SCIENCE REVISION BOOKLET

Trimester 2 | Academic Year 2025–2026

Grade 7 - General

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Lesson 1: States of Matter & Kinetic Molecular Theory

★ Exam Tip

This lesson covers approximately **25% of the exam questions**. Pay special attention to particle arrangement diagrams and the relationship between temperature and kinetic energy. Exam questions frequently ask you to describe or draw particle arrangements in different states.

1.1 Core Concepts

The Kinetic Molecular Theory (KMT)

The **Kinetic Molecular Theory** explains the behavior of matter based on the motion of its particles. The theory states that:

- All matter is composed of tiny particles (atoms, molecules, or ions)
- These particles are in constant motion
- Particles possess kinetic energy due to their motion
- The temperature of a substance is directly related to the average kinetic energy of its particles

> ***Kinetic Energy:*** *The energy an object possesses due to its motion. For particles, this means the faster they move, the more kinetic energy they have.*

The Three States of Matter

Property	Solid	Liquid	Gas
Particle Arrangement	Tightly packed in fixed positions	Close together but can move past each other	Far apart, moving freely
Particle Movement	Vibrate in fixed positions	Slide and flow around each other	Move rapidly in all directions

Shape	Fixed shape	Takes shape of container	Fills entire container
Volume	Fixed volume	Fixed volume	Expands to fill space
Kinetic Energy	Lowest	Medium	Highest

Temperature and Kinetic Energy

When the **temperature** of a substance increases, the particles gain energy and move faster. This increases their kinetic energy. Conversely, when temperature decreases, particles slow down and lose kinetic energy.

Relationship: Higher Temperature → Faster Particle Movement → Higher Kinetic Energy

Gas Laws

Boyle's Law

At constant temperature, the pressure and volume of a gas are inversely related:

$$P_1V_1 = P_2V_2$$

When volume decreases, pressure increases (particles hit walls more frequently). When volume increases, pressure decreases.

Pressure-Temperature Relationship

In a closed container, when temperature increases:

- Particles move faster
- Particles hit the container walls more frequently and with more force
- Pressure increases

When temperature decreases, the opposite occurs: particles slow down, hit walls less frequently, and pressure decreases.

Phase Changes

Phase changes occur when a substance transitions between solid, liquid, and gas states. These changes involve the transfer of **thermal energy**:

Phase Change	Process	Energy Transfer
Melting	Solid → Liquid	Thermal energy ADDED
Freezing	Liquid → Solid	Thermal energy REMOVED
Evaporation/Boiling	Liquid → Gas	Thermal energy ADDED
Condensation	Gas → Liquid	Thermal energy REMOVED

1.2 Model Answer Analysis

Model Answer: Modelling Phase Changes (From Exam)

Question: Describe or draw the arrangement and movement of water particles as they transition from Liquid (water) to Gas (steam). Explain how adding thermal energy causes this change in behaviour.

Model Answer:

Step 1 - Liquid State Description: In liquid water, particles are close together but not in fixed positions. They can slide and flow past one another, allowing the liquid to take the shape of its container.

Step 2 - Gas State Description: In steam (gas), particles are far apart and move rapidly in all directions. They fill the entire container and have no fixed arrangement.

Step 3 - Energy Explanation: When thermal energy is added, the particles gain kinetic energy and move faster. As they move faster, the attractive forces between particles can no longer hold them together, allowing them to break free and spread apart.

Step 4 - Key Point: The added thermal energy increases particle kinetic energy, overcoming intermolecular forces and causing the phase change from liquid to gas.

Model Answer: Real-World Gas Laws (From Exam)

Question: If you take a sealed, half-empty plastic water bottle from a warm car into a freezing cold house, the bottle will appear to "collapse" or cave in. Explain why this happens.

Model Answer:

Step 1 - Initial State: In the warm car, the air particles inside the bottle have high kinetic energy and move quickly, creating higher pressure inside the bottle.

Step 2 - Temperature Change: When moved to the cold house, the temperature of the air inside the bottle decreases rapidly.

