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(E)1. Which compound would you expect to have the lowest boiling point?
(A) $CH_3CH_2CH_2NH_2$ (B) $CH_3\underset{\displaystyle NH_2}{\underset{|}{C}}HCH_3$ (C) $CH_3CH_2NHCH_3$ (D) $CH_3\underset{\displaystyle CH_3}{\underset{|}{N}}CH_3$ (E) $CH_3\underset{\displaystyle NH_2}{\underset{|}{C}}CH_3$

(C)2. Which compound has the shortest carbon-carbon bond(s)?
(A)ethane (B)ethene (C)ethyne (D)benzene (E)All carbon-carbon bonds are the same length.

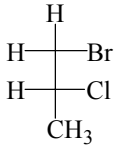
(B)3. Which acid-base reaction would not take place as written?
(A) $CH_3Li + CH_3CH_2OH \rightarrow CH_4 + CH_3CH_2OLi$
(B) $HC{\equiv}CH + NaOH \longrightarrow HC{\equiv}CNa + H_2O$
(C) $HC{\equiv}CNa + H_2O \longrightarrow HC{\equiv}CH + NaOH$
(D) $CH_3OH + NaH \rightarrow CH_3ONa + H_2$
(E) $CH_3CO_2H + CH_3ONa \rightarrow CH_3CO_2Na + CH_3OH$

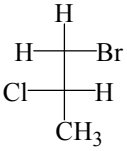
(D)4. Which cycloalkane has the lowest heat of combustion per CH_2 group?
(A)  (B)  (C)  (D)  (E) 

(B)5. The most stable conformation of trans-1-tert-buty1-3-methylcyclohexane is the one in which:
(A)the tert-buty1 group is axial and the methyl group is equatorial.
(B)the methyl group is axial and the tert-buty1 group is equatorial.
(C)both groups are equatorial.
(D)both groups are axial.
(E)none of the above.

(C)6. What shape does the methyl cation, $\overset{+}{C}H_3$, have?
(A)octahedral (B)tetrahedron (C)trigonal planar (D)linear (E)trigonal pyramidal

(B)7. The molecules shown are:





(A)constitutional isomers (B)enantiomers (C)diastereomers (D)identical (E)none of these

(B)8. What is the percent composition of a mixture of (s)-(+)-2-butanol, $[\alpha]_D^{25} = +13.52°$, and (R)-(−)-2-butanol, with a specific rotation $[\alpha]_D^{25} = +6.76°$?
(A)75% (R), 25% (S) (B)25% (R), 75% (S) (C)50% (R), 50% (S) (D)67% (R), 33% (S) (E)33% (R), 67% (S)

(D)9. How many stereoisomers can be drawn for $CH_3\underset{\displaystyle Cl}{\underset{|}{C}}H\underset{\displaystyle Br}{\underset{|}{C}}HCH_3$?

(A)1 (B)2 (C)3 (D)4 (E)8

(E)10. Which alkyl halide would give the highest yield of elimination product when treated with sodium ethoxide in ethanol?

(A) CH_3CH_2Br (B) $CH_3CH_2CH_2Br$ (C) $CH_3CH_2CH_2CH_2Br$ (D) $CH_3CH_2\underset{\displaystyle Br}{\underset{|}{C}}HCH_3$

(E) $CH_3CH_2\underset{\displaystyle Br}{\underset{|}{C}}(CH_3)_2$

(E)11. Select the strongest nucleophile for an S_N2 reaction.

(A) H_2O (B)ROH (C) RCO_2^- (D) OH^- (E) RO^-

(D)12. Consider the S_N1 reaction of tert-butyl chloride with iodide ion.

$$(CH_3)_3CCl + I^- \rightarrow (CH_3)_3CI + Cl^-$$

Assuming no other changes, how would it affect the rate if one simultaneously double the concentration of tert-butyl chloride and iodide ion?

