ASSIGNMENT 2: GATE 2011
CY: CHEMISTRY

AI25BTECH11021 - Abhiram Reddy N

1) Jahn-Teller distortion of $CuSO_4 \cdot 5H_2O$ acts to (**GATE CY 2011**)

   (A) raise symmetry
   (B) remove an electronic degeneracy
   (C) cause loss of H_2O ligand
   (D) promote a d-electron to an antibonding molecular orbital

2) Among the following, the group of molecules that undergoes rapid hydrolysis is (**GATE CY 2011**)

   (A) SF_6, Al_2Cl_6, $SiMe_4$
   (B) BCl_3, SF_6, $SiCl_4$
   (C) BCl_3, $SiCl_4$, PCl_5
   (D) SF_6, Al_2Cl_6, $SiCl_4$

3) The reaction of solid XeF_2 with AsF_5 in 1:1 ratio affords (**GATE CY 2011**)

   (A) XeF_4 and AsF_3
   (B) XeF_6 and AsF_3
   XeF^+ $[AsF_6^-]$
   $Xe_2F_3^+$ $[AsF_6^-]$

4) A well known naturally occurring organometallic compound is (**GATE CY 2011**)

   (A) vitamin B_{12} coenzyme
   (B) chlorophyll
   (C) cytochrome P-450
   (D) myoglobin

5) The complex that exists as a pair of enantiomers is (**GATE CY 2011**)

   (A) trans-$[Co(H_2NCH_2CH_2NH_2)_2Cl_2]^+$
   (B) cis-$[Co(NH_3)_4Cl_2]^+$
   (C) $[Pt(PPh_3)(Cl)(Br)(CH_3)]^-$
   (D) $[Co(H_2NCH_2CH_2NH_2)_3]^{3+}$

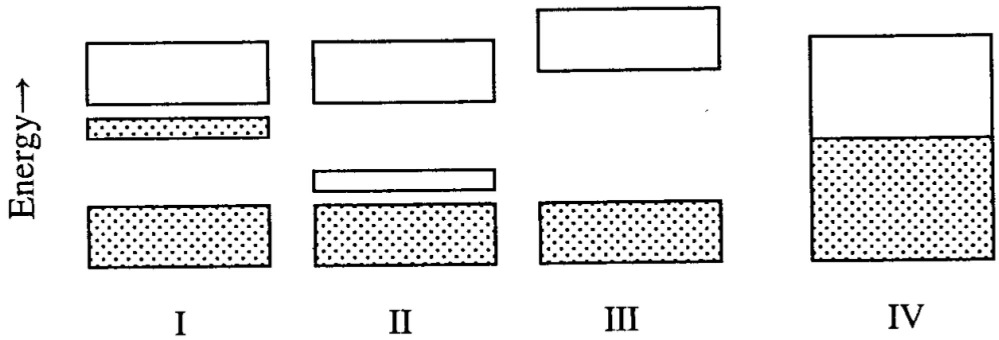
6) The region of electromagnetic spectrum employed in the electron spin resonance (ESR) spectroscopy is (**GATE CY 2011**)

   (A) radiowave
   (B) microwave
   (C) infrared
   (D) visible

7) The red color of oxyhaemoglobin is mainly due to the (**GATE CY 2011**)

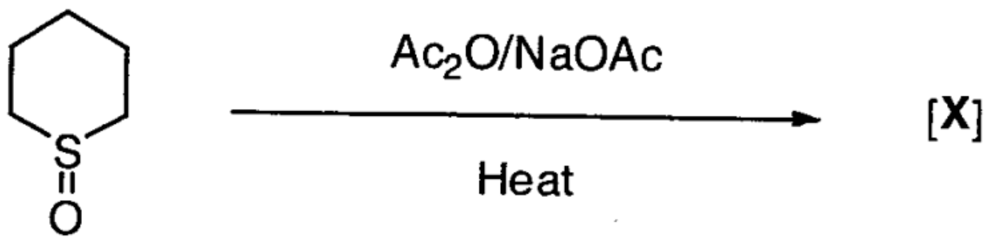
   (A) d-d transition
   (B) metal to ligand charge transfer transition
   (C) ligand to metal charge transfer transition
   (D) intraligand π-π^* transition

8) The band structure in an n-type semiconductor is (**GATE CY 2011**)



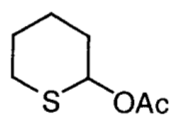
(A) I
(B) II
(C) III
(D) IV

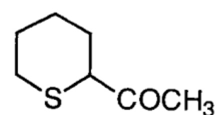
9) In the following reaction **(GATE CY 2011)**



The major product **[X]** is:

(A)


(B)


(C)


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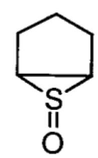
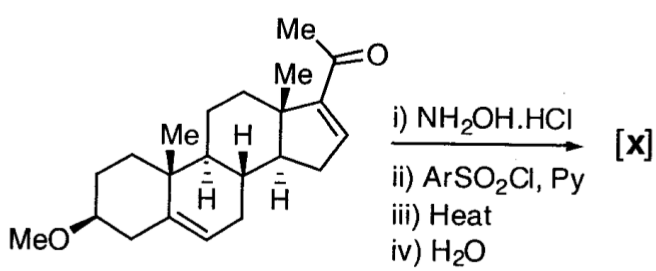
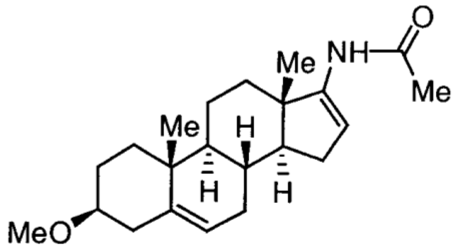