Step 3 - Particle Behavior: As temperature decreases, the air particles lose kinetic energy and move slower. They hit the bottle walls less frequently and with less force.

Step 4 - Pressure Change: The pressure inside the bottle decreases because the particles are exerting less force on the walls.

Step 5 - Collapse: The external air pressure (atmospheric pressure) is now greater than the internal pressure, pushing the flexible plastic walls inward, causing the bottle to collapse.

1.3 Practice Questions

Practice Set 1: States of Matter & Kinetic Molecular Theory

Question 1 (MCQ)

Which state of matter is characterized by particles that are packed tightly together and only vibrate in fixed positions?

A) Gas

B) Liquid

C) Solid

D) Plasma

Question 2 (MCQ)

When the temperature of a substance increases, what happens to its particles?

A) They move slower and their kinetic energy decreases

B) They move faster and their kinetic energy increases

C) They stop moving entirely

D) Their size increases but their speed remains the same

Question 3 (MCQ)

During the process of freezing, what occurs regarding thermal energy?

A) Thermal energy is added to the substance

B) Thermal energy is removed from the substance

C) Thermal energy remains constant

D) Thermal energy is converted into mass

Question 4 (MCQ)

According to Boyle's Law, if you decrease the volume of a gas in a container while keeping the temperature constant, the pressure will:

A) Decrease

B) Stay the same

C) Increase

D) Drop to zero

Question 5 (MCQ)

Why does a car tire appear "flatter" in very cold weather even if there is no leak?

A) The rubber of the tire shrinks

B) The air particles inside move slower and hit the walls with less force (lower pressure)

C) The air particles leak out through the pores of the rubber due to cold

D) The mass of the air decreases as it gets colder

Question 6 (FRQ)

Explain why a balloon expands when you leave it in direct sunlight on a hot day. Use the concepts of kinetic energy and particle movement in your answer.

Question 7 (FRQ)

A sealed container holds a gas at room temperature. If the container is heated, explain what happens to: (a) the speed of the gas particles, (b) the frequency of collisions with the container walls, and (c) the pressure inside the container.

Question 8 (FRQ)

Describe the arrangement and movement of particles in a solid block of ice. Then explain what happens to these particles as the ice melts into liquid water.

Question 9 (FRQ)

Using Boyle's Law ($P_1V_1 = P_2V_2$), calculate the new pressure if a gas initially at 2 atm and 6 L is compressed to a volume of 3 L at constant temperature.

Question 10 (FRQ)

Draw or describe what happens to the particles in a puddle of water as it evaporates on a hot day. Explain the energy changes involved in this process.

1.4 Answer Key

Answer Key - Lesson 1

Q1: C	**Q2:** B	**Q3:** B	**Q4:** C	**Q5:** B

Detailed Answers - Free Response Questions

Q6: When the balloon is in sunlight, thermal energy is transferred to the air particles inside. This increases their kinetic energy, causing them to move faster. The faster-moving particles hit the balloon walls more frequently and with greater force, increasing the pressure inside. Since the balloon is flexible, it expands to accommodate the increased particle movement and pressure.

Q7: (a) The gas particles move faster as they gain kinetic energy from the heat. (b) The particles collide with the walls more frequently and with greater force. (c) The pressure inside the container increases because pressure is caused by particles hitting the walls.

Q8: In ice (solid), particles are tightly packed in fixed positions and only vibrate. When melting occurs, thermal energy is added. The particles gain enough kinetic energy to break free from their fixed positions and can slide past each other, becoming liquid water.

Q9: Using $P_1V_1 = P_2V_2$: (2 atm)(6 L) = P_2(3 L) → 12 = $3P_2$ → P_2 = 4 atm

Q10: As water evaporates, particles at the surface gain enough kinetic energy from thermal energy (heat) to break free from the liquid and become gas. These gas particles move rapidly and spread out into the air. The process requires thermal energy input (endothermic).

Lesson 2: Atoms, Elements & Compounds

★ Exam Tip

Understanding the difference between elements and compounds is crucial. Exam questions often test your ability to identify reactants and products, interpret chemical formulas, and distinguish between pure elements and compounds. Remember: elements contain only ONE type of atom!

