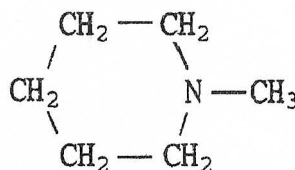


MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Which name is incorrect?

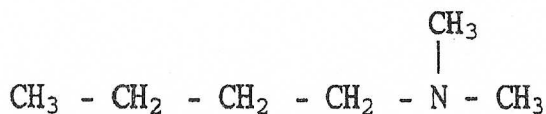
- A) N_2O_4 dinitrogen tetroxide
- B) SCl_2 sulfur dichloride
- C) CS_2 carbon disulfide
- D) CCl_4 carbon tetrachloride
- E) Al_2O_3 dialuminum trioxide

2) Which of the following is an isomer of:

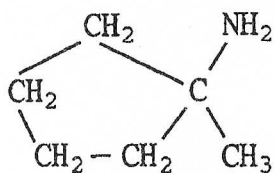


A) $(CH_3CH_2)_3N$

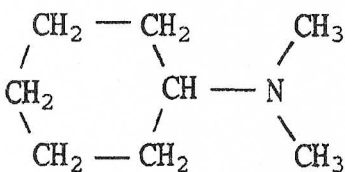
B)



C)



D)



E)



3) How many neutrons are there in the nucleus of ^{108}Ag ?

A) 47

B) 61

C) 18

D) 108

E) 54

4) In which of the compounds shown below is the sulfur most oxidized?

A) Na_2SO_4

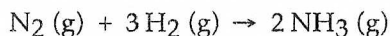
B) $NaSO_3$

C) H_2S

D) S_2Cl_2

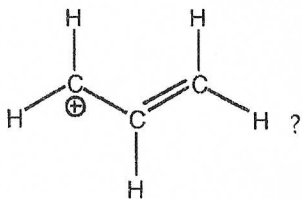
E) S_8

5) In the synthesis of ammonia gas from nitrogen and hydrogen,

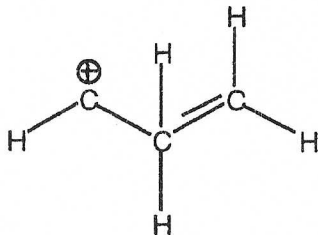


what is the maximum volume, in liters, of NH_3 that can be formed from 15.0 L of H_2 ?

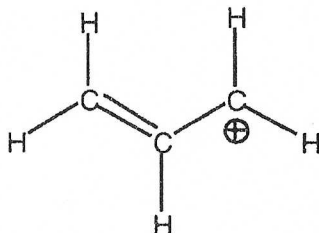
- A) 10.0 B) 15.0 C) 22.5 D) 30.0 E) 7.50
- 6) For which of the following types of electromagnetic radiation would the photons have the greatest energy?
- A) visible B) IR C) microwaves D) UV E) x-rays
- 7) Which of the following sets is not an acceptable set of quantum numbers.
- A) $n = 2, \ell = 1, m_\ell = -1$
 B) $n = 1, \ell = 0, m_\ell = 0$
 C) $n = 3, \ell = 1, m_\ell = -3$
 D) $n = 7, \ell = 3, m_\ell = +3$
 E) $n = 2, \ell = 1, m_\ell = +1$
- 8) Lithium exists as two isotopes: ${}^6\text{Li}$ with a mass of 6.01512 u and an abundance of 7.42%, and ${}^7\text{Li}$ with a mass of 7.01600 u and an abundance of 92.58%. Calculate the atomic weight of lithium.
- A) 6.94 B) 6.02 C) 6.06 D) 7.42 E) 7.02
- 9) Which of the following orders of electronegativity is incorrect?
- A) $\text{Se} < \text{S} < \text{O}$ B) $\text{Si} < \text{P} < \text{N}$ C) $\text{I} < \text{Cl} < \text{F}$ D) $\text{Si} < \text{N} < \text{O}$ E) $\text{N} < \text{P} < \text{S}$
- 10) Which of the following is a resonance structure of



