

# CHM 1143

# Exam 1

1-4 30 points each

Multiple choice 10 points each

with 3 free misses

TUD Department of Chemistry

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1. a) A piece of metal alloy with a mass of 5.0 g is heated to 95°C and then dumped into 45 g of water ( $C_{H_2O} = 4.184 \text{ J/g}^\circ\text{C}$ ). The water temperature increases from 21°C to 26°C. What is the specific heat of the metal?

$$q_{\text{cal}} = m C \Delta T$$
$$= 45 \text{ g} (4.184 \text{ J/g}^\circ\text{C}) (26 - 21)^\circ\text{C}$$
$$= 941 \text{ J}$$

$$q_{\text{metal}} = m C \Delta T$$
$$- 941 \text{ J} = (5.0 \text{ g}) (C) (26 - 95)^\circ\text{C}$$
$$C_{\text{metal}} = \frac{-941 \text{ J}}{(5.0 \text{ g}) (-69)^\circ\text{C}}$$
$$= 2.7 \frac{\text{J}}{\text{g}^\circ\text{C}}$$

- b) How many Joules of heat would be required to increase the temperature of a human body by 1.0 °C? (That's to go from about 98.6 °F to a fever of 100.4 °F). Assume the specific heat of the body is 3.5 J/g°C and an FAA standard man - 70 Kg or 70,000 g.

$$q = m C \Delta T = 70,000 \text{ g} (3.5 \frac{\text{J}}{\text{g}^\circ\text{C}}) (38 - 37)^\circ\text{C}$$
$$= 245,000 \text{ J}$$
$$= 245 \text{ kJ}$$

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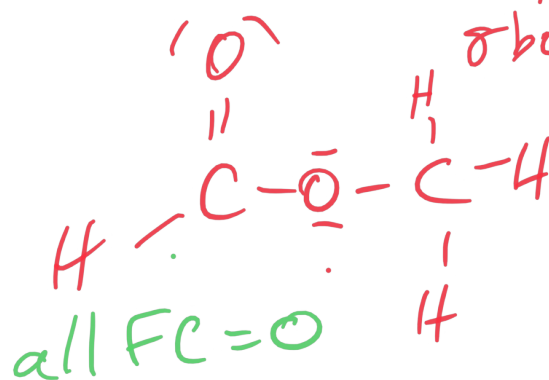
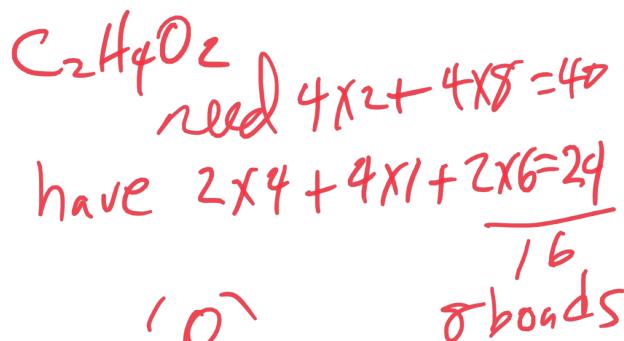
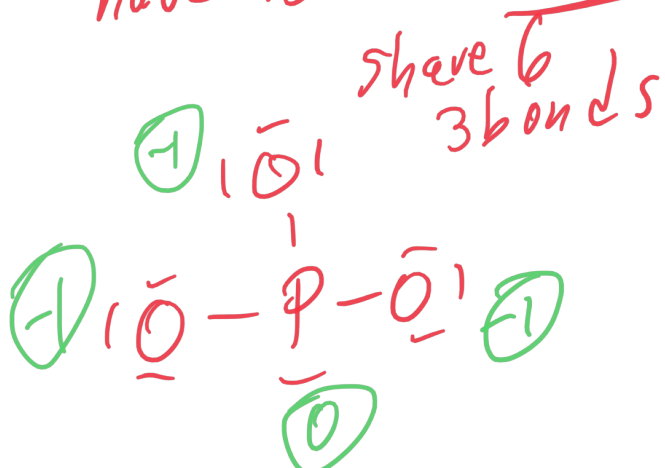
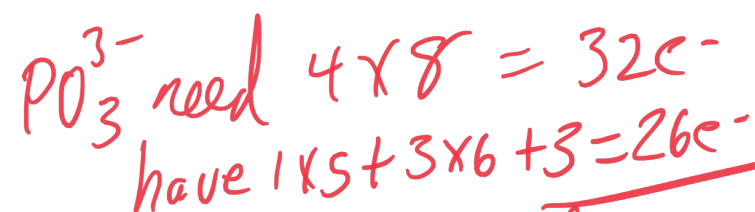
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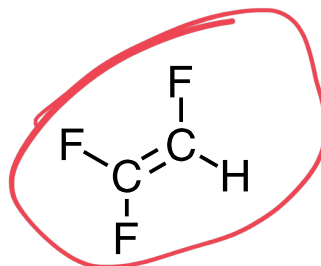
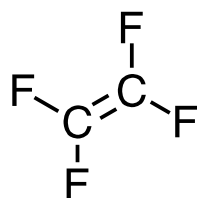
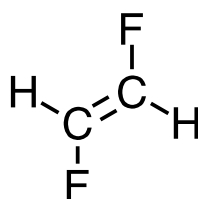
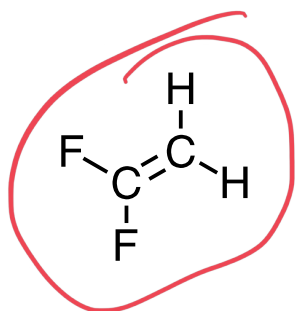
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2. a) Draw the Lewis structure for phosphite,  $\text{PO}_3^{3-}$  and for methyl formate,  $\text{C}_2\text{H}_4\text{O}_2$ . (Hint: The skeletal structure for methyl formate is on the board.). Show the formal charges on all atoms. (Hint: Skeletal structure for formic acid is on the board)



