Chapter 8 Practice
Dr. Palmer Graves, Instructor

MULTIPLE CHOICE

## Section 8.4 Expansion Work

1. What is w for the expansion of a gas from 15. L to 35. L against a constant external pressure of 1.5 atm?
$1 \mathrm{~L} \cdot \mathrm{~atm}=101 \mathrm{~J}$
a) - 5.3 kJ
b) - 3.0 kJ
c) 3.0 kJ
d) 5.3 kJ

## Section 8.6 The Thermodynamic Standard State

2. Find $\Delta E^{\circ}$ for the reaction below if the process is caried out at a constant pressure of 1.00 atm and $\Delta V(t h e ~ v o l u m e ~ c h a n g e)=-24.5 L .(1 L \cdot a t m=101) ~(1)$ $2 \mathrm{CO}(\mathrm{g})+\mathrm{O}_{2}(\mathrm{~g}) \rightarrow 2 \mathrm{CO}_{2}(\mathrm{~g}) \quad \Delta \mathrm{H}^{\circ}=-566 . \mathrm{kJ}$
a) +2.47 kJ
b) -2.47 kJ
c) -564 kJ
d) .568 kJ

## Section 8.7 Enthal pies of Physical and Chemical Changes

3. How much heat is absorbed in the reaction of 30 . o g of carbon with excess $\mathrm{SO}_{\mathrm{a}}(\mathrm{g})$ to form CSis(l) and CO(g)? $5 \mathrm{C}(\mathrm{s})+2 \mathrm{SO}_{2}(\mathrm{~g}) \rightarrow \mathrm{CS}_{2}(\mathrm{l})+4 \mathrm{CO}(\mathrm{g}) \quad \Delta H^{\circ}=239.9 \mathrm{~kJ}$
a) 120 kJ
b) 240 kJ
c) 600 kJ
d) 1439 kJ
4. The combustion of 5.00 g of $C_{2} H_{5}(g)$, at constant pressure, releases 259 kJ of heat. Find sH for the reaction:
$2 \mathrm{C}_{2} \mathrm{H}_{5}(\mathrm{~g})+7 \mathrm{O}_{2}(\mathrm{~g}) \rightarrow 4 \mathrm{CO}_{2}(\mathrm{~g})+6 \mathrm{H}_{2} \mathrm{O}(\mathrm{l})$.
a) -518 kJ
b) - 1295 kJ
c) -1560 kJ
d) -3120 kJ

Chapter 8 Practice
Dr. Pal mer Graves, Instructor

## Section 8. 8 Calorimetry and Heat Capacity

5. The specific heat of copper is $0.385 \mathrm{~J} /\left(\mathrm{g}^{\circ}{ }^{\circ} \mathrm{C}\right)$. If 34.2 g of copper, initially at $25^{\circ} \mathrm{C}$ , absorbs 4.689 kJ, what will be the final temperature of the copper?
a) $14.2^{\circ} \mathrm{C}$
b) $25.4^{\circ} \mathrm{C}$
c) $356^{\circ} \mathrm{C}$
d) $381^{\circ} \mathrm{C}$
6. It takes 11.2 kJ of energy to raise the temperature of 145 g of benzene from $25.0^{\circ} \mathrm{C}$
to 70.00C. What is the specific heat of benzene?
a) $1.10 \mathrm{~J} /\left(\mathrm{g} \cdot{ }^{\circ} \mathrm{C}\right)$
b) $1.72 \mathrm{~J} /\left(\mathrm{g} \cdot{ }^{\circ} \mathrm{C}\right)$
c) $3.48 \mathrm{~J} /\left(\mathrm{g} \cdot{ }^{\circ} \mathrm{C}\right)$
d) $9.96 \mathrm{~J} /\left(\mathrm{g} \cdot{ }^{\circ} \mathrm{C}\right)$

