

Physics 161: Thermodynamics

Practice Questions

1) An ideal gas expands isothermally against a constant pressure, from 100 atm to 1 atm. Which of the following is true?

- (a) $\Delta S_{\text{universe}} > 0$
- (b) $\Delta S_{\text{surroundings}} < 0$
- (c) $\Delta S > 0$
- (d) $\Delta U = 0$
- (e) $Q = W$

2) An ideal gas expands adiabatically against a constant pressure, from 100 atm to 1 atm. Which of the following is true?

- (a) $\Delta S_{\text{universe}} > 0$
- (b) $\Delta S_{\text{surroundings}} = 0$
- (c) $\Delta S > 0$
- (d) $\Delta U < 0$
- (e) $Q = 0$

3) An ideal gas expands adiabatically and reversibly from 100 atm to 1 atm. Which of the following is true?

- (a) $\Delta S_{\text{universe}} = 0$
- (b) $\Delta S_{\text{surroundings}} = 0$
- (c) $\Delta S = 0$
- (d) $\Delta U < 0$
- (e) $W > 0$

4) An ideal gas isothermally and reversibly, from 100 atm to 1 atm. Which of the following is true?

- (a) $\Delta S_{\text{universe}} = 0$
- (b) $\Delta S_{\text{surroundings}} < 0$
- (c) $\Delta S > 0$
- (d) $\Delta U = 0$
- (e) $W > 0$

5) A cup of water is in equilibrium with the surroundings at $T = 298$ K and $P = 1$ atm. The water spontaneously warms up to $T = 398$ K and $P = 1$ atm. Take C_P and C_V to be independent of temperature. Which of the following is true?

- (a) $\Delta S_{\text{universe}} < 0$
- (b) $\Delta S_{\text{surroundings}} < 0$
- (c) $\Delta S > 0$
- (d) $\Delta U = C_V \times (398\text{K} - 298\text{K})$
- (e) $\Delta H = C_P \times (398\text{K} - 298\text{K})$

6) Two glass bulbs each having a volume of 1 liter are connected by a stopcock. Initially there is a mole of He gas in one bulb, and a mole of N₂ gas in the other bulb. When the stopcock is opened, the gases mix. In equilibrium there is 1/2 a mole of each type of gas in each bulb.

- (a) $\Delta S_{\text{universe}} > 0$
- (b) $\Delta S_{\text{surroundings}} = 0$
- (c) $\Delta S > 0$

7) Two glass bulbs each having a volume are connected by a stopcock. Initially bulb A is filled with n moles of Helium, and bulb B is empty. When the stopcock is opened, the He distributes uniformly throughout the system. If bulb B is 3 times larger than bulb A, what is the change in entropy? Assume ideal gas behavior.

- (a) $\Delta S = 0$
- (b) $\Delta S = nR \ln 2$
- (c) $\Delta S = nR \ln 3$
- (d) $\Delta S = nR \ln (4/3)$
- (e) $\Delta S = nR \ln (3/4)$
- (f) $\Delta S = nR \ln 4$

8) If C_V for an ideal gas is $(5/2)nR$, what is C_P ?

- (a) $7/2 nR$
- (b) $3/2 nR$
- (c) $5/2 nR$

9) For a process which takes place spontaneously at constant pressure, the following must be true:

- (a) $\Delta H = Q$
- (b) $\Delta U = Q$
- (c) $Q = W$
- (d) $\Delta U = 0$
- (e) $\Delta G < 0$
- (f) $\Delta(PV) > 0$
- (g) $\Delta G = -T\Delta S_{\text{universe}}$

10) For a process which takes place spontaneously at constant pressure and constant temperature, which of the following must be true?

- (a) $\Delta G < 0$
- (b) $\Delta G = -T\Delta S$
- (c) $\Delta G = -T\Delta S_{\text{universe}}$
- (d) $\Delta G > 0$

11) For a spontaneous process taking place at constant pressure and constant temperature, the Gibbs free energy must always decrease.

- (a) True
- (b) False

12) For a spontaneous process, the entropy must always

- (a) Increase
- (b) Decrease
- (c) Increase or Decrease or remain the same.

13) For a spontaneous process, the entropy of the system plus the entropy of the surroundings must always

- (a) Increase
- (b) Decrease
- (c) Increase or Decrease or remain the same.

14) A spontaneous process takes place in a system which is in contact with the surroundings at $T = 300K$. If $Q = 6$ kJ, what is $\Delta S_{\text{surroundings}}$?

- (a) Can not be determined unless the process is reversible.
- (b) $2 \frac{J}{K}$
- (c) $-2 \frac{J}{K}$

15) A spontaneous process takes place in a system which is in contact with the surroundings at $T = 300K$. If $Q = 6$ kJ, what can be said about ΔS ?

- (a) $\Delta S > 0$.
- (b) $\Delta S < 0$.