10) In the following reaction sequence: **(GATE CY 2011)**



The major product **[X]** is:

(A)



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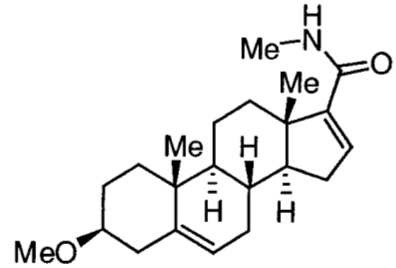
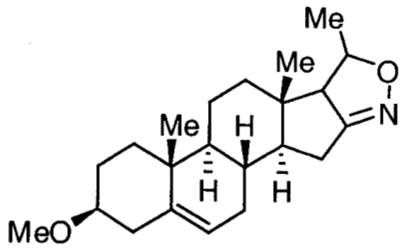


(C)



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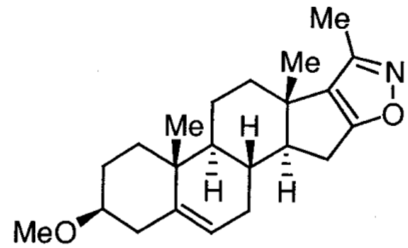
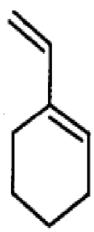


11) The diene which undergoes Diels-Alder reaction with maleic anhydride is: (**GATE CY 2011**)

(A)



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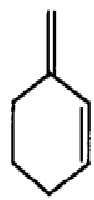
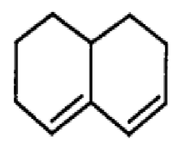
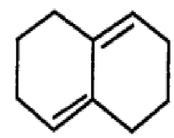


(C)



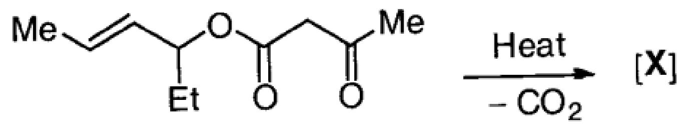
(D)



12) The sequence of an mRNA molecule produced from a DNA template strand with the composition 5'-AGCTCACACT-3' is (**GATE CY 2011**)

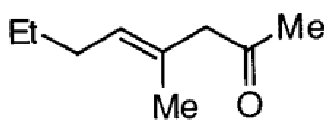
(A) 5'-AGGUUAGGCU-3'
(A) 5'-AGTGTAGCT-3'
(A) 5'-UCGAUGUGA-3'
(A) 5'-TCGATGTGA-3'

13) In the following reaction (**GATE CY 2011**)

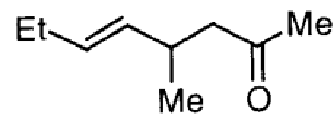


the major product [**X**] is

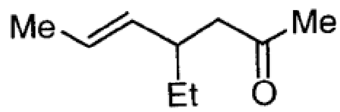
(A)



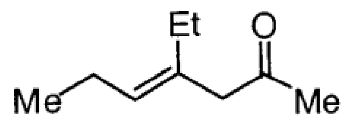
(B)



(C)

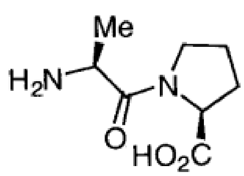


(D)

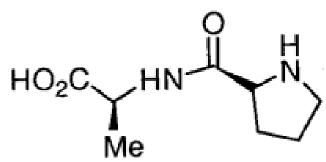


14) The structure of the dipeptide Ala-Pro derived from the natural amino acids is (**GATE CY 2011**)

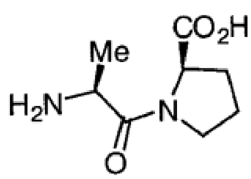
(A)



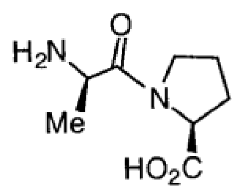
(B)



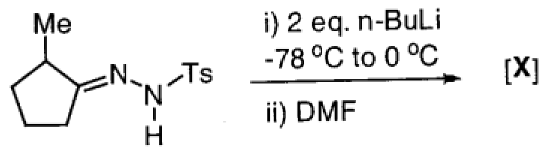
(C)



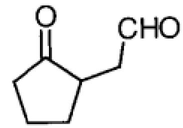
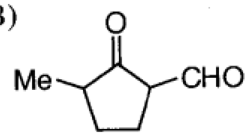
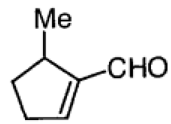
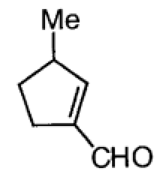
(D)



