

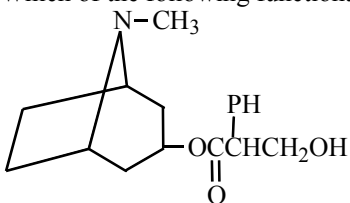
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- (C)1. What is the formula for the ionic compound formed by calcium ions and nitride ions?
(A)Ca(NO₃)₂ (B)Ca(NO₂)₂ (C)Ca₃N₂ (D)Ca₃N (E)CaNO₃
- (D)2. The correct name for KHCO₃ is
(A)calcium bicarbonate (B)potassium carbonate (C)potassium hydrogen carbon trioxide
(D)potassium bicarbonate (E)potassium carbonate
- (B)3. Which of the following should be soluble in water?
(A)Hg₂Cl₂ (B)Na₂S (C)Ag₂CO₃ (D)AlPO₄ (E)BaSO₄
- (A)4. The oxidation number of Fe in K₃Fe(CN)₆ is
(A)+3 (B)+2 (C)+1 (D)-3 (E)-4
- (B)5. In the following chemical reaction the oxidizing agent is
 $5\text{H}_2\text{O}_2 + 2\text{MnO}_4^- + 6\text{H}^+ \rightarrow 2\text{Mn}^{2+} + 5\text{O}_2 + 8\text{H}_2\text{O}$
(A)H₂O₂ (B)MnO₄⁻ (C)H⁺ (D)Mn²⁺ (E)O₂
- (A)6. Complete and balance the following redox equation. What is the coefficient of H₂O when the equation is balanced with the set of smallest whole numbers?
 $\text{MnO}_4^- + \text{I}^- \rightarrow \text{MnO}_2 + \text{IO}_3^-$ (basic solution)
(A)1 (B)2 (C)4 (D)10 (E)None of the above
- (D)7. A gaseous compound is 30.4% nitrogen and 69.4% Oxygen by mass. A 5.25g sample of the gas occupies a volume of 1.00L and exerts a pressure of 1.26atm at -4.0°C. Which of the following is its molecular formula?
(A)NO (B)NO₂ (C)N₃O₆ (D)N₂O₄ (E)N₂O₅
- (E)8. Which of the following gas molecules have the highest average kinetic energy at 25°C?
(A)H₂ (B)O₂ (C)N₂ (D)Cl₂ (E)All of the same
- (D)9. For a substance that remains a gas under the conditions listed, deviation from the ideal gas law would be most pronounced at
(A)100°C and 2.0 atm (B)0°C and 2.0 atm (C)-100°C and 2.0 atm (D)-100°C and 4.0 atm
(E)100°C and 0.2 atm
- (C)10. Ethanol undergoes combustion according to the equation
 $\text{C}_2\text{H}_5\text{OH}_{(l)} + \text{O}_{2(g)} \rightarrow \text{CO}_{2(g)} + \text{H}_2\text{O}_{(l)}$ (not balanced)
The standard heat of combustion of ethanol, C₂H₅OH_(l), is -1366.8Kj/mol.
Given that $\Delta H_f^\circ \text{CO}_{2(g)} = -393.5\text{Kj/mol}$, $\Delta H_f^\circ \text{H}_2\text{O}_{(l)} = -285.8\text{Kj/mol}$
What is the standard enthalpy of formation of ethanol?
(A)3,010Kj (B)-687.6Kj (C)-277.3Kj (D)687.6Kj (E)1,367Kj
- (C)11. The heat of solution of KCl is +17.2Kj/mol and the lattice energy of KCl_(s) is 701.2Kj/mol. Calculate the total heat of hydration of 1 mol of gas phase K⁺ ions and Cl⁻ ions.
(A)718Kj (B)684Kj (C)-684Kj (D)-718Kj (E)None of the above
- (B)12. Calculate the amount of work done, in joules, when 2.50 mole of H₂O vaporizes at 1.0 atm and 25°C. Assume the volume of liquid H₂O is negligible compared to that of that of vapor.
(A)6,190Kj (B)6.19Kj (C)61.1j (D)5.66Kj (E)518Kj
- (A)13. A gas is allowed to expand, at constant temperature, from 1.0L to 10.1L against an external pressure of 0.50atm. If the gas absorbs 250j of heat from the surroundings, what are the values of q, w, and ΔE?
- | | q | w | ΔE |
|-----|-------|-------|-------|
| (A) | 250j | -460j | -210j |
| (B) | -250j | -460j | -710j |

