Test Questions

**Question 01:** 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 °C
Temperature of ice = 0 °C
Mass of ice = 19.2 g
Final temperature of water = 13.2 °C

Room temperature was 21 °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 × 105 J kg-1. Suggest two reasons why your answer is not this value.

**Question 02:** A car of mass 1800 kg and moving at 25 m s-1 is brought to rest by the application of disc brakes. Find the average increase in temperature of the brakes if each of the four brakes has a mass of 4.5 kg. Take the specific heat capacity of the brake material to be 680 J kg-1 K-1, and assume that all the kinetic energy is changed into heat energy in the brakes.

**Question 03:** The temperature of 100 g of water was raised from 20 °C to 40 °C in 10 minutes by a heating coil of resistance 5.0 ohms and carrying a current of 2.0 A. Given that the specific heat capacity of water is 4.2 x 103 J kg-1 K-1, calculate the amount of energy lost to the surroundings.

**Question 04:** Water is being pumped through a central heating system at a rate of 1.15 m3 per hour. The temperature of the water leaving the boiler is 58.0 °C and the temperature of the water returning is 48.0 °C. Calculate the power output of the boiler. Assume heat losses to the surroundings to be negligible. Take the density of water to be 1.0 × 103 kg m–3 and the specific heat capacity of water to be 4.2 × 103 J kg-1 K-1.

**Question 05:** A copper calorimeter of mass 180 g contains 450 g of water and 50 g of ice, all at 0 °C. Dry steam is passed into the calorimeter until a certain temperature, q, is reached. The mass of the calorimeter and its contents at the end of the experiment increased by 25 g. If no heat was lost to the surroundings, find the final temperature, q.

Take the specific heat capacities of water and copper to be
4200 J kg-1 K -1 and 390 J kg-1 K-1, respectively.

Take the specific latent heat of fusion of ice to be 3.36 × 10 5 J kg-1 and the specific latent heat of vaporisation of water to be 2.26 × 106 J kg-1.

**Question 06:** A refrigerator converts 1.3 kg of water at 20 °C into ice at –15 °C in 1 hour. Calculate the total heat removed and the effective power of the refrigerator. Take the specific latent heat of ice to be 3.4 × 105 J kg-1, the specific heat capacity of water to be 4.2 × 103 J kg-1 K-1 and the specific heat capacity of ice to be 2.1 × 103 J kg-1 K-1.

**Question 07:** Given that the specific heat capacity of air is 1.0 × 103 J kg -1 K -1, calculate how much energy must be removed from a refrigerator containing 0.15 m3 of air to lower the temperature of the air from 20 °C to 4 °C (take density of air = 1.2 kg m-3 ).

**Question 08:** Explain the term power. In a microwave oven, energy is absorbed by the water present in food and is converted to heat. An electrician tested the efficiency of a microwave oven, which had a power rating of 650 W, as follows. A plastic jug, of negligible heat capacity, containing 500 cm3 of water at 20 °C was placed in the oven. It was switched on at full power for two minutes. The electrician found that the temperature of the water had risen to 54 °C.

Calculate the electrical energy supplied.

Calculate the energy absorbed by the water.

Hence determine the percentage efficiency of the microwave oven.

Microwaves are continuously reflected off the walls of the oven. Interference occurs at points where the reflected microwaves meet. How might this interference affect the heating of food placed in the oven?

Explain why a turntable can be used to ensure uniform heating of food in a microwave oven.

Give another use for microwave radiation.

**Question 09:** In an experiment to measure the specific heat capacity of a liquid, a quantity of liquid was heated in a copper calorimeter. The following measurements were obtained:

Mass of calorimeter = 53.0 g
Mass of calorimeter + liquid = 142.6 g
Initial temperature of calorimeter + liquid = 16 °C
Final temperature of calorimeter + liquid  = 21 °C
Energy supplied = 1168 J

Using these measurements, calculate the value for the specific heat capacity of the liquid, given that the specific heat capacity of copper is 390 J kg-1 K-1

Describe the apparatus that might have been used in addition to the calorimeter.

Give two ways in which heat loss from the calorimeter might have been reduced in this experiment.

Explain why using a larger mass of the liquid while supplying the same amount of energy might have produced a less accurate result.

**Question 10:** In an experiment to measure the specific latent heat of vaporisation of water, steam was passed into cold water in a copper calorimeter.

The following results were obtained:
Mass of calorimeter = 105.2 g
Mass of calorimeter + water = 228.8 g
Temperature of the cold water = 18 °C
Temperature of the steam = 100 °C
Mass of calorimeter + water + steam = 231.2 g
Final temperature of the water = 29 °C

Given that the specific heat capacity of copper is 390 J kg-1 K-1 and that the specific heat capacity of water is 4180 J kg-1 K-1 calculate the specific latent heat of vaporisation of water.

Draw a labelled diagram of the apparatus which could have been used in this experiment.

Explain why passing more steam into the water might have improved the accuracy of the result.

Explain, also, why cooling the water used in the calorimeter to below room temperature could have led to a more accurate result.