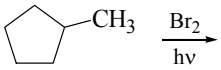
(A)no effect (B)it would double the rate (C)it would triple the rate (D)it would quadruple the rate (E)it would increase the rate five times

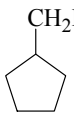
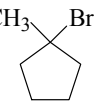
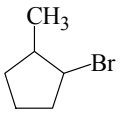
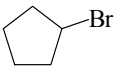
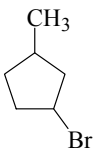
(E)13. You want to synthesize 2-methyl-l-butene from 2-chloro-2-methylbutane. Which reagent would you use?

(A)NaOH / H_2O (B)KOH / H_2O (C) CH_3ONa / CH_3OH (D) CH_3CH_2ONa / CH_3CH_2OH

(E) $(CH_3)_3COK / (CH_3)_3COH$

(B)14. Select the structure of the major product formed in the following reaction.



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

(C)15. The correct IUPAC name for the following compound is:

$$CH_3CH(CH_3)CH(CH_2CH_2CH_3)CH{=}CH_2$$

(A)4, 5-Dimethyl-3-propyl-2-hexene (B)3-(2, 3-Dimethylpropyl)-l-hexene

(C)4, 5-Dimethyl-3-propyl-l-hexene (D)2, 3-Dimethyl-4-isopropyl-5-hexene

(E)2, 3-Dimethyl-4-propyl-5-hexene

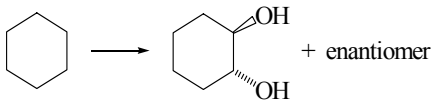
(A)16. What is the major product of the reaction.

$$CH_3C(CH_3)(CH_3)CH(OH)CH_3 \xrightarrow[\text{heat}]{H_2SO_4}$$

(A)2, 3-Dimethyl-2-butene (B)3, 3-Dimethyl-1-butene (C)2-Methyl-2-butene

(D)2-Methyl-2-pentene (E)None of these

(A)17. How could the following synthesis be accomplished?



(A)1. Cl_2 , hν 2.t-BuOK 3.peroxy acid 4. H_3O^+

(B)1.t-BuOK 2. Cl_2 , hν 3.peroxy acid 4. H_3O^+

(C)1. H_3O^+ 2.t-BuOK 3.peroxy acid 4. H_3O^+

(D)1. Cl_2 , hν 2.peroxy acid 3.t-BuOK 4. H_3O^+

(E)1. Cl_2 , hν 2. H_3O^+ 3.t-BuOK 4. peroxy acid

(E)18. The major product of the following reaction, would be:

$$CH_3CH_2C{\equiv}CH \xrightarrow{H_2O,\ H_2SO_4,\ HgSO_4}$$

(A) $CH_3CH_2CH_2CH(OH)_2$ (B) $CH_3CH_2CH{=}CHOH$ (C) $CH_3CH_2\underset{\displaystyle OH}{\underset{|}{C}}HCH_3$

(D) $CH_3CH_2CH_2\overset{\displaystyle O}{\overset{\|}{C}}H$ (E) $CH_3CH_2\overset{\displaystyle O}{\overset{\|}{C}}CH_3$

(B)19. Which reagent could be used to distinguish between 2-pentyne and 1-pentyne?

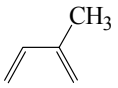
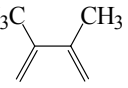
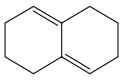
(A) Br_2 / CCl_4 (B) $Ag(NH_3)_2^+OH^-$ (C)Conc. H_2SO_4 (D) $KMnO_4$, OH^- (E)none of these

(D)20. Give the reagent(s) that would bring about the following reaction:

$$CH_3CH_2CH_2CO_2H \longrightarrow CH_3CH_2CH_2CH_2OH$$

(A) H_2 / Ni (B) $Li / NH_{3(\ell)}$ (C) $LiAlH(OBu^t)_3$ (D) $LiAlH_4$ (E) $NaBH_4$

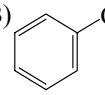
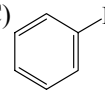
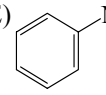
(E)21. Which diene would be least reactive toward Diels-Alder addition of maleic anhydride?

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

(D)22. The conversion of $(CH_3)_2CH\underset{\displaystyle OH}{\underset{|}{C}}HCH_3$ to $(CH_3)_2CH\underset{\displaystyle Br}{\underset{|}{C}}HCH_3$ is best achieved through use of which of these reagents in a low temperature reaction?

