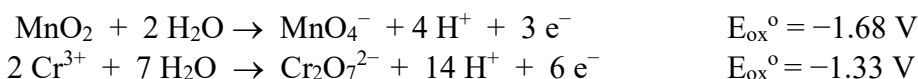


Multiple Choice – Three (3) points each

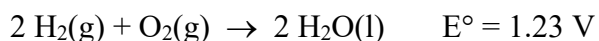
1. Which of the following statements is **false** regarding electrochemical cells?
- Galvanic cells utilize spontaneous oxidation-reduction reactions.
 - Electrolytic cells are based on oxidation-reduction reactions having positive ΔG values.
 - The cell potential (E_{cell}) in a concentration cell is produced by constructing a galvanic cell where both the anode and cathode compartments contain the same components but at different ion concentrations.
 - When the concentration of a reactant ion in a galvanic cell is increased, the cell potential (E_{cell}) decreases.
 - Batteries are examples of galvanic cells.

2. Consider the galvanic cell based on the following standard oxidation half-reactions:



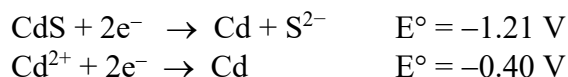
Which of the following statements (a-e) is **true** about the galvanic cell at standard conditions?

- Cr^{3+} is the oxidizing agent in the overall cell reaction.
 - Manganese (Mn) is oxidized in the overall cell reaction.
 - The oxidation state of chromium in $\text{Cr}_2\text{O}_7^{2-}$ is +5.
 - 12 electrons are transferred in the best balanced cell reaction.
 - The coefficient in front of H_2O in the best balanced cell reaction is 3.
3. Hydrogen-oxygen fuel cells are utilized in some cities to produce electricity. The fuel cell reaction and the standard cell potential are:



Calculate the maximum amount of work (w_{max}) this fuel cell reaction could produce for the production of 2 mol of $\text{H}_2\text{O}(\text{l})$ assuming standard concentrations and $T = 25^\circ \text{C}$. Note: $w_{\text{max}} = \Delta G$.

- a. -948 kJ b. -237 kJ c. -475 kJ d. -119 kJ e. -82.5 kJ
4. Cadmium sulfide (CdS) is used in some semiconductor applications. Calculate the value of the solubility product (K_{sp}) for CdS given the following standard reduction potentials.



- 3.9×10^{-28}
- 3.3×10^{-55}
- 2.1×10^{-14}
- 3.0×10^{54}
- 2.6×10^{22}

5. Consider the following standard reduction potentials:

	<u>E° (volts)</u>
$F_2 + 2e^- \rightarrow 2 F^-$	2.87
$Ag^+ + e^- \rightarrow Ag$	0.80
$Cu^{2+} + 2e^- \rightarrow Cu$	0.34
$Pb^{2+} + 2e^- \rightarrow Pb$	-0.13
$Ni^{2+} + 2e^- \rightarrow Ni$	-0.23

Assuming standard conditions, copper (Cu) will spontaneously reduce which of the following?

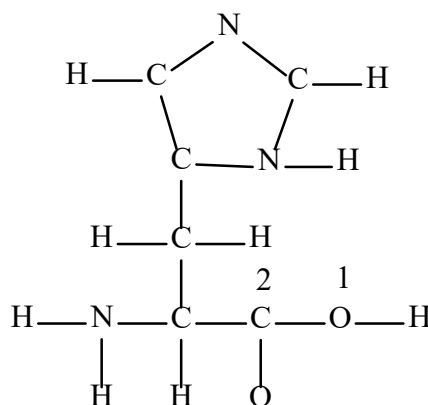
- a. Ag and F^- b. Ag^+ and F_2 c. Pb and Ni
d. Pb^+ and Ni^{2+} e. none of these
6. Consider the following reduction potentials:

	<u>E°</u>
$Cl_2 + 2e^- \rightarrow 2 Cl^-$	1.36 V
$O_2 + 4 H^+ + 2e^- \rightarrow 2 H_2O$	1.23 V
$2 H_2O + 2e^- \rightarrow H_2 + 2 OH^-$	-0.83 V
$Na^+ + e^- \rightarrow Na$	-2.71 V

When molten NaCl is electrolyzed, Na(s) and $Cl_2(g)$ are produced. When aqueous NaCl is electrolyzed, $H_2(g)$ and $Cl_2(g)$ are produced. Which of the following statements **best** explains why $H_2(g)$ is produced instead of Na(s) in an aqueous solution of NaCl?