2.1 Core Concepts

Atomic Structure

An **atom** is the smallest unit of matter that retains the properties of an element. Atoms are incredibly small—billions of them could fit on the head of a pin!

Subatomic Particles

Particle	Location	Charge	Mass
Proton	Nucleus	Positive (+)	1 amu
Neutron	Nucleus	Neutral (0)	1 amu
Electron	Electron cloud (orbits nucleus)	Negative (-)	Negligible

Key Fact: The number of protons determines what element an atom is. This is called the **atomic number**.

Elements vs. Compounds

Characteristic	Element	Compound
Definition	A pure substance made of only one type of atom	A substance made of two or more different elements chemically bonded
Examples	Gold (Au), Oxygen (O_2), Carbon (C)	Water (H_2O), Carbon dioxide (CO_2), Salt (NaCl)
Breakdown	Cannot be broken down by chemical means	Can be broken down into elements by chemical reactions

Chemical Symbols and Formulas

Reading Chemical Formulas

- **H_2O** (Water): 2 atoms of Hydrogen + 1 atom of Oxygen
- **CO_2** (Carbon Dioxide): 1 atom of Carbon + 2 atoms of Oxygen
- **$C_6H_{12}O_6$** (Glucose): 6 Carbon + 12 Hydrogen + 6 Oxygen atoms
- **O_2** (Oxygen gas): 2 atoms of Oxygen bonded together

Subscripts tell us how many atoms of that element are present. No subscript means 1 atom.

Extended Structures

Some substances form **extended structures** (also called network structures or crystals) where atoms are bonded in a repeating pattern throughout the entire solid.

Type	Example	Structure
Simple Molecule	CO_2 (Carbon Dioxide)	Discrete molecules with a fixed number of atoms
Ionic Crystal	NaCl (Salt)	Repeating pattern of positive and negative ions
Covalent Network	Diamond (Carbon)	Each carbon bonded to 4 others in a giant network

2.2 Model Answer Analysis

Model Answer: Extended Structures vs. Molecules (From Exam)

Question: Compare a molecule of Carbon Dioxide (CO_2) with an extended structure like a Diamond or a Salt Crystal (NaCl). How does the arrangement of atoms differ between a simple molecule and an extended structure?

Model Answer:

Step 1 - Simple Molecule (CO_2): A carbon dioxide molecule consists of exactly 3 atoms: 1 carbon atom bonded to 2 oxygen atoms (O=C=O). It is a discrete, separate unit with a fixed size.

Step 2 - Extended Structure (Diamond): In diamond, each carbon atom is covalently bonded to 4 other carbon atoms in a tetrahedral arrangement. This pattern repeats billions of times in all directions, creating a giant network structure.

Step 3 - Extended Structure (NaCl): In salt, sodium ions (Na^+) and chloride ions (Cl^-) alternate in a repeating cubic pattern. The structure extends throughout the entire crystal.

Step 4 - Key Difference: A simple molecule has a definite number of atoms and exists as separate units. An extended structure has no fixed number of atoms—the bonding pattern continues throughout the entire solid, making it essentially one giant molecule.

2.3 Practice Questions

Practice Set 2: Atoms, Elements & Compounds

Question 1 (MCQ)

Which of the following best describes the size of an atom?

A) Atoms are large enough to be seen with a standard school microscope

B) Atoms are so small that billions of them could fit on the head of a pin

C) Atoms are roughly the size of a grain of sand

D) Atoms vary in size, with some being as large as a cell

Question 2 (MCQ)

Which statement correctly distinguishes an element from a compound?

A) An element is made of two or more types of atoms

B) A compound is made of only one type of atom

C) An element consists of only one type of atom and cannot be broken down further by chemical means

D) Compounds can only be found in the gas state

Question 3 (MCQ)

In the chemical formula H_2O, what does the subscript "2" represent?

A) Two molecules of water

B) Two different elements

C) Two atoms of Hydrogen

D) Two atoms of Oxygen

Question 4 (MCQ)

Where are protons located in an atom?