(A)conc. HBr (B) Br_2 (C)NaBr, H_2SO_4 (D) PBr_3 (E)HBr, peroxide

(E)23. Which of the following compounds would be least reactive toward electrophilic substitution?

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

(E)24. Which of the following statements about cyclooctatetraene is not true?

(A)the compound rapidly decolorizes Br_2 / CCl_4 solutions.

(B)the compound rapidly decolorizes aqueous solutions of $KMnO_4$

(C)the compound rapidly adds hydrogen

(D)the compound is nonplanar

(E)the compound is comparable to benzene in stability.

(A)25. A compound with the molecular formula C_8H_9ClO gave the following ^{1}HNMR spectrum:

triplet, δ 3.7
triplet, δ 4.2
multiplet, δ 7.2

There was no evidence of an –OH band in the IR spectrum. The most likely structure for the compound is :

(A) $C_6H_5OCH_2CH_2Cl$ (B) $C_6H_5\underset{\displaystyle Cl}{\underset{|}{C}}HCH_3$ (C) p—$ClC_6H_4OCH_2CH_3$

(D) o—$ClC_6H_4OCH_2CH_3$ (E) p—$CH_3OC_6H_4CH_2Cl$

(D)26. Predict the base peak for tert-butyl chloride

(A)m/z 15 (B)m/z 92 (C)m/z 43 (D)m/z 57 (E)m/z 77

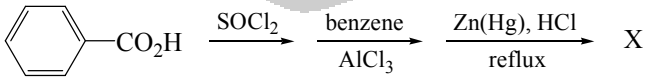
(E)27. Which reagent(s) would you use to carry out the following transformation?

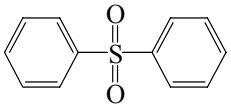
toluene ⟶ benzoic acid

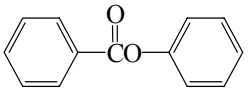
(A) Br_2 , heat, and light (B) Cl_2 , $FeCl_3$ (C) HNO_3 , H_2SO_4 (D) SO_3 , H_2SO_4

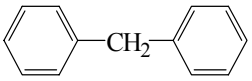
(E) $KMnO_4$, OH^- , heat, then H_3O^+

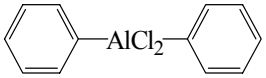
(C)28. Which would be the product , X, of the following reaction sequence?

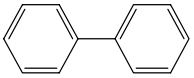


(A) 

(B) 

(C) 

(D) 

(E) 

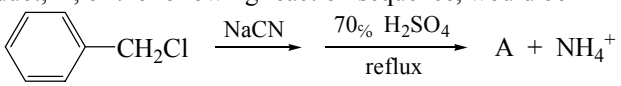
(B)29. Select the structure of the major product in the following reaction.

$C_6H_5C{\equiv}CH \xrightarrow{Sia_2BH} \xrightarrow{H_2O_2,\ OH^-}$

(A) $C_6H_5CH_2CH_3$ (B) $C_6H_5CH_2CHO$ (C) $C_6H_5\underset{\displaystyle OH}{\underset{|}{C}}HCH_3$ (D) $C_6H_5COCH_3$

(E) $C_6H_5CH{=}CH_2$

(B)30. The product, A, of the following reaction sequence, would be



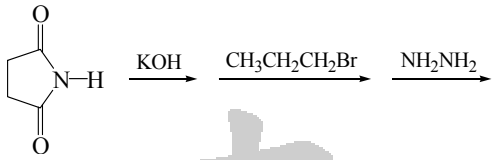
(A) $C_6H_5CH_2O\overset{\displaystyle O}{\overset{\|}{C}}H$ (B) $C_6H_5CH_2CO_2H$ (C) $C_6H_5CH_2OSO_3H$ (D) $C_6H_5CHClCO_2H$

(E) $C_6H_5CH_2COCH_2C_6H_5$

(E)31. Which of the following can be used to prepare propylamine (pure)?

