

10. What is the oxidation number of U in UO_3 Each O is -2 and the compound is neutral, so $U = +6$.

S in HSO_3^- : $H = +1$; each $O = -2$, the ion is -1, so $S = +4$ (i.e. $+1 + 3(-2) + (+4) = -1$)

Given the reaction, $\text{Cu}^{2+}(\text{aq}) + \text{H}_2(\text{g}) \rightarrow \text{Cu}(\text{s}) + 2 \text{H}^+(\text{aq})$

Which element is oxidized? *H or Hydrogen* Which element is reduced? *Cu or Copper*

What is the oxidizing agent? Cu^{2+} What is the reducing agent? H_2

11. For each of the following, write *the net ionic equation* for the reaction that occurs between the given reactants. If no reaction occurs, write "No Reaction." 5 points each.

a. $\text{NaCl} + \text{Pb}(\text{NO}_3)_2$ $\text{Pb}^{2+}(\text{aq}) + 2 \text{Cl}^-(\text{aq}) \rightarrow \text{PbCl}_2(\text{s})$

b. $\text{HCl} + \text{Ca}_3(\text{PO}_4)_2$ $\text{Ca}_3(\text{PO}_4)_2(\text{s}) + 6 \text{H}^+(\text{aq}) \rightarrow 3 \text{Ca}^{2+}(\text{aq}) + 2 \text{H}_3\text{PO}_4(\text{aq})$

c. $\text{HCl} + \text{NH}_3$ $\text{H}^+(\text{aq}) + \text{NH}_3(\text{aq}) \rightarrow \text{NH}_4^+(\text{aq})$

d. $\text{Na}_2\text{CO}_3 + \text{HNO}_3$ $2 \text{H}^+(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$

12. The heating curves for water and benzene are shown here. Answer the following questions regarding them.

Part 1. Which has the greater heat of fusion?

water or benzene

Line B-C represents melting. The longer that line, the greater the heat of fusion.

Part 2. From segment D to E for water, what type of energy (if any) is increasing?

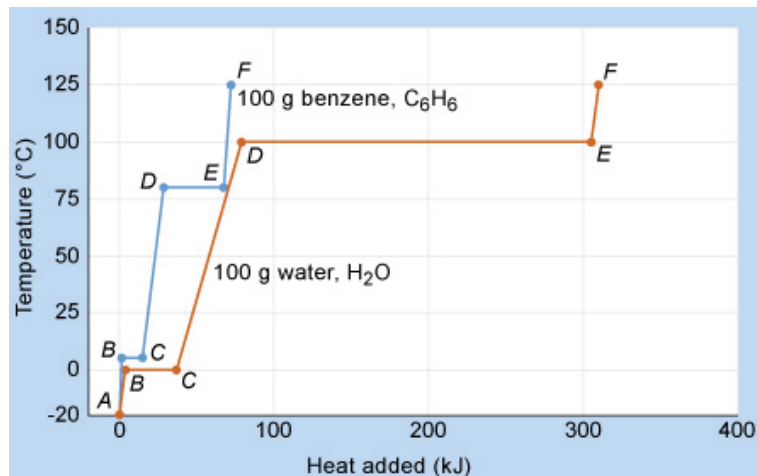
c) potential energy

This is boiling. Because the temperature is constant, the kinetic energy does not change.

Part 3. Which has the higher melting point?

water or **benzene**

(its B-C line is at higher temperature)



13. A titration is performed to determine the molar mass of an unknown monoprotic acid. A solution of 0.122 M NaOH is used to titrate 1.082 grams of acid. If 39.9 mL of the NaOH solution are required to titrate the acid, what is the molar mass of the acid?

$$0.0399 \text{ L NaOH} \times 0.122 \text{ mol NaOH/L} = 0.004868 \text{ mol NaOH}$$

The acid is monoprotic, so mol acid = mol NaOH = 0.004868 mol acid

$$\text{Molar mass acid} = 1.082 \text{ g acid} / 0.004868 \text{ mol acid} = \mathbf{222 \text{ g/mol}}$$

14. When 10.0 g KOH is dissolved in 100.0 g of water in a coffee-cup calorimeter, the temperature rises from 25.18 °C to 47.53 °C. What is the enthalpy change per gram of KOH dissolved in the water? Assume that the solution has a specific heat capacity of 4.18 J/g·°C.

