Thermodynamics I

Prep Session

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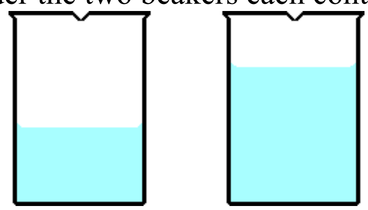
G1. Consider the two beakers each containing water at 25 ˚C.



Beaker A has 25 mLs of water and Beaker B has 50 mLs of water. Twice as much heat is added to Beaker B compared to Beaker A

A) the final temperature of Beaker B will be greater than the final temperature of Beaker A because beaker B started with more heat compared to Beaker A.
B) the final temperature of Beaker A will be the same as the final temperature of Beaker B because the heat absorbed is directly proportional to the mass of water.
C) the final temperature of Beaker A will be greater than the final temperature of Beaker B because beaker A has a half as much water compared to Beaker B.
D) the final temperature of Beaker A will be the same as the final temperature of Beaker B because both beakers contain the same substance, and the specific heat of water is a constant.
E) the final temperature of Beaker A will be greater than the final temperature of Beaker B because Beaker A has less water and will absorb heat faster than Beaker B.

G2. What is the final temperature of a mixture prepared by adding 118 g of H_2O at 73.5 ˚C to 78.5 g of H_2O at 15.2 ˚C?

A) 35.5 ˚C
B) 38.0 ˚C
C) 44.4 ˚C
D) 50.2 ˚C
E) 190. ˚C

G3. When 89.5 grams of water at 87.4 ˚C are added to 106 grams of cool water, the final temperature is 52.6 ˚C. Calculate the initial temperature of sample of water weighing 106 grams.

G4. Calculate the final temperature after mixing 200. gram of water initially at 23.0 ˚C with 168 g of water at 72.0 ˚C.

A) 20.4 ˚C
B) 32.9 ˚C
C) 45.4 ˚C
D) 47.5 ˚C
E) 83.5 ˚C

G5. If equal masses of each of the following substances, at the same initial temperature, absorb the same amount of heat, which will experience the largest change in temperature?

Substance	Specific Heat $\left(\frac{J}{g \cdot °C}\right)$
wood	1.76
iron	0.450
water	4.184
graphite	0.711
copper	0.387

A) wood
B) iron
C) water
D) graphite
E) copper

G6. Given the following information

Metal	Specific Heat (J g^{-1} ˚C^{-1})
Au	0.128
Mn	0.48
Zr	0.278
Zn	0.388
Fe	0.45

If samples of each of the metals listed above, have the same mass and the same initial temperature, which will transfer the smallest amount of heat to a given mass of water?

A) Au
B) Mn
C) Zr
D) Zn
E) Fe

G7. The addition of 3.31 kJ of heat to a 300. g sample of mercury at 19.0 ˚C caused the temperature to rise to 99.0 ˚C. What is the specific heat of mercury?

A) 41.4 J g^{-1} ˚C^{-1}
B) 7.25 J g^{-1} ˚C^{-1}
C) 0.581 J g^{-1} ˚C^{-1}
D) 0.138 J g^{-1} ˚C^{-1}
E) 0.111 J g^{-1} ˚C^{-1}

G8. A 75.0 gram sample of aluminum (specific heat = 0.90 $\frac{J}{g\cdot{}^\circ C}$) is heated in a Bunsen burner for a period of time and then carefully added to a 200. g sample of distilled water in an OSU calorimeter at an initial temperature of 23.5 ˚C. The heat capacity of the OSU calorimeter is 65.0 $\frac{J}{{}^\circ C}$. The temperature of the water and aluminum is recorded until constant temperature is attained. The final temperature is 39.5˚C.

a) Calculate the amount of heat absorbed by the water.

b) Calculate the amount of heat absorbed by the calorimeter.

c) Calculate the initial temperature of the aluminum metal. (4)

G9. When 72 g of a metal at 97.0 ˚C is added to 100 g of water at 25.0 ˚C, the final temperature is found to be 29.1 ˚C. What is the specific heat of the metal? (Specific heat of water is 4.184 $\frac{J}{g\cdot{}^\circ C}$)

A. 0.35
B. 0.46
C. 2.0
D. 2.8
E. 24

G10. The addition of 3.31 kJ of heat to a 300. g sample of mercury at 19.0 ˚C caused the temperature to rise to 99.0 ˚C. What is the specific heat of mercury?

