Latent Heat

U77-19. Which of the following statements about the boiling point of a liquid is ***true***?

A. The boiling point of a liquid is a fixed temperature and independent of atmospheric pressure.
B. The boiling point of a liquid decreases with the increase of atmospheric pressure.
C. The boiling point of a liquid is the temperature at which the saturated vapour pressure is equal to the atmospheric pressure on the surface of the liquid.
D. The boiling point of a liquid varies directly as the product of the volume of the liquid and the atmospheric pressure.

U87-P7a If a litre of water initially at 20 °C is heated with 2 kW of power, how long would it take to boil?

(b) If a '2 kW' electric kettle (originally at room temperature) had been used for the above experiment, would the time taken be longer or shorter than that calculated for part (a)? Why?

(c) If the boiling water was left boiling for another 1.5 min., what is the mass of water which would be boiled away (as steam)?

(d) Why is dangerous to switch on the kettle when there is no water (or any other liquid) in it? Explain. [168 s; 0.08 kg]

U88-7 A heating coil is placed within a filter funnel filled with ice cubes. The potential difference V across the heater, and the current I passing through the heater are adjustable every 10minutes. The following table shows the data obtained (t = time taken, i.e. 10 minutes and m is the mass of water melted from the ice every 10 minutes):

V(V)	4.0	5.0	6.0	7.0	8.0
I(A)	2.0	2.5	3.0	3.8	4.0
m(g)	17.9	26.0	35.8	51.0	60.7
t(s)	600	600	600	600	600

(a) Draw a graph of m against P where $P = IV$.

(b) Use your graph to determine the rate at which the ice would melt if no power were supplied to the heater.

(c) Determine the specific latent heat of fusion of ice.

U90-P6a What do you understand by **latent heat of fusion**?

(a) List **two** methods by which a given amount of liquid (which is being exposed to air and is thereby undergoing the natural process of evaporation) may be evaporated more easily. For each method listed, give the corresponding theory/theories or principle(s) of operation.

(b) A calorimeter, made of material of specific heat capacity 390 J kg^{-1} K^{-1}, and of mass 0.18 kg, contains 0.15 kg of water at 22 °C. If 0.10 kg of ice at 0 °C is poured into the calorimeter and then thoroughly stirred, what would be the temperature of the resulting mixture? Is there any ice left unmelted? If so, find its mass. [Latent heat of fusion of ice = 3.36×10^5 J kg^{-1} K^{-1}] [0.054 kg]

U92-14 Other conditions being equal, the effects of scalding on the human body caused by boiling water at 100 °C and steam at 100 °C _____.

A. would be same
B. would not be the same. The effect caused by the boiling water would be more serious as water is more adhesive
C. would not be the same. The effect caused by the steam would be more serious because steam is a vapour, capable of flowing faster than boiling water
D. would not be the same. The effect caused by the steam would be more serious because steam possesses the extra latent heat of condensation, which would be given off, when it is in contact with the body and becomes liquefied

U93-P7a What do you understand by **latent heat**?

(b) Heat is applied at a constant rate to a certain body initially in the solid state so that it first changes to a liquid and finally to a vapour. Neglecting heat loss, draw a temperature – time graph to show how the temperature of the body varies with time and explain briefly and precisely the meaning of your graph.

U97-11 A constant power supply is used to melt 2 kg of ice, to heat the water produced and finally to turn all the water into steam. Given that

Specific heat capacity of water $= 4\times10^3$ J kg^{-1} K^{-1}
Specific latent heat of fusion of ice $= 3\times10^5$ J kg^{-1}
Specific latent heat of vaporization of water $= 2\times10^6$ J kg^{-1}

Which of the following graphs in Fig.U97-11 **best** shows how the temperature varies with time for this sequence?

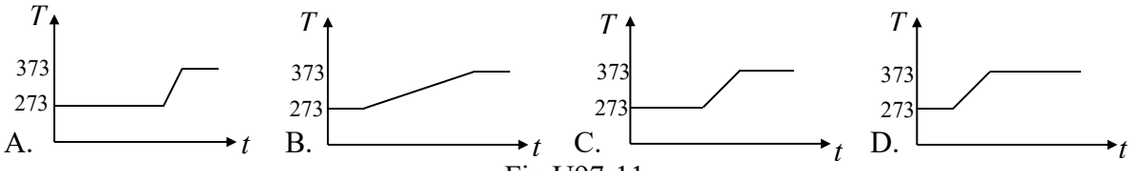

Fig.U97-11

U97-P6a Define

(i) **latent heat of fusion**, and
(ii) **specific heat capacity**
of a substance.

