Roll No. | | | | | | | |

(Write Roll Number from left side exactly as in the Admit Card)

Signature of Invigilators

1. _____

2. _____

1217

Question Booklet Series **X**

PAPER–II

Question Booklet No.

(Identical with OMR Answer Sheet Number)

Subject Code : 12

CHEMICAL SCIENCES

Time : 1 Hour 15 Minutes *Maximum Marks: 100*

Instructions for the Candidates

1. Write your Roll Number in the space provided on the top of this page as well as on the OMR Sheet provided.
2. At the commencement of the examination, the question booklet will be given to you. In the first 5 minutes, you are requested to open the booklet and verify it:
   (i) To have access to the Question Booklet, tear off the paper seal on the edge of this cover page.
   (ii) Faulty booklet, if detected, should be get replaced immediately by a correct booklet from the invigilator within the period of 5 minutes. Afterwards, neither the Question Booklet will be replaced nor any extra time will be given.
   (iii) Verify whether the Question Booklet No. is identical with OMR Answer Sheet No.; if not, the full set to be replaced.
   (iv) After this verification is over, the Question Booklet Series and Question Booklet Number should be entered on the OMR Sheet.
3. This paper consists of fifty (50) multiple-choice type questions. All the questions are compulsory. Each question carries *two* marks.
4. Each Question has four alternative responses marked: (A) (B) (C) (D). You have to darken the circle as indicated below on the correct response against each question.

   Example: (A) (B) ● (D), where (C) is the correct response.
5. Your responses to the questions are to be indicated correctly in the OMR Sheet. If you mark your response at any place other than in the circle in the OMR Sheet, it will not be evaluated.
6. Rough work is to be done at the end of this booklet.
7. If you write your Name, Roll Number, Phone Number or put any mark on any part of the OMR Sheet, except the space allotted for the relevant entries, which may disclose your identity, or use abusive language or employ any other unfair means, such as change of response by scratching or using white fluid, you will render yourself liable to disqualification.
8. Do not tamper or fold the OMR Sheet in any way. If you do so, your OMR Sheet will not be evaluated.
9. You have to return the Original OMR Sheet to the invigilator at the end of the examination compulsorily and must not carry it with you outside the Examination Hall. You are, however, allowed to carry question booklet and duplicate copy of OMR Sheet after completion of examination.
10. **Use only Black Ball point pen.**
11. **Use of any calculator or mobile phone etc. is strictly prohibited.**
12. **There are no negative marks for incorrect answers.**

[Please Turn Over]

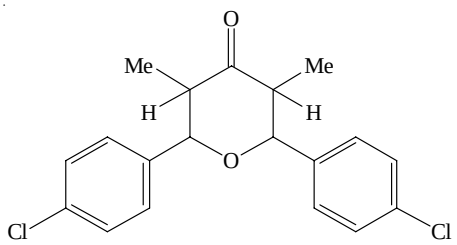
CHEMICAL SCIENCES

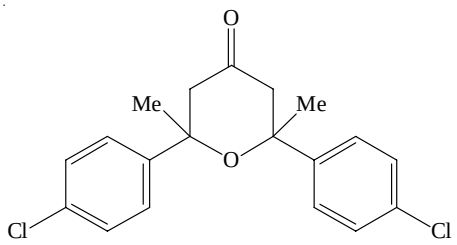
PAPER II

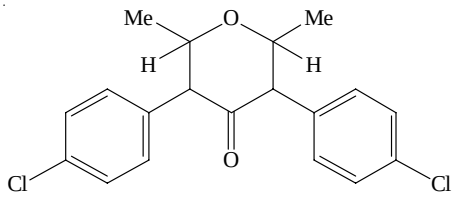
1. An organic compound exhibited the following ^1H NMR spectral data:

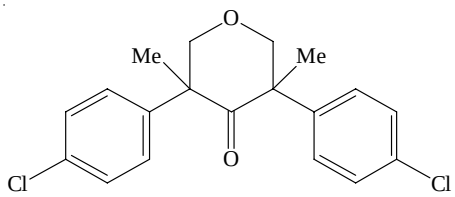
δ 1·08 (6H, d, J = 6·6 Hz), 2·98 (2H, dq, J = 10·4 Hz, 6·6 Hz) 4·49 (3H, d, J = 10·4 Hz) and 7·73 (8H, S)

The structure of the compound is:

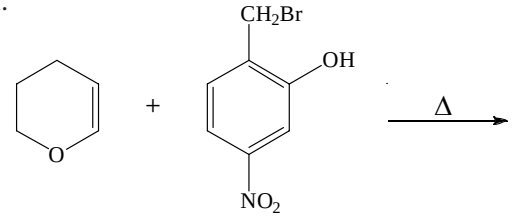
(A) 

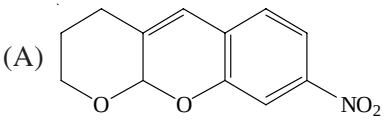
(B) 

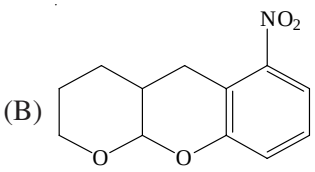
(C) 

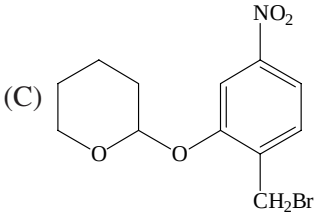
(D) 

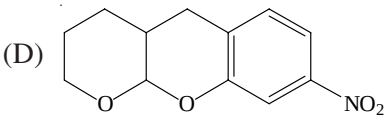
2. Predict the major product in the following reaction:



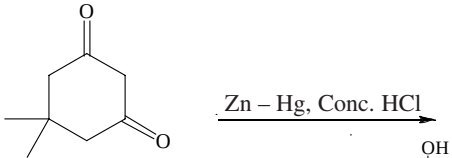
(A) 

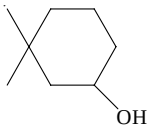
(B) 

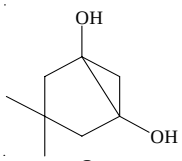
(C) 

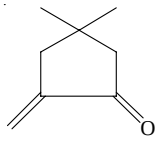
(D) 

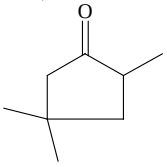
3. The major product in the following reaction is:



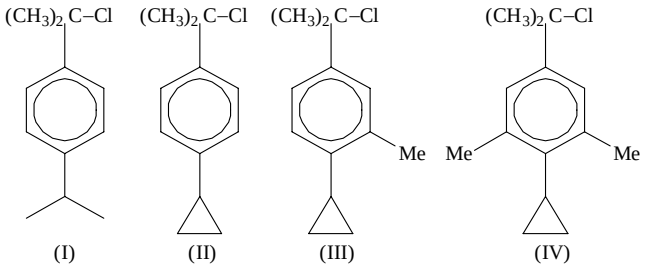
(A) 

(B) 

(C) 

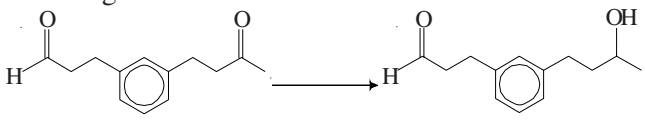
(D) 

4. The correct order of the relative rates of solvolysis of the following chlorides in aqueous acetone solvent is:



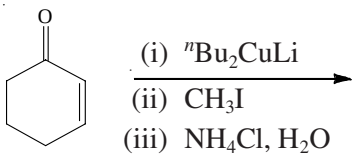
(A) II 〉 III 〉 IV 〉 I
(B) III 〉 II 〉 IV 〉 I
(C) II 〉 III 〉 I 〉 IV
(D) I 〉 II 〉 IV 〉 III

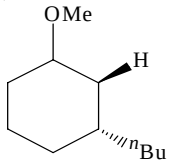
5. Which is the most suitable reagent for the following conversion?