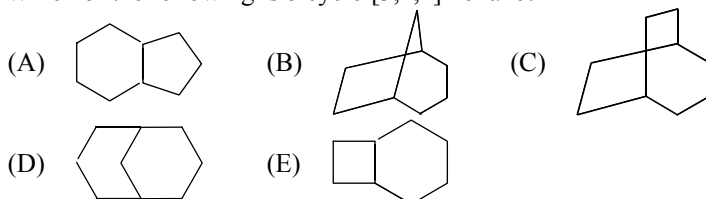
- | | q | w | ΔE |
|-----|-------|--------|------------|
| (C) | 250j | 460j | 710j |
| (D) | -250j | 460j | 210j |
| (E) | 250j | -4.55j | 245j |
- (B)14. The maximum number of electrons in an atom that have the following set of quantum number is $n=4$ $l=3$ $m_l=-2$ $m_s=+1/2$
 (A)0 (B)1 (C)2 (D)6 (E)10
- (C)15. A possible set of quantum numbers for the last electron added to complete an atom of gallium, Ga, in its ground state is
- | | n | l | m_l | m_s |
|-----|---|---|-------|-------|
| (A) | 4 | 0 | 0 | -1/2 |
| (B) | 3 | 1 | 0 | -1/2 |
| (C) | 4 | 1 | 0 | +1/2 |
| (D) | 3 | 1 | 1 | +1/2 |
| (E) | 4 | 2 | 1 | +1/2 |
- (C)16. Which one of the following ions has the largest radius?
 (A)Cl⁻ (B)K⁺ (C)S²⁻ (D)Na⁺ (E)O²⁻
- (E)17. Which of the following elements has the greatest electron affinity (largest negative value)?
 (A)Mg (B)Al (C)Si (D)P (E)S
- (C)18. Which of the following is an amphoteric oxide?
 (A)Na₂O (B)MgO (C)Al₂O₃ (D)SO₂ (E)Cl₂O₇
- (C)19. Which of the following solids would have the highest melting point?
 (A)NaI (B)NaF (C)MgO (D)MgCl₂ (E)CaO
- (E)20. The formal charge on the bromine atom in BrO₃⁻.
 (A)-2 (B)-1 (C)0 (D)+1 (E)+2
- (E)21. The geometry of the SF₄ molecule is
 (A)tetrahedral. (B)trigonal pyramidal. (C)trigonal planar. (D)square planar.
 (E)distorted tetrahedron.
- (E)22. The F-Cl-F bond angles in ClF₃ are
 (A)90° only (B)109.5° only (C)120° only (D)180° only (E)90° and 180°
- (C)23. Which one of the following molecules has no dipole moment?
 (A)CO (B)CH₂Cl₂ (C)SO₃ (D)SO₂ (E)NH₃
- (A)24. Palladium crystallizes in a face-centered cubic unit cell. Its density is 12.0g/cm³ at 27° C. Calculate the atomic radius of Pd. (Pd=106.4)
 (A)140pm (B)1.95×10⁻⁸nm (C)1.95×10⁻⁸cm (D)154pm (E)0.109nm
- (B)25. Calculate the molality of 6.0M H₂SO₄ solution. The density of the solution is 1.34g/mL.
 (A)4.48m (B)7.98m (C)8.10m (D)8.43m (E)10.2m
- (B)26. Which of the following aqueous solution has the lowest freezing point?
 (A)0.18m KCl (B)0.15m Na₂SO₄ (C)0.12m Ca(NO₃)₂ (D)pure water (E)0.20m ethylene glycol
- (E)27. For the overall chemical reaction shown below, which one of the following statements can you rightly assume?
 $2\text{H}_2\text{S}_{(g)} + \text{O}_{2(g)} \rightarrow 2\text{S}_{(s)} + 2\text{H}_2\text{O}_{(l)}$
 (A)The reaction is third-order overall.
 (B)The reaction is second-order overall.
 (C)The rate law is, rate = k[H₂S]²[O₂]
 (D)The rate law is, rate = k[H₂S][O₂]
 (E)The rate law cannot be determined from the information given.

- (B)28. For the reaction $X + Y \rightarrow Z$; the reaction rate is found to depend only upon the concentration of X. A plot of $1/X$ verses time gives a straight line.
 (A) rate = $k[X]$ (B) rate = $k[X]^2$ (C) rate = $k[X][Y]$ (D) rate = $k[X]^2[Y]$ (E) none of the above
- (A)29. For what order reaction does the half-life get longer as the initial concentration increases?
 (A) zero order (B) first order (C) second order (D) all of the above (E) none of the above
- (D)30. An increase in the temperature of the reactants causes an increase in the rate of reaction. The best explanation is: As the temperature increase,
 (A) the concentration of reactants increases
 (B) the activation energy decreases.
 (C) the collision frequency increases.
 (D) the fraction of collisions with total kinetic energy $> E_a$ increases.
 (E) the activation energy increases.
- (E)31. For the following reaction at equilibrium in a reaction vessel, which one of the changes below would cause the Br_2 concentration to decrease?
 $2NOBr_{(g)} \rightleftharpoons 2NO_{(g)} + Br_{2(g)} \quad \Delta H^\circ = 30Kj$
 (A) Increase the temperature.
 (B) Remove some NO.
 (C) Add more NOBr.
 (D) Compress the gas mixture into a smaller volume.
 (E) None of the above.
- (D)32. The reaction $2SO_{3(g)} \rightleftharpoons 2SO_{2(g)} + O_{2(g)}$
 If the temperature is increased:
 (A) More SO_3 will be produced.
 (B) K_c will decrease.
 (C) No change will occur in K_c .
 (D) K_c will increase.
 (E) The pressure will decrease.
- (B)33. What is the pH of a solution prepared by mixing 10.0mL of a strong acid solution with $pH = 2.00$ and 10mL of a strong acid solution with $pH = 6.00$?
 (A) 2.0 (B) 2.3 (C) 4.0 (D) 6.0 (E) 8.0
- (D)34. Hydrosulfuric acid is diprotic acid. Its two stages of ionization are
 $H_2S_{(aq)} \rightleftharpoons HS^-_{(aq)} + H^+_{(aq)} \quad K_{a_1} = 5.7 \times 10^{-8}$
 $HS^-_{(aq)} \rightleftharpoons S^{2-}_{(aq)} + H^+_{(aq)} \quad K_{a_2} = 1 \times 10^{-19}$
 Determine the concentration of S^{2-} -ion in a 0.10M H_2S solution.
 (A) 0.10M (B) $7.5 \times 10^{-5}M$ (C) $5.7 \times 10^{-9}M$ (D) $1 \times 10^{-19}M$ (E) $1 \times 10^{-20}M$
- (C)35. Which one of the following combinations cannot function as a buffer solution?
 (A) HCN and KCN (B) NH_3 and $(NH_4)_2SO_4$ (C) HNO_3 and $NaNO_3$
 (D) HF and NaF (E) HNO_2 and $NaNO_2$
- (A)36. The K_{sp} for Ag_3PO_4 is 1.8×10^{-18} . Calculate the molar solubility of Ag_3PO_4 .
 (A) $1.6 \times 10^{-5}M$ (B) $2.1 \times 10^{-5}M$ (C) $3.7 \times 10^{-5}M$ (D) $7.2 \times 10^{-1}M$ (E) $1.8 \times 10^{-1}M$
- (C)37. Arrange the following reactions according to increasing ΔS .
 (1) $CH_{4(g)} + H_2O \rightarrow CO_{(g)} + 3H_{2(g)}$
 (2) $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$
 (3) $H_2O_{2(l)} \rightarrow H_2O_{(l)} + \frac{1}{2}O_{2(g)}$
 (A) $3 < 2 < 1$ (B) $2 < 1 < 3$ (C) $2 < 3 < 1$ (D) $3 < 1 < 2$ (E) $1 < 3 < 2$

