ASSIGNMENT: GATE 2021
CY: CHEMISTRY

EE25BTECH11039 - Manupati Manideep

Q.1 - Q.5 MCQ, CARRY ONE MARK EACH

1) Getting to the top is _ _ _ _ than staying on top.

a) more easy
b) much easy
c) easiest
d) easier

(GATE CY - 2021)

2) The mirror image of the above text about the x-axis is:

a) TRIANGLE
b) TRIANGLE
c) TRIANGLE
d) TRIANGLE

(GATE CY - 2021)

3) In a company, 35% of the employees drink coffee, 40% of the employees drink tea and 10% of the employees drink both tea and coffee. What % of employees drink neither tea nor coffee?

a) 15
b) 25
c) 35
d) 40

(GATE CY - 2021)

4) $\oplus$ and $\odot$ are two operators on numbers p and q such that $p \oplus q = \frac{p^2+q^2}{pq}$ and $p \odot q = \frac{p^2}{q}$; If $x \oplus y = 2 \odot 2$ then $x =$

a) $\frac{y}{2}$
b) y
c) $\frac{3y}{2}$
d) 2 y

(GATE CY - 2021)

5) Four persons P, Q, R and S are to be seated in a row, all facing the same direction, but not necessarily in the same order. P and R cannot sit adjacent to each other. S should be seated to the right of Q. The number of distinct seating arrangements possible is:

a) 2
b) 4
c) 6
d) 8

(GATE CY - 2021)

Q.6 - Q.10 MCQ, CARRY TWO MARKS EACH

6) Statement: Either P marries Q or X marries Y. Among the options below, the logical NEGATION of the above statement is:

a) P does not marry Q and X marries Y.
b) Neither P marries Q nor X marries Y.
c) X does not marry Y and P marries Q.
d) P marries Q and X marries Y.

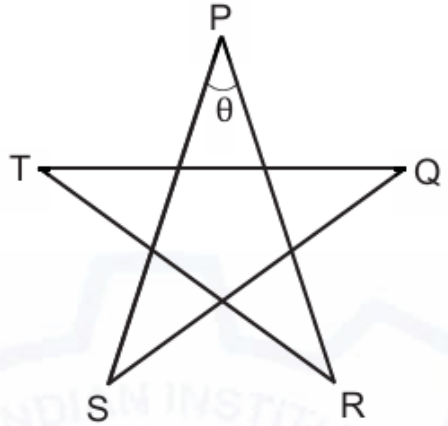
(GATE CY - 2021)

7) Consider two rectangular sheets, Sheet M and Sheet N of dimensions 6 cm x 4 cm each. Folding operation 1: The sheet is folded into half by joining the short edges of the current shape. Folding operation 2: The sheet is folded into half by joining the long edges of the current shape. Folding operation 1 is carried out on Sheet M three times. Folding operation 2 is carried out on Sheet N three times. The ratio of perimeters of the final folded shape of Sheet N to the final folded shape of Sheet M is:

a) 13:7
b) 3:2
c) 7:5
d) 5:13

(GATE CY - 2021)

8) Five line segments of equal lengths, PR, PS, QS, QT and RT are used to form a star as shown in the figure above. The value of θ, in degrees, is:



a) 36
b) 45
c) 72
d) 108

(GATE CY - 2021)

9) A function, λ, is defined by $\lambda(p,q) = \begin{cases} (p-q)^2, & if\ p \geq q, \\ p+q, & if\ p < q. \end{cases}$ The value of the expression $\frac{\lambda(-(-3+2),(-2+3))}{(-(-2+1))}$ is:

a) -1
b) 0
c) $\frac{16}{3}$
d) 16

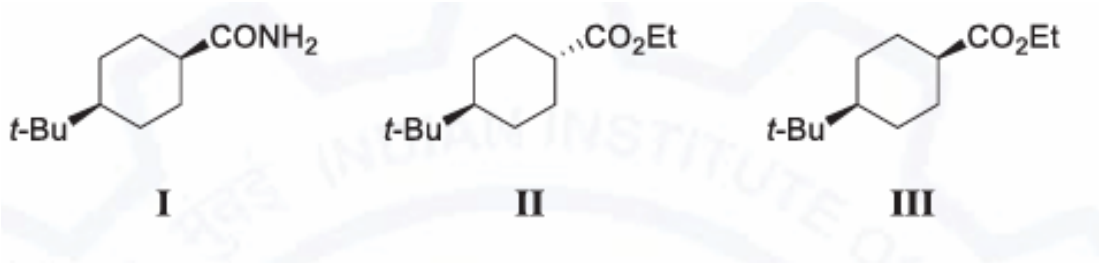
(GATE CY - 2021)

10) Humans have the ability to construct worlds entirely in their minds, which don't exist in the physical world. So far as we know, no other species possesses this ability. This skill is so important that we have different words to refer to its different flavors, such as imagination, invention and innovation. Based on the above passage, which one of the following is TRUE?
a) No species possess the ability to construct worlds in their minds.
b) The terms imagination, invention and innovation refer to unrelated skills.
c) We do not know of any species other than humans who possess the ability to construct mental worlds.
d) Imagination, invention and innovation are unrelated to the ability to construct mental worlds.

