03 Thermal physics review questions

Part A: Thermal Concepts:

1. In the phrase "two object in thermal equilibrium….." what does this mean and what does it tell you about the two objects?
2. The Celsius scale is defined as being a centigrade (100 intervals) between the ice point of water and the steam point of water. How is the Kelvin scale defined?
3. The symbol U is used to denote internal energy of an object. This energy is contained within the individual particles of the object in which forms?
4. Choose between the words "thermal, internal, kinetic, potential" to fill in these three gaps. "When ____1____ energy is transferred to a pot of ice and water the ice melts so the ____2____ energy of the water particles increases. When ____1____ energy is transferred a the pot of cold water the particles move quicker so the ____3____ energy of the water particles increases. In both of these situations the _____4_____ energy of the water increases.
5. Water has a molar mass of $18 gmol^{-1}$. How many water molecules are there in $1cm^3$ of water (Water density = $1000 kgm^{-3}$)?

Part B Thermal Properties of matter (Heat capacities etc..)

Data: Specific heat capacity, ice = 2.11 $kJkg^{-1}K^{-1}$
Specific heat capacity, water = 4.19 $kJkg^{-1}K^{-1}$
Latent heat of melting of ice = 334 $kJkg^{-1}$
Latent heat of evaporation of water (at atmospheric pressure) = 2.27 $MJkg^{-1}$

[Ignore heat exchanges with containers or the surroundings in these questions]

1. Explain the term phase change and state the four phases of matter.
2. Give two differences between evaporation and boiling.
3. Explain in terms of bonds why the latent heat of evaporation of water is much greater than the latent heat of melting of ice. (HL students can give another reason)
4. How much heat is required to warm 1.0 kg ice initially at -10 ºC to ice at 0 ºC? How much heat is required to melt the ice at 0 ºC? How much heat is required to further increase the temperature of the water from 0 ºC to 10 ºC? In which stage (warming the ice, melting the ice, warming the water) is the heat required the largest?
5. Radiation from the sun falls on the frozen surface of a pond at a rate of 600 Wm^{-2}. If the ice temperature is 0 ºC, find how long it will take to melt a 1.0 cm thick layer of ice. (Take the density of ice to be 900 kgm^{-3}.)
6. The surface of a pond of area 20 m^2 is covered by ice of uniform thickness 6 cm. The temperature of the ice is -5 ºC. How much heat is required to melt this amount of ice into water at 0 ºC? (Take the density of ice to be 900 kg m^{-3}.)
7. Crushed ice at 0 ºC is added to one litre of water at 20 ºC. While mixing the ice melts and the mixtures final temperature is 10 ºC. How much ice was added?
8. A 200g piece of metal at 100ºC is added to a container which has 150 g water at 15ºC. The final temperature inside the container is 35 ºC. What is the specific heat capacity of the metal?

Part B Thermal Properties of matter (Kinetic model of an ideal gas)

1. Define pressure and explain how a gas exerts a seemingly constant pressure on a surface.
2. The ideal gas model makes three assumptions about the behaviour of the particles.
    a. What are they?
    b. Two of these assumptions are false, which ones?
    c. Despite these false assumptions explain why, at temperatures well above boiling point and relatively low pressures, the ideal gas model can be used to approximate the behaviour of real gases. Why is this?
    d. Explain why reducing the volume of a gas increases the pressure.
    e. Explain why reducing the temperature of a gas decreases the pressure.