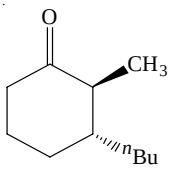


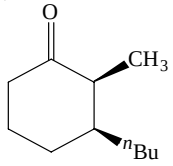
(A) $NaBH_4$, MeOH – CH_2Cl_2 at –78°C
(B) $CeCl_3$, $NaBH_4$, MeOH
(C) $LiAlH_4$ in THF at –15°C
(D) DIBAL–H in THF at –78°C

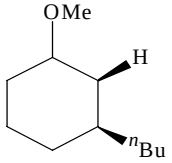
6. The major product of the following reaction is:



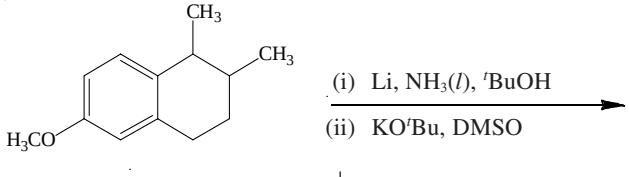
(A) 

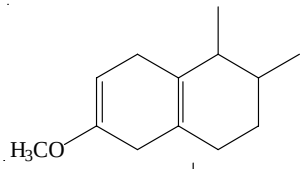
(B) 

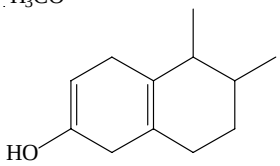
(C) 

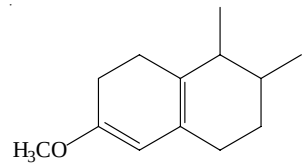
(D) 

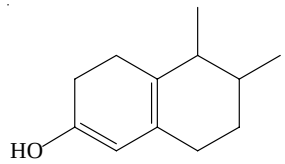
7. The major product of the following reaction is:



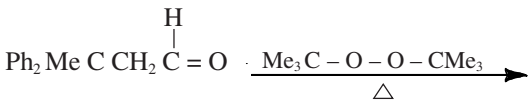
(A) 

(B) 

(C) 

(D) 

8. The major product of the following reaction is:



(A) Ph Me CH – CH_2 Ph
(B) Ph_2 Me C CH_2 – O CMe_3

(C) Ph_2 Me C CH_2 O C Me_3
(D) Ph_2 Me C CH_2 CH_2 C Me Ph_2

9. In the following sequence of reaction predict the product:

$C_4H_9 - C \equiv C - H \xrightarrow[CH_3COCl,\ Anhy.\ AlCl_3]{Me\ MgBr,\ (CH_3)_3SiCl}$

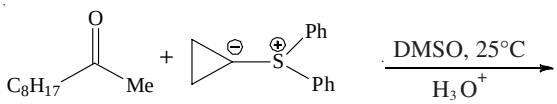
(A) $C_4H_9-\underset{\underset{Me}{|}}{C}=CH-\underset{\underset{O}{\|}}{C}-Me$

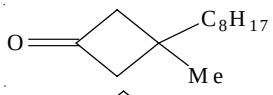
(B) $C_4H_9-C\equiv C-\underset{\underset{O\ SiMe_3}{|}}{\overset{\overset{Me}{|}}{C}}-Me$

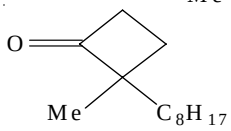
(C) $C_4H_9-C\equiv C-\underset{\underset{O}{\|}}{C}-Me$

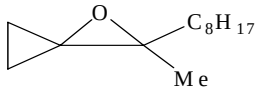
(D) $C_4H_9-C\equiv C-\underset{\underset{OH}{|}}{\overset{\overset{Me}{|}}{C}}-Me$

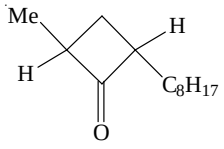
10. Identify the major product from amongst the choices given below in the following reaction sequence:



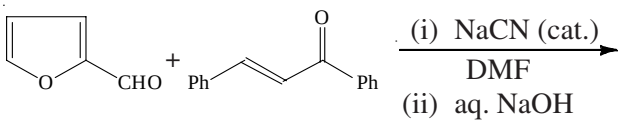
(A) 

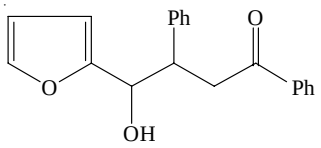
(B) 

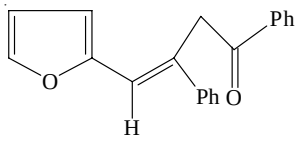
(C) 

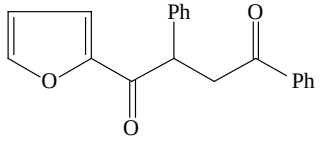
(D) 

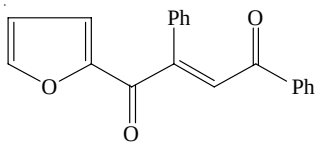
11. The major product of the following reaction is:



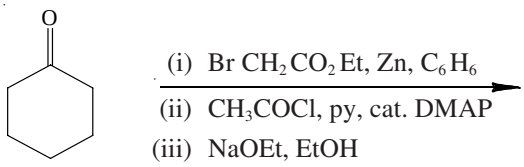
(A) 

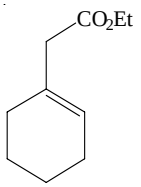
(B) 

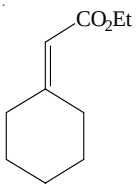
(C) 

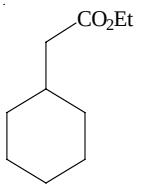
(D) 

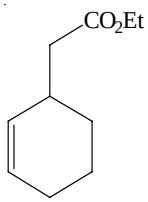
12. The major product of the following reaction is:



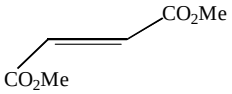
(A) 

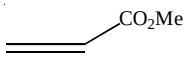
(B) 

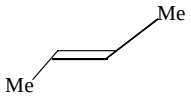
(C) 

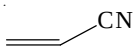
(D) 

13. Which of the following alkene will undergo [2+2]–cycloaddition reaction with dichlorocarbene?

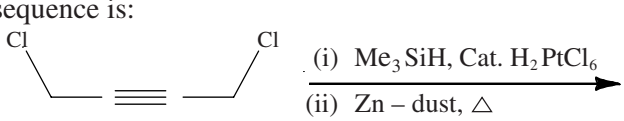
(A) 

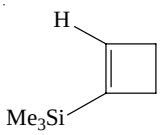
(B) 

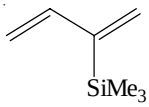
(C) 

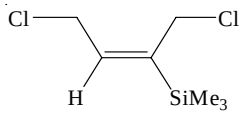
(D) 

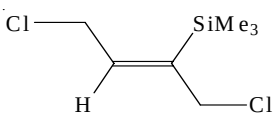
14. The major product in the following reaction sequence is:



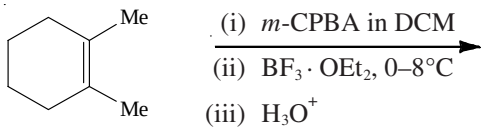
(A) 

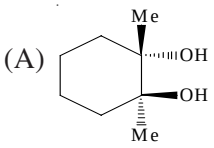
(B) 

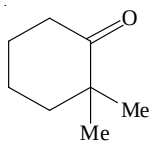
(C) 

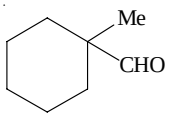
(D) 

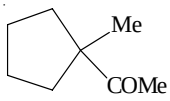
15. The major product formed in the following reaction sequence is:



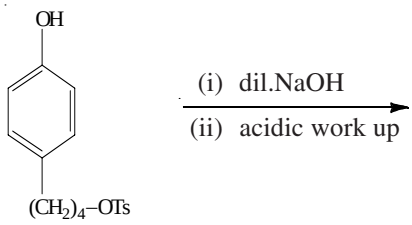
(A) 

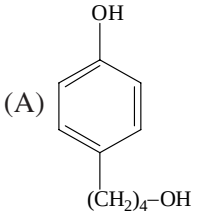
(B) 

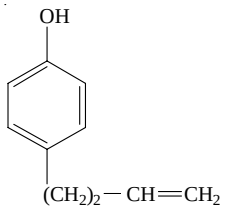
(C) 

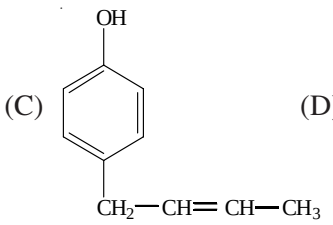
(D) 

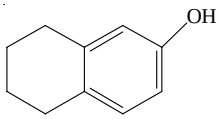
16. Predict the product of the following reaction:



(A) 

(B) 

(C) 

(D) 

17. For the molecule OCF_2 the correct statement is:

(A) Both $\angle FCF$ and $\angle FCO$ are $<120°$

(B) $\angle FCF > 120°$ but $\angle FCO < 120°$

(C) $\angle FCF < 120°$ but $\angle FCO > 120°$

(D) Both $\angle FCF$ and $\angle FCO > 120°$

18. An element has valence shell configuration $5d^5 6s^1$. Which group and period does it belong to?

(A) 1st group and 6th period

(B) 6th group and 5th period

(C) 6th group and 6th period

(D) 5th group and 6th period

19. Followings are the order of increasing lattice energy (kJ mol^{-1}) of ionic crystals. Select the correct order:

(A) $CaF < CsI < NaCl < MgF_2$

(B) $NaCl < CsI < CaF_2 < MgF_2$

(C) $CsI < NaCl < CaF_2 < MgF_2$

(D) $MgF_2 < CaF_2 < NaCl < CsI$

20. IUPAC nomenclature of $[Co(H_2O)_2 (NH_3)_4]Cl_3$ is:

(A) Trichlorotetraamminediaquacobalt(III)

(B) Tetraamminediaquacobalt(III) chloride

(C) Tetraamminediaquacobalt(III) trichloride

(D) Diaquatetraamminecobalt(III) chloride

21. Numbers of bridging carbonyls in $Fe_2 (CO)_9$ and $Fe_3 (CO)_{12}$, respectively are:

(A) 2 and 3

(B) 3 and 2

(C) 2 and 2

(D) 3 and 3

22. The number of possible stereoisomers in $[Co(NH_2 – CH_2 – CH_2 – NHCH_3)_3] Cl_3$ is:

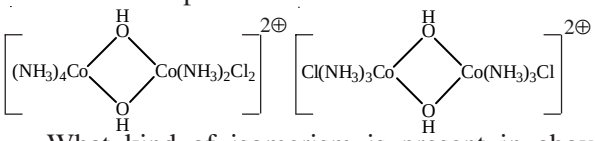
(A) 2

(B) 3

(C) 4

(D) 6

23. Observe the following structural formulae of the co-ordination compounds



What kind of isomerism is present in above mentioned pair of co-ordination compounds?

(A) Hydrate isomerism

(B) Coordination isomerism

(C) Coordination position isomerism

(D) Linkage isomerism

24. The correct order of increasing basicity of oxides is:

(A) $BaO > CaO > BeO > B_2O_3$

(B) $B_2O_3 > BeO > CaO > BaO$

(C) $B_2O_3 > BaO > CaO > BeO$

(D) $B_2O_3 > BeO > BaO > CaO$

25. The correct order of acidity of the following is:

(A) $H_3PO_4 > H_3PO_3 > H_3PO_2$

(B) $H_3PO_2 > H_3PO_3 > H_3PO_4$

(C) $H_3PO_3 > H_3PO_4 > H_3PO_2$

(D) $H_3PO_2 > H_3PO_4 > H_3PO_3$

26. In the titration of a solution of acetic acid in pyridine (py) by tetramethyl ammonium hydroxide in pyridine, the products at the end point are:

(A) $Hpy^+, (CH_3)_4N^+, OAc^-$

(B) Hpy^+, OH^-, Py

(C) $Py, OH^-, OAc^-, (CH_3)_4N^+$

(D) $OAc^-, (CH_3)_4N^+, H_2O$

27. The structures of NF_3 and NH_3 are based on a tetrahedron with one corner occupied by a lone pair. Which one of the statements is true for both the molecules?

(A) both are pyramidal with bond angles 107·5°.

(B) both are pyramidal with bond angles 102·3° and 107·5°, respectively.

(C) both are pyramidal with bond angles 109·5°.

(D) both are pyramidal with bond angles 105° and 107·5°, respectively.

28. According to VSEPR concept, which one of the following would adopt trigonal planar geometry?

(A) $NH_4^{\oplus}$

(B) $(CH_3)_2HN$

(C) $CH_3^{\oplus}$

(D) $CH_3^{\ominus}$

29. Match list of molecules / ions with point group:

(i) PF_5	(a) $D_{\infty h}$
(ii) CO_2	(b) D_{3h}
(iii) $POCl_3$	(c) C_{2v}
(iv) SO_2	(d) C_{3v}

(A) (i) — (b), (ii) — (a), (iii) — (d), (iv) — (c)

(B) (i) — (b), (ii) — (a), (iii) — (c), (iv) — (d)

(C) (i) — (d), (ii) — (a), (iii) — (b), (iv) — (c)

(D) (i) — (d), (ii) — (c), (iii) — (b), (iv) — (a)

30. Correct order of thermal stability of MCO_3:

(A) $BaCO_3 > SrCO_3 > CaCO_3 > MgCO_3$

(B) $MgCO_3 > CaCO_3 > SrCO_3 > BaCO_3$

(C) $CaCO_3 > SrCO_3 > BaCO_3 > MgCO_3$

(D) $BaCO_3 > SrCO_3 > MgCO_3 > CaCO_3$

31. On the basis of molecular orbital theory, which one of the following should have shortest bond length?

(A) NO

(B) NO^+

(C) NO^{2+}

(D) NO^-

32. The value of crystal field stabilization energy (CFSE) of a d^3 octahedral complex should be equal to:

(A) Zero

(B) 4 Dq

(C) 6 Dq

(D) 12 Dq

33. Which one of the following statements is correct for indeterminate (Random) error?

(A) It is due to the limitations of physical measurement.

(B) A better experiment may reduce the magnitude of error.

(C) It cannot be eliminated entirely.

(D) All the statements are correct.

34. N_2 gas is heated to 500K in a vessel of constant volume. If it entered the vessel at 100 atm and 300K, the pressure would be (assume ideal gas laws):

(A) 176 atm

(B) 167 atm

(C) 616 atm

(D) 300 atm

35. The critical compression factor of a gas obeying van der Waals equation is:

(A) $\frac{3}{8}$

(B) $\frac{1}{8a}$

(C) $\frac{3}{27b}$

(D) $\frac{1}{27a}$

36. The most probable speed v_{mp} is related to the root mean square speed v_{rms} as:

(A) $v_{mp} = \left(\frac{2}{3}\right)^{1/2} v_{rms}$

(B) $v_{mp} = \left(\frac{4}{3}\right)^{1/2} v_{rms}$

(C) $v_{mp} = \left(\frac{1}{3}\right)^{1/2} v_{rms}$

(D) $v_{mp} = \left(\frac{8}{3\pi}\right)^{1/2} v_{rms}$

37. If one makes an error of 3% in measuring a radius for calculating an area of a circle, then the percentage error in the calculation of area would be:

(A) 6

(B) 9

(C) 18

(D) 4

38. Suppose that gas molecules are point particles but the attraction between them is important. Work done on the surroundings when it expands will (compared to an ideal gas):

(A) be same.

