

### 3.5 SPECIFIC LATENT HEAT OF VAPORIZATION

#### Section A: True or False

- |  | True  | False |
|--|-------|-------|
| 1. A steam burn is more serious than a boiling water scald because it releases more energy when it condenses.  | _____ | _____ |
| 2. When an equal mass of ice at 0°C and steam at 100°C are mixed, the final mixture is water at 50°C.  | _____ | _____ |
| 3. The specific latent heat of vaporization of water is greater than the specific latent heat of fusion of ice because the increase in potential energy of boiling water molecules is much larger. | _____ | _____ |

#### Section B: Fill in the blanks

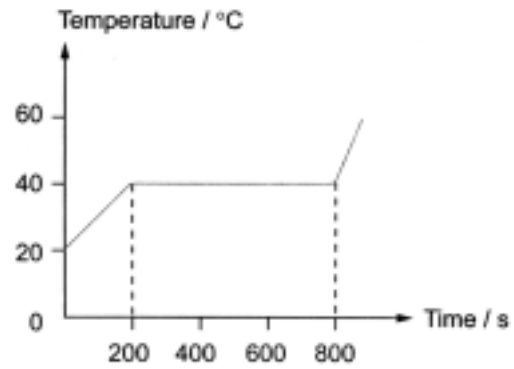
- The specific latent heat of fusion of a substance is the amount of \_\_\_\_\_ required to melt \_\_\_\_\_ kg of solid to \_\_\_\_\_ without changing the \_\_\_\_\_. Its unit is \_\_\_\_\_. Similarly, the change of the same mass of a \_\_\_\_\_ to a gas without changing the \_\_\_\_\_ is called the specific latent heat of \_\_\_\_\_.
- During a change of state for a substance, its molecules absorb latent heat. Their average speed \_\_\_\_\_ and their molecular separation \_\_\_\_\_. It means that only the \_\_\_\_\_ of the molecules becomes greater.

#### Section C: Multiple Choice Questions

- $5 \times 10^6$  J of energy is needed to vaporize 2 kg of a liquid at its boiling point. The specific latent heat of vaporization of the liquid is  
A.  $10^6$  J kg<sup>-1</sup>  
B.  $2 \times 10^6$  J kg<sup>-1</sup>  
C.  $2.5 \times 10^6$  J kg<sup>-1</sup>  
D.  $5 \times 10^6$  J kg<sup>-1</sup>
- An immersion heater takes 5 minutes to boil a cup of water from 20°C. What is the time required to vaporize the boiling water completely?  
(Given: specific heat capacity of water = 4 200 J kg<sup>-1</sup> °C<sup>-1</sup>  
specific latent heat of vaporization of water =  $2.26 \times 10^6$  J kg<sup>-1</sup>)  
A. 25.4 min  
B. 33.6 min  
C. 40.8 min  
D. 63.2 min

3. A 500 W heater is used to heat 0.5kg of a liquid. From the temperature-time graph shown, what is the specific latent heat of vaporization of the liquid?

- A.  $5 \times 10^4 \text{ J kg}^{-1}$   
 B.  $5 \times 10^5 \text{ J kg}^{-1}$   
 C.  $6 \times 10^4 \text{ J kg}^{-1}$   
 D.  $6 \times 10^5 \text{ J kg}^{-1}$



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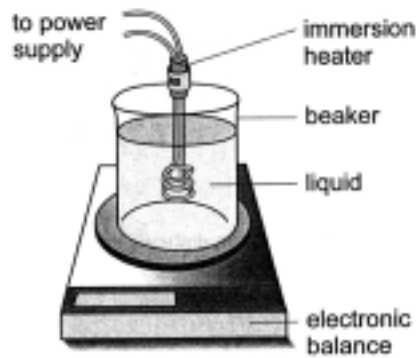


Fig. (a)

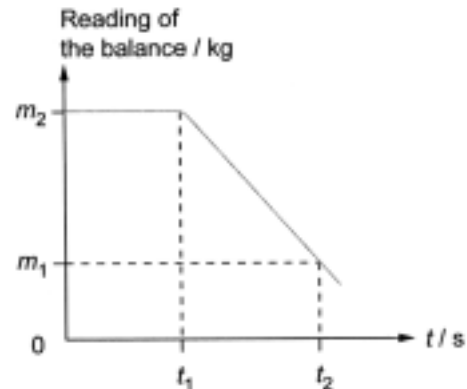


Fig. (b)

A liquid in a beaker is heated by a 500 W immersion heater as shown in Fig. (a). Fig. (b) shows the variation of the reading of the electronic balance with time  $t$ . Which of the following statements about the liquid is / are correct?