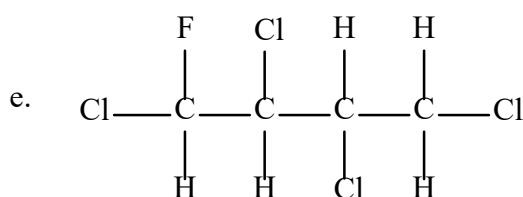
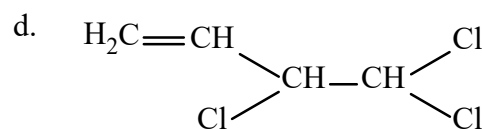
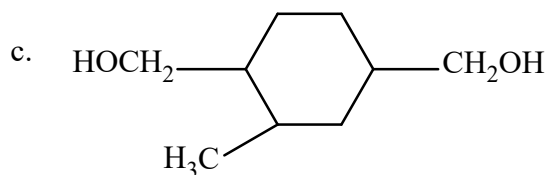
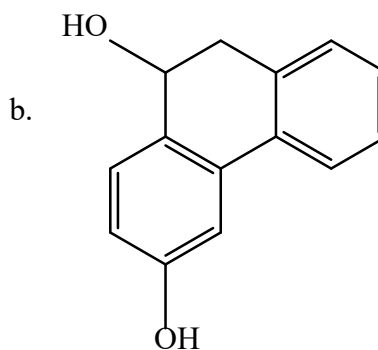
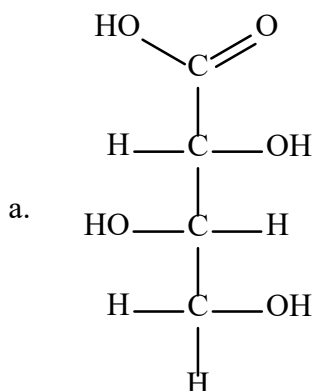
- a) H_2O is more easily reduced relative to Na.
b) H_2O is more easily oxidized relative to Na.
c) H_2O is more easily reduced relative to Na^+ .
d) H_2O is more easily oxidized relative to Na^+ .
7. Which of the following statements is **false**?
- a. Corrosion involves the oxidation of iron.
b. Corrosion is an example of an electrolytic cell.
c. Sacrificial metals (or cathodic protection) utilize metals that are more easily oxidized than iron.
d. Dry climates tend to have less of a problem with corrosion as compared to climates with ample moisture.
e. Paint or protective oxides can help prevent corrosion by eliminating contact of the iron with $O_2(g)$.
8. Which of the following has a bond order of 1 and is paramagnetic?
- a. H_2 b. Li_2 c. He_2 d. H_2^+ e. B_2

Histidine, one of the 20 naturally occurring amino acids, has the following skeletal structure. Complete a Lewis structure for histidine and answer the following two questions.