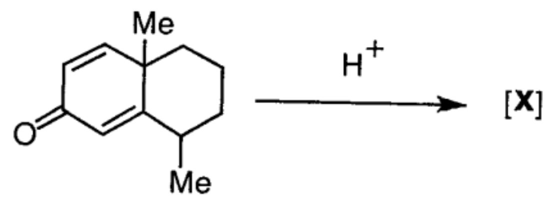
15) In the following reaction (**GATE CY 2011**)



the major product [**X**] is

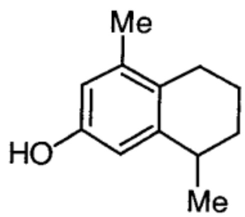
(A)  (B)  (C)  (D) 

16) In the following reaction (**GATE CY 2011**)

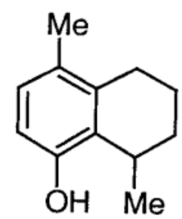


the major product [**X**] is

(A)



(B)



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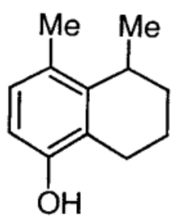
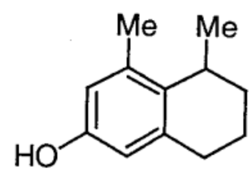


(D)



17) For a given first order reaction, the reactant reduces to 1/4th its initial value in 10 minutes. The rate constant of the reaction is (**GATE CY 2011**)

(A) 0.1386 min^{-1} (A) 0.1386 mol L^{-1} min^{-1}
(A) 0.0693 min^{-1} (A) 0.0693 mol L^{-1} min^{-1}

18) The freezing point constant for water is 1.86 K (mol $\text{kg}^{-1})^{-1}$. The change in freezing point when 0.01 mol glucose is added to 1 kg water is (**GATE CY 2011**)

(A) 1.86 K (A) 0.186 K
(A) –1.86 K (A) –0.0186 K

19) On the pressure-temperature diagram for a one-component system, the point where the solid-liquid and the liquid-gas curves intersect is (**GATE CY 2011**)

(A) triple point (A) melting point
(A) critical point (A) boiling point

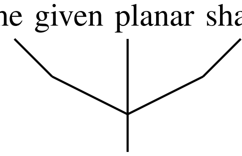
20) The wave function for a Harmonic oscillator described by $Nx\exp(-\alpha x^2/2)$ has (**GATE CY 2011**)

(A) one maximum only (A) two maxima, one minimum only
(A) one maximum, one minimum only (A) two maxima, two minima only

21) If an arbitrary wave function is used to calculate the energy of a quantum mechanical system, the value calculated is never less than the true energy.
The above statement relates to (**GATE CY 2011**)

(A) perturbation theory (A) Heisenberg's uncertainty principle
(A) variation principle (A) quantization of energy

22) The point group symmetry of the given planar shape is (**GATE CY 2011**)

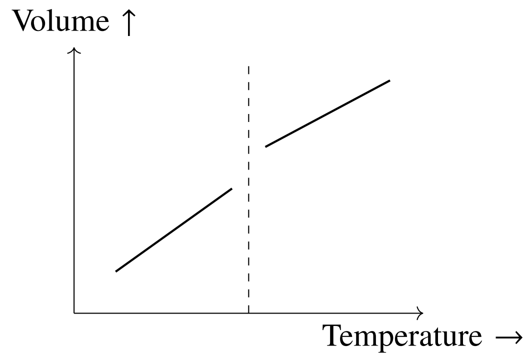


(A) D_{3h} (A) C_{3h}
(A) C_1 (A) C_{3v}

23) $\left(\frac{\partial G}{\partial P}\right)_T =$ (**GATE CY 2011**)

(A) V (A) $-S$
(A) S (A) $-V$

24) (**GATE CY 2011**)



According to the Ehrenfest classification of phase transitions, the above diagram refers to

(A) Zeroth order phase transition
(A) First order phase transition
(A) Second order phase transition
(A) λ transition

25) According to conventional transition state theory, for elementary bimolecular reactions, the molar entropy of activation $\Delta S^{0\ddagger}$ is (**GATE CY 2011**)

(A) positive
(A) zero
(A) negative
(A) positive for endothermic and negative for exothermic reactions

26) The crystal field stabilization energy (CFSE) value for $[Ti(H_2O)_6]^{3+}$ that has an absorption maximum at 492 nm is (**GATE CY 2011**)

(A) 20,325 cm^{-1}
(A) 10,162 cm^{-1}
(A) 12,195 cm^{-1}
(A) 8,130 cm^{-1}

27) For Et_2AlX (X = PPh_2, Ph^-, Cl^- and F^-), the tendency towards dimeric structure follows the order (**GATE CY 2011**)

(A) $PPh_2 > Cl^- > H^- > Ph^-$
(A) $Ph^- > H^- > Cl^- > PPh_2$
(A) $Cl^- > PPh_2 > H^- > Ph^-$
(A) $H^- > Ph^- > PPh_2 > Cl^-$

28) In the isoelectronic series, VO_4^{3-}, CrO_4^{2-} and MnO_4^-, all members have intense charge transfer (CT) transitions. The **INCORRECT** statement is (**GATE CY 2011**)

