Dept. of Education and Science – Physics Higher Level, 2002.

Question 2.

In an experiment to measure the specific latent heat of fusion of ice, warm water was placed in an aluminium calorimeter. Crushed dried ice was added to the water. The following results were obtained.

Mass of calorimeter ..... = 77.2 g
Mass of water ..... = 92.5 g
Initial temperature of water ..... = 29.4 ^{0}C
Temperature of ice ..... = 0 ^{0}C
Mass of ice ..... = 19.2 g
Final temperature of water ..... = 13.2 ^{0}C

Room temperature was 21 ^{0}C. What was the advantage of having the room temperature approximately halfway between the initial temperature of the water and the final temperature of the water?
Describe how the mass of the ice was found.
Calculate a value for the specific latent heat of fusion of ice. The specific heat capacity of aluminium is 790 J kg^{-1} K^{-1} and the specific heat capacity of water is 4180 J kg^{-1} K^{-1}
The accepted value for the specific latent heat of fusion of ice is 3.3 x 10^5 J kg^{-1}, suggest two reasons why your answer is not this value.

What was the advantage of having the room temperature approximately halfway between the initial temperature of the water and the final temperature of the water?

So that the heat lost by the calorimeter and its contents to the surroundings, when their temperature is above room temperature, is cancelled out by the heat gained by the calorimeter and its contents when their temperature is below room temperature.

Describe how the mass of the ice was found.

By subtracting the mass of the calorimeter with the added warm water from the final mass of the calorimeter and its contents of original warm water + water from melted ice.

Calculate a value for the specific latent heat of fusion of ice. The specific heat capacity of aluminium is 790 J kg^{-1} K^{-1} and the specific heat capacity of water is 4180 J kg^{-1} K^{-1}.

		Heat Gained	=	Heat Lost		
Heat gained by ice melting	+	Heat gained by resulting water rising to final temperature	=	Heat lost by calorimeter cooling to final temperature	+	Heat lost by warm water cooling to final temperature
$(ml)_{ice}$	+	$(mc\Delta\theta)_{ice}$	=	$(mc\Delta\theta)_{Al}$	+	$(mc\Delta\theta)_{water}$
0.0192 x l	+	0.0192 x 4180 x 13.2	=	0.0772 x 790 x 16.2	+	0.0925 x 4180 x 16.2

Solving for l gives l = 3.2 x 10^5 J kg^{-1}

The accepted value for the specific latent heat of fusion of ice is 3.3 x 10^5 J kg^{-1}, suggest two reasons why your answer is not this value

The calorimeter could have been poorly insulated and the thermometer might have lacked sensitivity.