(Ⅰ) $CH_3CH_2CH_2Br$ (1 mol) + NH_3 (1 mol)

(Ⅱ) $CH_3CH_2CH_2Br$ (1 mol) + NaN_3 (1 mol) $\xrightarrow{}$ $\xrightarrow{LiAlH_4}$

(Ⅲ) 

(A) Ⅰ (B) Ⅱ (C) Ⅲ (D) Ⅰ and Ⅱ (E) Ⅱ and Ⅲ

(C)32. What would be the final product?

$$C_6H_5CH_2CONH_2 \xrightarrow[\Delta]{P_4O_{10}} \xrightarrow{CH_3MgI} \xrightarrow{H_3O^+} ?$$

(A) $C_6H_5CH_2CO_2CH_3$ (B) $C_6H_5CH_2CH_2NHCH_3$ (C) $C_6H_5CH_2COCH_3$

(D) $C_6H_5CH_2CH(CH_3)CN$ (E) $C_6H_5CH{=}NCH_3$

(C)33. The product, X, of the following reaction sequence, would be:

$$CH_3\overset{O}{\overset{\|}{C}}CH_2\overset{O}{\overset{\|}{C}}OC_2H_5 \xrightarrow[2.\ C_6H_5CH_2Br]{1.\ C_2H_5ONa} \xrightarrow[2.\ H_3O^+]{1.\ NaOH,\ H_2O,\ \Delta} \xrightarrow{heat} X$$

(A) $CH_3\overset{O}{\overset{\|}{C}}CH_2C_6H_5$ (B) $C_6H_5CH_2\overset{O}{\overset{\|}{C}}OC_2H_5$ (C) $C_6H_5CH_2CH_2\overset{O}{\overset{\|}{C}}CH_3$ (D) $C_6H_5CH_2CH_2\overset{O}{\overset{\|}{C}}OC_2H_5$

(E)None of these

(A)34. Which of these is not a reversible process?

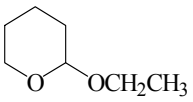
(A)Base-promoted ester hydrolysis (B)Acid-catalyzed ester hydrolysis

(C)Aldol addition (D)Claisen Condensation (E)Acetal formation

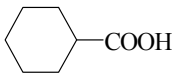
(B)35. Which region in the IR spectrum could distinguish between benzene and cyclohexane?

(A)3000 cm^{-1} (B)1600 cm^{-1} (C)1680～1750 cm^{-1} (D)3200～3600 cm^{-1}

(C)36. Compound X has the molecular formula $C_7H_{14}O_2$. The IR spectrum has a broad signal in the region of 2500～3000 cm^{-1} and also has a signal in the 1710～1780 cm^{-1} region. What compound could Compound X be?

(A) $CH_3CH_2CH_2\overset{O}{\overset{\|}{C}}OCH(CH_3)_2$ (B) 

(C) $CH_3(CH_2)_5COOH$

(D) 

(C)37. Compound B give two signals in the ^{13}CNMR spectrum and a single signal in the ^{1}HNMR spectrum. Which of the following is most likely compound B?

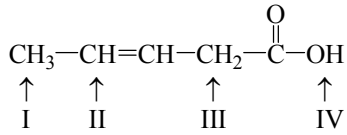
(A)dimethyl ether (B)diethyl ether (C)neopentane (D)methyl acetate

(D)38. What is the order of increasing δ value in the ^{13}CNMR spectra for the following carbon atoms?

CH_4	CH_3F	CH_3Br	CH_3OH	CH_3Cl
Ⅰ	Ⅱ	Ⅲ	Ⅳ	Ⅴ

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

(B)39. What is the order of increasing chemical shift values in the ^{1}HNMR spectrum for the indicated hydrogen atoms (lowest first)?



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

(C)40. What is the oxidizing agent for the following transformation?

