

1. Calculate the change in molar Gibbs free energy and state if the process is spontaneous for $\text{NH}_3(\text{l}) \rightarrow \text{NH}_3(\text{g})$ at 1 atm and a) $-15\text{ }^\circ\text{C}$, b) $-45\text{ }^\circ\text{C}$?
 $\Delta H_{\text{vap}}^\circ = 23.4\text{ kJ} \cdot \text{mol}^{-1}$
 $T_b = 239.7\text{ K}$
2. A student rides a bicycle to class every day, a round trip of 10 miles that takes 30 minutes in each direction. the student burns 420 kJ/h cycling. the same round trip in an automobile would require 0.4 gallons of gasoline. Assume that the student goes to class 150 days per year and that the enthalpy of combustion of gasoline can be approximated by that of octane (C_8H_{18} ; $H_{\text{comb}} = -5470\text{ kJ} \cdot \text{mol}^{-1}$), which has a density of 0.702 g/cm^3 . What is the yearly energy requirement in KWh of that journey by a) bicycle, b) automobile?
Please note: $1\text{ W h} = 3600\text{ J}$; $1\text{ gallon} = 3.785\text{ L}$
3. Which of the elements has atoms with the greatest polarizability?
A) carbon
B) aluminium
C) argon
D) germanium
4. Which of the elements has the greatest electron affinity?
A) oxygen
B) sulphur
C) gallium
D) tellurium
5. Which of the following pairs have about the same atomic radius?
A) Cu and Ag
B) Co and Rh
C) Fe and Ru
D) Ru and Os
6. Metal hydrides are often used to remove traces of water from nonpolar solvents. What is the balanced chemical equation for the reaction of calcium hydride with water?
A) $\text{CaH}_2(\text{s}) + 2\text{ H}_2\text{O}(\text{l}) \rightarrow \text{Ca}(\text{OH})_2(\text{s}) + 2\text{ H}_2(\text{g})$
B) $\text{CaH}_2(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{CaOH}(\text{s}) + \text{H}_3\text{O}^+(\text{aq})$
C) $\text{CaH}_2(\text{s}) + 2\text{ H}_2\text{O}(\text{l}) \rightarrow \text{Ca}(\text{s}) + 2\text{H}_3\text{O}^+(\text{aq})$
D) $\text{CaH}_2(\text{s}) + 2\text{ H}_2\text{O}(\text{l}) \rightarrow \text{Ca}(\text{s}) + \text{O}_2(\text{g}) + 6\text{ H}^+(\text{aq})$

7. What is the element in Period 3 that forms an amphoteric oxide with the formula E_2O_3 where E is the element of interest?
- A) sodium
 - B) aluminum
 - C) sulfur
 - D) phosphorous
8. What type of material would gallium (Group 13) doped with germanium (Group 14) make?
- A) semiconductor
 - B) superconductor
 - C) n-type conductor
 - D) p-type conductor
9. What type of material would antimony (Group 15) doped with tin (Group 14) make?
- A) semiconductor
 - B) superconductor
 - C) n-type conductor
 - D) p-type conductor
10. Which bond distance is longer:
- a) the Li-Cl distance in lithium chloride or the K-Cl distance in potassium chloride?
 - b) the K-O distance in potassium oxide or the Ca-O distance in calcium oxide?
11. Identify the element with the higher first ionization energy in each of the following pairs: a) iron and nickel, b) nickel and copper, c) osmium and platinum, d) nickel and palladium, e) hafnium and tantalum.
12. Write the formulas for the oxoanions of the following elements in which the element is found in its highest oxidation number. In each case, the charge of the oxoanion is given in parentheses: a) V (-3), b) Ti (-4), c) Mn (-1).

To find the highest oxidation number, please refer to slide 29 from the last lecture. In case of an exam, these details would be provided!

Short Answers

1. a) spontaneous
b) non-spontaneous
2. a) 17.5 kWh
b) 2121 kWh
3. Germanium
4. Oxygen
5. Ru and Os
6. A)
7. B)
8. C)
9. D)
10. a) K–Cl is longer
b) K–O is longer
11. a) Ni b) Cu c) Pt d) Ni e) Ta
12. a) VO_4^{3-} b) TiO_4^{4-} c) MnO_4^-