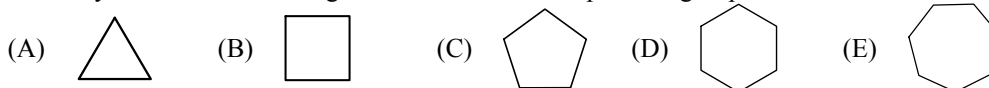
- (C)38. For the reaction $\text{H}_{2(g)} + \text{S}_{(s)} \rightarrow \text{H}_2\text{S}_{(g)}$
 $\Delta H^\circ = -20.2\text{Kj}$ and $\Delta S^\circ = +43.1\text{j/K}$
Which of the following statements is true?
(A) The reaction is only spontaneous at low temperatures.
(B) The reaction is spontaneous at all temperatures.
(C) ΔG° becomes less favorable as temperature increases.
(D) The reaction is spontaneous only at high temperatures.
(E) The reaction is at equilibrium at 25°C under standard conditions.
- (A)39. Which of the following exhibits the correct orders for both atomic radius and ionization energy, respectively?
(A) S, O, F and F, O, S (B) F, S, O and O, S, F (C) S, F, O and S, F, O (D) F, O, S and S, O, F
(E) none of these
- (E)40. Which of the following statements is true about P-type silicon?
(A) it is produced by doping Si with P or As.
(B) electrons are the mobile charge carriers.
(C) it does not conduct electricity as well as pure Si.
(D) all are true.
(E) none is true.
- (B)41. Two liquids form a solution and release a quantity of heat. How does the pressure above the solution compare to that predicted by Raoult's law?
(A) it will be greater (B) it will be less (C) it will be same (D) it will show positive deviation
(E) none of these
- (A)42. Which one of the following statements is true?
(A) when two opposing processes are proceeding at identical rates, the system is at equilibrium.
(B) catalysts are an effective means of changing the position of at equilibrium.
(C) the concentration of products equals that of reactions and is constant at equilibrium.
(D) an endothermic reaction shifts toward reactants when heat is added to the reaction.
(E) none of the above statements is true.
- (C)43. A solution contains 0.250M HA ($K_a=1.0\times 10^{-6}$) and 0.45M NaA . What is the pH after 0.10 mole HCl is added to 1.0L of the solution?
(A) 3.17 (B) 3.23 (C) 6.00 (D) 10.77 (E) 10.83
- (B)44. At constant pressure, the following reaction
 $2\text{NO}_{2(g)} \rightarrow \text{N}_2\text{O}_{4(g)}$
is exothermic. The reaction is
(A) always spontaneous.
(B) spontaneous at low temperature, but not high temperature.
(C) spontaneous at high temperature, but not low temperature.
(D) never spontaneous.
(E) all of these.
- (C)45. Which of the following statements is true?
(A) the exact location of an electron can be determined if we know its energy.
(B) an electron in a $2s$ orbital can have the same n , ℓ and m_ℓ quantum numbers as an electron in a $3s$ orbital.
(C) Ni has 2 unpaired electrons in its $3d$ orbitals.
(D) in the buildup of atoms, electrons occupy the $4f$ orbitals before the $6s$ orbitals.
(E) only three quantum numbers are needed to uniquely describe an electron.
- (C)46. For a reaction in voltaic cell both VH° and VS° are positive. Which of the following statements is true?

- (A) $\varepsilon_{\text{cell}}^{\circ}$ will increase with an increase in temperature.
 (B) $\varepsilon_{\text{cell}}^{\circ}$ will decrease with an increase in temperature.
 (C) $\varepsilon_{\text{cell}}^{\circ}$ will not change when the temperature increases.
 (D) $\Delta G^{\circ} > 0$ for all temperature.
 (E) $\Delta G^{\circ} < 0$ for all temperature.
- (D)47. Which of the following statements about the thiocyanate ion SCN^{-} , is true?
 (A) its Lewis structure contains an unpaired electron.
 (B) its shape is bent like that of H_2O .
 (C) only one correct resonance structure can be drawn.
 (D) there are two sigma bonds in the ion.
 (E) there are two pi electrons in the ion.
- (D)48. In the molecular orbital description of CO. Which of the following statements is true?
 (A) the highest energy electrons occupy antibonding orbitals.
 (B) six molecular orbitals contain electrons.
 (C) there are two unpaired electrons.
 (D) the bond order is 3.
 (E) CO is paramagnetic.
- (C)49. ^{11}C is unstable isotope, what type of radioactive decay would be expected?
 (A) β^{-} (B) α (C) β^{+} (D) electron capture (E) neutron
- (B)50. Calculate the pH of a 5.0×10^{-8} M HCl solution.
 (A) 6.72 (B) 6.89 (C) 7.00 (D) 7.30 (E) 7.7
- (C)51. Which of these would you expect to have the lowest boiling point?
 (A) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ (B) $\begin{array}{c} \text{CH}_3\text{CHCH}_3 \\ | \\ \text{OH} \end{array}$ (C) $\text{CH}_3\text{OCH}_2\text{CH}_3$ (D) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
 (E) $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$
- (E)52. Which of the following functional groups is not in atropine?