## Section 8.9 Hess's Law

7. Coal gasification can be represented by the equation: $2 \mathrm{C}(\mathrm{s})+2 \mathrm{H}_{2} \mathrm{O}(\mathrm{g}) \rightarrow \mathrm{CH}_{4}(\mathrm{~g})+\mathrm{CO}_{2}(\mathrm{~g}) \quad \mathrm{BH}=$ ?
Use the following information to find $\Delta H_{\text {for }}$ fore reaction above.
$\mathrm{CO}(\mathrm{g})+\mathrm{H}_{2}(\mathrm{~g}) \rightarrow \mathrm{C}(\mathrm{s})+\mathrm{H}_{2} \mathrm{O}(\mathrm{g}) \quad \mathrm{AH}=-131 \mathrm{~kJ}$
$\mathrm{CO}(\mathrm{g})+\mathrm{H}_{2} \mathrm{O}(\mathrm{g}) \rightarrow \mathrm{CO}_{2}(\mathrm{~g})+\mathrm{H}_{2}(\mathrm{~g}) \quad \Delta \mathrm{H}=-41 \mathrm{~kJ}$ $\mathrm{CO}(\mathrm{g})+3 \mathrm{H}_{2}(\mathrm{~g}) \rightarrow \mathrm{CH}_{4}(\mathrm{~g})+\mathrm{H}_{2} \mathrm{O}(\mathrm{g}) \quad \Delta \mathrm{H}=-206 \mathrm{~kJ}$
a) 15 kJ
b) 116 kJ
c) -116 kJ
d) .372 kJ
8. Find AH for $\mathrm{BaCO}_{3}(\mathrm{~s}) \rightarrow \mathrm{BaO}(\mathrm{s})+\mathrm{CO}_{2}(\mathrm{~g})$
given $2 \mathrm{Ba}(\mathrm{s})+\mathrm{Og}_{\mathrm{a}}(\mathrm{g}) \rightarrow 2 \mathrm{BaO}(\mathrm{s}) \quad \mathrm{AH}=-1107.0 \mathrm{~kJ}$
$\mathrm{Ba}(\mathrm{s})+\mathrm{CO}_{2}(\mathrm{~g})+1 / 2 \mathrm{O}_{2}(\mathrm{~g}) \rightarrow \mathrm{BaCO}(\mathrm{g}) \quad \mathrm{AH}=-822.5 \mathrm{~kJ}$
a) - 1929.5 kJ
b) - 1376.0 kJ
c) -284.5 kJ
d) 269.0 kJ

Chapter 8 Practice
Dr. Palmer Graves, Instructor

## Section 8. 10 Standard Heats of Formation

9. Use the given standardenthalpies of formation to calculate atoror following reaction
$3 \mathrm{Fe}_{2} \mathrm{O}_{3}(\mathrm{~s})+\mathrm{CO}(\mathrm{g}) \rightarrow 2 \mathrm{Fe}_{3} \mathrm{O}_{4}(\mathrm{~s})+\mathrm{CO}_{2}(\mathrm{~g})$.

| Species | d $\mathrm{H}_{\mathrm{f}} \mathrm{l}, \mathrm{kJ} / \mathrm{mol}$ |
| :---: | :---: |
| $\mathrm{Feg}_{2} \mathrm{O}_{2}(\mathrm{~s})$ | - 824.2 |
| $\mathrm{Fe}_{3} \mathrm{O}_{4}(\mathrm{~s})$ | -1118.4 |
| $\mathrm{CO}(\mathrm{g})$ | -110.5 |
| $\mathrm{CO}_{2}(\mathrm{~g})$ | - 393.5 |

a) -5213.4 kJ
b) -577.2 kJ
c) -47.2 kJ
d) +47.2 kJ
10. Acetylene torches utilize the following reaction: $2 \mathrm{C}_{2} \mathrm{H}_{2}(\mathrm{~g})+5 \mathrm{O}_{2}(\mathrm{~g}) \rightarrow 4 \mathrm{CO}_{2}(\mathrm{~g})+2 \mathrm{H}_{2} \mathrm{O}(\mathrm{g})$

Use the given standardenthal pies of formation to calculate ato for this reaction

| Species | $\Delta H_{f}^{0}, \mathrm{~kJ} / \mathrm{mol}$ |
| :---: | :---: |
| $\mathrm{C}_{2} \mathrm{H}_{2}(\mathrm{~s})$ | +226.7 |
| $\mathrm{CO}_{2}(\mathrm{~g})$ | - 393.5 |
| $\mathrm{H}_{2} \mathrm{O}(\mathrm{g})$ | . 241.6 |