- (1) Its temperature increases during the period  $t = 0$  to  $t_1$ .  
 (2) Its specific heat capacity can be estimated by  $\frac{500t_1}{m_2}$ .  
 (3) Its specific latent heat of vaporization can be estimated by  $\frac{500(t_2 - t_1)}{m_2 - m_1}$ .

- A. (1) and (2) only  
 B. (1) and (3) only  
 C. (2) and (3) only  
 D. (1), (2) and (3)



5. We regulate our body temperature after exercise by sweating and evaporation of sweat. This is because sweat has a

- (1) high specific heat capacity  
 (2) high specific latent heat of fusion  
 (3) high specific latent heat of vaporization

- A. (1) only  
 B. (3) only

- C. (1) and (2) only  
D. (1) and (3) only

6. Which of the following physical quantities have the same unit?

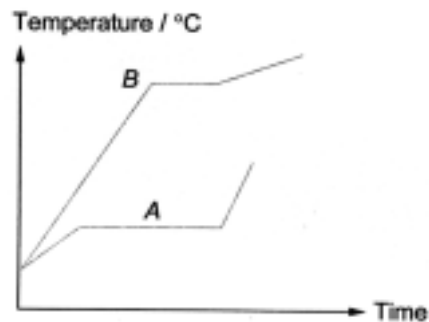
- (1) Latent heat of fusion  
(2) Heat capacity  
(3) Latent heat of vaporization

- A. (1) and (2) only  
B. (1) and (3) only  
C. (2) and (2) only  
D. (1), (2) and (3)

7. A beaker of water is heated from  $40^{\circ}\text{C}$  to  $100^{\circ}\text{C}$  by an immersion heater in 10 minutes. How much time does it take for all the water to be vaporized completely?

- A. 40 minutes  
B. 70 minutes  
C. 90 minutes  
D. 110 minutes

8. Two liquids *A* and *B* of equal mass are heated by two identical heaters. The variations of temperature with time for two liquids are shown below.



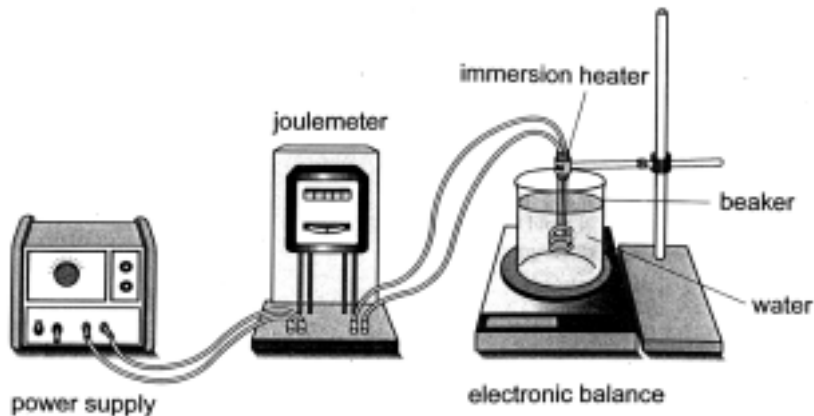
Which of the following statement is / are correct?

- (1) The specific heat capacity of liquid *A* is greater than that of liquid *B*.  
(2) The boiling point of *A* is lower than that of *B*.  
(3) The specific latent heat of vaporization of *A* is larger than that of *B*.

- A. (2) only  
B. (1) and (2) only  
C. (1) and (3) only  
D. (1), (2) and (3)



9. The figure shows a set-up used to investigate the specific latent heat of vaporization of water. Which of the following should not be made to improve the accuracy of the result?



- A. Cover the beaker with a lid (蓋) to prevent heat lost to the surroundings.
- B. Replace the beaker with a polystyrene cup.
- C. Use less water to prevent water from spilling out.
- D. Use a low voltage power supply.



Section D: Structured Questions

1. (a) Calculate the energy required to melt 2 kg of ice at 0°C to water at 0°C.

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- (b) Calculate the energy required to boil 2 kg of water at 100°C to steam at 100°C.

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- (c) Find the approximate ratio of the value in part (a) to that in part (b). What do you conclude from this ratio?