A) In the electron cloud

B) In the nucleus

C) Orbiting the neutrons

D) Outside the atom

Question 5 (MCQ)

Which of the following is a compound?

A) Gold (Au)

B) Oxygen gas (O_2)

C) Water (H_2O)

D) Helium (He)

Question 6 (FRQ)

Explain the difference between an atom and a molecule. Provide one example of each.

Question 7 (FRQ)

How many atoms of each element are present in the formula $C_6H_{12}O_6$ (glucose)? Show your counting.

Question 8 (FRQ)

Describe the structure of a diamond. Explain why it is considered an extended structure rather than a simple molecule.

Question 9 (FRQ)

Compare table salt (NaCl) as an extended structure with a water molecule (H_2O). Explain at least two differences in their atomic arrangements.

Question 10 (FRQ)

A substance is found to contain only carbon atoms. Is this substance an element or a compound? Explain your reasoning.

2.4 Answer Key

Answer Key - Lesson 2

Q1: B	**Q2:** C	**Q3:** C	**Q4:** B	**Q5:** C

Detailed Answers - Free Response Questions

Q6: An atom is the smallest unit of an element (e.g., a single oxygen atom, O). A molecule is two or more atoms chemically bonded together (e.g., O_2, water H_2O). Atoms are the building blocks; molecules are combinations of atoms.

Q7: Carbon: 6 atoms (subscript after C), Hydrogen: 12 atoms (subscript after H), Oxygen: 6 atoms (subscript after O). Total: 24 atoms per molecule.

Q8: In diamond, each carbon atom forms covalent bonds with 4 neighboring carbon atoms in a tetrahedral pattern. This bonding repeats throughout the entire crystal. It is an extended structure because there is no fixed number of atoms—the network continues in all directions, unlike a simple molecule which has a definite size.

Q9: (1) NaCl forms a repeating crystal lattice with alternating Na^+ and Cl^- ions extending in all directions, while H_2O exists as discrete molecules with only 3 atoms each. (2) NaCl has ionic bonds throughout the crystal; H_2O has covalent bonds within each molecule but weaker forces between molecules.

Q10: This is an element. By definition, an element consists of only one type of atom. Since the substance contains only carbon atoms, it is the element carbon (which could exist as graphite, diamond, or other forms).

Lesson 3: Density & Physical Properties

★ Exam Tip

Density calculations are a major component of the exam. Remember the formula D = m/V and always include units! When identifying substances, compare your calculated density to known values. Watch for unit consistency—mass in grams and volume in cm^3 gives density in g/cm^3.

3.1 Core Concepts

Physical Properties of Matter

Physical properties are characteristics that can be observed or measured without changing the substance's chemical identity. These include:

Property	Description	Example
Mass	Amount of matter in an object (measured in grams, g)	A block has a mass of 54 g
Volume	Space an object occupies (measured in cm^3 or mL)	A cube has volume of 20 cm^3
State	Solid, liquid, or gas at room temperature	Water is liquid; iron is solid
Boiling Point	Temperature at which a liquid becomes gas	Water boils at 100°C
Density	Mass per unit volume	Water has density of 1.0 g/cm^3

Important: Physical properties can be observed without changing the substance chemically. Boiling point is a physical property because the water is still H_2O after boiling—just in a different state!

Understanding Density

Density Formula

$$D = m / V$$

Where: D = Density, m = Mass, V = Volume

Units: g/cm³ (grams per cubic centimeter) or g/mL

Density tells us how much mass is packed into a given volume. A substance with high density has more mass in the same amount of space compared to a substance with low density.

Density of Common Substances

Substance	Density (g/cm³)	Notes
Air	0.0012	Very low density
Water (liquid)	1.0	Reference point
Ice (solid water)	0.92	Less dense than liquid water—ice floats!
Aluminium	2.7	Light metal
Iron/Steel	7.8	Common construction metal
Silver	10.5	Precious metal
Gold	19.3	Very dense precious metal

Key Principle: Objects with density LESS than water (1.0 g/cm³) will float. Objects with density GREATER than water will sink.