a) 2511 kJ
b) 408.6 kJ
c) -408.6 kJ
d) - 2511 . kJ
11. For the reaction $2 \mathrm{CH}_{4}(\mathrm{~g})+3 \mathrm{Cl} 2(\mathrm{~g}) \rightarrow 2 \mathrm{CHCl}_{3}(1)+3 \mathrm{H}_{2}(\mathrm{~g})$, $\boldsymbol{4} \mathrm{H}^{\circ}=$ -118.6 kJ.
$\Delta H_{f}^{O}=-134.1 \mathrm{~kJ} / \mathrm{mol}$ for $\mathrm{CHCl}_{\boldsymbol{z}}(\mathrm{l})$. Find $\Delta \mathrm{H}_{\mathrm{f}}$ for $\mathrm{CH}_{\mathbf{4}}(\mathrm{g})$.
a) $-193.4 \mathrm{~kJ} / \mathrm{mol}$
b) $-74.8 \mathrm{~kJ} / \mathrm{mol}$
c) $74.8 \mathrm{~kJ} / \mathrm{mol}$
d) $193.4 \mathrm{~kJ} / \mathrm{mol}$

Chapter 8 Practice
Dr. Palmer Graves, Instructor

## Section 8. 11 Bond Dissociation Energies

12. One method for making ethanol, $\mathrm{C}_{\mathbf{2}} \mathrm{H}_{\mathbf{s}} \mathrm{OH}$, involves the gas-phase hydration of ethylene, $\mathrm{C}_{2} \mathrm{H}_{4}$ :




Estimate aH for this reaction from the given average bond dissociation energies, D.

| Bond | D, $k J / \mathrm{mol}$ |
| :--- | :--- |
| $C=C$ | 615 |
| $C-H$ | 410 |
| $C-C$ | 350 |
| $C-0$ | 350 |
| $0-H$ | 460 |

a) -580 kJ
b) -35 kJ
c) +35 kJ
d) 580 kJ

Section 8. 14 An Introduction to Free Energy
13. Methanol can be produced from carbon monoxide and hydrogen with suitable catalysts: $\mathrm{CO}(\mathrm{g})+2 \mathrm{H}_{2}(\mathrm{~g}) \rightarrow \mathrm{CH}_{3} \mathrm{OH}(\mathrm{l})$ at $25^{\circ} \mathrm{C} \Delta \mathrm{H}^{\circ}=-128.1 \mathrm{~kJ}$ and $\mathrm{A}^{\circ}=-332 \mathrm{~J} / \mathrm{K}$.

Find $\Delta G^{\circ}$ at $25^{\circ} \mathrm{C}$.
a) -157.2 kJ
b) - 29.1 kJ
c) 98.9 kJ
d) 157.2 kJ
14. Calculate $\mathrm{A}^{\circ}$ for the reaction below and tell whether it is spontaneous or nonspontaneous under standard conditions at $25^{\circ} \mathrm{C}$.
$2 \mathrm{~S}(\mathrm{~s})+3 \mathrm{O}_{2}(\mathrm{~g})+2 \mathrm{H}_{2} \mathrm{O}(\mathrm{l}) \rightarrow 2 \mathrm{H}_{2} \mathrm{SO}_{4}(\mathrm{l}) \mathrm{AHO}^{\circ}=-1056 \mathrm{~kJ} / \mathrm{mol}$
$\Delta S^{\circ}=-505 \mathrm{~J} / \mathrm{mol}$
a) $\Delta G^{\circ}=-1207 \mathrm{~kJ}$ and the process is spontaneous.
b) $\Delta G^{\circ}=-1207 \mathrm{~kJ}$ and the process is nonspontaneous.
c) $\Delta G^{\circ}=-906 \mathrm{~kJ}$ and the process is spontaneoous.
d) $\Delta G^{\circ}=-906 \mathrm{~kJ}$ and the process is nonspontaneous.

Chapter 8 Practice
Dr. Pal mer Graves, Instructor

1. b)

Chapter: 8 QUESTION: 9
2. C)

Chapter: 8 QUESTION: 22
3. a)

Chapter: 8 QUESTION: 30
4. d)

Chapter: 8 QUESTION: 31
5. d)

Chapter: 8 QUESTION: 35
6. b)

Chapter: 8 QUESTION: 36
7. a)

Chapter: 8 QUESTION: 44
8. d)

Chapter: 8 QUESTION: 45
9. C)

Chapter: 8 QUESTION: 50

Chapter: 8 QUESTION: 52
11. b)

Chapter: 8 QUESTION: 53
12. b)
13. b)
14. C)

Chapter: 8 QUESTION: 54

Chapter: 8 QUESTION: 76

Chapter: 8 QUESTION: 79