(GATE CY - 2021)

Q.11 - Q.24 CARRY ONE MARK EACH

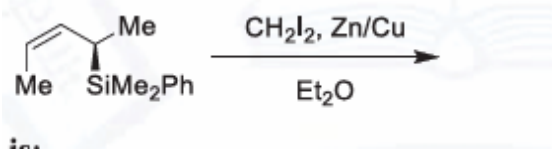
11) The rates of alkaline hydrolysis of the compounds shown below follow the order:

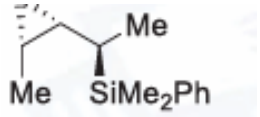


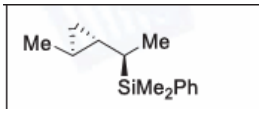
a) I > II > III
b) II > I > III
c) II > III > I
d) III > I > II

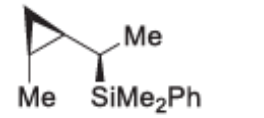
(GATE CY-2021)

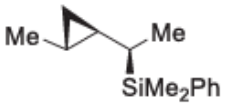
12) The major product formed in the following reaction is:



a)


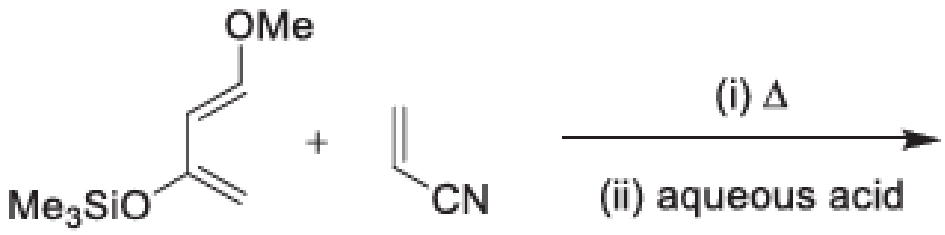
b)


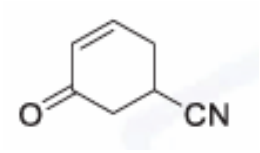
c)


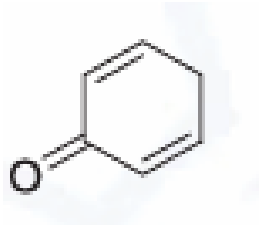
d)


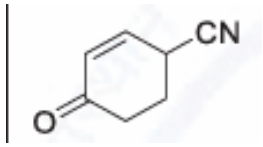
(GATE CY-2021)

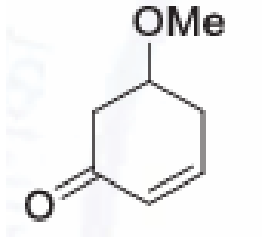
13) The major product formed in the following reaction is:



a) 

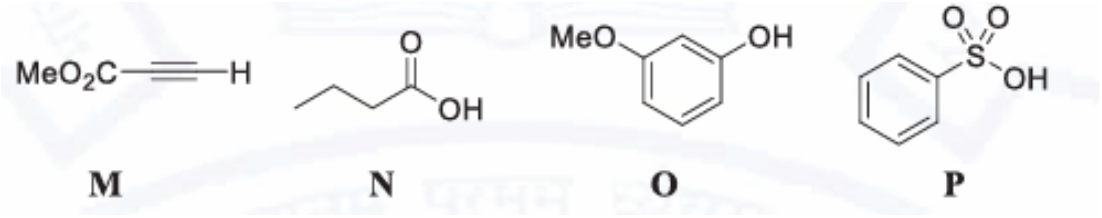
b) 

c) 

d) 

(GATE CY-2021)

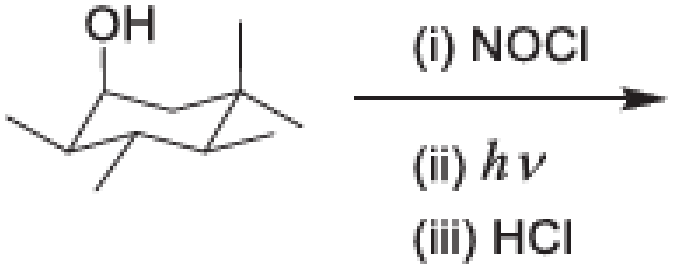
14) The least acidic among the following compounds is:

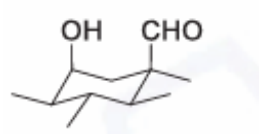


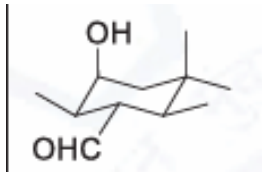
a) M
b) N
c) O
d) P

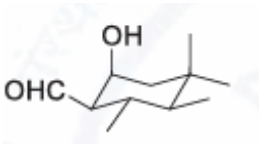
(GATE CY-2021)