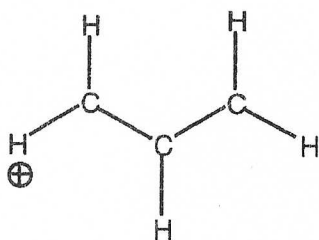
A)



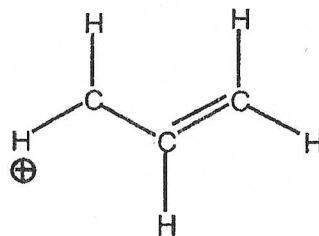
B)



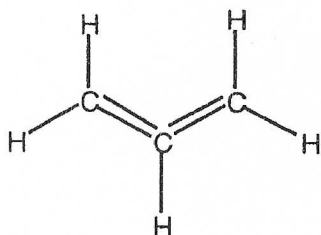
C)



D)



E)



11) Which is the strongest acid?

- A) CF_3COOH B) CCl_3COOH C) CH_3COOH D) CBr_3COOH E) Cl_3COOH

12) Three acids are represented by HA, HB, and HC. In light of the following observations, what is the correct order for the relative acid strengths of the acids?

1. NaA reacts with HB completely in a neutralization reaction.
2. A 0.1 M HB solution has a higher pH than a 0.1 M HC solution.

weaker acid stronger acid

- A) $\text{HC} < \text{HB} < \text{HA}$
 B) $\text{HB} < \text{HC} < \text{HA}$
 C) $\text{HB} < \text{HA} < \text{HC}$
 D) $\text{HC} < \text{HA} < \text{HB}$
 E) $\text{HA} < \text{HB} < \text{HC}$

13) Which one of the following salts will have a water solution with a pH less than 7?

- A) $\text{NaC}_2\text{H}_3\text{O}_2$ B) NaBr C) K_2CO_3 D) KCN E) NH_4Cl

14) The conjugate acid of HPO_4^{2-} is

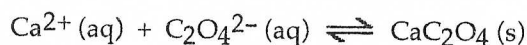
- A) H_2PO_4^- B) H_3PO_4 C) $\text{H}_2\text{PO}_4^{2-}$ D) PO_4^{3-} E) none of these

15) Which would precipitate first upon addition of the sodium salts of the following anions to solutions 0.10 M in $\text{Pb}(\text{NO}_3)_2$?

K_{sp} of lead salt

- | | |
|---------------------------------------|-----------------------|
| A) Br^- | 4.0×10^{-5} |
| B) IO_3^- | 3.2×10^{-13} |
| C) Cl^- | 1.6×10^{-5} |
| D) OH^- | 1.2×10^{-15} |
| E) $\text{C}_2\text{H}_3\text{O}_2^-$ | 1.8×10^{-3} |

16) What will be the effect on the following system if a catalyst is added?



- A) K_{sp} increases
- B) precipitation of CaC_2O_4
- C) an increase in $[\text{Ca}^{2+}]$
- D) precipitation of Ca^{2+}
- E) There is no change in the equilibrium.

17) In which aqueous solution will the molar solubility of $\text{Ca}(\text{OH})_2$ be smallest?

- A) pure water
- B) 1 M NH_4Cl
- C) 1 M NH_3
- D) 1 M NH_3 and 1 M NH_4Cl
- E) 1 M HCl

18) The metal center in a complex ion is

- A) a Lewis acid.
- B) insoluble in the solvent.
- C) a Lewis base.
- D) a Bronsted-Lowry base.
- E) a ligand.

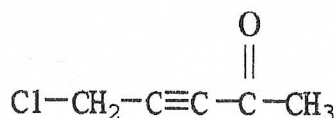
19) Which process is accompanied by a decrease in entropy for the system?

