt{-1}]$  is:

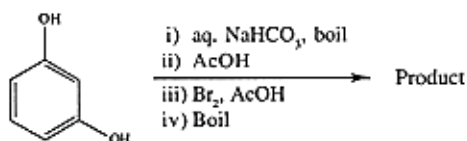
- (A)  $e^{i\pi}$
- (B)  $e^\pi$
- (C)  $e^{-\pi/2}$
- (D)  $e^{-i\pi/2}$

16. If  $U$  is a function of  $V$  and  $T$ ,  $\left(\frac{\partial U}{\partial T}\right)_p$  is equal to

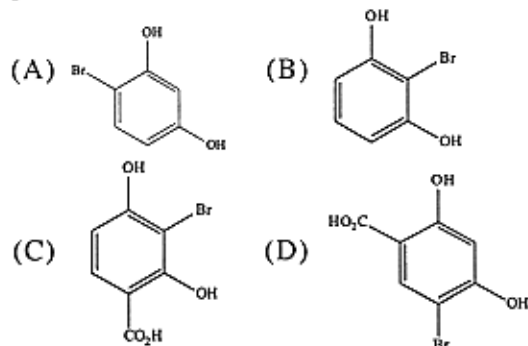
( $\pi$  and  $\alpha$  are  $\left(\frac{\partial U}{\partial V}\right)_T$  and the coefficient of thermal expansion, respectively.)

- (A)  $C_p$
- (B)  $C_v$
- (C)  $C_p - \pi V \alpha$
- (D)  $C_v + \pi V \alpha$

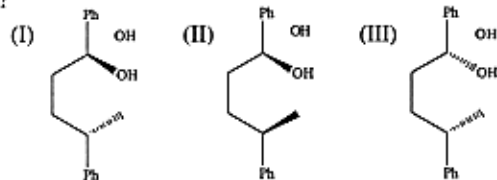
17.



The product is

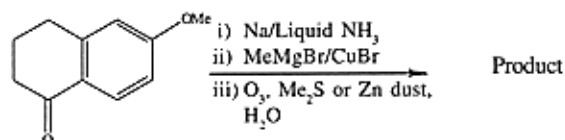


18. Which of the following molecules are optically active?

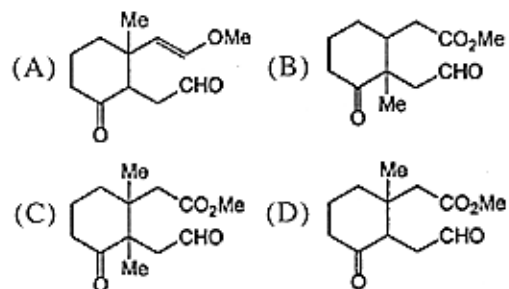


- (A) I & III  
 (B) II & III  
 (C) only I  
 (D) I, II & III

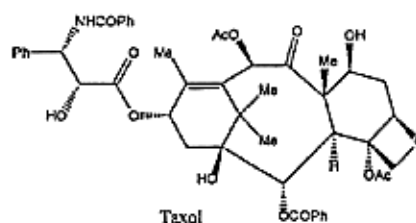
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Product is

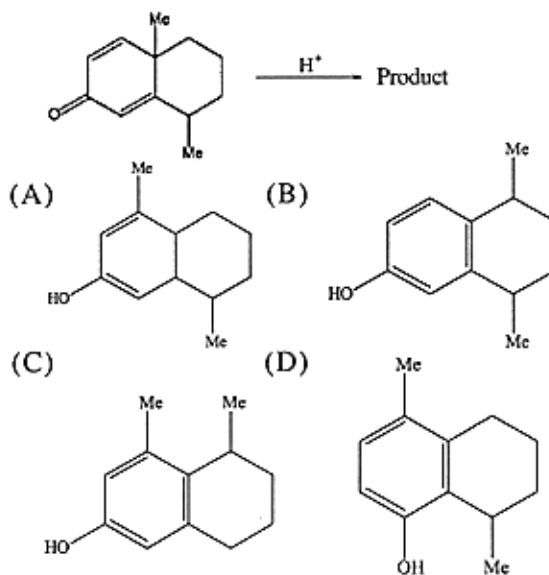


20. How many chiral centers are there in Taxol?



- (A) 9  
 (B) 10  
 (C) 11  
 (D) 13

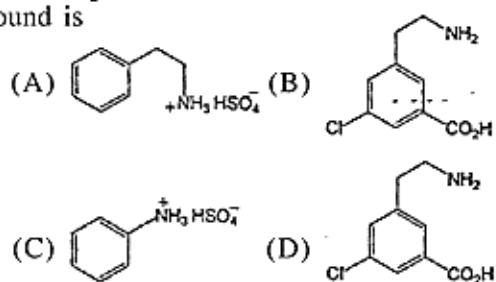
21. What is the product in the following reaction?