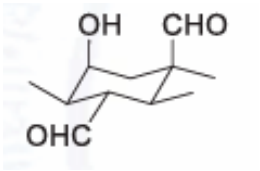
15) The major product formed in the following reaction is:



a) 

b) 

c) 

d) 

(GATE CY-2021)

16) The reagent(s) required for the conversion of hex-3-yne to (E)-hex-3-ene is/are:

a) H2, $Pd/BaSO_4$
b) Bu3SnH
c) Li/liquid NH3
d) LiAlH4

(GATE CY-2021)

17) An organic compound exhibits the $[M]^+$, $[M+2]^-$ and $[M+4]^-$ peaks in the intensity ratio 1:2:1 in the mass spectrum, and shows a singlet at δ 7.49 in the ^{1}H NMR spectrum in $CDCl_3$. The compound is:

a) 1,4-dichlorobenzene
b) 1,4-dibromobenzene
c) 1,2-dibromobenzene
d) 1,2-dichlorobenzene

(GATE CY-2021)

18) Reaction of $LiAlH_4$ with one equivalent of $Me_3N \cdot HCl$ gives a tetrahedral compound, which reacts with another equivalent of $Me_3N \cdot HCl$ to give compound N. The compound N and its geometry, respectively, are:

a) $LiAlH_4NMe_3$ and trigonal bipyramidal
b) Li_2AlH_4Cl and square pyramidal
c) $AlH_3(NMe_3)_2$ and trigonal bipyramidal
d) $AlH_3(NMe_3)_2$ and pentagonal

(GATE CY-2021)

19) Which one of the following is a non-heme protein?

a) hemoglobin
b) hemocyanin
c) myoglobin
d) cytochrome P-450

(GATE CY-2021)

20) A correct example of a nucleotide is:

a) adenosine monophosphate (AMP)
b) RNA
c) uridine
d) DNA

(GATE CY-2021)

21) The equilibrium constant for the reaction

$$3\ NO\ (g) \rightleftharpoons N_2O\ (g) + NO_2\ (g)$$

at 25 °C is closest to: [ΔG° = -104.18 kJ; R = 8.314 J mol^{-1} K^{-1}]

a) 1.043
b) 1.8×10^{18}
c) 1.651
d) 5.7×10^{-19}

(GATE CY-2021)

22) The reaction of $NiBr_2$ with two equivalents of PPh_3 in CS_2 at -78 °C gives a red-colored diamagnetic complex, [$NiBr_2(PPh_3)_2$]. This transforms to a green-colored paramagnetic complex with the same molecular formula at 25 °C. The geometry and the number of unpaired electrons in the green-colored complex, respectively, are:

a) tetrahedral and 1
b) tetrahedral and 2
c) square planar and 2
d) square planar and 4

(GATE CY-2021)

23) The rate of the substitution reaction of $[Co(CN)_5Cl]^{3-}$ with OH^- to give $[Co(CN)_5(OH)]^{3-}$

a) depends on the concentrations of both $[Co(CN)_5Cl]^{3-}$ and OH^-
b) depends on the concentration of $[Co(CN)_5Cl]^{3-}$ only
c) is directly proportional to the concentration of OH^- only
d) is inversely proportional to the concentration of OH^-

(GATE CY-2021)

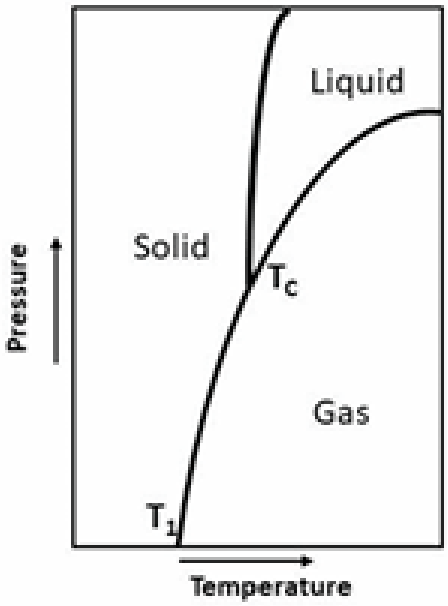
24) The Δ_o of $[Cr(H_2O)_6]^{3+}$, $[CrF_6]^{3-}$ and $[Cr(CN)_6]^{3-}$ follows the order:

a) $[Cr(H_2O)_6]^{3+} > [CrF_6]^{3-} > [Cr(CN)_6]^{3-}$
b) $[CrF_6]^{3-} > [Cr(H_2O)_6]^{3+} > [Cr(CN)_6]^{3-}$
c) $[Cr(CN)_6]^{3-} > [Cr(H_2O)_6]^{3+} > [CrF_6]^{3-}$
d) $[CrF_6]^{3-} > [Cr(CN)_6]^{3-} > [Cr(H_2O)_6]^{3+}$

(GATE CY-2021)

Q.25 - Q.28 MULTIPLE SELECT QUESTION, CARRY ONE MARK EACH

25) The phase diagram of CO_2 is shown below:



The correct statement(*s*) about CO_2 is/are:

a) Below T_c, it does not exist in liquid state.
b) Above T_c, it does not exist in liquid state.
c) At T_c, it can exist in all three phases.
d) Above T_2, it does not exist in solid state.