Calculating Density: Step-by-Step

Problem-Solving Strategy

1. **Identify given values:** Note the mass and volume provided
2. **Check units:** Ensure mass is in grams and volume is in cm^3 or mL
3. **Apply the formula:** D = m ÷ V
4. **Calculate:** Perform the division carefully
5. **Include units:** Always write g/cm^3 after your answer
6. **Compare (if identifying):** Match your result to known density values

Volume Calculations for Regular Shapes

For a rectangular block: V = length × width × height

For a cube: $V = side^3$

3.2 Model Answer Analysis

Model Answer: Density Identification (From Exam)

Question: A scientist finds a shiny silver-coloured cube. Its mass is 54 grams, and its volume is 20 cm^3.

1. Calculate the density of the cube.

2. If the density of pure Aluminium is 2.7 g/cm^3 and the density of Silver is 10.5 g/cm^3, identify which metal the cube is likely made of.

Model Answer:

Step 1 - Write the formula: D = m / V

Step 2 - Substitute values: D = 54 g / 20 cm^3

Step 3 - Calculate: D = 2.7 g/cm^3

Step 4 - Compare with known values:

- Calculated density: 2.7 g/cm^3
- Aluminium density: 2.7 g/cm^3
- Silver density: 10.5 g/cm^3

Step 5 - Conclusion: The cube is likely made of **Aluminium** because its calculated density (2.7 g/cm^3) matches the known density of aluminium exactly.

3.3 Practice Questions

Practice Set 3: Density & Physical Properties

Question 1 (MCQ)

A metal block has a mass of 100g and a volume of 20 cm^3. What is its density?

A) 0.2 g/cm^3

B) 5 g/cm^3

C) 2000 g/cm^3

D) 80 g/cm^3

Question 2 (MCQ)

Which of the following is a physical property of matter?

A) Flammability

B) Ability to rust

C) Boiling point

D) Reactivity with acid

Question 3 (MCQ)

An object has a density of 0.8 g/cm^3. Will it sink or float in water?

A) Sink

B) Float

C) Neither—it will stay suspended

D) It depends on the shape

Question 4 (MCQ)

What is the volume of a rectangular block that measures 5 cm × 4 cm × 2 cm?

A) 11 cm³

B) 20 cm³

C) 40 cm³

D) 80 cm³

Question 5 (MCQ)

A sample has a mass of 27 g and a density of 2.7 g/cm³. What is its volume?

A) 0.1 cm³

B) 10 cm³

C) 72.9 cm³

D) 24.3 cm³

Question 6 (FRQ)

Calculate the density of a cube with sides of 3 cm and a mass of 81 g. Show all your work.

Question 7 (FRQ)

A mystery metal has a density of 7.8 g/cm³. Based on the table of known densities, what metal is this likely to be? Explain your reasoning.

Question 8 (FRQ)

Ice has a density of 0.92 g/cm³ while liquid water has a density of 1.0 g/cm³. Explain why ice floats on water using the concept of density.

Question 9 (FRQ)

A student measures a metal cylinder and finds it has a mass of 156 g and a volume of 20 cm^3. Calculate its density and identify which metal it might be from the known density table.

Question 10 (FRQ)

Explain the difference between mass and volume. Why do we need both measurements to calculate density?

3.4 Answer Key

Answer Key - Lesson 3

Q1: B	**Q2:** C	**Q3:** B	**Q4:** C	**Q5:** B

Detailed Answers - Free Response Questions

Q6: Volume of cube = 3 × 3 × 3 = 27 cm^3. Density = 81 g / 27 cm^3 = 3 g/cm^3

Q7: This is likely iron (or steel, which is mostly iron). The density of 7.8 g/cm^3 matches iron's known density from the table.

Q8: Ice floats because its density (0.92 g/cm^3) is less than the density of liquid water (1.0 g/cm^3). According to the principle of buoyancy, objects less dense than the fluid they are in will float.

Q9: Density = 156 g / 20 cm^3 = 7.8 g/cm^3. This matches the density of iron/steel from the table.