 (A) amine (B) ester (C) alcohol (D) benzene ring (E) ketone
- (D)53. Which is an incorrect statement?
 (A) RSH compounds are stronger acids than ROH compounds.
 (B) PH_3 is a weaker base than NH_3 .
 (C) NH_2^{-} is a stronger base than OH^{-} .
 (D) OH^{-} is a stronger base than OR^{-} .
 (E) H^{-} is a stronger base than OR^{-} .
- (C)54. Which combination of reagents is the least effective in generating sodium ethoxide, $\text{CH}_3\text{CH}_2\text{ONa}$?
 (A) $\text{CH}_3\text{CH}_2\text{OH} + \text{NaH}$ (B) $\text{CH}_3\text{CH}_2\text{OH} + \text{NaNH}_2$ (C) $\text{CH}_3\text{CH}_2\text{OH} + \text{NaOH}$
 (D) $\text{CH}_3\text{CH}_2\text{OH} + \text{CH}_3\text{Li}$ (E) $\text{CH}_3\text{CH}_2\text{OH} + \text{HC} \equiv \text{CNa}$

(C)55. Which of the following is bicyclo [3,2,2] nonane?



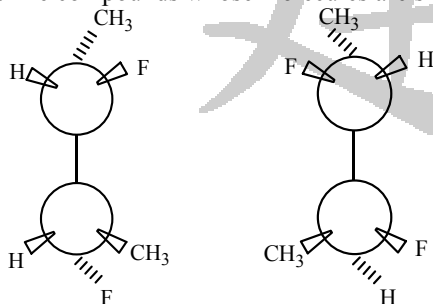
(A)56. Which cycloalkane has the largest heat of combustion per CH₂ group?



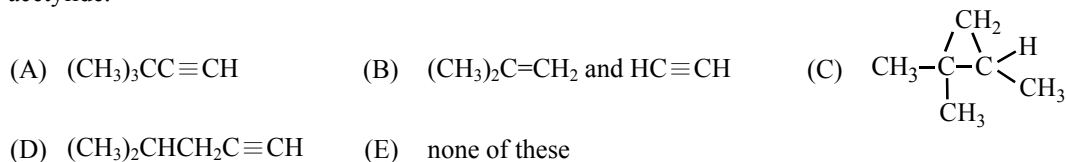
(B)57. The most stable conformation of cis-1-tert-butyl-4-methyl-cyclohexane is the one in which :

- (A) the tert-butyl group is axial and the methyl group is equatorial.
 (B) the methyl group is axial and the tert-butyl group is equatorial.
 (C) both groups are axial.
 (D) both groups are equatorial.
 (E) the twist boat conformation is adopted.

(B)58. The compounds whose molecules are shown below would have :



- (A) the same melting point.
 (B) different melting points.
 (C) equal but opposite optical rotations.
 (D) more than one of the above.
 (E) none of the above.
- (D)59. Which of the following is true about any (R)-enantiomer?
- (A) it is dextrorotatory.
 (B) it is levorotatory.
 (C) it is an equal mixture of + and - .
 (D) it is the mirror image of the (s)-enantiomer.
 (E) (R) indicates a racemic mixture.
- (B)60. What would you expect to be the chief organic product(s) when tert-butyl bromide reacts with sodium acetylide.

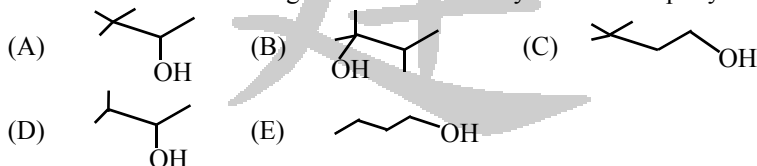


(B)61. S_N2 reactions of the type, Nu:⁻ + RL → R-Nu + :L⁻, are favored :

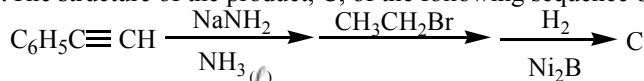
- (A) when tertiary substrates are used.
 (B) by using a high concentration of the nucleophile.

- (C) by using a solvent of high polarity.
 (D) by the use of weak nucleophiles.
 (E) by none of the above.
- (B)62. Which nucleophilic substitution reaction would be unlikely to occur?
- (A) $\text{Br}^- + \text{CH}_3\text{O}^+\text{H}_2 \rightarrow \text{CH}_3\text{Br} + \text{H}_2\text{O}$
 (B) $\text{NH}_3 + \text{CH}_3\text{O}^+\text{H}_2 \rightarrow \text{CH}_3\text{-NH}_3^+ + \text{H}_2\text{O}$
 (C) $\text{I}^- + \text{CH}_3\text{Cl} \rightarrow \text{CH}_3\text{I} + \text{Cl}^-$
 (D) $\text{CH}_3\text{CH}_2\text{I} + \text{OH}^- \rightarrow \text{CH}_3\text{CH}_2\text{OH} + \text{I}^-$
 (E) more than one of the above.
- (E)63. You want to synthesize 2-methyl-1-butene from 2-chloro-2-methylbutane. Which reagent would you use?
- (A) NaOH/H₂O
 (B) KOH/H₂O
 (C) CH₃ONa/CH₃OH
 (D) CH₃SNa/H₂O
 (E) (CH₃)₃COK/(CH₃)₃COH

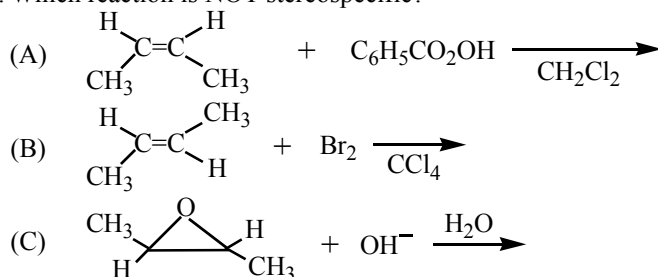
- (B)64. Which one of the following alcohols would dehydrate most rapidly when treated with sulfuric acid?