(GATE CY-2021)

26) Acceptable wavefunctions for a quantum particle must be:

a) odd
b) even
c) single-valued
d) continuous

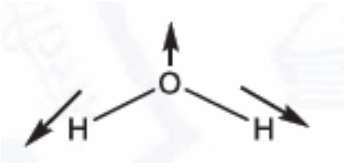
(GATE CY-2021)

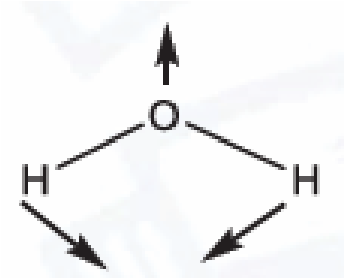
27) The characters of E, C_2, σ_v, and σ_v' symmetry operations, in this order, for valid irreducible representation(*s*) of the C_{2v} point group is/are:

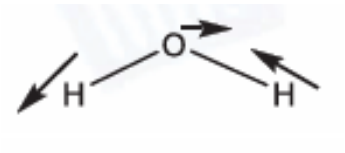
a) 1, 1, 1, 1
b) 1, 1, -1, -1
c) 1, -1, 1, -1
d) 1, -1, -1, 1

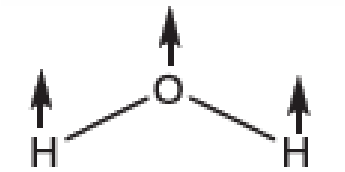
(GATE CY-2021)

28) The normal mode(*s*) of vibration of H_2O is/are:

a) 

b) 

c) 

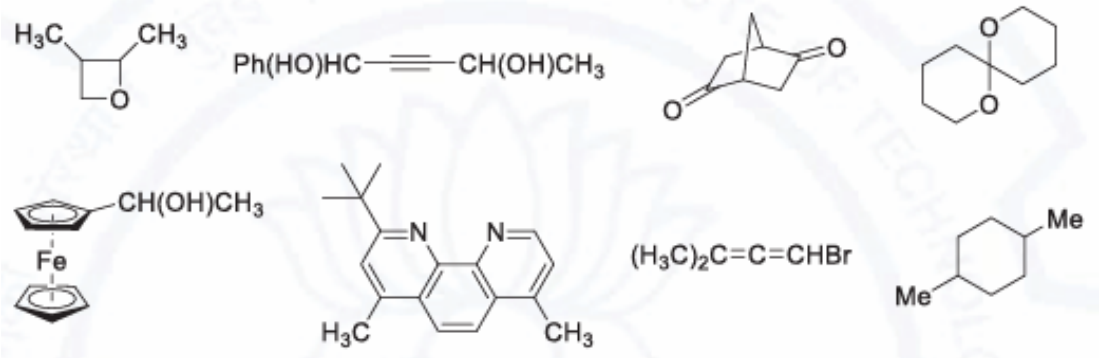
d) 

(GATE CY-2021)

Q.29 - Q.35 NUMERICAL ANSWER TYPE, CARRY ONE MARK EACH

29) A reversible heat engine absorbs 20 kJ of heat from a source at 500 K and dissipates it to the reservoir at 400 K. The efficiency of the heat engine is _ _ _ _ _ _ _ _ %. (GATE CY-2021)

30) Among the following eight compounds, the number of compound(*s*) which can exhibit stereoisomerism is .



(GATE CY-2021)

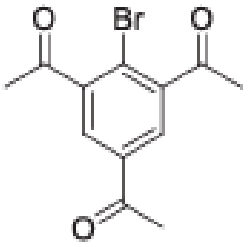
31) The Mo-Mo bond order in $[(K_5 - C_5H_5)Mo(CO)_2]_2$ which obeys the 18-electron rule is _ _ _ _ _ _ _. (GATE CY-2021)

32) The change in enthalpy (ΔH) for the reaction

$$2\ P\ (s) + Br_2\ (l) \rightarrow 2\ PBr_3\ (l)$$

is -243 kJ. In this reaction, if the amount of phosphorus consumed is 3.1 g, the change in enthalpy (rounded off to two decimal places) is _ _ _ _ _ _ _ _ kJ. [Atomic Wt. of P = 31] (GATE CY-2021)

33) The number of signal(s) in the ^1H NMR spectrum of the following compound recorded at 25 °C in $CDCl_3$ is _ _ _ _ _ _ _.