22. Which one among the following dimethylcyclohexanes is thermodynamically most stable?

- (A) *cis* 1, 2-dimethylcyclohexane  
 (B) *trans* 1, 2-dimethylcyclohexane  
 (C) *cis* 1, 4-dimethyl cyclohexane  
 (D) *trans* 1, 4-dimethylcyclohexane

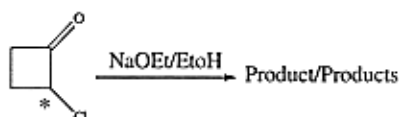
23. A compound is soluble in water. Its aqueous solution liberates  $\text{CO}_2$  from  $\text{NaHCO}_3$ . It forms white ppt with  $\text{BaCl}_2$  solution and given a (+)ve dye test. The compound is



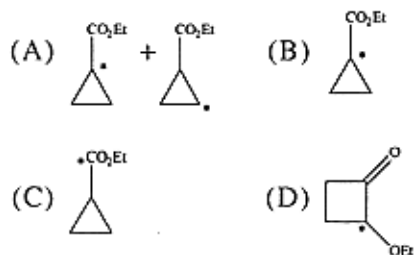
24. You have been supplied with eight aldopentoses (D & L series). Each is allowed to react with excess of  $\text{PhNHNH}_2$  in  $\text{AcOH}$ . How many osazone derivatives can be obtained?

- (A) 8  
(B) 6  
(C) 5  
(D) 4

25.



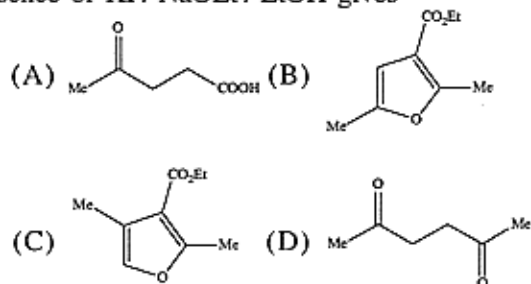
Product(s) of the above reactions is (are)



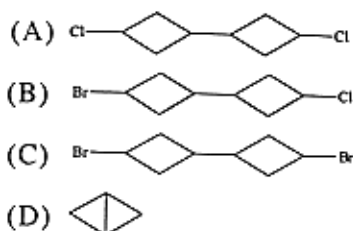
26. Reaction of  $\text{R}-^*\text{CO}-\text{Cl}$  with  $\text{CH}_2\text{N}_2$  followed by heating with moist  $\text{Ag}_2\text{O}$  and then hydrolysis gives

- (A)  $\text{R}-^*\text{CO}-\text{CH}_2\text{Cl}$   
(B)  $\text{R}-\text{CH}_2-^*\text{CO}_2\text{H}$   
(C)  $\text{R}-\text{CH}_2-^*\text{CO}_2\text{H}$  &  $\text{R}-^*\text{CH}_2-\text{CO}_2\text{H}$   
(D)  $\text{R}-\text{CO}-^*\text{CH}_2\text{Cl}$

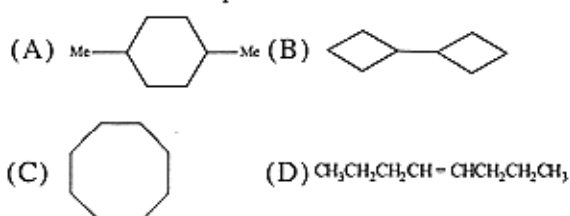
27. Reaction of  $\text{MeCOCH}_2\text{Cl}$  with ethyl acetoacetate in presence of  $\text{KI} / \text{NaOEt} / \text{EtOH}$  gives



28. The reaction of 1-bromo-3-chlorocyclobutane with metallic sodium in dioxane under reflux gives



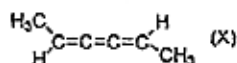
29. A compound with molecular mass 112 is transparent to UV absorption. However, it shows two bands at  $2941\text{ cm}^{-1}$  and  $1464\text{ cm}^{-1}$  in the IR spectrum. Its  $^1\text{H-NMR}$  spectrum shows a singlet at 8.48 ppm. The structure of the compound is



