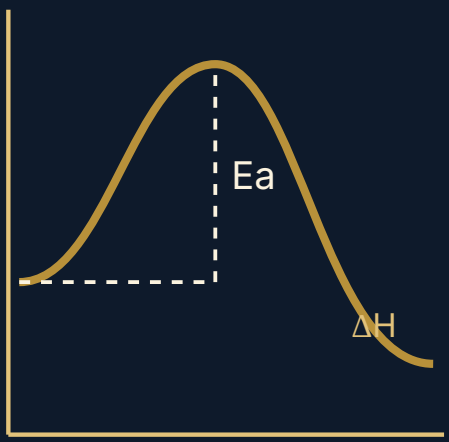
KECUDO

HIGH SCHOOL CHEMISTRY

Energy, Rates & Equilibrium

Class 5 · Concepts, Labs & Structures



PREMIUM
V
EDITION

2026 EDITION · STUDENT SERIES

About this book

Welcome to **High School Chemistry, Class 5: Energy, Reaction Rates & Equilibrium**. Every reaction has three big questions: how much energy does it release or absorb, how fast does it go, and how far does it go? This class answers all three.

How each chapter works

- **Depth dots** show the level: Foundation ●○○, Core ●●○, Advanced ●●●.
- **Concepts** with worked examples and figures drawn from real data.
- **Kecudo Lab** boxes: one hands-on experiment per chapter.
- **Try it** questions with answers, plus a 25-question scored self-assessment at the end.

Our running example

Kecudo Chem Co. uses Sample K (53.6 g of copper) in a calorimeter to measure copper's specific heat, then studies hand warmers, cold packs and a catalytic converter. Kecudo Bakery returns to show why fridges slow down spoilage.

Data sources

CRC Handbook and NIST Chemistry WebBook (specific heats, phase-change and reaction enthalpies, bond energies); U.S. DOE (fuel heating values). Class rate data are fictional. Kecudo company names and Sample K are fictional teaching examples.

> **Safety & use.** Educational content only. Perform experiments only with a qualified teacher, proper safety equipment and your school's safety rules. Steps marked “teacher demonstration” or “teacher-supervised” are not for students alone.

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FOUNDATION

Chapter 1

Energy & Chemistry

Energy is the ability to do work or transfer heat. Every chemical change involves energy changes: bonds store chemical potential energy, and moving particles carry kinetic energy.

Form	Description	Chemistry example
Kinetic	Energy of motion	Fast-moving gas particles
Potential (chemical)	Stored in bonds and attractions	Fuel, food, batteries
Thermal	Total kinetic energy of particles	A hot beaker of water
Radiant	Light	Flame tests, photosynthesis

System and surroundings

The **system** is the part you study (the reacting chemicals); the **surroundings** are everything else (the beaker, water, air, you). Energy moves between them, but the **law of conservation of energy** says the total never changes.

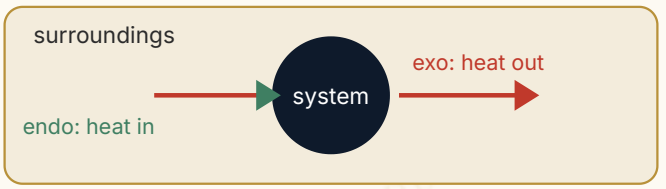


FIG 1.1 · Heat flows between a system and its surroundings



FIG 1.2 · Energy stored in everyday things (kJ, typical)

Source: USDA FoodData Central; typical battery ratings.

Units of energy

Unit	Equal to	Used for
joule (J)	1 J	SI unit
kilojoule (kJ)	1000 J	Reaction energies
calorie (cal)	4.184 J	Heat to warm 1 g water by 1 °C
food Calorie (Cal)	1000 cal = 4184 J	Nutrition labels

A 250-Calorie snack bar stores about 1 046 000 J — enough, in principle, to heat about 3.1 kg of water from 20 °C to boiling.

> **Exothermic vs. endothermic:** if the system releases heat, the surroundings warm up (exothermic, like burning). If it absorbs heat, the surroundings cool down (endothermic, like a cold pack). Chapter 5 goes deeper.

⚗ Kecudo Lab · Energy Detectives

Mix, in turn: (1) calcium chloride + water, (2) ammonium chloride + water, (3) baking soda + vinegar, (4) steel wool + vinegar in a sealed bag with a thermometer. Record the temperature change in each. Classify each as exothermic or endothermic.

✎ Try it

1. Convert 2.5 kJ to J.
2. How many joules in 1 cal?
3. A cold pack feels cold. Exo- or endothermic?

Answers: **1.** 2500 J · **2.** 4.184 J · **3.** endothermic

FOUNDATION

Chapter 2

Heat, Temperature & Specific Heat

Temperature measures the average kinetic energy of particles. **Heat** (q) is energy transferred because of a temperature difference — always from hot to cold.