(A)FAD (B)FADH (C) NAD^+ (D)NADH

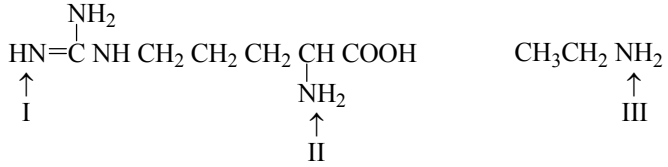
(B)41. When DNA is hydrolyzed, which of the following is true for the concentration of the products?
(A) A = G = C = T (B) (A + G) = (C + T) (C) (A + T) = (G + C) (D)There is no relationship

(C)42. Nucleosides are rapidly hydrolyzed in which of the following?
(A) H_2O (B)dilu. NaOH (C)dilu. HCL (D)none of these

(B)43. The secondary structure of proteins depends primarily on which property of amino acids?
(A)disulfide bonds (B)hydrogen bonds (C)amide bonds (D)polar side chains

(C)44. What is the charge on lysine at pH 11?
(A)0 (B)+1 (C)–1 (D)+2 (E)–2

(B)45. What is the order of increasing basicity for the indicated amino groups (least first)?

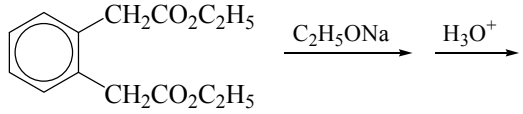


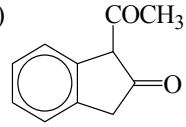
(A) Ⅰ Ⅱ Ⅲ (B) Ⅱ Ⅲ Ⅰ (C)Ⅲ Ⅱ Ⅰ (D) Ⅰ Ⅲ Ⅱ

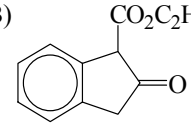
(A)46. Fats, oils, waxes, phospholipids, prostaglandins and steroids all have in common which of the following properties?
Ⅰ.Oxygen functionality Ⅱ.nonpolar groups Ⅲ.polar groups Ⅳ.unsaturation
(A) Ⅰ Ⅱ (B)Ⅲ Ⅳ (C) Ⅰ Ⅲ (D) Ⅱ Ⅳ

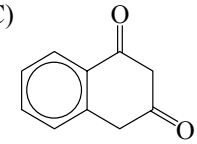
(B)47. What natural products have structures that could be derived from cholesterol?
Ⅰ.Vitamin A Ⅱ.Vitamin D Ⅲ.Cholic acid Ⅳ.Cortisone Ⅴ.squalene
(A) Ⅰ Ⅱ Ⅲ (B) Ⅱ Ⅲ Ⅳ (C)Ⅲ Ⅳ Ⅴ (D) Ⅰ Ⅲ Ⅴ

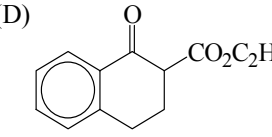
(B)48. What is the major product from the following reactions?



(A) 

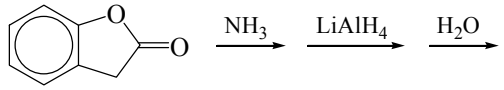
(B) 

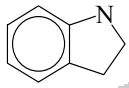
(C) 

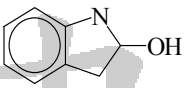
(D) 

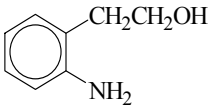
(D)49. Which compounds will yield benzoic acid when hydrolyzed?
Ⅰ.benzyl acetate Ⅱ.benzamide Ⅲ.phenyl acetate Ⅳ.methyl benezoate
(A) Ⅰ, Ⅱ (B) Ⅲ, Ⅳ (C) Ⅰ, Ⅲ (D) Ⅱ, Ⅳ

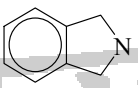
(E)50. What is the product from the following reaction?

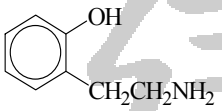


(A) 

(B) 

(C) 

(D) 

(E) 

(E)51. Which element does not belong to the family or classification indicated?
(A)Br, halogen (B)He, noble gas (C)Fe, transition metal (D)K, alkali metal (E)Se, Lanthanide

(D)52. Which of the following relations is correct?
(A) $H = E - PV$ (B) $H = G - TS$ (C)for a reversible change $dS_{sys} = dH_{sys}$
(D)for an irreversible change $dS_{surr} < \frac{dq}{T}$ (E)at the phase transition $\Delta S_{sys} = \Delta H/T$

