

Turn in both Part I and Part II of the exam along with the Scan-Tron sheet to me.
Take no part of the exam with you when you leave.

Part I: Multiple Choice - Each question is worth 4 points.

- The total number of valence electrons in the oxalate ion, $\text{C}_2\text{O}_4^{2-}$, is:
 - 28
 - 30
 - 32
 - 34
 - 36
- Which of the following statement is **false** as it concerns resonance?
 - Resonance makes a species a bit less stable because of the moving electrons.
 - The chlorate ion, ClO_3^- , will demonstrate resonance.
 - The water molecule cannot have resonance forms.
 - Resonance only involves the way electrons are shared between the atoms of a species.
 - If a species has two or more resonance forms the bond angles are the same in each one of the species. That is, the resonance forms have the same shape.
- The central atom in the iodite anion, IO_2^- , is surrounded by
 - four bonding pairs and two nonbonding pairs of electrons.
 - three bonding pairs and one nonbonding pair of electrons.
 - two bonding pair and three nonbonding pairs of electrons.
 - two double bonds and one nonbonding pair of electrons.
 - three bonding pairs and two nonbonding pairs of electrons.
- Which species has the largest number of nonbonding pairs of electrons about the central atom?
 - XeOF_4
 - XeF_6
 - XeF_4
 - XeF_2
 - SiF_6^{2-}
- Which of the following is the best explanation for a covalent bond?
 - Shared electrons simultaneously attracted to more than one nucleus.
 - The overlapping of two electron-filled orbitals having different energies.
 - The overlapping of unoccupied orbitals of two atoms.
 - Simultaneous attraction of positive and negative ions for one another.
 - An interaction between outer electrons.
- In which of the following is the central atom sp^2 hybridized?
 - SO_2
 - BeF_2
 - H_2O
 - NO_3^-
 - ClF_3
 - 1 and 4 only
 - 1 and 3 only
 - 4 and 5 only

- d. 1 only
- e. 5 only

7. From a consideration of the Lewis structure of the thiocyanate ion, SCN^- , in which carbon has a double bond with both the sulfur and nitrogen atoms, the formal charges on sulfur, carbon and nitrogen atoms are, respectively:
- 1, 0, 0
 - 0, 0, -1
 - 1, +1, -1
 - 2, +1, 0
 - 2, 0, +1
8. The molecular shape of the chlorate ion, ClO_3^- , is best described as:
- square-based pyramid
 - tetrahedral
 - trigonal-planar
 - trigonal-based pyramid
 - T-shaped
9. The O-I-O bond angle in the IO_2^+ cation is expected to be:
- 180°
 - 90°
 - 120°
 - 109.5°
 - 45°
10. Which of the following statements concerning hybridization is **false**?
- Hybridization allows the formation of stronger bonds.
 - The promotion step in hybridization requires an input of energy.
 - If a molecule is described as AX_3E_2 , then A is sp^3 hybridized.
 - Nitrogen can never be dsp^3 hybridized.
 - Carbon is sp^2 hybridized in $\text{H}_2\text{C}=\text{CH}_2$.
11. What is the enthalpy change for the reaction in which 143.7 grams of FeO is consumed?
(At. Wts. Fe = 55.85; O = 16.0)
- $$6 \text{FeO}_{(s)} + \text{O}_{2(g)} \rightarrow 2 \text{Fe}_3\text{O}_{4(s)} + 635 \text{ kJ}$$
- 635 kJ
 - +635 kJ
 - 106 kJ
 - +106 kJ
 - 212 kJ

12. Calculate the standard enthalpy change for the following reaction



from the standard enthalpies of formation.

$$\Delta H_f(\text{C}_2\text{H}_5\text{OH}_{(l)}) = -278 \text{ kJ/mol} \quad \Delta H_f(\text{CO}_{2(g)}) = -394 \text{ kJ/mol}$$

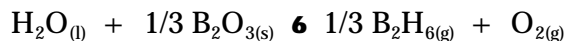
$$\Delta H_f(\text{H}_2\text{O}_{(l)}) = -286 \text{ kJ/mol}$$

- 958 kJ
- 1368 kJ
- 1082 kJ
- 402 kJ
- Insufficient data give to answer this question.

13. A 20. g mass of metal at a temperature of 125.0°C was dropped into 200. g of water (S.H. = 4.184 J/EC-g) at 20.0°C. When thermal equilibrium was reached, the temperature of the metal and water was 21.50°C. What is the specific heat of the metal?

