

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.