A bathtub of warm water holds more heat than a cup of boiling water, even though the cup is hotter: heat depends on **how much** matter there is, temperature doesn't.

$$q = m \cdot c \cdot \Delta T$$

q = heat (J) · m = mass (g) · c = specific heat (J/g·°C) · $\Delta T = T_{final} - T_{initial}$

Specific heat is the energy needed to raise 1 g of a substance by 1 °C. High specific heat = slow to heat up and slow to cool down.

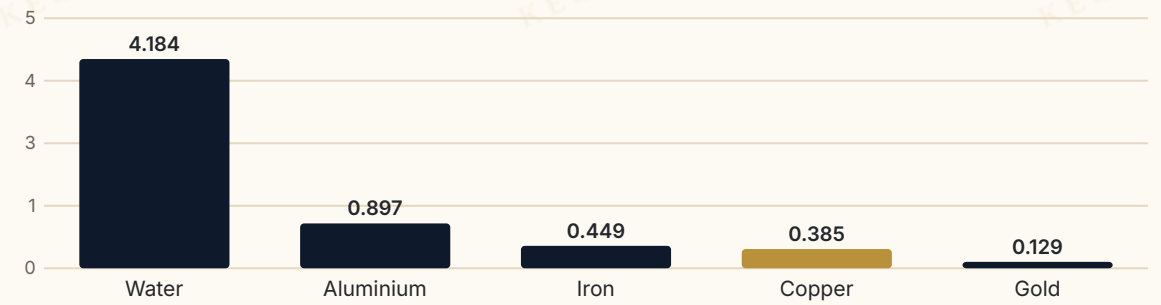


FIG 2.1 · Specific heats at 25 °C (J/g·°C)

Source: CRC Handbook of Chemistry and Physics.

FOUNDATION

Chapter 3

Heating Curves & Phase Changes

Heat ice steadily and its temperature rises — then **stops** while it melts, rises again, and stops again while it boils. During a phase change, all the energy goes into separating particles, not speeding them up.

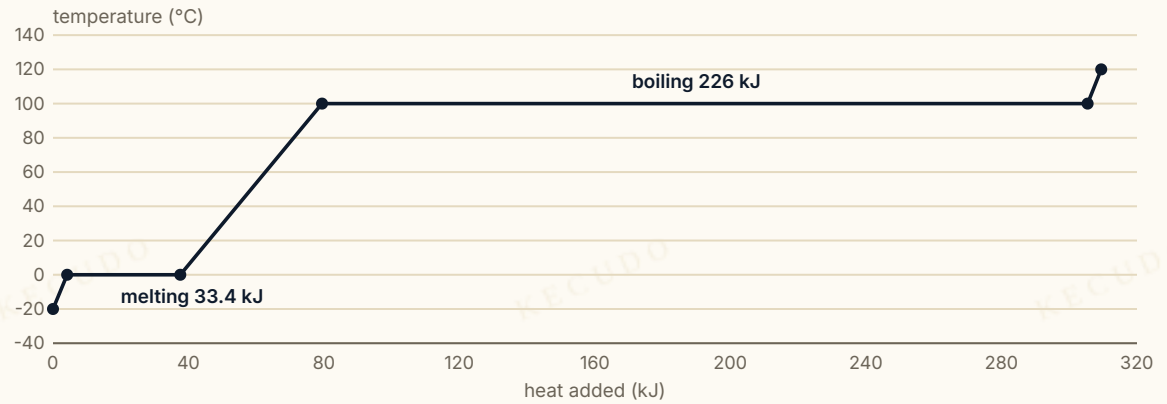


FIG 3.1 · Heating curve for 100 g of ice from −20 °C to steam at 120 °C

Source: Calculated with c(ice) 2.09, c(water) 4.184, c(steam) 2.01 J/g·°C; ΔH_{fus} 334 J/g; ΔH_{vap} 2260 J/g (CRC Handbook).

Segment	Equation	Energy (kJ)
Warm ice −20 → 0 °C	m c ΔT	4.18
Melt ice at 0 °C	m × 334	33.40
Warm water 0 → 100 °C	m c ΔT	41.84
Boil water at 100 °C	m × 2260	226.00
Warm steam 100 → 120 °C	m c ΔT	4.02
Total		**309.44**

SELF-ASSESSMENT

Part A · Basics

Choose one answer per question. Your choice locks, and your score updates at the top of the screen.

A1. In an exothermic reaction, ΔH is...

A. Positive	B. Zero
C. Negative	D. Always 890 kJ

A2. Specific heat is the energy needed to raise...

A. 1 g by 1 °C	B. 1 mol by 1 K
C. 1 kg by 100 °C	D. 1 L by 1 °C

A3. A catalyst speeds up a reaction by...

A. Raising the temperature	B. Lowering the activation energy
C. Increasing ΔH	D. Adding more reactant

A4. At dynamic equilibrium, the forward and reverse reactions...

A. Have stopped	B. Have equal concentrations
C. Go only forward	D. Go at equal rates

A5. Which is endothermic?

A. Burning wood	B. Melting ice
C. Freezing water	D. A hand warmer

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Thank you for learning with Kecudo.

Next in the series

Class 6 — Acids, Bases & Redox

pH & indicators · neutralisation & titration · oxidation numbers · batteries & electroplating

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