(B) be more.

(C) be less.

(D) depend on the nature of the gas.

39. Freezing point constant is typically larger than the corresponding boiling point constant of a solvent since:

(A) entropy of fusion is smaller than enthalpy of vaporization of a substance.

(B) enthalpy of fusion is smaller than enthalpy of vaporization of a substance.

(C) enthalpy of fusion is grater than enthalpy of vaporization of a substance.

(D) enthalpy of fusion is equal to the enthalpy of vaporization of a substance.

40. Consider that at equilibrium the partial pressures of A and B of a gas phase reaction $A \rightleftharpoons B$ at a temperature T are equal. The standard free energy change of the reaction is:

(A) – RT

(B) – 2·303 RT

(C) 2·303 RT

(D) 0

41. Consider decomposition of hydrogen peroxide, catalysed by iodine in solution. If the rate constant changes by a factor of 2000 at 25°C upon addition of the catalyst, the activation barrier is reduced by:

(A) 25%

(B) 10%

(C) 80%

(D) 20%

42. The wave function of the electron in the lowest energy state of hydrogen atom is proportional to $\exp(-r/a_o)$ where a_o is a constant. The relative probability of finding the electron inside a volume d_v at a_o relative to nucleus is:

(A) 14·2

(B) 13·6

(C) 0·71

(D) 7·1

43. The bond orders of O_2, O_2^+ and O_2^- are respectively:

(A) 1, 2, 5/2
(B) 2, 1, 1/2
(C) 2, 5/2, 1
(D) 1, 5/2, 2

44. The selection rule for transition in vibrational energy levels according to anharmonic oscillator model is:

(A) 0
(B) ± 1
(C) $\pm 1, \pm 2, \pm 3$
(D) $0, \pm 1$

45. Which of the following set of molecules have pure rotational spectra?

(A) H_2, NO, N_2O, CH_4
(B) NO, N_2O
(C) H_2, NO, CH_4
(D) N_2O, H_2, CH_4

46. Regarding infrared active modes of H_2O, which of the following statement is true?

(A) Three normal modes; all active
(B) Three normal modes; two active
(C) Two normal modes; both active
(D) Three normal modes; one active

47. The compound acetone shows electronic spectrum with:

(A) one strong transition
(B) two weak transitions
(C) one strong transition and one weak transition
(D) two strong transitions

48. The set of angular parts of $2p_z$, $2p_x$, $2p_y$ orbitals of hydrogen atom are:

(A) $Cos\theta, -Sin\theta e^{i\varphi}, Sin\theta e^{-i\varphi}$
(B) $Cos\theta, -Sin\theta e^{i\varphi}, Sin\theta e^{i\varphi}$
(C) $Sin\theta, -Cos\theta e^{i\varphi}, Sin\theta e^{-i\varphi}$
(D) $Cos\theta, Sin\theta\, Cos\varphi, Sin\theta\, Sin\varphi$

49. Match the following molecules with proper classifications:

Molecule	*Classification*
(a) CH_4	(i) Oblate symmetric top
(b) CH_3Cl	(ii) Asymmetric top
(c) BCl_3	(iii) Symmetric top
(d) $H_2C = CH–Cl$	(iv) Prolate symmetric top

(A) (a) → (i), (b) → (ii), (c) → (iii), (d) → (iv)
(B) (a) → (iii), (b) → (iv), (c) → (i), (d) → (ii)
(C) (a) → (ii), (b) → (i), (c) → (iv), (d) → (iii)
(D) (a) → (iv), (b) → (iii), (c) → (ii), (d) → (i)

50. For a hetero nuclear diatonic molecule which of the following statements is true?

As the energy difference between the two interacting atomic orbitals increases

(A) both bonding and anti bonding effects increases.
(B) both bonding and anti bonding effects decreases.
(C) bonding effect decreases but anti bondings effect increases.
(D) bonding effect increases but anti bonding effect decreases.

ROUGH WORK

ROUGH WORK