- A) dry ice sublimates
- B) wax melts
- C) sodium chloride dissolves
- D) water evaporates
- E) ethanol condenses

- 20) The ultimate criterion for spontaneity of a process is
- A) the change in free energy for the process.
 - B) the change in entropy.
 - C) the change in enthalpy.
 - D) the change in internal energy of the process.
 - E) the change in numbers of moles of gaseous species.
- 21) Which one of the following processes is not spontaneous and endothermic (at 1 atm)?
- A) $\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{O}(\text{g})$ at 101°C
 - B) condensation of water at 99°C
 - C) melting of ice at 10°C
 - D) dissolving the soluble salt, NH_4NO_3 , and the temperature drops
 - E) sublimation of CO_2 at 25°C
- 22) Which of the following processes would lead to a decrease in entropy?
- A) $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$
 - B) $2\text{O}_3(\text{g}) \rightarrow 3\text{O}_2(\text{g})$
 - C) $\text{NH}_4\text{NO}_3(\text{s}) \rightarrow \text{N}_2\text{O}(\text{g}) + 2\text{H}_2\text{O}(\text{g})$
 - D) $\text{N}_2\text{O}_4(\text{g}) \rightarrow 2\text{NO}_2(\text{g})$
 - E) $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$
- 23) For a certain reaction, the standard free energy change is -80.0 kJ at 300 K and -40.0 kJ at 600 K . For this reaction
- A) ΔH is negative, and ΔS is negative.
 - B) ΔH is positive, and ΔS is positive.
 - C) ΔH is positive, and ΔS is negative.
 - D) ΔH is negative, and ΔS is positive.
 - E) impossible to tell
- 24) The K_{eq} for the following reaction is found to be 4.5×10^{-26} at 25°C . Determine the value of E° for the reaction.
- $$2\text{Mn}^{2+}(\text{aq}) + 5\text{Cl}_2(\text{g}) + 8\text{H}_2\text{O} \rightarrow 2\text{MnO}_4^{-}(\text{aq}) + 16\text{H}^{+}(\text{aq}) + 10\text{Cl}^{-}(\text{aq})$$
- A) -1.5 B) 15 C) 1.5 D) -0.15 E) +0.15
- 25) Which of the following statements is not correct?
- A) A sacrificial electrode hinders corrosion of attached metals.
 - B) The density of the sulfuric acid solution decreases in a lead storage battery as the battery discharges.
 - C) Oxidation must always accompany a corresponding reduction.
 - D) Oxidation occurs at the cathode.
 - E) A free metal can displace from solution the ions of a metal that lie below the free metal in the activity series.

- 26) Consider a cell made up of two half cells consisting of the same metal in solutions of the metal ion of different concentrations. Which statement is incorrect?
- The cell containing more concentrated electrolyte is the anode.
 - The spontaneous reaction will proceed until the concentrations become equal.
 - Reduction occurs in the more concentrated solution.
 - The greater the ratio in concentrations between the two cells, the greater is the initial voltage.
 - The E°_{cell} is zero.
- 27) Which equation accounts for the formation of a positron?
- $n \rightarrow p^+ + \beta^-$
 - $n \rightarrow e^- + p^+$
 - $p^+ \rightarrow n + \beta^+$
 - $n + \beta^+ \rightarrow p^+$
 - $\beta^+ + \beta^- \rightarrow p^+$
- 28) Which of these metals is not a transition element?
- Pb
 - Os
 - Zr
 - Mo
 - Hg
- 29) Which of the following ions would have three unpaired electrons?
- Cr^{3+}
 - Co^{3+}
 - Fe^{3+}
 - Sc^{3+}
 - Fe^{2+}
- 30) What is the ground state electron configuration of Fe^{3+} ?
- $[\text{Ar}] 3d^3$
 - $[\text{Ar}] 4s^2 3d^3$
 - $[\text{Ar}] 3d^5$
 - $[\text{Ar}] 4s^1 3d^4$
 - $[\text{Ar}] 4s^2 4d^3$
- 31) Mercury is toxic to the body, in part, because Hg^{2+} interferes with
- antioxidant activity.
 - oxygen uptake.
 - transport of electrons across the blood-brain barrier.
 - sulfur containing enzymes.
 - digestion.
- 32) Which statement is not true regarding optical isomerism?
- Two optical isomers of square planar $[\text{Pt}(\text{en})\text{BrCl}]$ exist.
 - Optical isomers are not superimposable.
 - Optical isomers are mirror images of each other.
 - Optical isomers rotate plane polarized light in opposite directions.
 - Two optical isomers of $[\text{Co}(\text{en})_3]^{3+}$ exist.
- 33) How many unpaired electrons would you expect for the tetrahedral complex, $[\text{FeBr}_4]^-$? (Br^- is a weak field ligand.)
- 4
 - 0
 - 1
 - 2
 - 5
- 34) Which of the following ions would be colored?
- Co^{3+}
 - Ca^{2+}
 - Na^+
 - Sn^{2+}
 - Zn^{2+}

44) How many σ bonds are there in the following structure?