- 0.606 J/EC-g
- 0.720 J/EC-g
- 0.404 J/EC-g
- 0.299 J/EC-g
- 0.598 J/EC-g

14. First consider this reaction: $\text{B}_2\text{H}_{6(g)} + 3 \text{O}_{2(g)} \rightarrow \text{B}_2\text{O}_{3(s)} + 3 \text{H}_2\text{O}_{(l)}$ $\Delta H = -1260 \text{ kJ}$
then, determine the enthalpy change for this reaction:



- +3780 kJ
- 3780 kJ
- 420 kJ
- +420 kJ
- +1260 kJ

15. How many hydrogen atoms are in 48.0 g of ammonium carbonate, $(\text{NH}_4)_2\text{CO}_3$ (FW = 96.0)?

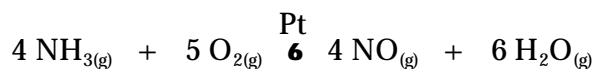
- 0.50 mole
- 4.0 mole
- 8.0 mole
- 2.0 mole
- 1.0 mole

16. What is the percent copper in $\text{Cu}_3(\text{PO}_4)_2 \cdot 4\text{H}_2\text{O}$?

At. Wts.: Cu = 63.5; P = 31.0; O = 16.0; H = 1.00

- 50.0 %
- 14.0 %
- 47.8 %
- 42.1 %
- 35.9 %

17. Consider the following equation:

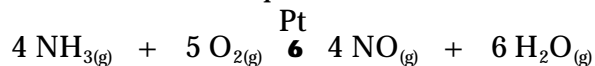


How many grams of NO will be produced for each 100. g of O_2 consumed?

At. Wts.: N = 14.0; O = 16.0; H = 1.00

- 160 g
- 117 g
- 80 g
- 94 g
- 75 g

18. Again consider the same reaction used in question 17:



How many grams of H_2O will be produced if 8.00 g of NH_3 and 16.0 g of O_2 are combined and reacted to completion? At. Wts.: N = 14.0; O = 16.0; H = 1.00

- 12.7 g
- 10.8 g
- 9.0 g
- 7.5 g
- 5.6 g

19. How many milliliters of 0.350 M NaOH is required to just neutralize all the acid in 350. mL of 0.250 M H_2SO_4 ?

- 125 mL
- 250 mL
- 500 mL
- 750 mL
- 1000 mL

20. Which of the following is **not** a property of Brittany Spears?

- gender
- height
- 2 hands, 2 feet

- d. weight
- e. talent

Part II. Problems, etc. You must show all work to receive credit for your answers.

1. Complete the following table with the requested information: (36 pts)
- Y The **Lewis structures** should show all bonding and non-bonding electrons **and should be corrected for formal charge.**
 - Y The **hybridization** should be given with the correct s-p-d representation.
 - Y Give the **shape** of the species by describing it with the correct term from the following list: *linear, bent, trigonal planar, trigonal-based pyramid, tetrahedral, trigonal bipyramid, see-saw, T-shaped, square planar, square-based pyramid or octahedral.*

Species	Lewis structure	Hybridization of central atom	Shape of the species (choose name from list)
ClF_4^+			
AsO_4^{3-}			
IF_4^-			
PSCl_3			

2. A sample of an organic polymer was completely burned in a bomb calorimeter. From the following data, calculate the enthalpy change for the combustion reaction in kilojoules (kJ) of heat **per gram** of polymer. (8 pts)

mass of polymer sample: 0.1552 g

heat capacity of the calorimeter: 523 J/EC

mass of water in calorimeter: 1210 g

specific heat of water: 4.184 J/EC-g

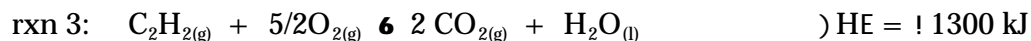
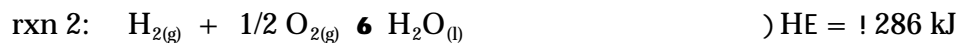
initial temperature: 19.450EC

final temperature: 22.820EC

answer = _____

3. Determine the standard enthalpy of formation, ΔH_f° , of acetylene, $C_2H_2(g)$, by applying Hess' Law using the following reactions with their associated enthalpies. (6 pts)

The equation describing the formation of acetylene is: $2 C_{(s)} + H_{2(g)} \rightarrow C_2H_2(g)$



$$\Delta H_f^\circ(\text{C}_2\text{H}_2) = \underline{\hspace{10em}}$$