A) 41.4 J g^{-1} $^\circ C^{-1}$
B) 7.25 J g^{-1} $^\circ C^{-1}$
C) 0.581 J g^{-1} $^\circ C^{-1}$
D) 0.138 J g^{-1} $^\circ C^{-1}$
E) 0.111 J g^{-1} $^\circ C^{-1}$

Questions G11 and G12 are related to the following experiment:

A 10.0 g sample of a manganese initially at 100. ˚C is dropped into a 100.0 gram sample of water initially at 22.5 ˚C in a coffee-cup calorimeter. The specific heat of manganese is 0.480 J g^{-1} $˚C^{-1}$, specific heat of water is 4.184 J g^{-1} $˚C^{-1}$, and the heat capacity of the coffee-cup calorimeter is 15.0 J $˚C^{-1}$.

G11. Which of the following statements about this experiment is true?

A) the heat absorbed by the water will equal the heat released by the metal, according to the first law of thermodynamics;
B) when the final temperature is attained the average kinetic energy of the manganese atoms will be different than the average kinetic energy of the water molecules;
C) since the specific heat of the metal is so much smaller than the specific heat of water, it can be neglected;
D) heat will flow from the water to the metal until the final temperature of both are the same;
E) since the mass of the calorimeter is not likely to change we can use its heat capacity, rather than its specific heat in this problem.

G12. Calculate the final temperature of the water and metal in the coffee-cup calorimeter.

A) 22.5 ˚C
B) 23.6 ˚C
C) 25.4 ˚C
D) 28.5 ˚C
E) 30.5 ˚C

G13. A 125 grams sample of metal with the specific heat of 0.463 J g^{-1} $˚C^{-1}$ initially at 100.0 ˚C is added to 200.0 grams of water in an OSU calorimeter initially at 25.0 ˚C. The heat capacity of the calorimeter is 40 J $˚C^{-1}$. Calculate the final temperature of the metal and the water in the calorimeter.

A) 62.5 ˚C
B) 53.8 ˚C
C) 41.7 ˚C
D) 29.7 ˚C
E) 26.5 ˚C

G14. A 3.46 g sample of a metal initially at 95.4 ˚C is dropped into a 50.0 gram sample of water initially at 20.7 ˚C in a calorimeter. The temperature of the water and metal in the calorimeter rose to 21.2 ˚C. Assuming the calorimeter absorbs no heat calculate the specific heat of the metal.

A) $0.140 \frac{J}{g{\cdot}^{\circ}C}$

B) $0.230 \frac{J}{g{\cdot}^{\circ}C}$

C) $0.410 \frac{J}{g{\cdot}^{\circ}C}$

D) $0.900 \frac{J}{g{\cdot}^{\circ}C}$

E) $1.23 \frac{J}{g{\cdot}^{\circ}C}$

G15. A 13.4 gram sample of NH_4Cl is added to 100.0 gram of water initially at a temperature of 23.8 ˚C in an OSU calorimeter. The calorimeter has a heat capacity of 40.0 J $^{\circ}C^{-1}$, and the specific heat of the solution is assumed to be the same as the specific heat of water.

a) Write a chemical equation describing what happens when the ammonium chloride is added to water.

b) Using the Table of ΔH°_f, calculate the $\Delta H^{\circ}_{dissolution}$ for ammonium chloride.

c) Calculate the final temperature of the solution.

Q16. 50.0 mL of 1.0 M HNO_3 solution and 50.0 mL of 1.0 M NH_3 solution are placed in a coffee cup calorimeter having a heat capacity of $30.3 \frac{J}{^{\circ}C}$. The density of each solution is $1.00 \frac{g}{mL}$ and the specific heat of the solution is $4.20 \frac{J}{g \cdot {}^{\circ}C}$. The original temperature was 23.7 ˚C and the final temperature was 24.8 ˚C.

a) Determine the heat released in the reaction.

b) How much heat is released per mole of ammonium nitrate formed?

G17. Calculate the heat produced per mole of benzoic acid when 0.235 g of benzoic acid, $C_7H_6O_2$, are reacted with excess oxygen in a bomb calorimeter containing 2.00 kg of water. The temperature change measured is 0.658 °C. The heat capacity of the calorimeter is 1050 $\frac{J}{°C}$.

A. 6.2 kJ mol^{-1}
B. 23.2 kJ mol^{-1}
C. 26.2 kJ mol^{-1}
D. 2858 kJ mol^{-1}
E. 3220 kJ mol^{-1}

G18. Which of the following reactions is endothermic?.