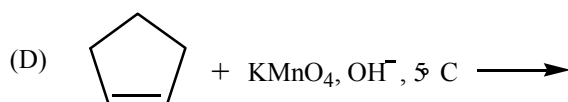


- (A)65. The structure of the product, C, of the following sequence of reactions would be :



- (A) *cis*-C₆H₅CH=CHCH₂CH₃ (B) *cis*-C₆H₅CH=CHCH₃ (C) *trans*-C₆H₅CH=CHCH₂CH₃
 (D) C₆H₅C≡CCH₂CH₂Br (E) C₆H₅CH₂CH₂CH₂CH₃
- (E)66. Which of the following reactions would yield a meso product?
- (A) cyclobutene + H⁺, H₂O
 (B) cyclobutene + Br₂, CCl₄
 (C) cyclobutene + RCO₂OH, then H₂O, H⁺
 (D) cyclobutene + BH₃-THF, then H₂O₂, OH⁻
 (E) cyclobutene + D₂, Pt
- (E)67. Which reaction is NOT stereospecific?



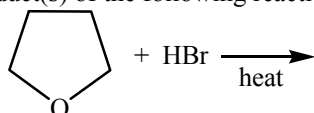


(B)68. The conversion of ethylene to vinyl bromide can be accomplished by use of these reagents in the order indicated.

(A) 1.HBr 2. $\text{C}_2\text{H}_5\text{ONa}$ (B) 1. Br_2 2. $\text{C}_2\text{H}_5\text{ONa}$ (C) 1. Br_2 2. H_2O (D) 1. NaNH_2 2.HBr

(E) 1.HBr 2. H_2SO_4

(D)69. The product(s) of the following reaction

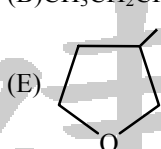


(A) $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$

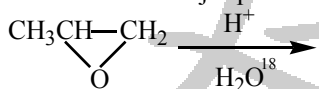
(B) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$

(C) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$

(D) $\text{BrCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$



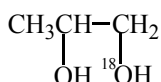
(C)70. Select the structure of the major product formed in the following reaction.



(A) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}^{18}$

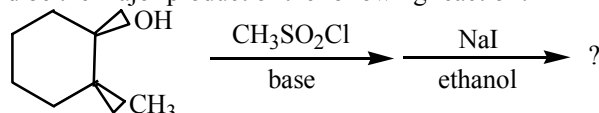
(B) $\text{CH}_3\text{CH}(\text{OH}^{18})\text{CH}_3$

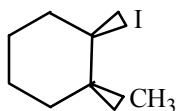
(C) $\text{CH}_3\text{CH}(\text{OH}^{18})\text{CH}_2\text{OH}$

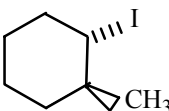
(D) 

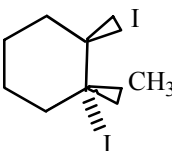
(E) $\text{CH}_3\text{CH}(\text{OH}^{18})\text{CH}_2\text{OH}^{18}$

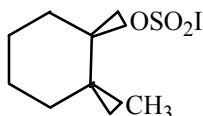
(B)71. What would be the major product of the following reaction?



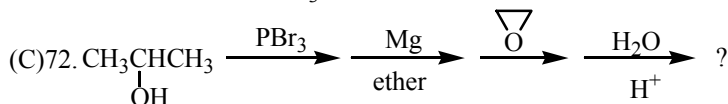
(A) 

(B) 

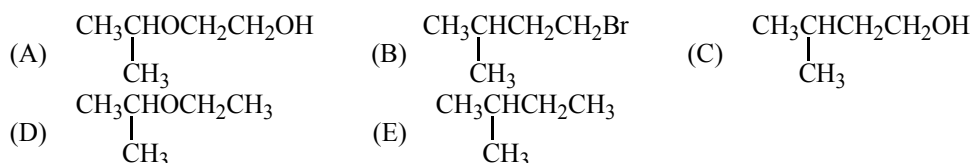
(C) 

(D) 

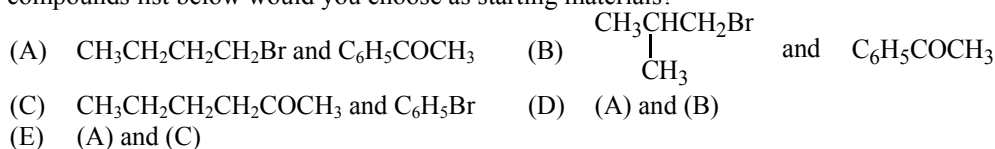
(E) an equimolar mixture of (A) and (B)



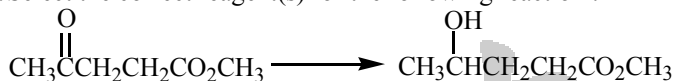
What is the final product?



(E)73. You task is to synthesize 2-phenyl-2-hexanol through a Grignard synthesis. Which pair(s) of compounds list below would you choose as starting materials?