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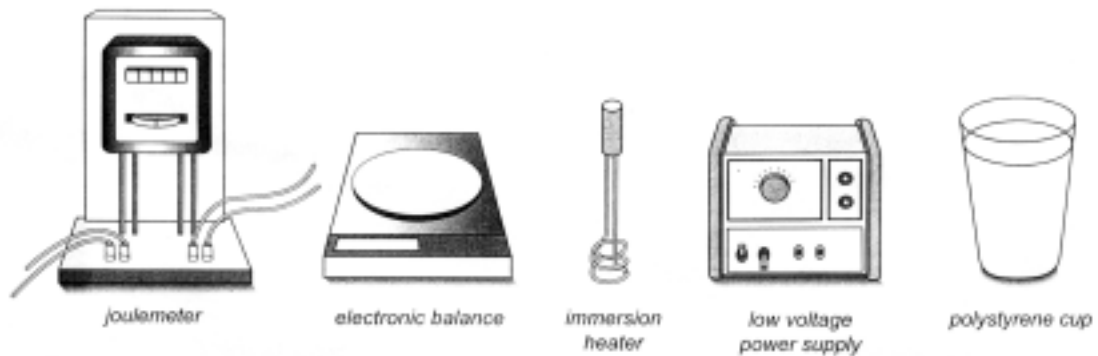


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2. The apparatus below is used to measure the specific latent heat of vaporization of water.



- (a) Draw a diagram to show the set-up of the experiment.



- (b) When the water in the cup starts to boil, the reading of balance is recorded. After 10 minutes, the reading is taken again. The following data are obtained:

Initial reading of balance = 814.2 g

Final reading of balance = 302.5 g

Find

- (i) the mass of water lost in 10 minutes,

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- (ii) the energy supplied by the heater in 10 minutes if its power is 2 000 W, and

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- (iii) the specific latent heat of vaporization of water.

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2. (c) Comment (評述) on the statement:

The calculated value of the specific latent heat of vaporization of water should be lower than the accepted value because some boiling water spills out from the cup.

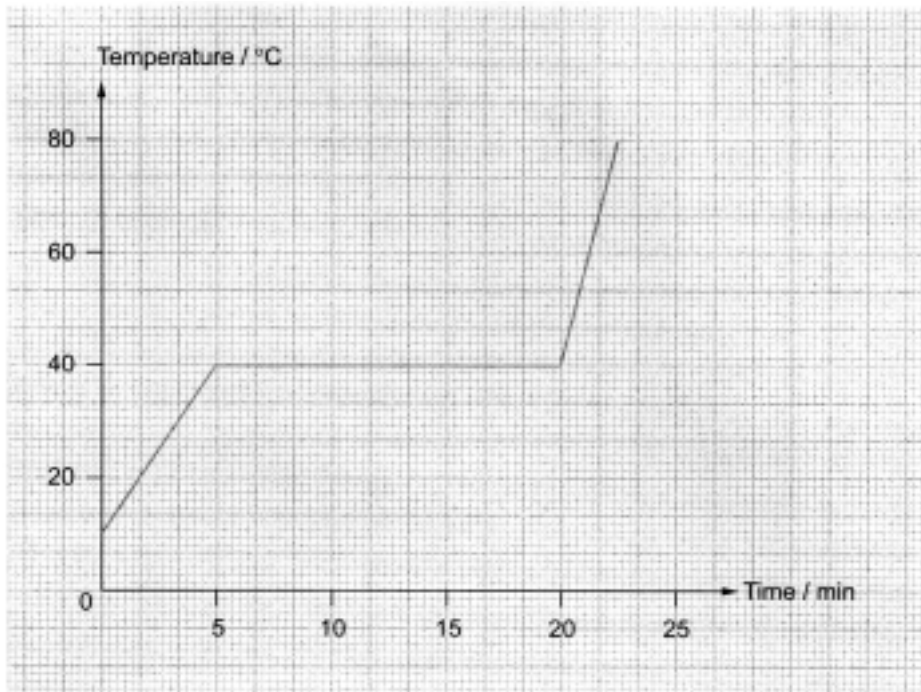
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3. A liquid X of mass 0.5 kg is heated by a heater with power of 200 W. The temperature-time graph is shown below. Assume that the heat loss to the surroundings is negligible.



(a) Find the boiling point of liquid X.

(b) What is the specific heat capacity of X?

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(c) Which one is higher, the specific heat capacity at liquid state or at gaseous state?

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(d) What is the specific latent heat of vaporization of X.

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4. A 1.5 kW heater is immersed in 0.5 kg of water at 25°C. If it is switched on for 10 minutes, how much water is boiled away?

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5. What is the final temperature when 2 kg of ice at 0°C is mixed with 2 kg of steam at 100°C?

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