**THERMODYNAMICS**

**CHAPTER 18 (A) WORKSHEET**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_

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| 1. | For the isothermal (constant-temperature) expansion of an ideal gas, |
| A) | *w* > 0 and *q* > 0. |
| B) | *w* < 0 and *q* > 0. |
| C) | *w* > 0 and *q* < 0. |
| D) | *w* = 0 and *q* > 0. |
| E) | *w* < 0 and *q* = 0. |

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| 2. | *H* and *U* are nearly the same in all the following processes except |
| A) | F2(*g*) + H2(*g*)  2HF(*g*). |
| B) | 3O2(*g*)  2O3(*g*). |
| C) | CuO(*s*) + H2(*g*)  Cu(*s*) + H2O(*g*). |
| D) | CH4(*g*) + Cl2(*g*)  CH3Cl(*g*) + HCl(*g*). |
| E) | C6H6(*s*)  C6H6(*l*). |

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| 3. | A gas absorbs 0.0 J of heat and then performs 16.5 J of work. What is the change in internal energy of the gas? |
| A) | –23.5 J |
| B) | 16.1 J |
| C) | 56.5 J |
| D) | –16.5 J |
| E) | none of these |

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| 4. | For a particular process, *q* = 20 kJ and *w* = 15 kJ. Which of the following statements is true? |
| A) | Heat flows from the system to the surroundings. |
| B) | The system does work on the surroundings. |
| C) | *U* = 35 kJ. |
| D) | All of the above are true. |
| E) | None of the above are true. |

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| 5. | The standard enthalpy of vaporization of ether is 26.5 kJ/mol at its normal boiling point, 34.5°C. What is the standard change in entropy for the vaporization of ether at its normal boiling point? |
| A) | –26.5 J/(mol · K) |
| B) | 0.768 J/(mol · K) |
| C) | 768 J/(mol · K) |
| D) | 86.1 J/(mol · K) |
| E) | 0.0861 J/(mol · K) |

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| 6. | The standard enthalpy of fusion of iodobenzene is 9.75 kJ/mol at its melting point, 241.8 K. What is the standard change in entropy for the melting of iodobenzene at its melting point? |
| A) | –9.75 J/(mol · K) |
| B) | –311 J/(mol · K) |
| C) | 0.0403 J/(mol · K) |
| D) | 40.3 J/(mol · K) |
| E) | 0.0189 J/(mol · K) |

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| 7. | For which of the following processes would *S*° be expected to be most positive? |
| A) | O2(*g*) + 2H2(*g*)  2H2O(*g*) |
| B) | H2O(*l*)  H2O(*s*) |
| C) | NH3(*g*) + HCl(*g*)  NH4Cl(*g*) |
| D) | 2NH4NO3(*s*)  2N2(*g*) + O2(*g*) + 4H2O(g) |
| E) | N2O4(*g*)  2NO2(*g*) |

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| 8. | What is *S*° at 298 K for the following reaction?2O3(*g*)  3O2(*g*)

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| Substance | *S*° (J/(mol · K)) at 298 K |
| O2(*g*) | 205.0 |
| O3(*g*) | 238.8 |

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| A) | +137.4 J/K |
| B) | –137.4 J/K |
| C) | +33.8 J/K |
| D) | –33.8 J/K |
| E) | +443.8 J/K |

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| 9. | What is the change in entropy when 7.67 mL of liquid benzene (C6H6, *d* = 0.879 g/mL) is combusted in the presence of 12.7 L of oxygen gas, measured at 298 K and 1 atm pressure? (*R* = 0.0821 L · atm/(K · mol))2C6H6(*l*) + 15O2(*g*) → 12CO2(*g*) + 6H2O(*l*); ∆*S*° = –437.7 J/K at 298 K |
| A) | –265 J/K |
| B) | –227 J/K |
| C) | –37.8 J/K |
| D) | –34.0 J/K |
| E) | –15.1 J/K |

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| 10. | Consider the following hypothetical reaction at 310 K. Standard free energies of formation are given in parentheses. B C *G°* = –28.3 kJ/mol (?) (176.4 kJ/mol)Calculate the standard free energy of formation of compound B. |
| A) | 204.7 kJ/mol |
| B) | –204.7 kJ/mol |
| C) | 148.1 kJ/mol |
| D) | –148.1 kJ/mol |
| E) | none of these |

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| 11. | Consider the following hypothetical reaction (at 310.0 K). Standard free energies, in kJ/mol, are given in parentheses. A B + C *G°* = ? (–32.2) (207.8) (–237.0)What is the value of the equilibrium constant for the reaction at 310.0 K? |
| A) | 0.31 |
| B) | 1.0 |
| C) | 8.3 × 104 |
| D) | 273 |
| E) | 0.42 |

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| 12. | What is *G*° at 500.0 K for the following reaction?Ba(*s*) + H2O(*g*)  BaO(*s*) + H2(*g*)

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| Substance | *H*°*f* (kJ/mol) at 298 K | *S*° (J/(mol · K)) at 298 K |
| Ba(*s*) | 0 | 62.8 |
| H2O(*g*) | –241.8 | 188.7 |
| BaO(*s*) | –592.0 | 70.4 |
| H2(*g*) | 0 | 130.6 |

 |
| A) | –324.9 kJ |
| B) | –335.2 kJ |
| C) | 324.9 kJ |
| D) | 335.2 kJ |
| E) | –375.4 kJ |

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| 13. | The reaction CaO(*s*) + SO3(*g*)  CaSO4(*s*) is nonspontaneous at 2200 K, whereas it is spontaneous at room temperature. Which of the following statements is false? |
| A) | *G* is negative at room temperature. |
| B) | Both *H* and *S* are negative for the reaction. |
| C) | *G* becomes zero at a temperature between 300 and 2200 K. |
| D) | The change in enthalpy is the main driving force of the reaction. |
| E) | The change in entropy is the main driving force of the reaction. |

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| 14. | The reaction C(*s*) + CO2(*g*)  2CO(*g*) is spontaneous only at temperatures in excess of 1100 K. We can conclude that |
| A) | *H*° is positive and *S*° is negative. |
| B) | *H*° is negative and *S*° is negative. |
| C) | *H*° is positive and *S*° is positive. |
| D) | *H*° is negative and *S*° is positive. |
| E) | *G*° is negative for all temperatures. |

**Answer Key**

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| 1. | B |
| 2. | B |
| 3. | D |
| 4. | C |
| 5. | D |
| 6. | D |
| 7. | D |
| 8. | A |
| 9. | E |
| 10. | A |
| 11. | A |
| 12. | A |
| 13. | E |
| 14. | C |