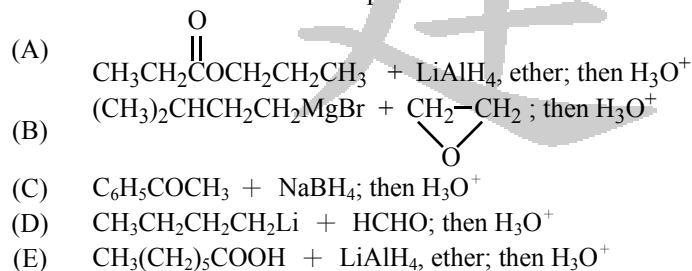


(A)74. Select the correct reagent(s) for the following reaction :

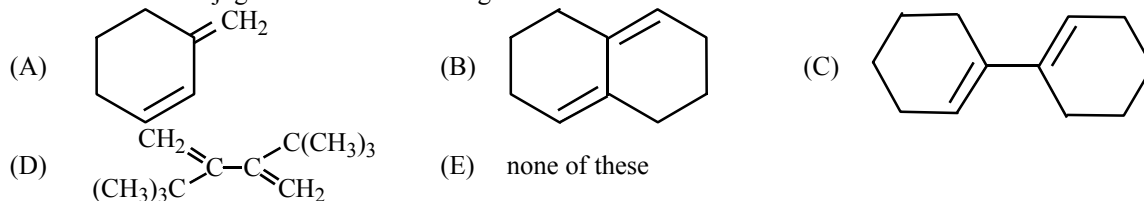


(A) LiAlH_4 ; then H^+ (B) NaBH_4 ; then H^+ (C) H_2 with Pt/c (D) (A) and (B) (E) (A), (B) and (C)
 (E)75. Which of these compounds cannot be used to prepare the corresponding Grignard reagent?
 (A) $\text{CH}_3\text{OCH}_2\text{CH}_2\text{CH}_2\text{Br}$ (B) $(\text{CH}_3)_3\text{CCl}$ (C) $\text{CH}_2=\text{CHCH}_2\text{Br}$ (D) $(\text{CH}_3)_2\text{NCH}_2\text{CH}_2\text{Br}$
 (E) $\text{CH}_3\text{COCH}_2\text{I}$

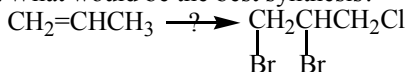
(C)76. Which of these reactions will not produce a 1° alcohol?



(C)77. Which of these conjugated dienes can undergo a Diels-Alder reaction?

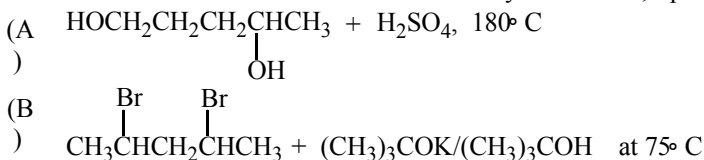


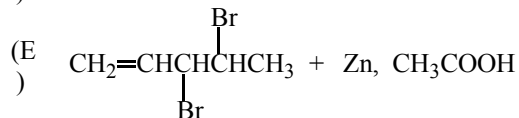
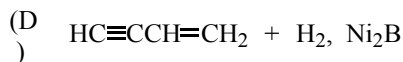
(C)78. What would be the best synthesis?



(A) 1. Br_2 , CCl_4 2. Cl_2 , $\text{h}\nu$ (B) 1. NBS , CCl_4 2. Cl_2 , CCl_4 (C) 1. Cl_2 , 400°C 2. Br_2 , CCl_4
 (D) 1. Cl_2 , CCl_4 2. NBS , CCl_4 (E) 1. HCl 2. Br_2 , $\text{h}\nu$

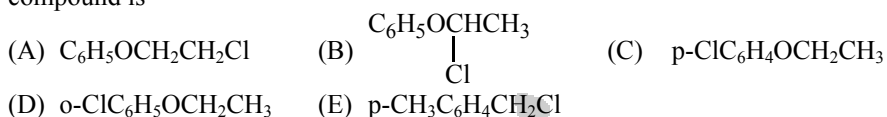
(B)79. Which of these is not a useful method for the synthesis of 1,3-pentadiene?





(A)80. A compound with the molecular formula $\text{C}_8\text{H}_9\text{ClO}$ gave the following ^1H NMR spectrum :
 $\delta 3.7(\text{t}), \delta 4.2(\text{t}), \delta 7.1(\text{m})$

There was no evidence of an $-\text{OH}$ band in the IR spectrum. The most likely structure for the compound is



(B)81. In ^{13}C NMR spectroscopy, the signal due to this type of carbon occurs furthest downfield.

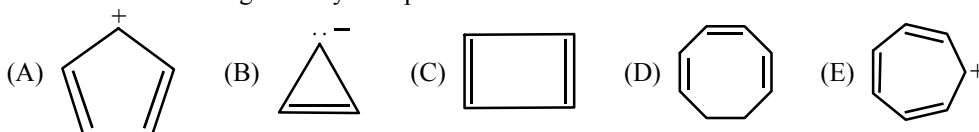


(E)82. What is the molecular formula of this compound?

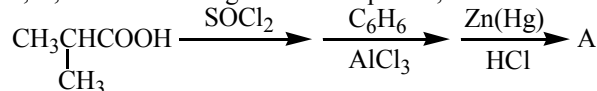
m/Z	intensity
78(M)	10.00
79	1
80	3.3
81	0.3



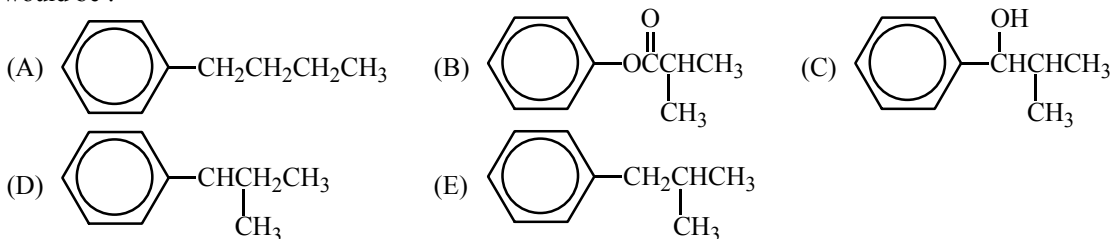
(E)83. Which of the following would you expect to be aromatic?



