Homework #4

Problems 5-6, 5-20, 5-21, 6-3, 6-5, 6-23, 6-28 from the book and

#1 The figure below shows a thermally insulated chamber, containing an ideal gas. Within the chamber is a paddle wheel, connected externally to a weight which can be lowered to operate the paddle wheel. Prove thermodynamically that the process of turning the paddle wheel by lowering the weight is irreversible.

![Diagram of thermally insulated chamber with a paddle wheel and a weight](image)

#2 The heat of fusion of ice at 0°C is $3.33 \times 10^5 \frac{J}{kg}$. A metric ton (1000 kg) of ice is to be made by a refrigerator in a room at 25°C. If the cost of electricity is 12 cents per kilowatt-hour, what is the minimum cost of electricity necessary to make this ice? Assume that ice is made from water that originally was at room temperature and specific heat of water can be taken as $4186 \frac{J}{kgK}$ and considered as a constant independent of temperature.

#3 a) One kilogram of water at 273K is brought in contact with a heat reservoir at 373K. When the temperature of water has reached 373K, what is the entropy change of water, of the heat reservoir, of the universe?

b) If instead this water was heated from 273K to 373K by first brining it in contact with the reservoir at 323K and then with the reservoir at 373K, what the entropy change of the universe in this case will be?