(GATE CY-2021)

34) A 5 V battery delivers a steady current of 1.5 A for a period of 2 h. The total charge that has passed through the circuit is _ _ _ _ _ _ _ _ Coulombs. (GATE CY-2021)

35) The spin-only magnetic moment of $[Co(H_2O)_6]^{2+}$ (rounded off to one decimal place) is _ _ _ _ _ _ _ _ BM. (GATE CY-2021)

Q.36 - Q.52 MCQ, CARRY TWO MARK EACH

36) The geometry and the number of unpaired electrons in tetrakis(1 – *norbornyl*)Co, respectively, are:

a) tetrahedral and one
b) tetrahedral and five
c) square planar and one
d) square planar and three

(GATE CY-2021)

37) The yellow color of an aqueous solution of K_2CrO_4 changes to red-orange upon the addition of a few drops of HCl. The red-orange complex, the oxidation state of its central element(s), and the origin of its color, respectively, are:

a) chromium chloride, +3, d-d transition
b) dichromate ion, +6 and +6, charge transfer
c) perchlorate ion, +7, charge transfer
d) chromic acid, +6, charge transfer

(GATE CY-2021)

38) The shapes of the compounds ClF_3, $XeOF_2$, N_3^- and XeO_3F_2 respectively, are:

a) T-shape, T-shape, linear and trigonal bipyramidal
b) trigonal planar, T-shape, V-shape and square pyramidal
c) T-shape, trigonal planar, linear and square pyramidal
d) trigonal planar, trigonal planar, V-shape and trigonal bipyramidal

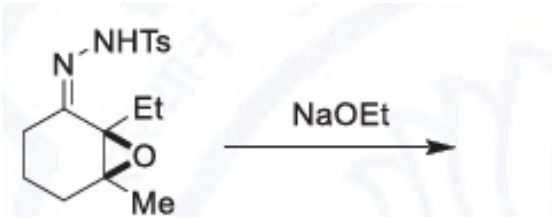
(GATE CY-2021)

39) The metal borides that contain isolated boron atoms are:

a) Tc_7B_3 and Re_7B_3
b) Cr_5B_3 and V_3B_2
c) Ti_4B_4 and V_3B_4
d) TiB and HfB

(GATE CY-2021)

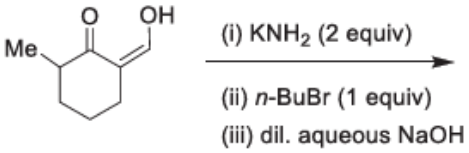
40) The major product formed in the following reaction is:



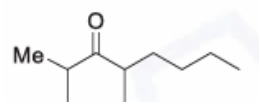
a) non-6-yn-2-one
b) non-3-yn-8-one
c) non-2-yn-6-one
d) non-3-en-8-one

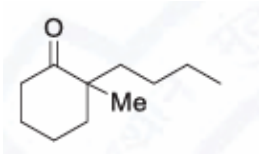
(GATE CY-2021)

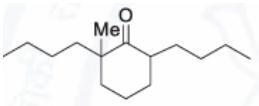
41) The major product formed in the following reaction

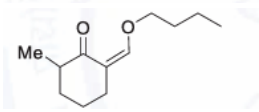


is:

a) 

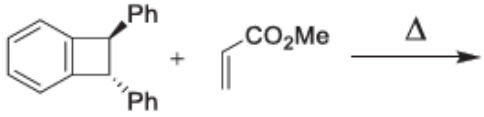
b) 

c) 

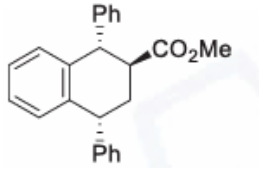
d) 

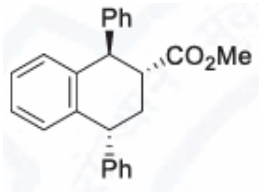
(GATE CY-2021)

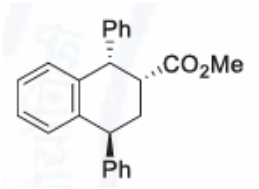
42) The major product formed in the following reaction

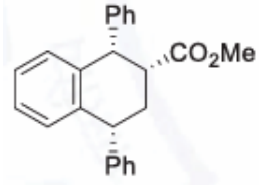


is:

a) 

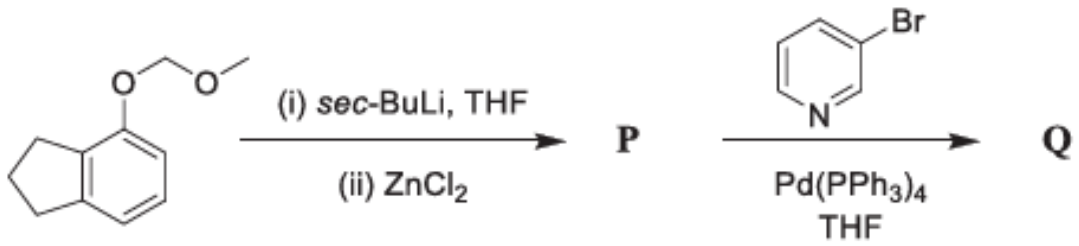
b) 

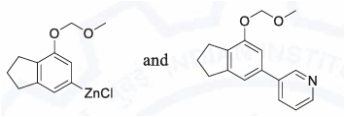
c) 

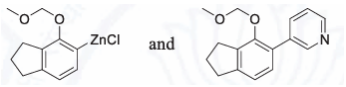
d) 

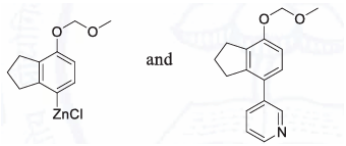
(GATE CY-2021)