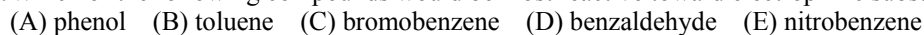
(E)84. The product, A, of the following reaction sequence,



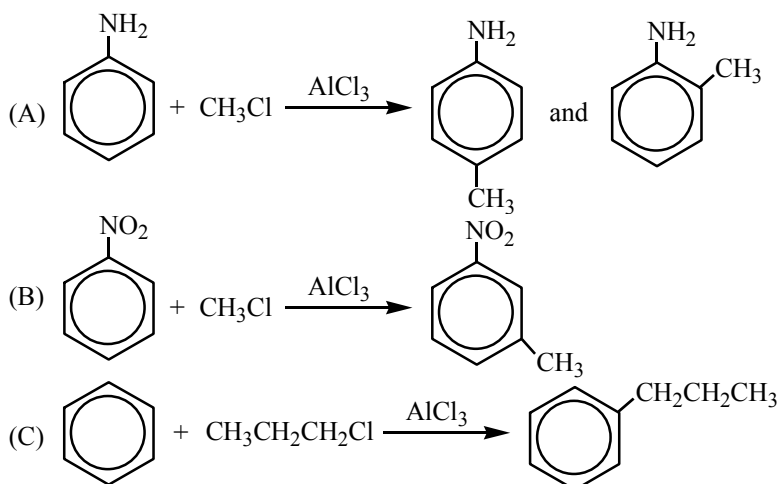
would be :



(A)85. Which of the following compounds would be most reactive toward electrophilic substitution?

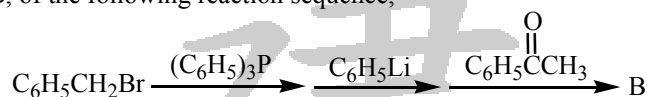


(E)86. Which of the following reactions would give the product(s) indicated in substantial amounts (i.e., in greater than 50% yield)?

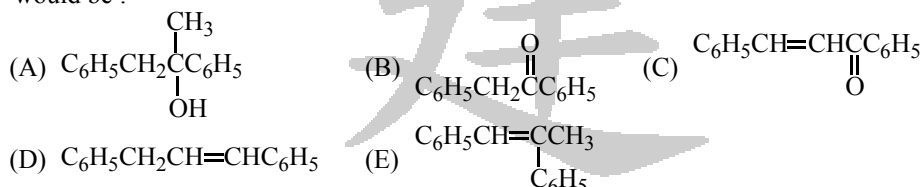


- (D) all of these
(E) none of these

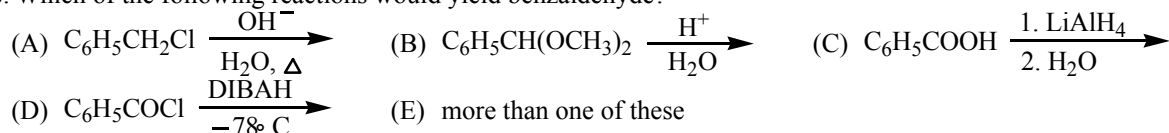
(E)87. The product, B, of the following reaction sequence,



would be :



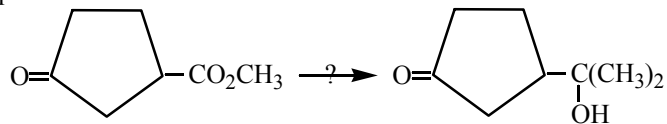
(E)88. Which of the following reactions would yield benzaldehyde?






(E)89. Which of the reactions listed below would serve as a synthesis of acetophenone.

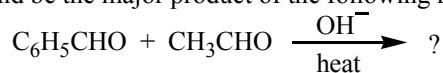
- (A) $\text{C}_6\text{H}_5\text{COCl} + (\text{CH}_3)_2\text{CuLi}$
(B) $\text{C}_6\text{H}_6 + \text{CH}_3\text{COCl}, \text{AlCl}_3$
(C) $\text{C}_6\text{H}_5\text{CN} + \text{CH}_3\text{Li}; \text{then } \text{H}_3\text{O}^+$
(D) answers (A) and (B) only.
(E) answers (A), (B) and (C).

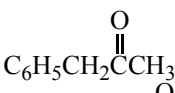
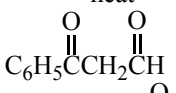
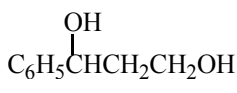
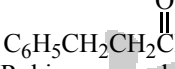
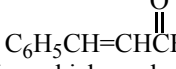
(C)90. Which sequence of reactions would be utilized to convert

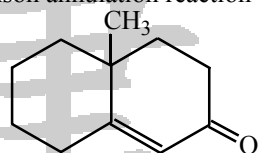


- (A) 1. $2\text{CH}_3\text{MgBr}$ 2. H_3O^+
(B) 1.  H^+ 2. $\text{LiAlH}_4, \text{ether}$ 3. $2\text{CH}_3\text{MgBr}$ 4. H_3O^+