(A) CT transitions are attributed to excitations of electrons from ligand (σ) to metal (e)
(A) The wavelengths of transitions increase in the order $VO_4^{3-} < CrO_4^{2-} < MnO_4^-$
(A) MnO_4^- exhibits charge transfer at shortest wavelength among the three
(A) The charge on metal nucleus increases in the order $VO_4^{3-} < CrO_4^{2-} < MnO_4^-$

29) The increasing order of wavelength of absorption for the complex ions: i) $[Cr(NH_3)_6]^{3+}$, ii) $[CrCl_6]^{3-}$, iii) $[Cr(H_2O)_6]^{3+}$, iv) $[Cr(CN)_6]^{3-}$, is (**GATE CY 2011**)

(A) i < ii < i < iii
(A) iv < i < iii < ii
(A) iv < iii < i < ii
(A) ii < i < iv < iii

30) The total number of metal-metal bonds in $Ru_3(CO)_{12}$ and $Co_4(CO)_{12}$ respectively, is (**GATE CY 2011**)

(A) 3 and 6
(A) zero and 4
(A) 4 and 5
(A) 3 and 4

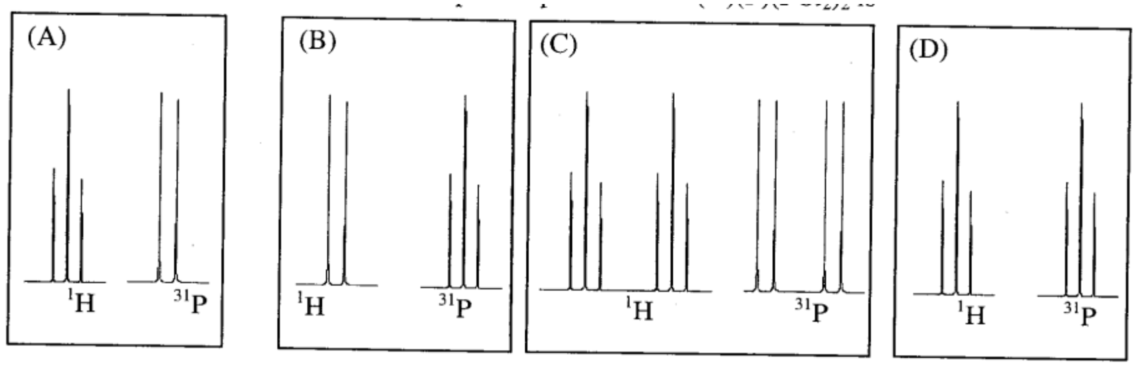
31) According to VSEPR theory the shapes of $[SF_2Cl_2]$ and $[SO_4]^{2-}$ should be (**GATE CY 2011**)

(A) trigonal planar for $[SO_4]^{2-}$ and trigonal pyramidal for $[SF_2Cl_2]$
(A) trigonal pyramidal for $[SO_4]^{2-}$ and trigonal planar for $[SF_2Cl_2]$
(A) both trigonal planar
(A) both trigonal pyramidal

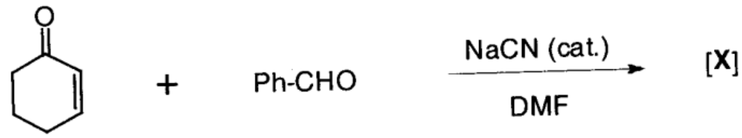
32) The product of the reaction between $CH_3Mn(CO)_5$ and ^{13}CO is (**GATE CY 2011**)

(A) $(CH_3)^{13}COMn(CO)_5$
(A) $(CH_3)COMn(^{13}CO)_5$
(A) $(CH_3)COMn(CO)_4(^{13}CO)$
(A) $(CH_3)^{13}COMn(^{13}CO)_4(CO)$

33) The ^1H and ^{31}P NMR spectra of $(CH_3)_2N(CH_2)PPh_2$ and $(CH_3)_2N(CH_2)P(Cl)_2$ is (**GATE CY 2011**)

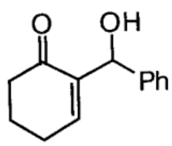


34) In the following reaction **(GATE CY 2011)**

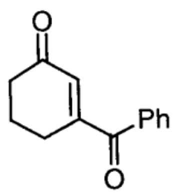


the major product [**X**] is

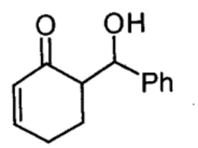
(A)



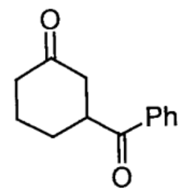
(B)



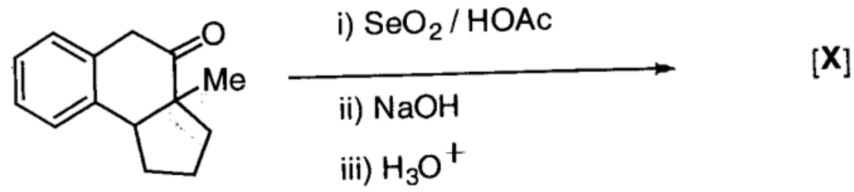
(C)



(D)

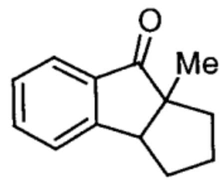


35) In the following reaction **(GATE CY 2011)**



the major product [**X**] is

(A)