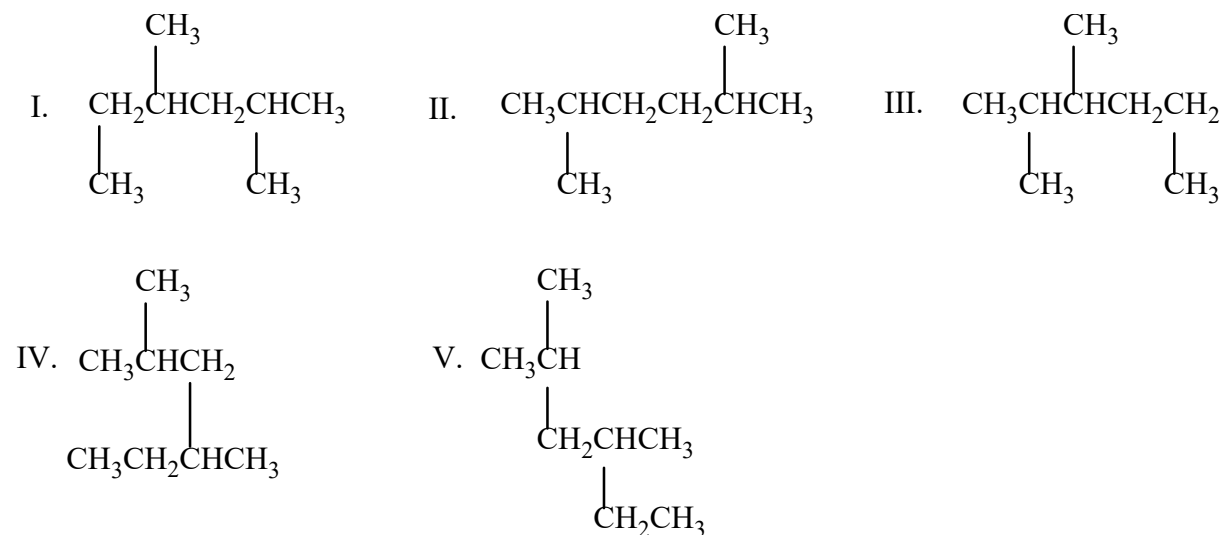
9. How many π bonds are in histidine?
- a. 0 b. 1 c. 2 d. 3 e. 4
10. Which of the following statements is **false** concerning the structure of histidine?
- a. There are four carbon atoms in histidine that are sp^2 hybridized.
b. The bond angle about the oxygen atom labeled 1 is approximately 109° .
c. The bond angles about the carbon atom labeled 2 is approximately 120° .
d. There are 7 lone pairs of electrons in the complete Lewis structure.
e. All of the nitrogen atoms are sp^3 hybridized.
-
11. A student incorrectly named a compound 4-ethyl-2,3-diisopropylpentane. What is the correct IUPAC name for this compound?
- a. 2,3-diisopropyl-4-methylhexane
b. 4,5-diisopropyl-3-methylhexane
c. 4-isopropyl-3,5,6-trimethylheptane
d. 4-isopropyl-2,3,5-trimethylheptane
e. 2,3,5-trimethyl-4-sec-butylhexane
12. Which of the following compounds has at least one carbon atom with sp hybridization?
- a. 1-chloro-4-methyl-2-heptyne
b. cyclopropane
c. 3-methyl-1-cyclopentene
d. 2-hexene
e. 3,4-dibromo-2,3,4,5-tetramethylhexane

13. Which of the following compounds is least soluble in water?
- a. CO_2 b. H_2CO c. NH_3 d. SO_2 e. CO
14. Which of the following compounds has a trigonal pyramidal molecular structure (shape)?
- a. CO_2 b. H_2CO c. NH_3 d. SO_2 e. CO
15. Which of the following compounds contain two and **only** two chiral carbon atoms?

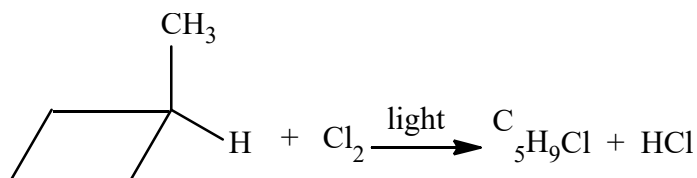


16. Which of the following statements is **false** concerning benzene, C_6H_6 ?
- a. Aromatic compounds are compounds based on benzene rings.
- b. Benzene exhibits 109° bond angles.
- c. Benzene is, in general, less reactive than alkenes due to the delocalized π electrons in benzene.
- d. Benzene cannot exhibit cis/trans isomerism.
- e. Benzene has two equivalent (resonance) Lewis structures.