A) $Ba(OH)_2 \cdot 10\ H_2O(s) + 2\ NH_4SCN(s) \rightarrow Ba(SCN)_2(aq) + 2\ NH_3(aq) + 12\ H_2O(l)$
B) $C_2H_5OH(l) \rightarrow C_2H_5OH(g)$
C) $CH_4(l) + 2\ O_2(g) \rightarrow CO_2(g) + 2\ H_2O(l)$
D) $2\ H_2(g) + O_2(g) \rightarrow 2\ H_2O(l)$
E) $C(s) + O_2(g) \rightarrow CO_2(g)$

G19. Which of the following reactions is exothermic?
A) $2K(s) + 2H_2O(l) \rightarrow 2KOH(g) + H_2(g)$
B) $CCl_4(l) \rightarrow CCl_4(g)$
C) $PCl_5(s) \rightarrow PCl_5(l)$
D) $2H_2O(l) \rightarrow O_2(g) + 2H_2(g)$
E) $O_2(g) + N_2(g) \rightarrow 2NO(l)$

G20. Exothermic processes transfer heat from the system to the surroundings. Identify the change that is exothermic?
A. $Br_2(l) \rightarrow Br_2(g)$
B. $2H_2O(g) \rightarrow 2H_2(g) + O_2(g)$
C. $Fe_2O_3(s) + 2Al(s) \rightarrow Al_2O_3(s) + 2Fe(s)$
D. $CO_2(s) \rightarrow CO_2(g)$
E. $Cl_2(g) \rightarrow 2Cl(g)$

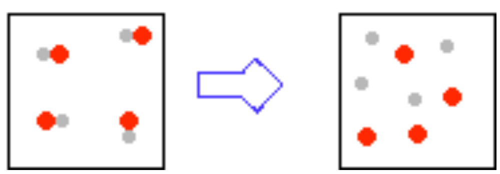
G21. Which of the diagrams below describe an exothermic process?

A. 

B. 

C. 

D. 

E. 

G22. Which of the diagrams below describe an endothermic process?

A.

B.

C.

D.

E.

G23. Which of the following is a formation reaction?

A) $Pb^{2+}(aq) + S^{2-}(aq) \rightarrow PbS(s)$
B) $3CO_2(g) + 4H_2O(l) \rightarrow C_3H_8(g) + 5\ O_2(g)$
C) $2HgO(s) \rightarrow 2Hg(l) + O_2(g)$
D) $Cu^{2+}(aq) + Zn(s) \rightarrow Zn^{2+}(aq) + Cu(s)$
E) $6C(s) + \frac{3}{2}H_2(g) + 3O_2(g) + \frac{3}{2}N_2(g) \rightarrow C_6H_3(NO_2)_3(l)$

G24. Using the following information calculate the ΔH˚ for the decomposition of NOCl to its elements?

Reaction	ΔH˚ (kJ mol^{-1})
$N_2(g) + O_2(g) \rightarrow 2NO(g)$	180.6
$NO(g) + \frac{1}{2}Cl_2(g) \rightarrow NOCl(g)$	-38.6

A) 141.4 kJ mol^{-1}
B) 51.4 kJ mol^{-1}
C) –141 kJ mol^{-1}
D) –51.4 kJ mol^{-1}
E) –219.2 kJ mol^{-1}

G25. Consider the following reactions.

Reactions	ΔH˚ (kJ mol^{-1})
$Cu(s) + \frac{1}{2}O_2(g) \rightarrow CuO(s)$	–155
$O_2(g) + S(s) \rightarrow SO_2(g)$	–297
$Cu_2S(aq) + 2O_2(g) \rightarrow 2CuO(s) + SO_2(g)$	–527.5

Calculate the ΔH°_f for $Cu_2S(s)$. (Assume the elemental form of sulfur has the formula S not S_8 for this problem.)

A. –79.5 kJ mol^{-1}
B. -1134 kJ mol^{-1}
C. +75.5 kJ mol^{-1}
D. -979.5 kJ mol^{-1}
E. +727.5 kJ mol^{-1}

G26. Consider the following reactions.

Reactions	ΔH° (kJ mol^{-1})
$N_2O_4(g) \rightarrow 2NO_2(g)$	+57.2
$N_2O_3(g) \rightarrow NO_2(g) + NO(g)$	+40.2
$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$	–114.5

Calculate the ΔH°_{rxn} when dinitrogen trioxide reacts with oxygen to form 1 mol of dinitrogen tetroxide.