(b) A substance of mass 2 kg melts and then solidifies as illustrated in Fig.U97-P6a. Given that the heat supplied by the heater is 800 J per minute, answer the following questions:

(i) The temperature of solidification of the substance is _____ °C, while the room temperature is _____°C.
(ii) The latent heat of fusion of the substance is _____.
(iii) The specific heat capacity of the substance when it is in solid state is _____.
(iv) What is the temperature of the substance at the 70th minute? What is its state at that time?

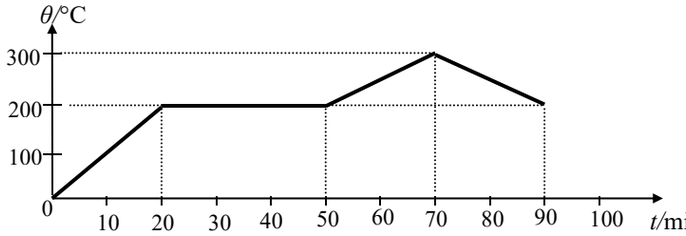

Fig.U97-P6a

(c) 50 g of ice at 0 °C is added to 70 g of water at 10 °C. 2 g of water vapour at 100 °C is then passed into the mixture. If the ice does not melt totally, how much will remain?
[Given that

Specific heat capacity of ice $= 2.1\times10^3$ J kg^{-1} K^{-1}
Specific heat capacity of water $= 4.2\times10^3$ J kg^{-1} K^{-1}
Specific latent heat of fusion of ice $= 3.36\times10^5$ J kg^{-1}
Specific latent heat of vaporization of water $= 2.26\times10^6$ J kg^{-1}]

[200 °C, 12000 J kg^{-1}, 40 J kg^{-1} k^{-1}, 300 °C, liquid; 25.3 g]

U98-15 Which of the following statements about evaporation and boiling are **correct**?

I. The rate of evaporation depends on the surface area but that of boiling does not.
II. Evaporation takes place at any temperature while boiling occurs only at the boiling point.
III. From the viewpoint of molecular kinetics, the contributing factor of evaporation and that of boiling are the same.
IV. Evaporation causes cooling, whereas in boiling the average kinetic energy of the molecules increases.

A. I, II, III, IV B. I, II, IV C. III, IV D. I, II

U2k07-6 Xiao Ming invited Xiao Hua to his house to watch a live telecast of football match between Manchester United and Real Madrid. Xiao Ming served his guest a cup of hot water. If the hot water was at 90 °C and weighed 240 g, how much ice (at 0 °C) should Xiao Hua add in order for the hot water to cool down to 40 °C? (The heat loss is negligible, the specific latent heat of fusion of ice is 334 J g^{-1})

A 50 g B 100 g C 150 g D 200 g

U2k05-11 Fig.U2k05-11 shows a graph that the temperature T of a 0.4 kg solid crystal varies with time t when it is heated by a 100 W heater. Which of the following expressions regarding the heating graph of the solid crystal are **true**?

I. the melting point of the crystal is 10 ºC
II. the latent heat of fusion of the crystal is 5.4×10^4 J
III. the solid crystal starts to melt after heating for 6 minutes

A. I, II B. I, III
C. II, III D. I, II, III

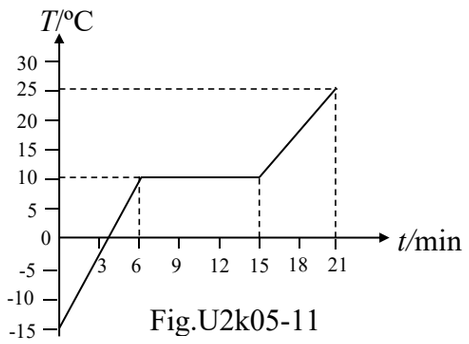

Fig.U2k05-11

U2k07-7 The scald on the skin caused by steam with temperature 100 °C is more serious than that caused by equal mass of boiling water at temperature of 100 °C. Which of the following statements can **best** explain the situation?

A. The heat conductivity of steam is much better than that of boiling water.
B. The density of steam is much smaller than that of boiling water.
C. A lot of heat will be released during steam's liquefaction.
D. The specific heat capacity of steam is greater than that of the boiling water.

U2k08-P4(a) A student wishes to cool 0.30 kg of Diet-cola (mostly water) at an initial temperature of 20 °C. He adds ice at an initial temperature of – 20 °C to it and cools it at 0 °C after all the ice has melted. How much ice was added if the heat capacity of the container is neglected?