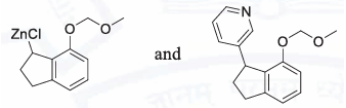
43) In the following reaction sequence the major products P and Q, respectively, are:



a) 

b) 

c) 

d) 

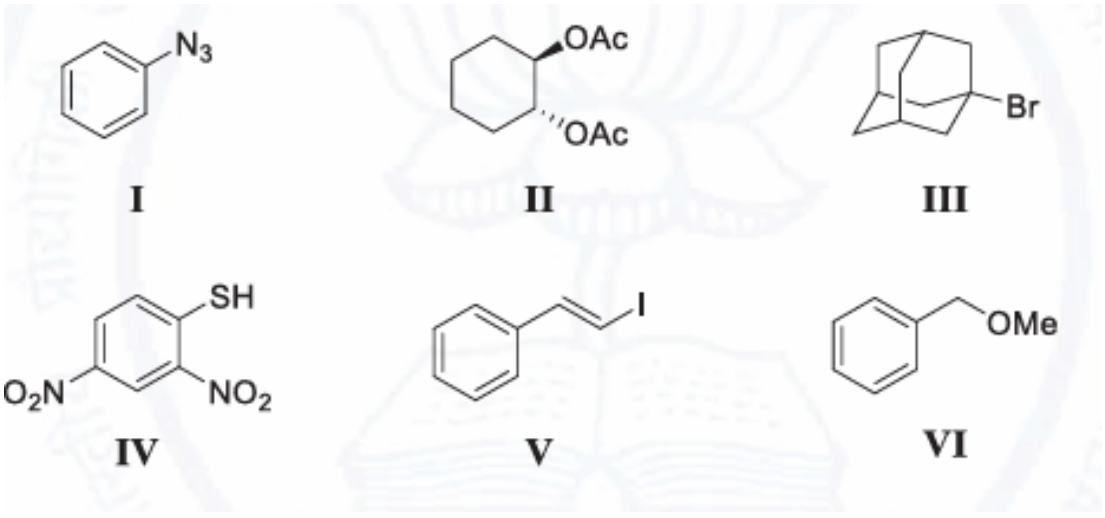
(GATE CY-2021)

44) In an electrochemical cell, Ag^{+} ions in $AgNO_3$ are reduced to Ag metal at the cathode and Cu is oxidized to Cu^{2+} at the anode. A current of 0.7 A is passed through the cell for 10 min. The mass (in grams) of silver deposited and copper dissolved, respectively, are: $\left[Faraday Constant = 96,485 C mol^{-1}, Aton\right.$

a) 0.469 and 0.138
b) 0.235 and 0.138
c) 0.469 and 0.069
d) 0.235 and 0.069

(GATE CY-2021)

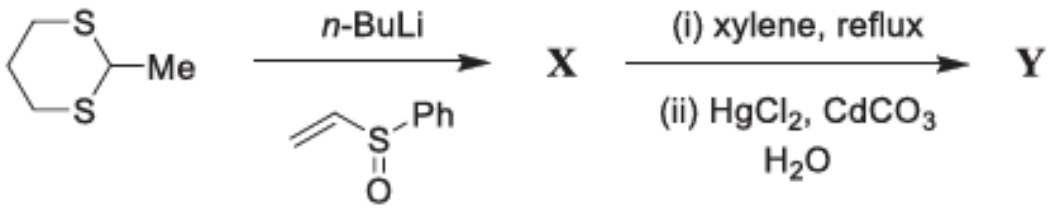
45) Among the following the compounds which can be prepared by nucleophilic substitution reaction are:



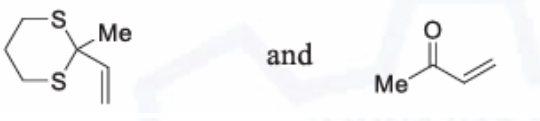
a) III, IV, and V
b) I, II, and VI
c) II, IV, and VI
d) I, III, and V

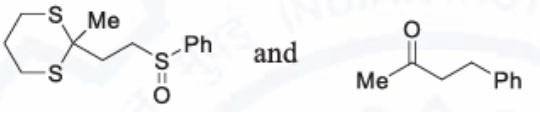
(GATE CY-2021)

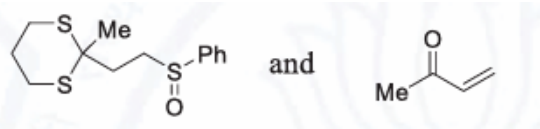
46) In the following reaction

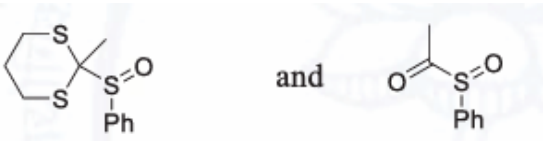


the major products X and Y, respectively, are:

a) 

