

14.2 Temperature scales

Name: _____ Class: _____ Date: _____

Total: 21 marks

KEY WORDS absolute zero 绝对零度 • celsius 摄氏度 • kelvin 开尔文 • thermocouple 热电偶
• temperature 温度

Objective

Build the skills to answer exam questions on **temperature scales** — thermometry, kelvin/Celsius, and absolute zero.

You must be able to:

- name **physical properties** used to measure temperature
- convert between **kelvin** and **Celsius** ($T/\text{K} = \theta/^{\circ}\text{C} + 273.15$)
- explain **absolute zero** and the thermodynamic scale

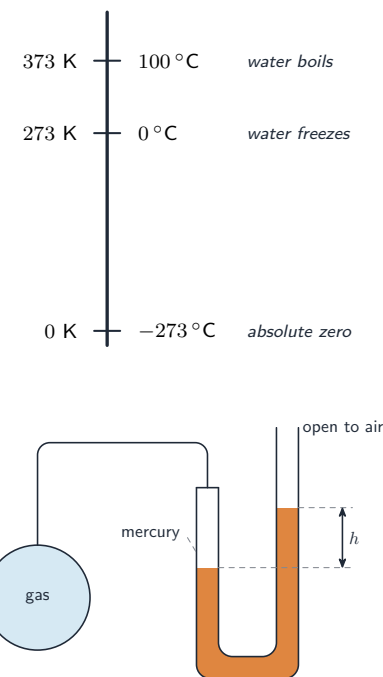
1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ Thermometers

Any **physical property** that changes repeatably with temperature can make a thermometer: density of a liquid, volume of a gas, **resistance** of a metal, or the **e.m.f.** of a **thermocouple**.

■ The two scales



A gas thermometer and absolute zero

$$T/\text{K} = \theta/^{\circ}\text{C} + 273.15.$$

The **thermodynamic** scale does **not** depend on any one substance. The lowest possible temperature is **absolute zero** ($0\text{ K} = -273.15\text{ }^{\circ}\text{C}$), where a system has its least internal energy.

2 Practice

Now apply the methods above.

2.1 Convert $27\text{ }^{\circ}\text{C}$ to **kelvin**.

[1]

2.2 Convert 200 K to **degrees Celsius**. [1]

2.3 State the value of **absolute zero** in °C. [1]

2.4 Name **two** physical properties used in thermometers. [2]

3 Exam-style questions

3.1 A temperature of 100 °C in kelvin is: [1]

- | | |
|---|---|
| A | B |
| C | D |
- A 173 K
B 373 K
C 273 K
D 100 K

3.2 State what is meant by **absolute zero**. [2]

3.3 Convert 310 K to **degrees Celsius**. [1]

3.4 Explain why the **thermodynamic** (kelvin) scale is preferred over a scale based on a single physical property. [2]

3.5 A sealed container holds a sample of an ideal gas. The Boltzmann constant is $1.38 \times 10^{-23} \text{ J K}^{-1}$, the Avogadro constant is $6.02 \times 10^{23} \text{ mol}^{-1}$ and $1 \text{ u} = 1.66 \times 10^{-27} \text{ kg}$.

(a) **State** the temperature of absolute zero on

(i) the Celsius scale, [1]

(ii) the thermodynamic scale, with its unit. [1]

(b) For this sample, a graph of pV against thermodynamic temperature T is a **straight line through the origin**. **State** what this tells you about the gas. [1]

(c) At one point on that line, $pV = 340 \text{ J}$ and $T = 640 \text{ K}$. **Determine** the number N of molecules in the sample. [2]

(d) **Determine** the amount of gas, in moles. [1]

(e) At that temperature the root-mean-square speed of the molecules is 1400 m s^{-1} . **Determine** the mass of one molecule, in u. [4]