A. +148 kJ mol^{-1}
B. –148 kJ mol^{-1}
C. –131 kJ mol^{-1}
D. +74.2 kJ mol^{-1}
E. –74.2 kJ mol^{-1}

G27. Calculate the ΔH° for the following reaction

$$2N_2(g) + 5O_2(g) \rightarrow 2N_2O_5(g)$$

using Hess' Law and the equations below.

Reaction	ΔH° (kJ mol^{-1})
$N_2(g) + 3O_2(g) + H_2(g) \rightarrow 2HNO_3(l)$	–348
$\frac{1}{2}N_2O_5(g) + \frac{1}{2}H_2O(l) \rightarrow HNO_3(l)$	–70
$O_2(g) + \frac{1}{2}H_2(g) \rightarrow H_2O(l)$	–241

Show Work:

G28. Given the following three reactions, use Hess' Law to calculate the ΔH°_f for $OF_2(g)$.

Reaction	ΔH°_{rxn} (kJ mol^{-1})
$2ClF(g) + O_2(g) \rightarrow Cl_2O(g) + OF_2(g)$	+170
$2ClF_3(g) + 2O_2(g) \rightarrow 3OF_2(g) + Cl_2O(g)$	+390
$ClF(g) + F_2(g) \rightarrow ClF_3(g)$	–140

A. +420 kJ mol^{-1}
B. +210 kJ mol^{-1}
C. –60 kJ mol^{-1}
D. –30 kJ mol^{-1}
E. + 40 kJ mol^{-1}

G29. For the reaction

$$2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(l)$$

ΔH°_{rxn} is –5882 kJ mol^{-1}. How many grams of butane must react (with excess oxygen) to produce 3500 J?

A) 58.0 g
B) 5.882 g
C) 34.5 g
D) 0.5882 g
E) 0.0345 g

G30. Acetylene burns in air according to the following reaction;

$$C_2H_2(g) + \frac{5}{2}O_2(g) \rightarrow 2CO_2(g) + H_2O\ (g)$$

The enthalpy, ΔH°_{rxn} is $-1255\ \frac{kJ}{mol\ rxn}$. Calculate the heat released when 3 mol of O_2 completely reacts with an excess of acetylene.

A. 3765 kJ
B. 1506 kJ
C. 1255 kJ
D. 502 kJ
E. 418 kJ

G31. Using the table of enthalpies of formation, calculate the ΔH˚rxn for the following chemical reaction.

$$CH_4(g) + 4Cl_2(g) \rightarrow CCl_4(l) + 4HCl(g)$$

G32. Using the table of enthalpies of formation, calculate the ΔH˚rxn for the following chemical reaction.

$$2H_2S(g) + 3O_2(g) \rightarrow 2SO_2(g) + 2H_2O(g)$$

G333. The $\Delta H^\circ_{combustion}$ for the combustion of <u>one mole</u> of octane, $C_8H_{18}(l)$ to carbon dioxide and liquid water.
A. +5930 kJ mol^{-1}
B. -5514 kJ mol^{-1}
C. -888 kJ mol^{-1}
D. -11,028 kJ mol^{-1}
E. -472 kJ mol^{-1}

G34. Calculate ΔH°_{rxn} for the following reaction

$$4NH_3(g) + 7O_2(g) \rightarrow 4NO_2(g) + 6H_2O(l)$$

A) –1399 kJ mol^{-1}
B) –207 kJ mol^{-1}
C) +1399 kJ mol^{-1}
D) +207 kJ mol^{-1}
E) -1583 kJ mol^{-1}

G35. Using the table of enthalpies of formation, calculate the ΔH°_{rxn} for the following chemical reaction.

$$3N_2O(g) + 2NH_3(g) \rightarrow 4N_2(g) + 3H_2O(l)$$

A) –1012 kJ mol^{-1}
B) +1012 kJ mol^{-1}
C) –322 kJ mol^{-1}
D) +322 kJ mol^{-1}
E) not sufficient information in the table of enthalpies of formation to answer this question.

