

# Physical Chemistry Cumulative Exam

Dec 5th, 2019

Dr. Nan Jiang

- (5 points) According to Kelvin-Planck statement, it is \_\_\_\_ for a heat engine to produce net work in a complete cycle if it exchanges heat only with bodies at \_\_\_\_
  - impossible, single fixed temperature
  - possible, changing temperature
  - impossible, changing temperature
  - possible, single fixed temperature
- (5 points) According to Clausius statement
  - it is impossible to construct a device than can transfer heat from a cooler body to a hotter body without any effect
  - it is impossible to construct a device than can transfer heat from a hotter body to a cooler body without any effect
  - it is possible to construct a device than can transfer heat from a cooler body to a hotter body without any effect
  - none of the mentioned
- (5 points) What does a refrigerant do?
  - absorbs the heat leakage into body from surroundings
  - evaporates in the evaporator
  - absorbs latent heat of vaporization form the body which is cooled
  - all of the mentioned
- (5 points) Processes inside a thermal energy reservoir are quasi-static. Ture or false? Why?
- (10 points) There is a house hold heater that operates at 4 V and at 35  $\Omega$  and is used to heat up 15 g of copper wire. The specific heat capacity of copper is 24.440 J/(mol K). How much time is required to increase the temperature from 25°C to 69°C?
- (20 points) A mixture of 1.78 kg of water and 262 g of ice at 0°C is, in a reversible process, brought to a final equilibrium state where the water / ice ratio, by mass 1:1 at 0°C. (a) Calculate the entropy change of the system during this process. (b) The system is then returned to the first equilibrium state, but in an irreversible way (by using a Bunsen burner, for instance). Calculate the entropy change of the system during this process.
- (10 points). When can a fluid be considered incompressible? Give an everyday example of such a fluid.

8. (20 points) Sketch the (tungsten) W(100) surface (as viewed from along the surface normal). (b) On your sketch of the surface, label the [010], [011], [021] and [043] directions.

9. (10 points). How can you tell the difference between dynamic and static quenching?

10. (10 points) Of the five rotational-vibrational transitions shown here, which two are valid and why?