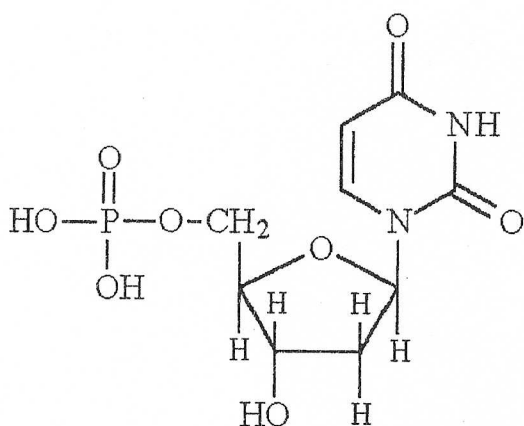


- A) 4 B) 6 C) 8 D) 11 E) 14

45) According to molecular orbital theory predict the bond order for O_2^- ?

- A) 0.5 B) 1 C) 1.5 D) 2 E) 2.5

46) Match the following classifications with the compound shown.



BASE

SUGAR

- | | |
|---------------|----------|
| A) purine | pyranose |
| B) purine | furanose |
| C) pyrimidine | pyranose |
| D) pyrimidine | furanose |
| E) pyrimidine | tetrose |

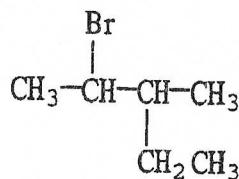
47) Why do aromatic compounds undergo electrophilic aromatic substitution reactions instead of addition reactions?

- A) The aromatic ring is very stable and quickly reforms if disrupted.
 B) The aromatic ring doesn't have any $\text{C}=\text{C}$ bonds to undergo addition reactions.
 C) The total number of π -electrons must remain constant.
 D) Additions to $\text{C}=\text{C}$ double bond always form carbanions.
 E) Aliphatic rings are unable to undergo addition reactions.

48) How do drugs exhibit biological activity?

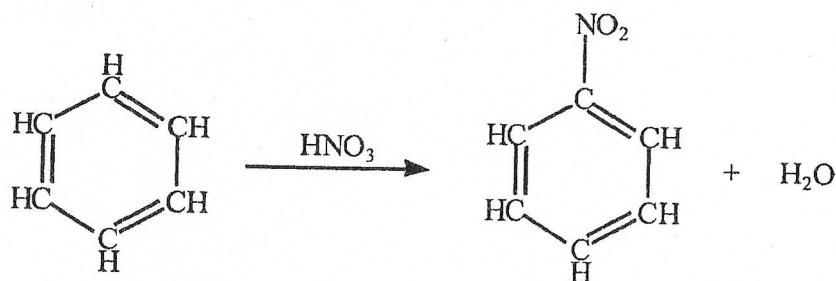
- A) They interact with specific enzymes and block or change the shape of the active site of the receptor.
 B) They hydrolyze the fats and oils in abnormal cells to make metal salts of fatty acids.
 C) They stimulate the cells to perform acid-base reactions.
 D) They react with abnormal cells in the body and form Lewis acids by electrophilic aromatic substitution.
 E) They mimic the action of a specific enzyme, increasing the availability of the receptors.

49) Name the following compound using the IUPAC nomenclature system.



- A) 2-bromo-3-ethylbutane
- B) 4-bromo-3-methylpentane
- C) 2-ethyl-3-bromobutane
- D) 2-bromo-3-methylpentane
- E) 3-methyl-4-bromopentane

50) The following reaction is an example of



- A) electrophilic aromatic substitution.
- B) nucleophilic aromatic substitution.
- C) condensation.
- D) addition polymerization.
- E) simple addition.