(specific heat capacity of water, $c_w = 4.2\times10^3$ J kg^{-1} K^{-1}, specific heat capacity of ice, $c_{ice} = 2.1\times10^3$ J kg^{-1}K^{-1}, specific latent heat of fusion of ice, $L_f = 3.34\times10^5$ J kg^{-1})

[66.8 g]

U2k09-13 Steam at 100 °C is mixed with 500 g of water at an initial temperature 0 °C. After a certain time interval, the temperature of the water stops rising and remains at 60 °C. Determine the mass of the steam used. (Specific latent heat of vaporization of water is 2.26×10^6 J kg^{-1})

A. 52 g B. 58 g C. 500 g D. 750 g

U2k11-11 A beaker contains a mixture of ice and water, where the ice is floating in the water. If the mixture is being heated, which of the following deductions about the temperature and the water level in the beaker, during the melting process of the ice is **true**?

A. Temperature unchanged, water level unchanged.
B. Temperature unchanged, water level decreased.
C. Temperature rises, water level decreased.
D. Temperature decreases, water level decreased.

U2k12-5 Under one standard atmospheric pressure, broken piece of ice in a glass are continuously heated. Which of the following descriptions is **correct**?

A. The temperature rises as the ice melts.
B. Both the mass and the volume of ice do not change as it melts.
C. No liquefaction or evaporation takes place from the surface of ice or from the surface of water.
D. All the ice melts into water after every gram of ice absorbs 334 J of heat.

U2k15-11 100 g of water at 20 °C is mixed with 10 g of ice at 0 °C. What is the final temperature of the mixture? (heat lost is neglected)

[specific heat capacity of water is 4200 J mol^{-1} K^{-1}; specific latent heat of fusion of ice is 3.34×10^5 J kg^{-1}]

A. 0 °C B. 10.95 °C C. 12.05 °C D. 18.18 °C

U2k16-12 A heater of resistance 120 Ω is connected to a voltage supply of 240 V. It is used to heat up 1 litre of water at 60 °C. What is the time taken for all the water to change into steam?

A. 64 minute B. 78 minute C. 84 minute D. 93 minute

U2k14-P5a Define

(i) Specific heat capacity;

(ii) Specific latent heat of vaporization.

U2k14-P5b A copper pot of mass 800 g is filled with 1.2 kg of pure water at 30 °C, and is heated by an electric heater of 750 W. If the heat lost is neglected, how much water would change into water vapour after 40 minutes of continued heating? [630.69 g]

(Given: heat capacity of copper $c_{Cu} = 3.90\times10^2$ J kg^{-1} K^{-1},
heat capacity of water $c_w = 4.20\times10^2$ J kg^{-1} K^{-1},
latent heat of vaporization of water $l_{fw} = 2.26\times10^6$ J kg^{-1})

U2k17-P1 (b) In an experiment to determine the specific latent heat of fusion of ice, the mass of the copper cup in the calorimeter is measured to be 120 g. Water of mass 200 g at 30 °C is first poured into the cup, followed by small pieces of ice of mass 25 g and temperature 0 °C. The mixture is then stirred uniformly until all the ice has melted. If the final temperature of the water in the cup is 18.5 °C, calculate the specific latent heat of fusion of ice. [3.30×10^5 J kg^{-1}]

(Given: the specific heat capacity of water = 4.2×10^3 J kg^{-1} K^{-1},
the specific heat capacity of water lopper = 3.9×10^2 J kg^{-1} K^{-1})

U2k18-10 Which of the following substances exists as liquid at room temperature (about 30 °C)?

Object A	Melting point / °C	Boiling point / °C
A	– 39	357
B	44	280
C	– 218	– 183
D	1083	2236

U2k19-P3(a) Define specific latent heat of vaporization. [1%]

(b) In the heat exchange unit of a solar thermal generator, molten salt at initial temperature 650 °C is used to change water at 80 °C into steam at 150 °C. In the process of heat exchange, 25% of the energy is lost to the surrounding and the final temperature of the molten salt is 150 °C.

(i) Determine the quantity of heat required to change 1 kg of water at 80 °C to steam at 150 °C. [2%]

(ii) How many kilograms of steam is produced by each kilogram of molten salt in the heat exchange unit? [2%]

(Given: the specific heat of molten salt is 920 J kg^{-1} K^{-1},
the specific heat of water is 4200 J kg^{-1} K^{-1},
the specific heat of steam is 1850 J kg^{-1} K^{-1},
the specific latent heat of vaporization of water is 22.6×10^5 J kg^{-1},
boiling point of water is 100 °C)

[2.44×10^6 J; 141.39 g]