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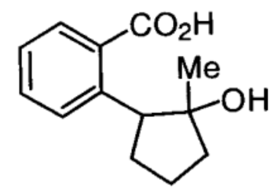
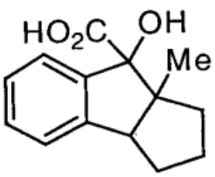
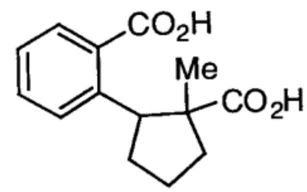


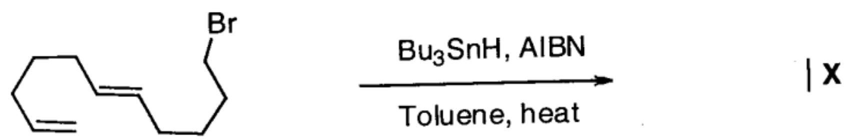
(C)



(D)

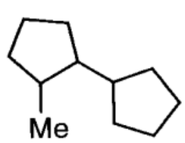


36) In the following reaction (**GATE CY 2011**)

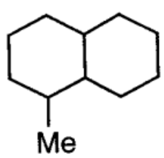


the major product [**X**] is

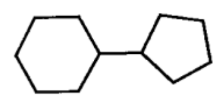
(A)



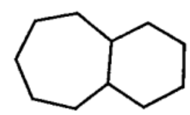
(B)



(C)



(D)



37) The most appropriate sequence of reactions for carrying out the following conversion is (**GATE CY 2011**)

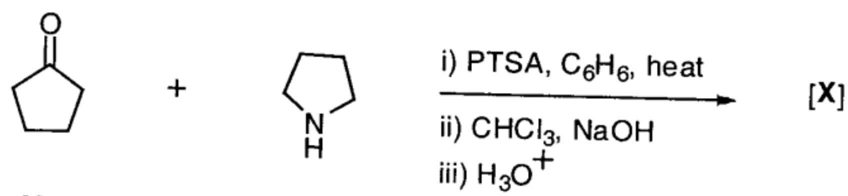
(A) Peracid; (ii) H^+; (iii) Zn / dil. HCl

(A) (i) Alkaline $KMnO_4$; (ii) $NaIO_4$; (iii) N_2H_4/KOH

(A) (i) Alkaline $KMnO_4$; (ii) H^+; (iii) Zn / dil. HCl

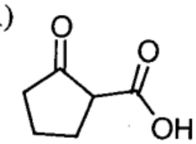
(A) (i) O_3 / Me_2S; (ii) NaOEt; (iii) N_2H_4/KOH

38) In the following reaction sequence (**GATE CY 2011**)

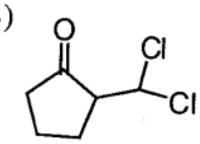


the major product [**X**] is

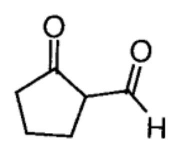
(A)



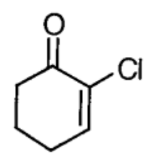
(B)



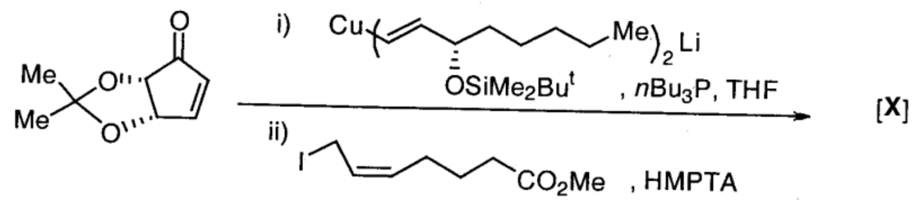
(C)



(D)

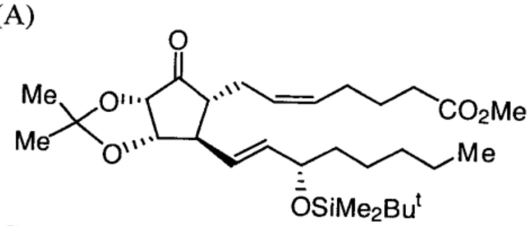


39) In the following conversion (**GATE CY 2011**)

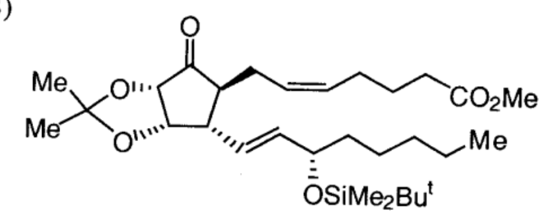


the major product [**X**] is

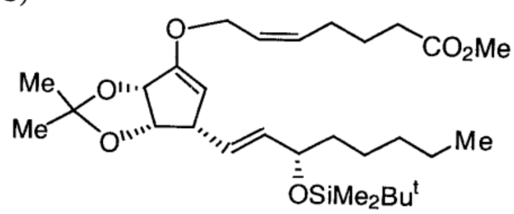
(A)



