

# 9.6 Entropy and the Second Law of Thermodynamics

---

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 9 marks

KEY WORDS entropy 熵 • second law 热力学第二定律 • heat 热量 • thermodynamics 热力学 • pressure 压强

## Objective

---

Build the skills to answer exam questions on **entropy and the second law of thermodynamics**.

You must be able to:

- describe **entropy** 熵 as a measure of disorder (the number of microstates)
- state the **second law of thermodynamics** 热力学第二定律: total entropy tends to increase
- explain why thermal energy flows spontaneously from hot to cold

## 1 Worked examples

---

Study these first. Each one shows the method for a question type used later.

### ■ Entropy

Entropy measures **disorder** — the number of ways (microstates) the particles can be arranged. More disorder means higher entropy.

### ■ The second law

The **total** entropy of an isolated system tends to **increase** over time.

### ■ Direction of heat flow

Heat flows from hot to cold on its own because that **raises** the total entropy. The reverse (cold to hot) needs external work — that is what a refrigerator does.

## 2 Practice

---

**2.1** State what entropy measures. [1]

---

**2.2** State the second law of thermodynamics. [1]

---

**2.3** Explain why heat does not flow from a cold object to a hot one on its own. [2]

---

---

## 3 Exam-style questions

---

**3.1** Entropy is a measure of a system's [1]

- **A** temperature
  - **B** energy
  - **C** disorder
  - **D** pressure
- 

**3.2** In an isolated system, the total entropy tends to [1]

- **A** decrease
  - **B** increase
  - **C** stay exactly constant
  - **D** fall to zero
- 

**3.3** A block of ice melts in a warm room.

(a) State whether the entropy of the water increases or decreases. [1]

(b) Explain your answer in terms of disorder. [2]

## Solutions

---

**2.1** the disorder of a system (the number of microstates).

**2.2** the total entropy of an isolated system tends to increase.

**2.3** that would **decrease** the total entropy, which the second law forbids without external work being done.

**3.1** C.

**3.2** B.

**3.3** (a) increases. (b) liquid water is more disordered than solid ice — its particles move more freely, so there are more microstates and higher entropy.