- b) Circle the polar molecules (Hint: the geometry is accurately portrayed in the drawings):



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3. a) A gas at 255 K occupies 4.0 L at a pressure of 1.1 atm. What volume does it occupy if the pressure is changed ( T constant) to 0.050 atm?

$$V_n = 4.0 \text{ L} \left( \frac{1.1 \text{ ATM}}{0.05 \text{ ATM}} \right) = 88 \text{ L}$$

- b) A gas at 273 K and 1.0 atm occupies 7.0 L . What is its pressure if the temperature is changed to 373 K and the volume is decreased to 1.0 L?

$$P_n = 1.0 \text{ ATM} \left( \frac{373 \text{ K}}{273 \text{ K}} \right) \left( \frac{7.0 \text{ L}}{1.0 \text{ L}} \right) = 9.6 \text{ ATM}$$

- c) What is the density of CO<sub>2</sub> at 315 K and 750 Torr?

$$PV = \frac{g}{MW} RT$$
$$\frac{g}{V} = \frac{P(MW)}{RT} = \frac{\left( \frac{750 \text{ Torr}}{760 \frac{\text{Torr}}{\text{ATM}}} \right) (44.0 \text{ g/mol})}{(R) 315 \text{ K}} = 1.7 \text{ g/L}$$

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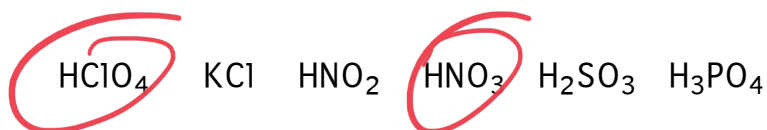
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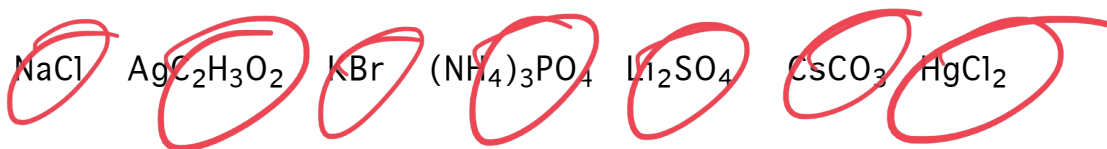
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4) a) Circle the strong acids



b) Circle the water soluble compounds



$\text{H}^+ + \text{OH}^- = \text{H}_2\text{O}$   
c) A 25.00 mL sample of aqueous HBr was titrated with 0.1500 M NaOH. 45.55 mL of the base was required to reach the equivalence point. What was the molar concentration of the acid?