G36. $CH_4\,(g) + 2\,O_2(g) \rightarrow CO_2\,(g) + 2\,H_2O\,(l)$ $\Delta H^\circ = -889.1$ kJ mol^{-1}

ΔH_f° $H_2O\,(l)$ = -285.8 kJ mol^{-1}

ΔH_f° $CO_2\,(g)$ = -393.3 kJ mol^{-1}

What is the standard heat of formation of methane, ΔH_f° ($CH_4\,(g)$), as calculated from the data above?
A. -210.0 kJ/mol
B. -107.5 kJ/mol
C. -75.8 kJ/mol
D. 75.8 kJ/mol
E. 210.0 kJ/mol

G37. The heat of combustion of one mole of solid napthalene ($C_{10}H_8$) to liquid water and gaseous carbon dioxide is -5162 kJ. Calculate the standard heat of formation of napthalene.
A) 1.02×10^4 kJ/mol
B) 2051 kJ/mol
C) 259 kJ/mol
D) 84 kJ/mol
E) -168 kJ/mol

G38. When acetylene, $C_2H_2(g)$ reacts with oxygen to produce carbon dioxide and water in the gas phase, 48.3 kJ of heat are released per gram of acetylene. Using information from Table of Standard Enthalpy of Formation, calculate the enthalpy of formation for acetylene;

A. 1028 kJ mol^{-1}
B. 635 kJ mol^{-1}
C. 227 kJ mol^{-1}
D. –1256 kJ mol^{-1}
E. –621 kJ mol^{-1}

G39. The standard enthalpy for the complete combustion for one mol of ethyl alcohol at 25 ˚C, $C_2H_5OH(l)$ is –1367 kJ mol^{-1}. Calculate the standard enthalpy of formation of ethyl alcohol.

A) –687 kJ mol^{-1}
B) –278 kJ mol^{-1}
C) +278 kJ mol^{-1}
D) +687 kJ mol^{-1}
E) +1367 kJ mol^{-1}

G40. The standard enthalpy for the complete combustion for one mol of pentane at 25 ˚C, $C_5H_{12}(l)$ is –3537 kJ mol^{-1}. Calculate the standard enthalpy of formation of pentane.

A) –709 kJ mol^{-1}
B) –149 kJ mol^{-1}
C) +149kJ mol^{-1}
D) +709 kJ mol^{-1}
E) +2857 kJ mol^{-1}

G41. The ΔH˚ for the reaction

$$N_2O_{4(g)} + 2N_2H_{4(g)} \rightarrow 3N_{2(g)} + 4H_2O_{(g)}$$

is –1078 kJ. Estimate the average bond energy for all the nitrogen-oxygen bonds in N_2O_4. (NOTE: the N-N bond in N_2O_4 is a single bond.)

A) 320 kJ
B) 436 kJ
C) 470 kJ
D) 520 kJ
E) 1742 kJ

G42. Order the C -X bond energies in CH_3F, CH_3Cl and CH_3Br from highest bond energy to lowest bond energy.

_______ > ________ > _______

b) Indicate a piece of evidence that supports this trend in the bond energies for this series of carbon-halogen bonds? How does this piece of evidence support the trend in bond energies above. (5)

Substance and State	ΔH°_f (kJ/mol)	Substance and State	ΔH°_f (kJ/mol)
C(*s*) (graphite)	0	$HCl(g)$	-92.3
C(*s*) (diamond)	2	$HBr(g)$	-36.4
$CO(g)$	-110.5	$HI(g)$	26.5
$CO_2(g)$	–393.5	$I_2(g)$	62.25
$CH_4(g)$	–75	$O_2(g)$	0
$CH_3OH(g)$	-201	$O(g)$	249
$CH_3OH(l)$	-239	$O_3(g)$	143
$H_2CO(g)$	-116		
$CCl_4(l)$	-135.4	$N_2(g)$	0
$HCOOH(g)$	-363	$NH_3(g)$	-46
$HCN(g)$	135.1	$NH_3(aq)$	-80
$CS_2(g)$	117.4	$NH_4^+(aq)$	-132
$CS_2(l)$	89.7	$NH_4Cl(s)$	-314.4
$C_2H_2(g)$	227	$N_2H_4(l)$	50.6
$C_2H_4(g)$	52	$NO(g)$	90.25
$CH_3CHO(g)$	-166	$NO_2(g)$	33.18
$C_2H_5OH(l)$	-278	$N_2O(g)$	82.0
$C_2H_5O_2N(g)$	-533	$N_2O_4(g)$	9.16
$C_2H_6(g)$	-84.7	$N_2O_4(l)$	20
$C_3H_6(g)$	20.9	$HNO_3(aq)$	-207.36
$C_3H_8(g)$	-104	$HNO_3(l)$	-174.10
$C_4H_{10}(g)$	-126	$NH_4ClO_4(s)$	-295
$C_8H_{18}(l)$	-208		
$CH_2 = CHCN(l)$	152		
$CH_3COOH(l)$	-484	$S_2Cl_2(g)$	-18
$C_6H_{12}O_6(s)$	-1275	$SO_2(g)$	-296.83
		$H_2S(g)$	-20.6
$Cl_2(g)$	0	$SOCl_2(g)$	-213
$Cl_2(aq)$	-23		
$Cl^-(aq)$	-167.5	$SiCl_4(g)$	-657
		$SiO_2(s)$	-910.94
		$SiF_4(g)$	-1614.9
$H_2(g)$	0		
$H(g)$	217	$TiO_2(s)$	-944.7
$H^+(aq)$	0	$TiCl_4(g)$	-763
$OH^-(aq)$	-230		
$H_2O(l)$	-286		
$H_2O(g)$	-242	$ZnS(s)$	-206

