

### PROBLEM 1 – 10 points

Heat is added to a sample of water at a constant rate over a two-minute period.

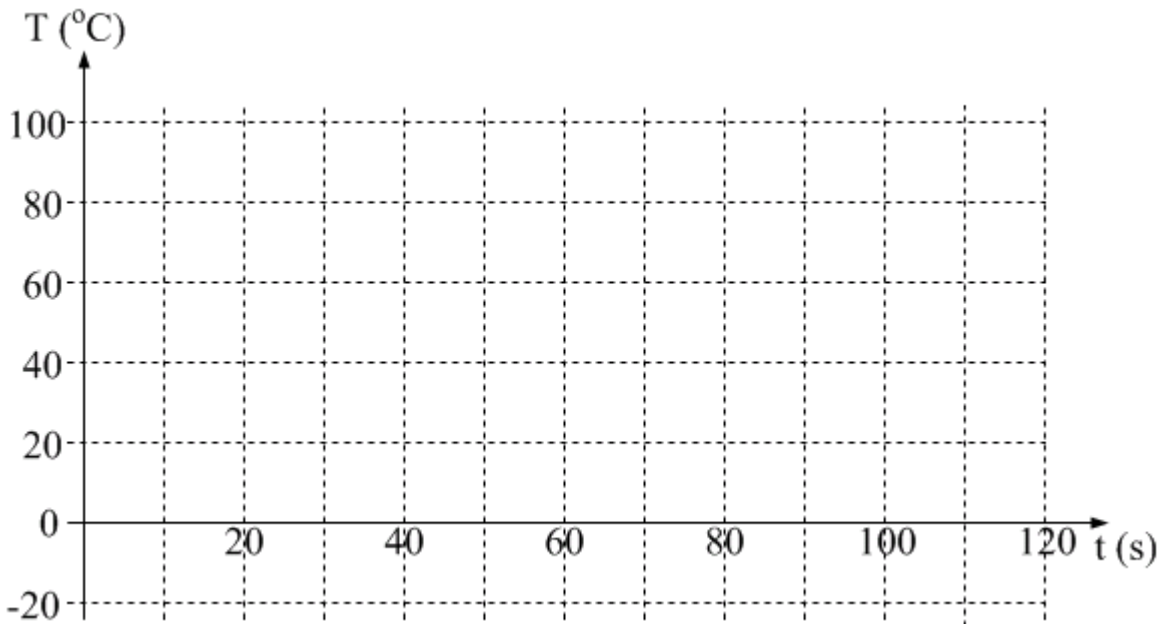
[7 points] (a) Using the axes provided below, draw a graph that represents the plot of the temperature of the sample vs. time over this two-minute period.

The sample, which is initially solid, starts at  $-20^{\circ}\text{C}$  and it takes 10 seconds to reach  $0^{\circ}\text{C}$ .

You may find the following data helpful when drawing the graph:

Specific heats for water:  $c_{\text{liquid}} = 1.0 \text{ cal/g }^{\circ}\text{C}$  and  $c_{\text{ice}} = c_{\text{steam}} = 0.5 \text{ cal/g }^{\circ}\text{C}$

Latent heats for water: heat of fusion  $L_f = 80 \text{ cal/g}$  and heat of vaporization  $L_v = 540 \text{ cal/g}$



[3 points] (b) If heat is being added to the sample at a constant rate of  $90 \text{ cal/s}$ , what is the mass of the sample?

**PROBLEM 2 – 8 points**

In preparing a cold drink with a final temperature of  $0^{\circ}\text{C}$ , Mary mixes 50 g of ice at  $-10^{\circ}\text{C}$  with some juice at  $+10^{\circ}\text{C}$ . Suppose the specific heat of the juice is  $4000 \text{ J}/(\text{kg } ^{\circ}\text{C})$ , the specific heat of ice is  $2000 \text{ J}/(\text{kg } ^{\circ}\text{C})$  and the latent heats of fusion of water and the juice are the same, equal to  $3 \times 10^5 \text{ J/kg}$ . Answer the following questions based on the information provided. You may assume that the cup Mary uses in making the drink insulates well so there is no heat loss during the mixing, i.e.,  $\Sigma Q = 0$ .

[4 points] (a) What mass of juice should Mary add to the ice so that no ice is transformed into liquid water and no liquid juice is transformed into solid juice?

[4 points] (c) What mass of juice should Mary add to the ice so that all the ice is just melted?