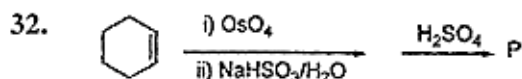
30. Total number of  $^1\text{H-NMR}$  signals for *cis* and *trans*-1,3-dibromocyclopropane respectively are

- (A) 3, 2  
(B) 2, 3  
(C) 4, 4  
(D) 3, 3

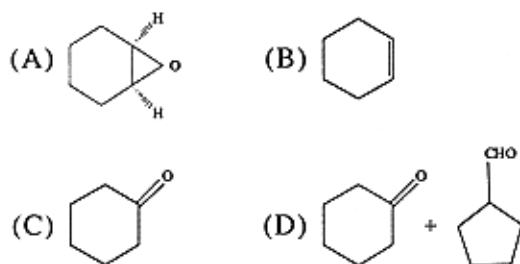
31. What is the point group of the compound 'X'?



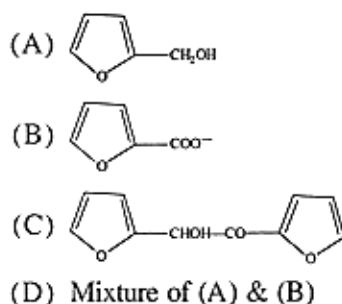
- (A)  $C_{2v}$   
 (B)  $C_s$   
 (C)  $C_{2h}$   
 (D)  $C_i$



The structure of 'P' in the above reaction is



33. Furfural on reaction with aqueous ethanolic KCN produces



34. A freshly prepared radioactive source of half life 2 hr emits radiation of intensity which is 64 times the permissible level. The minimum time after which it would be possible to work with this source is

- (A) 6h  
 (B) 12h  
 (C) 16h  
 (D) 32h

35. The  $\nu_{\text{ir}}(\text{CO})$  value in the compounds (i)  $(\text{Et}_3\text{P})_3\text{Mo}(\text{CO})_3$ , (ii)  $[(\text{PhO})_3\text{P}]_3\text{Mo}(\text{CO})_3$ , (iii)  $(\text{Cl}_3\text{P})_3\text{Mo}(\text{CO})_3$ , (iv)  $(\text{F}_3\text{P})_3\text{Mo}(\text{CO})_3$  changes depending on the  $d\pi(\text{Mo}) \rightarrow p\pi^*(\text{CO})$ . The order of change of the  $\nu_{\text{ir}}(\text{CO})$  value is

- (A) (i) < (ii) < (iii) < (iv)  
 (B) (i) > (ii) > (iii) > (iv)  
 (C) (ii) < (iii) < (iv) < (i)  
 (D) (iv) < (i) < (iii) < (ii)

36. Inverse spinel structure is observed in which of the following?

- (A)  $\text{Mn}_3\text{O}_4$   
 (B)  $\text{V}_2\text{O}_5$   
 (C)  $\text{Fe}_2\text{O}_3$   
 (D)  $\text{Fe}_3\text{O}_4$

37. Basic property increases in the order of

- (A)  $\text{MgO} < \text{CaO} < \text{SrO} < \text{BaO}$   
 (B)  $\text{CaO} < \text{MgO} < \text{SrO} < \text{BaO}$   
 (C)  $\text{MgO} < \text{CaO} < \text{BaO} < \text{SrO}$   
 (D)  $\text{BaO} < \text{SrO} < \text{CaO} < \text{MgO}$

38. Most appropriate designation of the reaction,  $3\text{SiCl}_4 + 4\text{NH}_3(\text{Liquid}) \rightarrow \text{Si}_3\text{N}_4 + 12\text{HCl}$  is a

- (A) redox reaction as oxidation state of both N and H have been changed.  
 (B) hydrolysis reaction as an acid generates in the reaction.  
 (C) solvolysis as the liquid  $\text{NH}_3$  (solvent) is responsible for the product  $\text{Si}_3\text{N}_4$ .  
 (D) precipitation reaction as the product  $\text{Si}_3\text{N}_4$  appeared as insoluble product.

39. Dipole moment of lithium hydride is  $1.964 \times 10^{-29}$  Cm and Li-H distance is 1.596 angstrom. Calculate the per cent ionic character of the molecule.