17. Which of the following are the same molecule (are conformations of each other)?

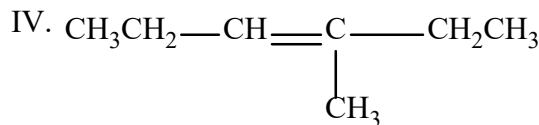
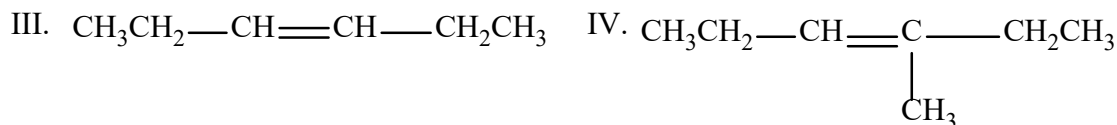
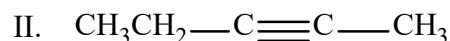
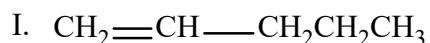


- a. I and III b. II and III c. I, III and V
d. I, IV, and V e. I, II, and IV
18. Consider the four possible monochlorination products ($\text{C}_5\text{H}_9\text{Cl}$) formed from the following reaction. How many of the monochlorination products can exhibit cis/trans isomerism?



- a. 0 b. 1 c. 2 d. 3 e. 4 (all)
19. When HCl is reacted with 1-pentene, two different products are possible. Which of the following statements **best** explains why 2-chloropentane is the major product of this reaction and 1-chloropentane is the minor product?
- a. The tertiary carbocation intermediate is more stable than the secondary carbocation intermediate.
b. The tertiary carbocation intermediate is more stable than the primary carbocation intermediate.
c. The secondary carbocation intermediate is more stable than the primary carbocation intermediate.

20. Which of the following compounds can exhibit cis-trans isomerism?



a. I, II, III, and IV

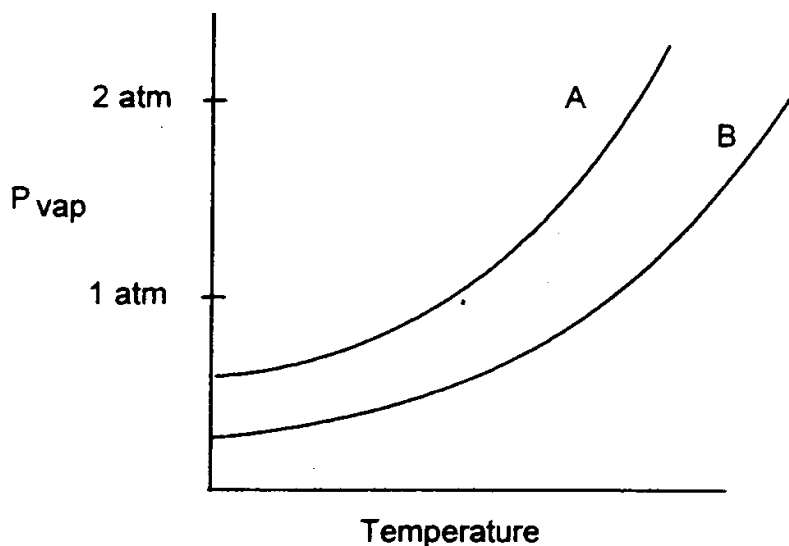
b. III and IV

c. I, III, and IV

d. III only

e. I and IV

21. Below is a plot of vapor pressure vs. temperature for two different substance A and B.



Which of the following statements is **false** concerning this plot?

a. As temperature increases, the vapor pressure of substance B increases.

b. Substance A has stronger intermolecular forces than substance B.

c. Substance A has a lower normal boiling point than substance B.

d. For substance A, the boiling point at 2 atm external pressure is higher than the boiling point at 1 atm external pressure.

22. Which of the following compounds has free rotation about every bond in the molecule?

a. 1-chloro-4-methyl-2-heptyne

b. cyclopropane

c. 3-methyl-1-cyclopentene

d. 2-hexene

e. 3,4-dibromo-2,3,4,5-tetramethylhexane