Exam 4 Solutions

Multiple Choice Key

1. a
2. b
3. d
4. b
5. d
6. a
7. b
8. e
9. d
10. a

Worked Problems

1. Heat will flow until everything in the system is at the same temperature. First check whether water can melt all ice before reaching $0^\circ\ C$. Heat necessary to melt all ice is

$$Q = mL_f = (0.075\ kg)(3.35 \times 10^5\ J/kg) = 25125\ J$$

heat released in cooling water from $14^\circ\ C$ to $0^\circ\ C$

$$Q = mc\Delta T = (0.33\ kg)(4186\ J/(kg^\circ C)(14^\circ) = 19339\ J.$$

Therefore, not all ice will melt, and system will equilibrate at $0^\circ\ C$ with $19339\ J/(3.35 \times 10^5\ J/kg) = 0.058\ kg$ of ice melted, or $0.075\ kg - 0.058\ kg = 0.017\ kg$ of ice left.

2. Starting with the first law of thermodynamics, $\Delta U = Q - W$, and the fact that the expansion happens at constant pressure, so $W = p\Delta V$, the heat will be

$$Q = \Delta U + p\Delta V.$$

Putting in values gives $Q = +93817\ J$. Since the heat is positive, it has entered the system.