Part I. Multiple choice

1. D
2. D
3. B
4. C
5. C

Part II. Problems

1. worth 10 pts
   Either use Hess’s law in the form of
   \[ \Delta H_{rxn} = \sum_{\text{products}} (\text{stoich coeff}) \Delta H_f^o - \sum_{\text{reactants}} (\text{stoich coeff}) \Delta H_f^o \]
   \[ \Delta H_{rxn} = \left[ \Delta H_f^o (\text{O}_3 \text{(g)}) + 3\Delta H_f^o (\text{H}_2 \text{(g)}) \right] - \left[ 3\Delta H_f^o (\text{H}_2\text{O} \text{(l)}) \right] \]
   \[ = \left[ \frac{+271 \text{ kJ}}{2} \right] + 3(0) - [3(-286 \text{ kJ})] \]
   \[ = 994 \text{ kJ} \]
   or arrange the reactions so that they sum to the overall rxn
   \((-3) \times \{ \text{H}_2 \text{(g)} + \frac{1}{2} \text{O}_2 \text{(g)} \rightarrow \text{H}_2\text{O} \text{(l)} \} \Delta H'' = (-3) \times (-286 \text{ kJ})\]
   \((\frac{1}{2}) \times \{ 3 \text{O}_2 \text{(g)} \rightarrow 2 \text{O}_3 \text{(g)} \} \Delta H'' = (\frac{1}{2}) \times (+271 \text{ kJ}) \]
   sums to:
   \[ 3 \text{H}_2 \text{(g)} + \text{O}_3 \text{(g)} \rightarrow 3 \text{H}_2\text{O} \text{(l)} \text{ with sum of } \Delta H'' = +994 \text{ kJ} \]

2. worth 20 pts, each part worth 5 pts
   a) \( \text{AgNO}_3 \) available = (0.1300 L)(0.110 M) = 0.0143 mol
   \( \text{CaCl}_2 \) available = (0.0900 L)(0.095 M) = 0.0086 mol
   need 2:1 mole ratio, so \( \text{AgNO}_3 \) is limiting
   moles of \( \text{AgCl} \) that form:
   \[ = 0.0143 \text{ mol AgNO}_3 \times \frac{2 \text{ mol AgCl}}{2 \text{ mol AgNO}_3} = 0.0143 \text{ mol AgCl} \]
   b) temperature change \( \Delta T = 27.00 - 25.00 = 2.00 \text{ °C} \)
   mass of solution = 220.0 mL \times 1.000 g/mL = 220.0 g
   heat,
   \[ q = mc\Delta T = (220.0 g) \left( 4.184 \frac{\text{J}}{\text{g} \cdot \text{°C}} \right) \left( 2.00 \text{ °C} \right) = 1841J = 1.84kJ \]
   c) reaction shown is exothermic because water temperature increased (indicating that reaction system gave off heat energy)
   d) \( \frac{\Delta H_{rxn}}{\text{mol AgCl}} = \frac{1.84 \text{ kJ}}{0.0143 \text{ mol AgCl}} = 129 \text{ kJ/mol} \)
   so \( \Delta H_{rxn} = -129 \text{ kJ/mol} \)