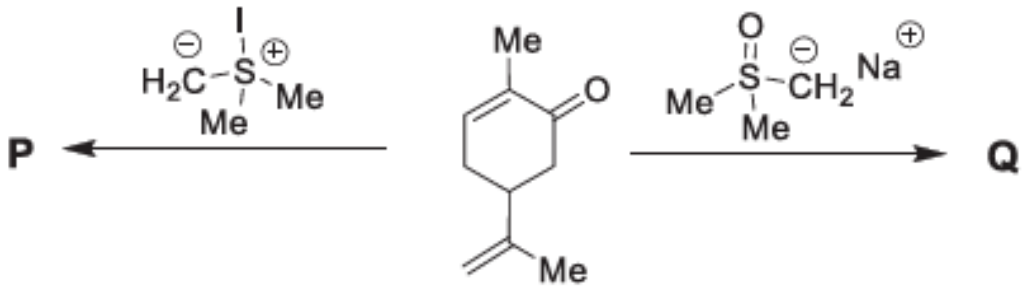
b) 

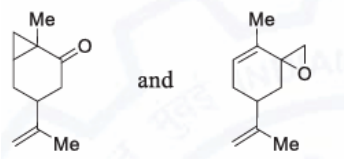
c) 

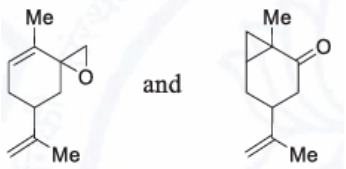
d) 

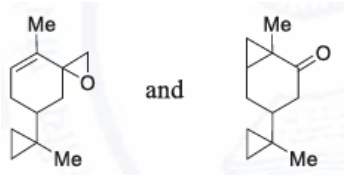
(GATE CY-2021)

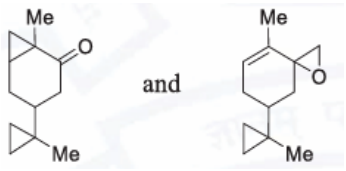
47) The major products P and Q formed in the following reactions respectively, are:



a) 

b) 

c) 

d) 

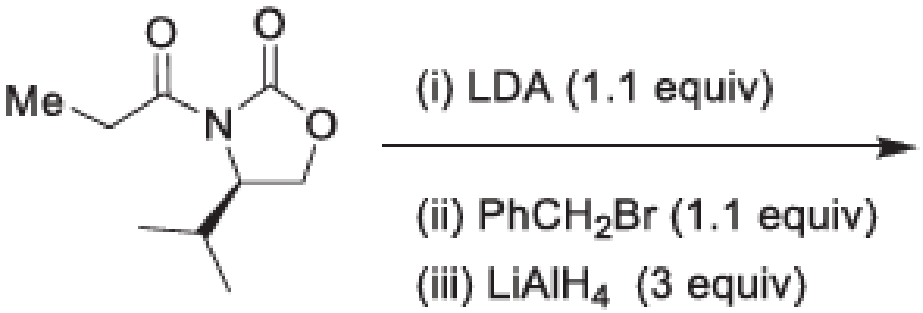
(GATE CY-2021)

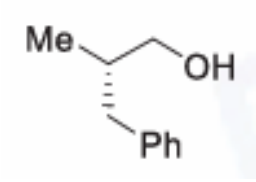
48) The major product formed in the reaction of (2*R*, 3*R*)-2-bromo-3-methylpentane with NaOMe is:

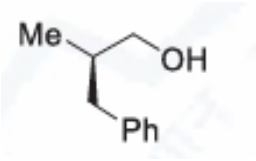
a) (*Z*)-3-methylpent-2-ene
b) (*E*)-3-methylpent-2-ene
c) (2*R*, 3*R*)-2-methoxy-3-methylpentane
d) (2*S*, 3*R*)-2-methoxy-3-methylpentane

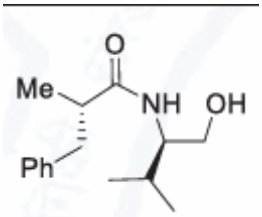
(GATE CY-2021)

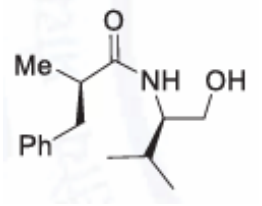
49) The major product formed in the following reaction is:



a) 

b) 

c) 

d) 

(GATE CY-2021)

50) Hexane and heptane are completely miscible. At 25 °C, the vapor pressures of hexane and heptane are 0.198 atm and 0.06 atm, respectively. The mole fractions of hexane and heptane in the vapor phase for a solution containing 4 M hexane and 6 M heptane, respectively, are:

a) 0.688 and 0.312
b) 0.400 and 0.600
c) 0.312 and 0.688
d) 0.600 and 0.400

(GATE CY-2021)

51) The correct order of Lewis acid strengths of BF_2Cl, BFClBr, BF_2Br and $BFBr_2$ is:

a) BF_2Cl > BFClBr > BF_2Br > $BFBr_2$
b) $BFBr_2$ > BFClBr > BF_2Br > BF_2Cl
c) BF_2Cl > BF_2Br > BFClBr > $BFBr_2$
d) BFClBr > $BFBr_2$ > BF_2Cl > BF_2Br

(GATE CY-2021)

