

## Chapter 18 Thermodynamics ; 11<sup>th</sup> edition

### Pg. 329 Review questions

6. State the lowest possible temperature in Celsius and in Kelvins.

**Ans.** The lowest possible temperature on the Celsius scale is  $-273.15\text{ }^{\circ}\text{C}$ , which we will round off to  $-273\text{ }^{\circ}\text{C}$ .

The lowest possible temperature in kelvins is 0 kelvins. Nothing can be colder than this. This is the temperature where the average kinetic energy of the molecules and atoms of the substance is zero.

9. How does the law of conservation of energy relate to the first law of thermodynamics?

**Ans.** The first law is a conservation of energy statement. If energy flows out of a system its energy goes down. If energy flows into a system its energy goes up. If a system does work, its energy goes down. If work is done to a system, it gains energy.

10. What is the relationship between heat added to a system, change in its internal energy, and external work done by the system?

**Ans.** The first law of thermodynamics states that:

$$\Delta U = \pm Q \pm W$$

where

U is the internal energy of the system

Q is the heat that may flow into or out of the system

W is the work done to or by the system

If heat is added to a system then its internal energy will increase.

If work is done by the system then its internal energy must decrease.

There is no free lunch!

11. What happens to the internal energy of a system when mechanical work is done on it? What happens to its temperature?

**Ans.** Its internal energy increases and its temperature increases.

12. What condition is necessary for a process to be adiabatic?

**Ans.** A process is adiabatic when a gas is compressed or expanded and there is no heat exchange with the environment. There will however be a temperature change.

13. What happens to the internal energy of a system when work is done to a system? Work done by a system?

The first law of thermodynamics states that:

$$\Delta U = \pm Q \pm W$$

where

U is the internal energy of the system

Q is the heat that may flow into or out of the system

W is the work done to or by the system

**Ans.** This question illustrates the reason for the + and - symbols in front of the W  
Its internal energy must increase.

When work is done by a system its internal energy must decrease.

## Thermodynamics Chapter 18; 11<sup>th</sup> edition

### Pg. 329 Review questions continued

16. What generally happens to the temperature of rising and sinking air? Explain.

**Ans.** This is an example of adiabatic cooling and warming and follows the rules in the first law of thermodynamics. Rising air is surrounded by air of lower pressure and it therefore expands. Because it expands, it does work. Since it does work it must lose energy. Therefore its temperature decreases. When air sinks, it is surrounded by air of higher pressure. The surrounding air compresses it, doing work to the sinking air. Since work is done to it, the sinking air gains energy and its temperature increases.

19. How does the second law of thermodynamics relate to the direction of heat flow?

**Ans.** The second law of thermodynamics states that left to itself, a system's entropy will increase. A consequence of this is that net heat flow is from higher temperature objects to lower temperature objects. This happens because of the transfer of kinetic energy during the random collisions of atoms and molecules.

27. What is the physicist's term for measure of amount of disorder?

**Ans.** Entropy

## Chapter 18; 11<sup>th</sup> edition

### Exercises pg. 329-330

7. When air is quickly compressed, why does its temperature increase?

**Ans.** First law again folks. When the air is compressed work is done to it. Therefore its internal energy will increase. Since it is compressed quickly, very little heat can leave the system, so its temperature increases.

8. Suppose you do 100 joules of work in compressing a gas. If 80 joules of heat escape in the process, what is the change in internal energy of the gas?

**Ans.**  $100\text{j} - 80\text{j} = 20 \text{ joules}$

37. According to the second law of thermodynamics, is the universe moving to a more ordered or to a more disordered state?

**Ans.** The universe is moving toward a more disordered state.