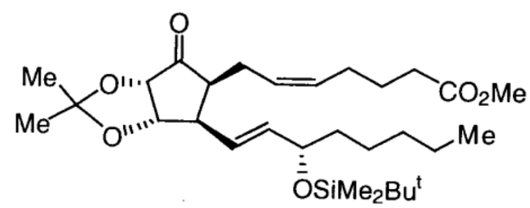
(B)



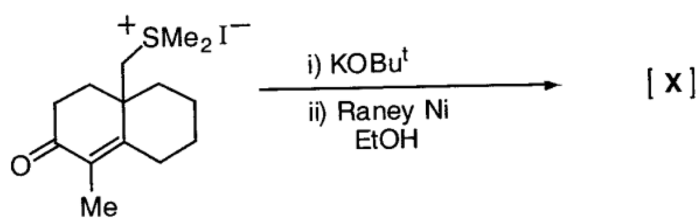
(C)



(D)

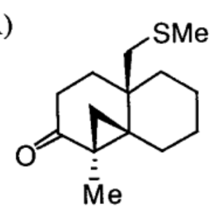


40) In the following reaction (**GATE CY 2011**)

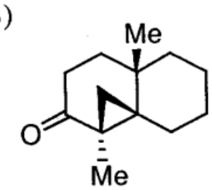


the major product [**X**] is

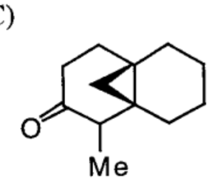
(A)



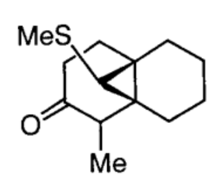
(B)



(C)



(D)



41) In the reaction (**GATE CY 2011**)

Optically pure (+)-*trans*-2-acetoxycyclohexyl tosylate

$$\xrightarrow[\Delta]{\text{HOAc, KOAc}} [\mathbf{X}]$$

The major product [X] is:

(A) racemic trans-1,2-cyclohexanediol diacetate
(A) optically active trans-1,2-cyclohexanediol diacetate
(A) racemic cis-1,2-cyclohexanediol diacetate
(A) optically active cis-1,2-cyclohexanediol diacetate

42) The activity of water at 11 bar and 298 K is (**GATE CY 2011**)

(A) 1.101
(A) 1.007
(A) 0.998
(A) 0.898

43) For the process (**GATE CY 2011**)

$$\mathbf{1\ Ar\ (300\ K,\ 1\ bar) \rightarrow 1\ Ar\ (200\ K,\ 10\ bar)}$$

Assuming ideal gas behavior, the change in molar entropy is:

(A) $-27.57\ \text{J K}^{-1}\text{mol}^{-1}$
(A) $+27.57\ \text{J K}^{-1}\text{mol}^{-1}$
(A) $-24.20\ \text{J K}^{-1}\text{mol}^{-1}$
(A) $+24.20\ \text{J K}^{-1}\text{mol}^{-1}$

44) The wave function for a quantum mechanical particle in a 1-dimensional box of length 'a' is given by (**GATE CY 2011**)

$$\psi = A \sin\left(\frac{\pi x}{a}\right)$$

The value of 'A' for a box of length 200 nm is:

(A) $4 \times 10^4\ (\text{nm})^{1/2}$
(A) $10\sqrt{2}\ (\text{nm})^{1/2}$
(A) $\frac{\sqrt{2}}{10}\ (\text{nm})^{-1/2}$
(A) $0.1\ (\text{nm})^{-1/2}$

45) For 1 mole of a monoatomic ideal gas, the relation between pressure (p), volume (V) and average molecular kinetic energy ($\bar{E}$) is (**GATE CY 2011**)

(A) $p = \frac{N_A \bar{E}}{V}$
(A) $p = \frac{2N_A \bar{E}}{3V}$
(A) $p = \frac{N_A \bar{E}}{3V}$
(A) $p = \frac{2N_A}{3V}\bar{E}$

46) For a 1 molal aqueous NaCl solution, the mean ionic activity coefficient ($\gamma_\pm$) and the Debye-HÃ¼ckel Limiting Law constant (A) are related as (**GATE CY 2011**)

(A) $\log \gamma_\pm = \sqrt{2}A$
(A) $\gamma_\pm = 10^A$
(A) $\log \gamma_\pm = -\sqrt{2}A$
(A) $\gamma_\pm = 10^{-A}$

47) For the concentration cell

$$M \mid M^{n+}(aq, 0.01 \text{ mol dm}^{-3}) \parallel M^{n+}(aq, 0.1 \text{ mol dm}^{-3}) \mid M$$

The EMF (E) of the cell at a temperature (T) equals (**GATE CY 2011**)

(A) $2.303\frac{RT}{F}$
(A) $E^\circ_{M^{n+}/M} + 2.303\frac{RT}{F}$
(A) $-2.303\frac{RT}{F}$
(A) $E^\circ_{M^{n+}/M} - 2.303\frac{RT}{F}$

Common Data for Questions 48 and 49:
A hypothetical molecule XY has the following properties:
Reduced mass: 2×10^{-26} kg
X-Y bond length: 100 pm
Force constant of the bond: 8×10^2 NÂ·m^{-1}

48) The frequency of radiation (in cm^{-1} units) required to vibrationally excite the molecule from $v = 0$ to $v = 1$ state is (**GATE CY 2011**)

(A) 3184.8
(A) 1061.6
(A) 2123.2
(A) 840.0

49) The frequency of radiation (in cm^{-1} units) required to rotationally excite the molecule from $J = 0$ to $J = 1$ state is (**GATE CY 2011**)

(A) 1.4
(A) 3.2
(A) 2.8
(A) 3.6

Common Data for Questions 50 and 51:
Na_2HPO_4 and NaH_2PO_4, on heating at high temperature produce a chain sodium pentaphosphate quantitatively.