(D)53. Balance the reaction below in acidic solution.

$$IO_3^- + I^- \longrightarrow I_2$$

What volume of 0.352 M HCl is needed to produce 2.48×10^{-3} moles of iodine, I_2, with an excess of KIO_3 and KI?
(A)2.48 mL (B)4.96 mL (C)7.05 mL (D)14.1 mL (E)none of these

(D)54. Consider the aqueous solutions containing 0.1 M of the following substances, which of them would have best conductivity?
(A) CH_3NH_2 (B) CH_3COOH (C) $HClO_4$ (D) $Ca(OH)_2$ (E) NH_4Br

(B)55. Which of the following underlined element has formal oxidation state of −1?
(A)$\underline{Na}_2O_2$ (B)$Ca\underline{H}_2$ (C)H$\underline{Cl}$O (D)$\underline{C}NO^{-1}$ (E)$C_2\underline{H}_2$

(A)56. Which one of the following represents a possible set of quantum numbers (n, ℓ, m_ℓ, m_s) for an electron in an atom.
(A)2, 1, −1, 1/2 (B)2, 1, 0, 0 (C)2, 2, 0, 1/2 (D)2, 0, 1, −1/2

(C)57. Which one of the following ions is responsible for making water "hard"?
(A) Na^+ (B) Al^{3+} (C) Mg^{2+} (D) SO_4^{2-} (E) CO_3^{2-}

(E)58. Which of the following metal element is a noble metal?
(A)Al (B)Fe (C)Cu (D)Na (E)Ag

(C)59. What volume will 1.3 moles of ideal gas occupy at 22°C and 2.5 atm pressure?
(A)0.079 L (B)0.94 L (C)13 L (D)31 L (E)33 L

(D)60. Consider the following reactions

$$AgNO_{3(aq)} + Zn_{(s)} \rightarrow Ag_{(s)} + Zn(NO_3)_{2(aq)}$$

$$Zn(NO_3)_{2(aq)} + Co_{(s)} \rightarrow \text{no reaction}$$

$$AgNO_{3(aq)} + Co_{(s)} \rightarrow Ag_{(s)} + Co(NO_3)_{2(aq)}$$

What is the correct order of increasing activity for these metals?
(A)$Ag < Zn < Co$ (B)$Co < Ag < Zn$ (C)$Co < Zn < Ag$ (D)$Ag < Co < Zn$

(A)61. Which one of the following forms of carbon contains only sp^3 hybridized carbon atoms?
(A)diamond (B)fullerene (C)carbon nanotube (D)graphite (E)charcoal

(C)62. Which one of the following metals is most likely element to form several different positive ions?
(A)Al (B)Cs (C)V (D)Ca (E)Si

(B)63. In acidic solutions, soaps are converted to which of the following materials
(A)Insoluble salts (B)fatty acids (C)detergents (D)esters (E)glycerol

(C)64. How many additional moles of gas would have to be added to a flask containing 2.00 moles of gas at 25°C and 1.00 atm pressure in order to increase the pressure to 1.60 atm under conditions of constant temperature and volume?
(A)0.80 (B)1.00 (C)1.20 (D)3.20 (E)1.60

(A)65. What is the empirical formula for a compound that is 29% by weight of sodium, 41% of sulfur and 30% of oxygen?
(A) $Na_2S_2O_3$ (B) $NaSO_2$ (C)NaSO (D) $NaSO_3$ (E) Na_2SO_3

(B)66. A solution is prepared by dissolving 23.7 g of $CaCl_2$ in 375 g of water. The density of the resulting solution is $1.05\ g/mL$. Calculate the molality of $CaCl_2$ in the solution describe above.
(A)0.214 (B)0.57 (C)2.14 (D)63.2 (E)0.63

(B)67. Which one of the following properties of a liquid is not affected by an increase in intermolecular forces?
(A)viscosity (B)molecular weight (C)heat of vaporization (D)boiling point (E)vapor pressure

(C)68. Which one of the following reactions will have a positive value of $\Delta H°$?
(A) $H_2O_{(\ell)} \rightarrow H_2O_{(s)}$

