31. (b).

32. (a) **Increases** since heat is added.  
   (b) **Decreases** since heat is removed.  
   (c) **Increases** since heat is added.  
   (d) **Decreases** since heat is removed.

33. There would be **energy created** if the change in entropy had been negative.

34. From the second law of thermodynamics, the entropy **increases**. The cold water gains more entropy than that lost by the hot water.

35. **No**, this is not a valid challenge, because **ice or water itself is not an isolated system**. When water freezes into ice, it gives off heat and that causes the entropy of the surroundings to increase. This increase actually is more than the decrease that occurred in the water-ice phase change. So the net change in entropy still increases.

36. The entropy **increases as heat is required to be added for the expansion**. For isothermal, \( T = \text{constant} \) so \( \Delta U = 0 \). In an expansion, the work done by the gas is positive, so \( Q = \Delta U + W = W \).

37. \[
\Delta S = \frac{Q}{T} = \frac{m_l s}{T} = \frac{(1.0 \text{ kg})(3.3 \times 10^5 \text{ J/kg})}{273 \text{ K}} = 1.2 \times 10^3 \text{ J/K}.
\]

38. (a) The change in entropy of the process is **negative** because heat is removed in the process (negative heat).
   (b) \[
\Delta S = \frac{Q}{T} = \frac{-m_l s}{T} = \frac{-(0.50 \text{ kg})(22.6 \times 10^4 \text{ J/kg})}{373 \text{ K}} = -3.0 \times 10^3 \text{ J/K}.
\]

39. \[
\Delta S = \frac{Q}{T} = \frac{-m_l s}{T} = \frac{-(0.50 \text{ kg})(2.7 \times 10^4 \text{ J/kg})}{630 \text{ K}} = -2.1 \times 10^3 \text{ J/K}.
\]

40. \[
\Delta S = \frac{Q}{T} = \frac{m_l s}{T} = \frac{(0.75 \text{ kg})(3.3 \times 10^4 \text{ J/kg})}{273 \text{ K}} = 9.1 \times 10^3 \text{ J/K}.
\]
\[
\Delta S = \frac{(0.25 \text{ kg})(22.6 \times 10^4 \text{ J/kg})}{373 \text{ K}} = 1.5 \times 10^3 \text{ J/K}.
\]

So **steam** has the greater change in entropy because steam has the most disorder and ice has the most order.