50) The ideal molar ratio of Na_2HPO_4 to NaH_2PO_4 is (**GATE CY 2011**)

(A) 4:1
(A) 3:2
(A) 1:4
(A) 2:3

51) The total charge on pentaphosphate anion is (**GATE CY 2011**)

(A) −5
(A) −7
(A) −3
(A) −9

Linked Answer Questions
Statement for Linked Answer Questions 52 and 53:
The decomposition of ozone to oxygen $O_2(g) \rightarrow 3O_2(g)$ occurs by the mechanism:

$$\text{(i)}\quad \mathrm{M(g)} + \mathrm{O_3}(g) \xrightarrow{k_1} \mathrm{O_2}(g) + \mathrm{O(g)} + \mathrm{M(g)} \quad E_{a,1}$$
$$\text{(ii)}\quad \mathrm{O_2}(g) + \mathrm{O(g)} + \mathrm{M(g)} \xrightarrow{k_2} \mathrm{M(g)} + \mathrm{O_3}(g) \quad E_{a,2}$$
$$\text{(iii)}\quad \mathrm{O(g)} + \mathrm{O_3}(g) \xrightarrow{k_3} 2\mathrm{O_2}(g) \quad E_{a,3}$$

where, M is the catalyst molecule.
k_i are rate constants and $E_{a,i}$'s are the activation energies for the elementary steps.

52) Under the steady state approximation for the intermediates, the rate of decomposition of ozone, $-\dfrac{d[O_3]}{dt}$, is (**GATE CY 2011**)

(A) $\dfrac{2k_1k_3[O_3]^2[M]}{k_2[O_2][M] + k_3[O_3]}$
(A) $\dfrac{2k_2k_1[O_3][M]}{k_2[O_2][M] + k_3[O_3]}$
(A) $\dfrac{2k_1k_3[O_3]^2[M]}{k_2[O_2][M] - k_3[O_3]}$
(A) $\dfrac{2k_2k_1[O_3][M]}{k_2[O_2][M] - k_3[O_3]}$

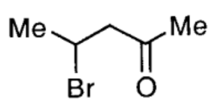
53) Assuming $k_3[O_3] \gg k_2[O_2][M]$, the activation energy of the overall reaction is (**GATE CY 2011**)

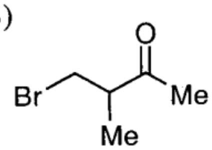
(A) $\dfrac{E_{a,1}E_{a,3}}{E_{a,2}}$
(A) $E_{a,2}$
(A) $E_{a,3} + E_{a,1} - E_{a,2}$
(A) $E_{a,1}$

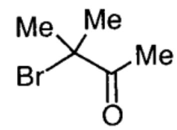
Statement for Linked Answer Questions 54 and 55:
A ketone on treatment with bromine in methanol gives the corresponding monobromo compound [X] having molecular formula C_5H_9BrO. The compound [X] when treated with

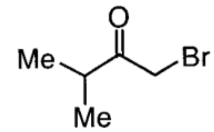
NaOMe in MeOH produces [Y] as the major product. The spectral data for compound [X] are: ^{1}H NMR : $\delta 1.17$(d, 6H), 3.02(m, 1H), 4.10(s, 2H); ^{13}C NMR : $\delta 17, 37, 39, 210$.

54) The compound [X] is **(GATE CY 2011)**

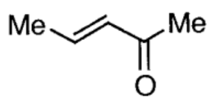
(A)


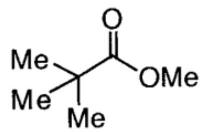
(B)


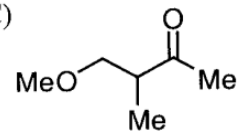
(C)


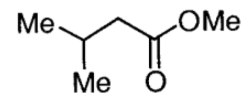
(D)


55) The major product [Y] is **(GATE CY 2011)**

(A)


(B)


(C)


(D)


General Aptitude (GA) Questions

56) The question below consists of a pair of related words followed by four pairs of words. Select the pair that best expresses the relation in the original pair:
Gladiator : Arena (**GATE CY 2011**)

(A) dancer : stage
(A) teacher : classroom
(A) commuter : train
(A) lawyer : courtroom

57) Choose the most appropriate word from the options given below to complete the following sentence:
Under ethical guidelines recently adopted by the Indian Medical Association, human genes are to be manipulated only to correct diseases for which ________ treatments are unsatisfactory. (**GATE CY 2011**)

(A) similar
(A) uncommon
(A) most
(A) available

58) Choose the word from the options given below that is most nearly opposite in meaning to the given word:
Frequency (**GATE CY 2011**)