Lattice Energy

15. Which of the following series are correctly ordered in increasing lattice energies?
    A. MgF_2 < NaCl < BaI_2 < $AlCl_3$
    B. $AlCl_3$ < MgF_2 < BaI_2 < NaCl
    C. MgF_2 < $AlCl_3$ < NaCl < BaI_2
    D. MgF_2 < NaCl < $AlCl_3$ < BaI_2
    E. NaCl < BaI_2 < MgF_2 < $AlCl_3$

16. Which of the following series are correctly ordered in increasing lattice energies?
    A. NaCl < LiF < BaI_2 < MgO
    B. LiF < NaCl < BaI_2 < MgO
    C. BaI_2 < LiF < MgO < NaCl
    D. LiF < NaCl < MgO < BaI_2
    E. MgO < LiF < NaCl < BaI_2

c) The energy required to break a sulfur–chlorine bond is 255 kJ mol^{-1}. Will a photon of light with a wavelength of 470 nm break one S–Cl covalent bond? Support your answer with a calculation.

Fall 2007

14. Calculate the heat produced per mol of methane, when 1.600 g of CH_4 reacts with excess oxygen in a bomb calorimeter containing 4.00 kg of water. The temperature change measured is 4.71 ˚ Celsius. The heat capacity of the calorimeter is 2200 J C^{-1}.?
    A) 788 kJ mol^{-1} produced
    B) 892 kJ mol^{-1} produced
    C) 104 kJ mol^{-1} produced
    D) 55.7 kJ mol^{-1} produced
    E) 49.3 kJ mol^{-1} produced

Fall 2008

(16) 7. The initial temperature of 50.0 mL of 0.250 M H_2SO_4 solution and 50.0 mL of 0.500 M NaOH solution is 23.45 ˚C. When the two solutions are mixed in a coffee-cup calorimeter the final temperature is found to be 26.79 ˚C. Assume the calorimeter absorbs no heat, the density of the solutions are same as the density of water, and the specific heat of the solutions are the same as water.

a) Calculate the q (heat) for the neutralization reaction; (10)

b) Write the balanced neutralization reaction that occurs when the solutions are mixed; (3)

c) Calculate the heat released per mol of water formed; (3)

11. Calculate the ΔH°_{soln} for ammonium nitrate.

A coffee-cup calorimeter holds 75.0 g of water initially at 24.0 ˚C. 2.00 g sample of ammonium nitrate are dropped into the sample of water in the calorimeter. The final temperature of the solution is 22.10 ˚C. Assume the specific heat of the solution is the same as the specific heat of water (4.184 J g^{-1} $^\circ C^{-1}$) and the heat capacity of the coffee-cup calorimeter is 15.0 J $^\circ C^{-1}$.

A) 22.5 kJ mol^{-1}
B) 24.6 kJ mol^{-1}
C) 25.1 kJ mol^{-1}
D) 25.6 kJ mol^{-1}
E) 30.5 kJ mol^{-1}

Fall 2009

(21) 6. In an experiment 2.00 g KCl are added to 50.0 g H_2O. The initial temperature of the H_2O in the experiment is 23.85 ˚C. Assume the specific heat of the solution is the same as the specific heat of water.

a) Write a chemical equation describing what happens when KCl(s) is added to H_2O(l). (4)

b) It is found that the temperature of the solution drops. The heat lost by the solution is equal to
435 J. Calculate the final temperature of the solution. (10)

c) Calculate the heat (released/absorbed) per mol of KCl dissolving. (7)