- (A) 35.2%
- (B) 91.6%
- (C) 76.8%
- (D) 91.3%

40. The common name of \_\_\_\_\_ is Inorganic Graphite.

- (A)  $B_3N_3H_6$
- (B)  $(BN)_x$
- (C) Amino Boranes
- (D) Peroxo Borates

41. Ionic size of Ni(II) < Cu(II) is due to the

- (A) higher shielding power of core electrons over the nuclear charge of Ni(II) than Cu(II).
- (B) higher shielding power of core electrons over the nuclear charge of Cu(II) than Ni(II).
- (C) higher crystal field stabilization of Cu(II) than Ni(II) in their oxides.
- (D) higher crystal field stabilization of Ni(II) than Cu(II) in their oxides.

42. Oxo anion of Cr(VI) is a good oxidant but that of W(VI) is very poor in acid medium, because

- (A) Cr(VI) appears as dimer while W(VI) appears as polymer.
- (B) higher stability of M-O bonds in oxo anion of Cr(VI) than W(VI) for more effective overlapping of pi-bond forming orbitals of the metal and oxygen.
- (C) higher stability of M-O bonds in oxo anion of W(VI) than Cr(VI) for more effective overlapping of pi-bond forming orbitals of metal and oxygen.
- (D) no plausible reasoning is known for this specific property.

43. Very close distribution ratio values of  $Ln_1^{3+}$  and  $Ln_2^{3+}$  over a cation exchange resin suggested the

- (A) separation of them is easy.
- (B) separation of them is impossible.
- (C) separation needs the increase of column length which will increase contact time.
- (D) separation needs the decrease of column length which will decrease the contact time.

44. If the single electron spin-orbit coupling constant of a  $4f^1$  species is  $800 \text{ cm}^{-1}$ , value of the theoretical magnetic moment ( $\mu$ , BM) of the species can be calculated by

- (A)  $[n(n+2)]^{1/2}$
- (B)  $[n(n+1)]^{1/2}$
- (C)  $[L(L+1) + 4S(S+1)]^{1/2}$
- (D)  $[J(J+1)]^{1/2}$

45.  $H_3N \rightarrow BF_3$  will have B-F length  $< r_B + r_F$  due to

- (A) ionic covalent resonance stabilization of the B-F bonds only.
- (B)  $P_n(F) \rightarrow P_n(B)$  only.
- (C)  $P_n(F) \rightarrow P_n(B)$  plus ionic covalent resonance stabilization of the bond.
- (D)  $P_n(B) \rightarrow P_n(F)$  plus interaction with ionic covalent resonance of the bond.

46. Which of the metal carbonyl amongst following is non-existent?

- (A)  $V(CO)_6$
- (B)  $Mn(CO)_5$
- (C)  $Fe(CO)_5$
- (D)  $Cr(CO)_6$



47. The ground state term of  $\text{Unp}^{2+}$  is

- (A)  ${}^4\text{F}_{3/2}$
- (B)  ${}^3\text{F}_{9/2}$
- (C)  ${}^4\text{D}_{3/2}$
- (D)  ${}^3\text{D}_{9/2}$

48. Number of moles of  $\text{MnO}_4^-$  required to oxidize one mole of ferrous oxalate completely in acidic medium will be

- (A) 1 mole
- (B) 0.4 mole
- (C) 0.6 mole
- (D) 2 mole

49. The equivalence point potential of the redox titration,  $6\text{Fe}^{2+} + \text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ \rightarrow 6\text{Fe}^{3+} + 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$ , depends not only on the  $E^0$  values of  $\text{Fe(III)/Fe(II)}$  and  $\text{Cr}_2\text{O}_7^{2-}/\text{Cr(III)}$  couples but also

- (A) independent of the others.
- (B) dependent on the  $[\text{H}^+]$ .
- (C) dependent on both  $[\text{H}^+]$  and  $[\text{Cr}^{3+}]$ .
- (D) dependent on  $[\text{H}^+]$ ,  $[\text{Cr}^{3+}]$  and the number of the electrons in each half of the redox couples.

50. The transition responsible for the red color of  $\text{HgS}$  is

- (A) d-d
- (B) ligand-to-metal charge transfer
- (C) metal-to-ligand charge transfer
- (D)  $\sigma-\sigma^*$

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Space for Rough Work

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