(A) periodicity
(A) gradualness
(A) rarity
(A) persistency

59) Choose the most appropriate word from the options given below to complete the following sentence:
It was her view that the country's problems had been ________ by foreign technocrats, so that to invite them to come back would be counter-productive. (**GATE CY 2011**)

(A) identified
(A) exacerbated
(A) ascertained
(A) analysed

60) There are two candidates P and Q in an election. During the campaign, 40% of the voters promised to vote for P, and rest for Q. However, on the day of election 15% of the voters went back on their promise to vote for P and instead voted for Q. 25% of the voters went back on their promise to vote for Q and instead voted for P. Suppose, P lost by 2 votes, then what was the total number of voters? (**GATE CY 2011**)

(A) 100
(A) 90
(A) 110
(A) 95

61) *The horses may be able to look unhurt but very important role in the field of medicine. Horses were injected with toxins of diseases until their blood built up immunities. Then a serum was made from their blood. Serum to fight with diphtheria and tetanus were developed this way.*
It can be inferred from the passage, that horses were (**GATE CY 2011**)

(A) identified as a disease carrier
(A) given diphtheria and tetanus
(A) given immunity to fatal diseases
(A) vaccinated successfully

62) The sum of n terms of the series $4 + 44 + 444 + \ldots$ is (**GATE CY 2011**)

(A) $\frac{4}{81}\left[10^{n+1} - 9n - 1\right]$
(A) $\frac{4}{81}\left[10^{n+1} - 9n - 10\right]$
(A) $\frac{4}{81}\left[10^{n} - 9n - 1\right]$
(A) $\frac{4}{81}\left[10^{n} - 9n - 10\right]$

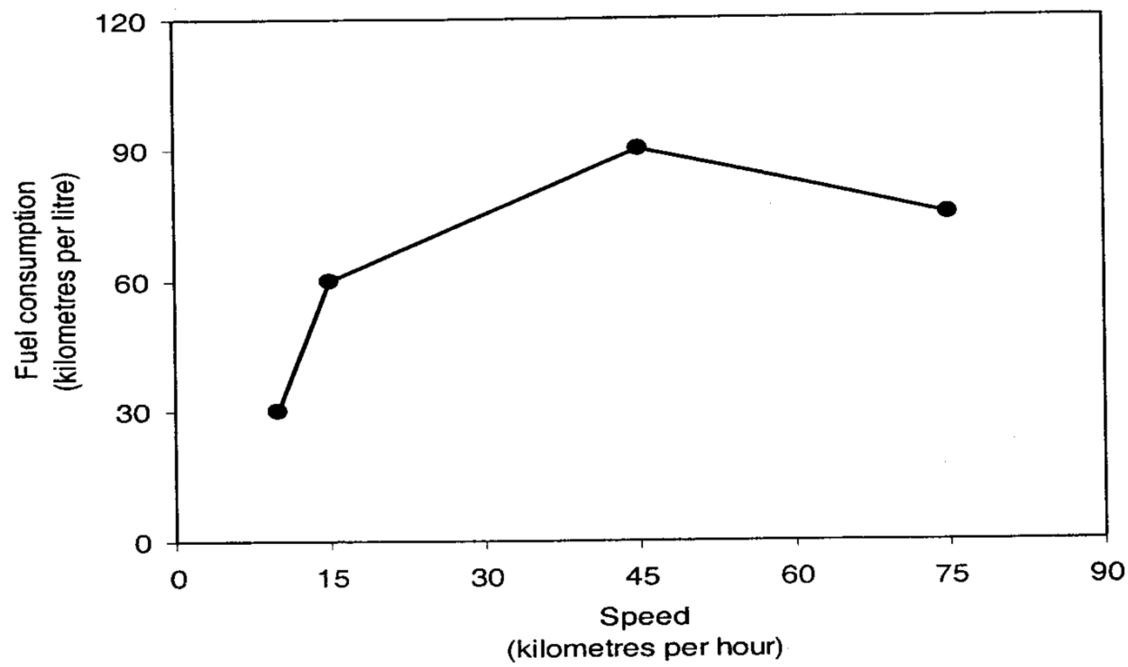
63) Given that $f(y) = \left\lfloor \frac{y}{y} \right\rfloor$, and q is any non-zero real number, the value of $|f(q) - f(-q)|$ is (**GATE CY 2011**)

(A) 0
(A) 1
(A) -1
(A) 2

64) Three friends, R, S and T shared toffee from a bowl. R took $\frac{1}{3}$rd of the toffees, but returned four to the bowl. S took $\frac{1}{4}$th of what was left but returned three to the bowl. T took half of the remainder but returned two back into the bowl. If the bowl had 17 toffees left, how many toffees were originally there in the bowl? (**GATE CY 2011**)

(A) 38
(A) 48
(A) 31
(A) 41

65) The fuel consumed by a motorcycle during a journey while traveling at various speeds is indicated in the graph below: (**GATE CY 2011**)



The distances covered during four laps of the journey are listed in the table below:

Lap	Distance (kilometres)	Average speed (km/h)
P	15	15
Q	75	45
R	40	75
S	10	10

From the given data, we can conclude that the fuel consumed per kilometre was least during the lap:

(A) P
(A) Q
(A) R
(A) S

END OF THE QUESTION PAPER