$$\Delta H = \text{heat exchanged (q)} / \text{mass (g)}$$

$$\text{mass} = 10.0 \text{ g KOH}$$

$$q = 4.18 \text{ J/g}\cdot\text{°C} \times 110.0 \text{ g solution} \times 22.35 \text{ °C} = 10277 \text{ J}$$

$$\Delta H = 10277 \text{ J} / 10.0 \text{ g} = -1028 \text{ J/g} \quad (\text{Note: if this were answered correctly in J/mol, full credit will be given.})$$

1. What mass of $\text{Na}_2\text{C}_2\text{O}_4$ (Molar mass 134.0 g/mol) is needed to prepare 500 mL of a 0.0622 M solution?

$$0.500 \text{ L} \times 0.0622 \text{ mol/L} \times 134.0 \text{ g Na}_2\text{C}_2\text{O}_4 / \text{mol} = 4.17 \text{ g Na}_2\text{C}_2\text{O}_4$$

- 2a) What type of reaction is each of the following?



- 2b) $\text{Zn(s)} + \text{CuCl}_2\text{(aq)} \rightarrow \text{ZnCl}_2\text{(aq)} + \text{Cu(s)}$ *single displacement*
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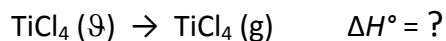
3. Which of the following are insoluble in water: FeSO_4 , CaCO_3 , H_3PO_4 *only CaCO_3*
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4. 5.00 grams of glass at 80°C is brought into contact with 5.00 g of wood at 20°C . When thermal equilibrium is reached, both objects are at a temperature of 39°C . Which has a greater specific heat capacity?

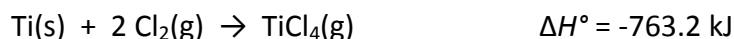
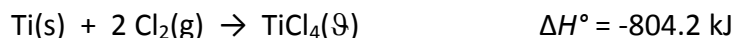
wood

Because they have the same mass, the object with the greater temperature change is known to have the lower specific heat capacity. Wood has the smaller temperature change.

5. Determine the heat of vaporization of titanium(IV) chloride,



given the enthalpies of reaction below.



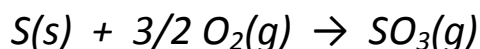
Need to reverse the top reaction to get them to add up to the reaction of interest. That changes the sign of ΔH° for that reaction. When adding, you get $+804.2 \text{ kJ} + (-763.2 \text{ kJ}) = +41.0 \text{ kJ}$

6. Wood is burning in a fireplace. This reaction is...

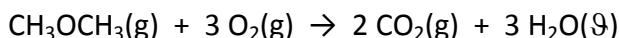
exothermic

7. Which of the following chemical equations corresponds to the standard molar enthalpy of formation of SO_3 ?

The formation reaction is one that forms 1 mol SO_3 from S and O in their normal states.



8. Calculate ΔH° for the combustion of gaseous dimethyl ether,



using standard molar enthalpies of formation.

<u>molecule</u>	<u>ΔH_f° (kJ/mol)</u>
$\text{CH}_3\text{OCH}_3(g)$	-184.1
$\text{CO}_2(g)$	-393.5
$\text{H}_2\text{O}(g)$	-285.8

$$\Delta H^\circ = [2 \times (-393.5) + 3 \times (-285.8)] \text{kJ} - [(-184.1) + 3 \times 0] \text{kJ} = -1460.3 \text{ kJ}$$

9. You have an unlabeled vial that contains one of the following solutions:

You mix portions of this solution with each of the following other solutions and observe the following results:

Mix with:	KCl	Na_2SO_4	$\text{Pb}(\text{NO}_3)_2$	NaOH	HCl
Observe:	no reaction	precipitate	precipitate	precipitate	no reaction

Which of the following could be the unknown solution? *CaCl_2*

- | | |
|-------------------------------|--|
| a) $\text{AgNO}_3(\text{aq})$ | d) $\text{Na}_2\text{CO}_3(\text{aq})$ |
| b) $\text{NaCl}(\text{aq})$ | e) $\text{HCl}(\text{aq})$ |
| c) $\text{CaCl}_2(\text{aq})$ | f) $\text{Ba}(\text{NO}_3)_2(\text{aq})$ |