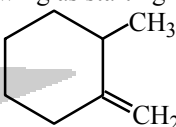
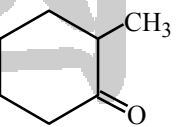
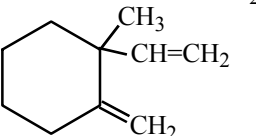
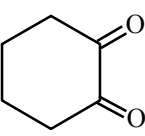
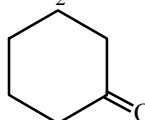
- (C) 1. , H^+ 2. $2.CH_3MgBr$ 3. H_3O^+
- (D) 1. , H^+ 2. H_2, Pt 3. CH_3OH, H^+
- (E) none of the above.
- (C)91. Which reagent will not differentiate between the two compounds
- $CH_2=CHCH_2\overset{O}{\parallel}CH$ and $CH_3CH_2\overset{O}{\parallel}CCH_3$
- (A) Br_2, CCl_4 (B) $Ag(NH_3)_2^+$ (C) $C_6H_5NHNH_2$ (D) $KMnO_4, OH^-$ (E) none of these
- (E)92. What would be the major product of the following reaction?



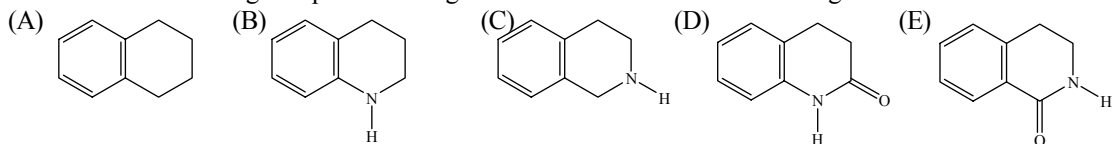
- (A)  (B)  (C) 
- (D)  (E) 
- (B)93. The Robinson annulation reaction which produces



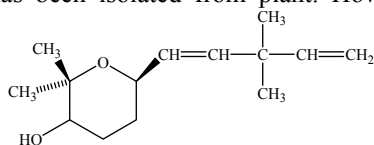
Uses which of the following as starting materials?

- (A) $CH_2=CHCHO$ + 
- (B) $CH_2=CHC(=O)CH_3$ + 
- (C) $HCHO$ + 
- (D) $CH_3CH=CHC(=O)CH_3$ + 
- (E) $CH_3CH=CHC(=O)CH_3$ + 

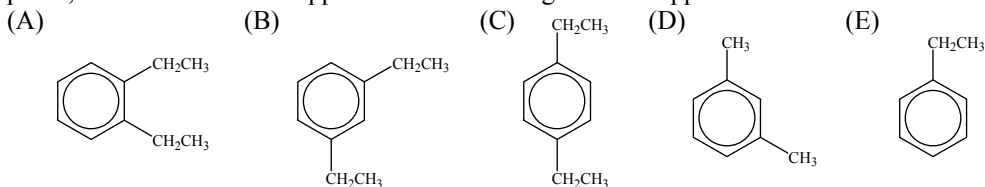
- (B)94. Which of the following compound undergoes bromination of its aromatic ring at the fastest rate?



- (D)95. The sesquiterpene A has been isolated from plant. How many stereoisomers of this structure are possible?



- (A)2 (B)4 (C)6 (D)8 (E)16
 (A)96. Which of the following compound would give a ^{13}C NMR spectrum which consists of a total of five peaks, three in the 120~140 ppm and two in the region 10~30 ppm?



- (A)97. Which of the following will not result in the formation of an amide?
 (A) $\text{C}_6\text{H}_5\text{COCl} + (\text{CH}_3\text{CH}_2)_3\text{N}$ (B) $(\text{CH}_3\text{CO})_2\text{O} + \text{C}_6\text{H}_5\text{NH}_2$ (C) $\text{ClCH}_2\text{CO}_2\text{C}_2\text{H}_5 + \text{NH}_3(\text{aq})$
 (D) $\text{C}_6\text{H}_5\text{COOC}_2\text{H}_5 + \text{CH}_3\text{NH}_2$ (E) All of above

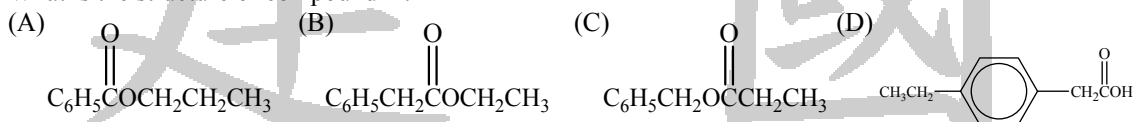
- (C)98. A compound B has the following spectroscopic properties:

composition : $\text{C}_{10}\text{H}_{12}\text{O}_2$

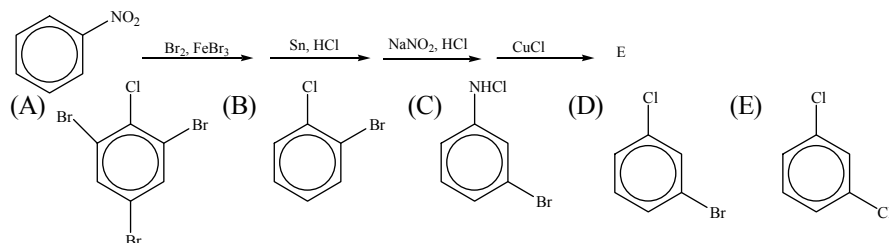
IR : 1735cm^{-1}

^1H NMR : $\delta 1.2(3\text{H}, \text{t})$, $\delta 2.3(2\text{H}, \text{q})$, $\delta 4.5(2\text{H}, \text{s})$, $\delta 7.3(5\text{H}, \text{m})$

What is the structure of compound B?



- (D)99. What is the final product, E, of the series of reaction shown below?



- (C)100. Which compound could be prepared using a Michael reaction?

