Heat and Thermo 6

1. In any natural process:
   A. The energy of the universe: increases; decreases; stays the same.
   B. The entropy of the universe: increases; decreases; stays the same.

2. Which has more positional entropy: a solid or a liquid?

3. A. When does a ball have more entropy: as it is falling thru the air or after it has hit the ground?
   B. Explain.

4. Which has more entropy?
   A. A liquid or a gas?
   B. An object with kinetic energy or after the kinetic energy turns to heat?
   C. Billiard (pool) balls when they are racked or after they are broken apart (scattered around the table)?

5. An egg is bumped off of a table and breaks when it hits the ground.
   A. What kind of energy does it gain as it drops?
   B. Does the egg have more entropy before or after it hits the ground?
   C. If the egg were to move up and put back together, would that contradict the Law of Conservation of Energy (and the 1st Law of Thermodynamics)?
   D. * What Law would be violated by the egg moving back up to the table?

C. No: KE still = PE

D. 2nd Law of Thermo (Entropy)

6. Imagine a closed system.
   A. If it is closed, can there be any outside work?
   B. If something is happening in the system the entropy: increases; decreases; stays the same.
   C. If nothing is happening in the system the entropy: increases; decreases; stays the same.
   D. Is there anything external to the universe?
   E. Is it possible for there to be external work for the universe?
   F. Is anything happening in the universe?

   This is why the total entropy of the universe must always increase.

6B. Increases
6C: stays same.

From "Thermodynamic Processes". Study Helps available.

7. Isothermal (T); Isovolumetric (V); Adiabatic (A)?
   A. ____ * A tire being rapidly inflated.
   B. ____ * A tire expanding gradually as it is heated.
   C. ____ A tire being heated with it is in a rigid metal container.
   D. ____ In a refrigerator when the compressor <u>compresses</u> the refrigerant <u>quickly</u>.
   E. ____ In a refrigerator when the refrigerant (which is in a <u>metal tube</u>) absorbs heat from the inside of the refrigerator.
   F. ____ In a refrigerator when the refrigerant <u>expands quickly</u>.
   G. ____ Q =W.
   H. ____ $\Delta U = 0$.
   I. ____ $\Delta U = Q$.

A: Adiabatic (rapidly)
B: both W and Q, so Isothermal

8. Positive, Negative, or Zero?
   A. ____ * ΔU during an isovolumetric process if heat is removed.
   B. ____ * Q in an isovolumetric process if ΔU is negative.
   C. ____ ΔU during an isothermal process.
   D. ____ Q in an adiabatic process if the gas expands.
   E. ____ ΔU if Q =W.
   F. ____ ΔU when positive work is done on the gas (Q = 0).
   G. ____ ΔU when negative work is done by the gas (Q = 0).
   H. ____ ΔU during an adiabatic expansion.
   I. ____ Work done by the gas when Q = 0, but temperature decreases.
   J. ____ Work done by the gas when the volume of the gas increases.
   K. ____ * Q in an isothermal process if the gas compresses.
   L. ____ ΔU if Q = 0 and the gas is compressed.
   M. ____ Work done by the gas during an isovolumetric process.

A. – (Isovol, so W = 0)
B. W = 0, so if ΔU is – , then Q must be –

K. $\Delta T = 0$, so $\Delta U = 0$. T wants to go ↑ (compressed), so Q must be –.

9. 75 joules of work is done to compress a gas, while 20 joules of heat is removed as heat.
   A. Since the gas is compressed, is the W done on the gas + or −?
   B. Since heat is removed, is Q + or −?
   C. * Use the First Law of Thermodynamics to find the change of internal energy of the gas.

10. 35 joules of work is done by a gas as it expands, yet the gas doesn't change temperature.
   A. Since the gas is expanded, is W + or −?
   B. Since the gas doesn't change temperature, what is the ΔU (change of internal energy) for the gas?
   C. How much heat (Q) was added?

9C) +55 joules