$$(45.55 \text{ mL})(0.1500 \frac{\text{mmol}}{\text{mL}}) = 6.832 \text{ mmol OH}^- = \text{mmol H}^+$$

$$[\text{HBr}] = \frac{\text{mmol H}^+}{\text{mL sol'n}} = \frac{6.832 \text{ mmol}}{25.00 \text{ mL}} = 0.2733 \text{ M}$$

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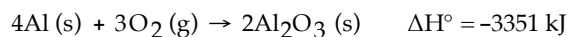
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MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1)  $\Delta H$  for an endothermic process is \_\_\_\_\_ while  $\Delta H$  for an exothermic process is \_\_\_\_\_. 1) B

- A) zero, positive
- B) positive, negative
- C) negative, positive
- D) positive, zero
- E) zero, negative

2) The reaction 2) D



is \_\_\_\_\_, and therefore heat is \_\_\_\_\_ by the reaction.

- A) endothermic, absorbed
- B) endothermic, released
- C) exothermic, absorbed
- D) exothermic, released
- E) thermoneutral, neither released nor absorbed

3) In which of the molecules below is the carbon-carbon distance the shortest? 3) E

- A)  $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_3$
- B)  $\text{H}_2\text{C}=\text{CH}_2$
- C)  $\text{H}_2\text{C}=\text{C}=\text{CH}_2$
- D)  $\text{H}_3\text{C}-\text{CH}_3$
- E)  $\text{H}-\text{C}\equiv\text{C}-\text{H}$

4) Of the atoms below, \_\_\_\_\_ is the most electronegative. 4) B

- A) Si
- B) Cl
- C) S
- D) Rb
- E) Ca

5) A valid Lewis structure of \_\_\_\_\_ cannot be drawn without violating the octet rule. 5) D

- A)  $\text{SO}_2$
- B)  $\text{SiF}_4$
- C)  $\text{NI}_3$
- D)  $\text{ICl}_5$
- E)  $\text{CO}_2$

6) The basis of the VSEPR model of molecular bonding is \_\_\_\_\_. 6) A

- A) electron domains in the valence shell of an atom will arrange themselves so as to minimize repulsions
- B) atomic orbitals of the bonding atoms must overlap for a bond to form
- C) hybrid orbitals will form as necessary to, as closely as possible, achieve spherical symmetry
- D) regions of electron density on an atom will organize themselves so as to maximize s-character
- E) regions of electron density in the valence shell of an atom will arrange themselves so as to maximize overlap

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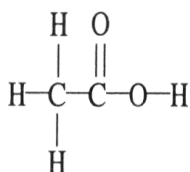
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7) The net ionic equation for the reaction between aqueous nitric acid and aqueous sodium hydroxide is \_\_\_\_\_.

- A)  $\text{HNO}_3(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{NO}_3^-(\text{aq}) + \text{H}_2\text{O}(\text{l})$   
B)  $\text{H}^+(\text{aq}) + \text{Na}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{Na}^+(\text{aq})$   
C)  $\text{H}^+(\text{aq}) + \text{HNO}_3(\text{aq}) + 2\text{OH}^-(\text{aq}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + \text{NO}_3^-(\text{aq})$   
D)  $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$   
E)  $\text{HNO}_3(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow \text{NaNO}_3(\text{aq}) + \text{H}_2\text{O}(\text{l})$

7) D

8) The molecular geometry of the right-most carbon in the molecule below is \_\_\_\_\_.



- A) tetrahedral  
B) trigonal bipyramidal  
C) T-shaped  
D) trigonal planar  
E) octahedral

8) D

9) Of the molecules below, only \_\_\_\_\_ is nonpolar.

- A)  $\text{NH}_3$       B)  $\text{TeCl}_2$       C)  $\text{H}_2\text{O}$       D)  $\text{CO}_2$       E)  $\text{HCl}$

9) D

10) Molecular compounds of low molecular weight tend to be gases at room temperature. Which of the following is most likely not a gas at room temperature?

- A)  $\text{CH}_4$       B)  $\text{Cl}_2$       C)  $\text{HCl}$       D)  $\text{LiCl}$       E)  $\text{H}_2$

10) D

11) A 0.100 M solution of \_\_\_\_\_ will contain the highest concentration of potassium ions.

- A) potassium oxide  
B) potassium phosphate  
C) potassium hydrogen carbonate  
D) potassium iodide  
E) potassium hypochlorite

11) B