(B) $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(\ell)}$

(C) $2H_2O_{(\ell)} \rightarrow 2H_{2(g)} + O_{2(g)}$

(D) $Cu^{2+}_{(aq)} + Zn_{(s)} \rightarrow Cu_{(s)} + Zn^{2+}_{(aq)}$

(E) $Cl_{(g)} + e^- \rightarrow Cl^-_{(g)}$

(C)69. Which one of the following forms of radiation can pentrate the deepest into body tissue?
(A)alpha (B)beta (C)gamma (D)positron (E)ultraviolet radiation

(E)70. Which of the following statements about the halogen family is true?
(A)Bromine is obtained by using the chloride ion as the oxidizing agent.
(B)Iodine is the strongest oxidizing agent.
(C)The halide ions are all oxidizing agents, and the fluoride the strongest.
(D)The halide ions are more reactive than the halogens.
(E)All of the halogens can be obstained by electrolysis of the molten halide salts.

(B)71. If the electronic structure of a solid substance consists of a valence band that is completely filled with electrons and there is a large energy gap to the next set of orbitals, then this substance will be a(n):
(A)alloy (B)insulator (C)conductor (D)semi-conductor (E)detector

(A)72. The order of increasing ionization energy for the atoms neon, nitrogen, phosphorus, and sodium is
(A)Na < P < N < Ne (B)N < Ne < Na < P (C)N < Na < Ne < P (D)Na < N < P < Ne
(E)N < Na < P < Ne

(B)73. Warm dilute nitric acid will oxidize
(A)Pt but not Au (B)Ag but not Pt (C)Au but not Ag (D)Sn but not Cd (E)Cu but not Ag

(B)74. A reaction for which the activation energies of the forward and reverse directions are equal in value, suggest that
(A)the stoichiometry in the mechanism (B) $\Delta H = 0$ (C) $\Delta S = 0$ (D)the order of reaction is 0
(E)there is no catalyst

(A)75. For which of the following ionic crystalline solids does the cation-anion bond have the largest amount of covalent character?
(A)CdS (B)NaBr (C)SrS (D)BaO (E)LiF

(C)76. Which of the following statements is not true of diborane?
(A)It is an electron-deficient compound.
(B)It has two three center bonds.
(C)It is a highly reactive oxidizing agent.
(D)It is a Lewis acid.
(E)It has two different types of hydrogen atoms.

(D)77. What is the maximum number of electrons in an atom that can have the quantum number of $n = 3, \ell = 2$?
(A)36 (B)18 (C)25 (D)10 (E)6

(E)78. Place the following aqueous solutions in order of increasing freezing point depression.
1.5 m glucose 1.0 m acetic acid 1.0 m NaCl 1.0 m H_3PO_4
1 2 3 4
(A)3 > 4 > 2 > 1 (B)4 > 3 > 1 > 2 (C)3 > 4 > 1 > 2 (D)4 > 1 > 3 > 2 (E)3 > 1 > 4 > 2

(B)79. A nuclear transformation is shown below.
$$^{27}_{13}\mathrm{Al} + {}^{4}_{2}\mathrm{He} \rightarrow \mathrm{X} + {}^{1}_{0}\mathrm{n}$$
What is the "X"?
(A) ^{31}P (B) ^{30}P (C) ^{30}Si (D) ^{31}S (E)none of these

(C)80. According to the VSEPR model, please predict which of the following molecule has the largest bond angle?
(A) NH_3 (B) CCl_4 (C) CSe_2 (D) H_2O (E) SO_2

(B)81. Which of the following is water-soluble?
(A)Vitamin A (B) Vitamin C (C) Vitamin D (D) Vitamin E

(B)82. Which amino acid plays the major role for cross linkage in central structure of hair?
(A)lysine (B)cysteine (C)valine (D)glycine (E)alanine

(B)83. A solution is prepared that 0.5 M acetic acid (pKa = 4.75) and 0.05 M sodium acetate. What is the pH of this solution?
(A)4.75 (B)3.75 (C)5.75 (D)4.65 (E)4.85