52) The correct order of increasing intensity (molar absorptivity) of the UV-visible absorption bands for the ions $[Ti(H_2O)_6]^{3+}$, $[Mn(H_2O)_6]^{2+}$, $[CrO_4]^{2-}$, and $[NiCl_4]^{2-}$ is:
   a) $[Ti(H_2O)_6]^{3+} < [Mn(H_2O)_6]^{2+} < [CrO_4]^{2-}$
   b) $[Mn(H_2O)_6]^{2+} < [Ti(H_2O)_6]^{3+} < [CrO_4]^{2-}$
   c) $[NiCl_4]^{2-} < [Ti(H_2O)_6]^{3+} < [Mn(H_2O)_6]^{2+}$
   d) $[NiCl_4]^{2-} < [Mn(H_2O)_6]^{2+} < [Ti(H_2O)_6]^{3+}$

(GATE CY-2021)

53) The correct statement(*s*) about the concentration of Na^+ and K^+ ions in animal cells is/are:
   a) $[Na^+]$inside the cell > $[Na^+]$outside the cell
   b) $[K^+]inside the cell > [K^+]outside the cell$
   c) $[Na^+]inside the cell < [Na^+]outside the cell$
   d) $[K^+]inside the cell < [K^+]outside the cell$

(GATE CY-2021)

54) The correct statement(*s*) about actinides is/are:
   a) The 5f electrons of actinides are bound less tightly than the 4f electrons.
   b) The trans uranium elements are prepared artificially.
   c) All the actinides are radioactive.
   d) Actinides do not exhibit actinide contraction.

(GATE CY-2021)

Q.55 - Q.65 NUMERICAL ANSWER TYPE, CARRY TWO MARK EACH

55) The number of photons emitted per nanosecond by a deuterium lamp (400*nm*) having a power of 1 microwatt (rounded off to the nearest integer) is _____. [h = 6.626×10^{-34} kg m^2 s^{-1}; c = 3.0×10^8 m s^{-1}] (GATE CY-2021)

56) Given the initial weight of 1 mg of radioactive ^{106}Ru (half-life = 5.27 years), the amount disintegrated in 1 year (rounded off to two decimal places) is _____ mg. (GATE CY-2021)

57) The de Broglie wavelength of an argon atom ($mass = 40amu$) traveling at a speed of 250 m s^{-1} (rounded off to one decimal place) is _____ picometers. [N = 6.022×10^{23}; h = 6.626×10^{-34} kg m^2 s^{-1}] (GATE CY-2021)

58) The molar absorption coefficient of a substance dissolved in cyclohexane is 1710 L mol^{-1} cm^{-1} at 500 nm. The reduction in intensity of light of the same wavelength that passes through a cell of 1 mm path length containing a 2 mmol L^{-1} solution (rounded off to one decimal place) is _____ %. (GATE CY-2021)

59) The fundamental vibrational frequency of $^1H^{127}I$ is 2309 cm^{-1}. The force constant for this molecule (rounded off to the nearest integer) is _____ N m^{-1}. [N = 6.022×10^{23}, c = 3.0×10^8 m s^{-1}] (GATE CY-2021)

60) A laser Raman spectrometer operating at 532 nm is used to record the vibrational spectrum of Cl_2 having its fundamental vibration at 560 cm^{-1}. The Stokes line corresponding to this vibration will be observed at _____ cm^{-1}. (Rounded off to the nearest integer) (GATE CY-2021)

61) The vapor pressure of toluene ($Mol.Wt. = 92$) is 0.13 atm at 25 °C. If 6 g of a hydrocarbon is dissolved in 92 g of toluene, the vapor pressure drops to 0.12 atm. The molar mass of the hydrocarbon (rounded off to the nearest integer) is _____. (GATE CY-2021)

62) The reaction
$CO\ (g) + Cl_2\ (g) \rightleftharpoons COCl_2\ (g)$
at 500 °C, with initial pressures of 0.7 bar of CO and 1.0 bar of Cl_2, is allowed to reach equilibrium. The partial pressure of $COCl_2$ (g) at equilibrium is 0.15 bar. The equilibrium constant for this reaction at 500 °C (rounded off to two decimal places) is _____. (GATE CY-2021)

63) The rate constants for the decomposition of a molecule in the presence of oxygen are 0.237×10^{-4} L mol^{-1} s^{-1} at 0 °C and 2.64×10^{-4} L mol^{-1} s^{-1} at 25 °C $\left(R = 8.314 Jmol^{-1}K^{-1}\right)$.

The activation energy for this reaction (rounded off to one decimal place) is _____ kJ mol^{-1}. (GATE CY-2021)

64) 2 L of a gas at 1 atm pressure is reversibly heated to reach a final volume of 3.5 L. The absolute value of the work done on the gas (rounded off to the nearest integer) is _____ Joules. (GATE CY-2021)

65) The quantity of the cobalt ore [$Co_3(AsO_4)_2 \cdot H_2O$] required to obtain 1 kg of cobalt (rounded off to two decimal p is _____ kg.

(GATE CY-2021)

END OF THE QUESTION PAPER