(B)84. "All spontaneous processes increase the entropy of the universe" The above statement is
(A)First law of thermodynamics (B)Second law of thermodynamics (C)Third law of

thermodynamics (D)Charles's Law (E)Hess's Law

(D)85. Which of the following base does not appear in DNA?
(A)Adenine (B)Guanine (C)Cytosine (D)Uracil (E)Thymine

(C)86. Which of the following is not a natural occurring polymer?
(A)DNA (B)Cellulose (C)Nylon (D)Starch

(A)87. Which of the following materials that are inorganic solids with high termal stability, usually formed through three-dimensional network bonding?
(A)Ceramics (B)Polystyrene (C)Liquid crystals (D)Rubber

(C)88. Which of the following is not an intermolecular force that affects the structure of a protein?
(A)Hydrogen bonds (B)Dispersion forces (C)Activation energy (D)Ionic forces
(E)Dipole-Dipole forces

(A)89. Given that the normal freezing point of ammonia is $-78°C$. Predict the signs of ΔH, ΔS, and ΔG for ammonia when it freezes at $-85°C$ and 1 atm.
(A) $\Delta H < 0, \Delta S < 0, \Delta G < 0$ (B) $\Delta H < 0, \Delta S > 0, \Delta G < 0$ (C) $\Delta H < 0, \Delta S < 0, \Delta G = 0$
(D) $\Delta H > 0, \Delta S > 0, \Delta G = 0$ (E) $\Delta H > 0, \Delta S < 0, \Delta G > 0$

(D)90. Which of the following ion has the largest hydration energy (Kj/mol)
(A) Li^+ (B) Na^+ (C) K^+ (D) Ca^{2+} (E) Cl^-

(C)91. Choose the substance with the higher positional entropy (per mole) at a given temperature
(A) $CO_{2(s)}$ (B) $CO_{2(\ell)}$ (C) $CO_{2(g)}$ (D) $N_{2(\ell)}$

(C)92. Which statement is correct?
(A)the trans isomer of $[Co(en)_2Cl_2]^+$ is optically active.
(B)the cis isomer of $[Co(en)_2Cl_2]^+$ and its mirror image are not optical isomers.
(C)the cis isomer of $[Co(en)_2Cl_2]^+$ and its mirror image are not superimposable.
(D)the trans isomers of $[Co(en)_2Cl_2]^+$ and its mirror image are not identical.

(D)93. The n-type semiconductor is a silicon crystal doped with
(A)boron (B)aluminum (C)phosphorus (D)arsenic

(A)94. The geometry of $COCl_4^{2-}$ is
(A)tetrahedral (B)square planar (C)octahedral (D)trigonal planar

(B)95. Teflon is a polymer. The formula is
(A) $(CHCl—CHCl)_n$ (B) $(CF_2—CF_2)_n$ (C)$(CH_2CH_2)_n$ (D)$(CH_2CHCN)_n$

(A)96. The overall reaction $NO_{2(g)} + CO_{(g)} \rightarrow NO_{(g)} + CO_{2(g)}$. The reaction mechanism follows:

$$NO_2 + NO_2 \xrightarrow{\text{slow}} NO_3 + NO$$

$$NO_3 + CO \xrightarrow{\text{fast}} NO_2 + CO_2$$

The rate law is
(A)Rate = $K[NO_2]^2$ (B)Rate = $K[NO_2]$ (C)Rate = $K[NO_3]$ (D)Rate = $K[NO_3][CO]$

(A)97. The molecular structure of I_3^- is
(A)linear (B)bent (C)trigonal bipyramidal (D)square planar

(D)98. The corrosion of iron is an electronchemical reaction. Which of the following statements is correct?
(A)anode: $Fe^{2+} \rightarrow Fe^{3+} + e^-$ (B)cathode: $Fe^{2+} + 2e^- \rightarrow Fe$

(C)anode: $Fe \rightarrow Fe^{3+} + 3e^-$ (D)cathode: $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$

(B)99. Which of the following has the strongest bond?
(A) O_2 (B) O_2^+ (C) O_2^- (D) O_2^{2-}

(C)100. Predict the number of unpaired electrons in the complex ion $[Cr(CN)_6]^{4-}$?
(A)0 (B)3 (C)2 (D)4