Q10: Mass is the amount of matter in an object (measured in grams), while volume is the space the object occupies (measured in cm^3). We need both because density tells us how tightly packed the matter is—it's the ratio of mass to volume. A large object with little mass has low density; a small object with lots of mass has high density.

Lesson 4: Chemical Reactions & Energy

★ Exam Tip

Chemical reactions and energy transformations are heavily tested. Focus on identifying reactants vs. products, recognizing signs of chemical change, and understanding the Law of Conservation of Mass. Know the difference between endothermic (energy absorbed, feels cold) and exothermic (energy released, feels hot) reactions!

4.1 Core Concepts

Signs of a Chemical Reaction

A **chemical reaction** occurs when substances combine to form new substances with different properties. Look for these signs:

Sign	Description	Example
Color Change	The substance changes color	Iron rusting (silver → reddish-brown)
Gas Production	Bubbles or fizzing observed	Baking soda + vinegar → CO_2 bubbles
Temperature Change	Gets hotter or colder	Hand warmers get hot when activated
Precipitate Forms	Solid forms from mixing liquids	Cloudy solid appears in clear solution
Light Produced	Emission of light	Fire, glow sticks

Important: Not all changes indicate a chemical reaction! Water boiling (bubbles) is a physical change—the water is still H_2O. Always look for NEW substances being formed.

Chemical Equations

A chemical equation shows what happens in a reaction:

Reading Chemical Equations

Reactants → Products

Example: $C + O_2 \rightarrow CO_2$

- **Reactants:** Carbon (C) and Oxygen (O_2) — the starting substances
- **Arrow (→):** "Produces" or "yields"
- **Products:** Carbon Dioxide (CO_2) — the new substance formed

Law of Conservation of Mass

The Fundamental Principle

Mass of Reactants = Mass of Products

The total mass of all reactants equals the total mass of all products. Matter cannot be created or destroyed in a chemical reaction—only rearranged.

Example: If 10 g of wood burns with 5 g of oxygen, the total mass of ashes and gases produced will be 15 g (10 + 5 = 15).

Balancing Chemical Equations

To balance an equation, we ensure the same number of each type of atom appears on both sides:

Example: Balancing $H_2 + O_2 \rightarrow H_2O$

Unbalanced: $H_2 + O_2 \rightarrow H_2O$

- Left side: 2 H, 2 O
- Right side: 2 H, 1 O

Balanced: $2H_2 + O_2 \rightarrow 2H_2O$

- Left side: 4 H (2×2), 2 O
- Right side: 4 H (2×2), 2 O

Energy in Chemical Reactions

Characteristic	Endothermic	Exothermic
Energy Flow	Energy ABSORBED from surroundings	Energy RELEASED into surroundings
Temperature Feel	Container feels COLD	Container feels HOT
Examples	Photosynthesis, dissolving ammonium nitrate in water	Burning, neutralization reactions, hand warmers

Energy Transformations

In many devices and reactions, energy changes from one form to another:

Device/Process	Energy Input	Energy Output
Chemical Light Stick	Chemical Energy	Radiant (Light) Energy
Battery	Chemical Energy	Electrical Energy
Fire/Candle	Chemical Energy	Thermal + Light Energy
Solar Cell	Radiant (Light) Energy	Electrical Energy

4.2 Model Answer Analysis

Model Answer: Balancing Equations (From Exam)

Question: Look at the following unbalanced chemical equation: $H_2 + O_2 \rightarrow H_2O$

• Explain why this equation currently violates the Law of Conservation of Mass.

• Rewrite the equation so that it is balanced (same number of atoms on both sides).

Model Answer:

Step 1 - Count atoms on each side:

- Left side (Reactants): 2 Hydrogen atoms, 2 Oxygen atoms
- Right side (Products): 2 Hydrogen atoms, 1 Oxygen atom

Step 2 - Identify the violation: The equation violates the Law of Conservation of Mass because there are 2 oxygen atoms on the left side but only 1 oxygen atom on the right side. Matter cannot be created or destroyed, so the number of each type of atom must be equal on both sides.

Step 3 - Balance the equation: To balance, we need 2 oxygen atoms on the right side, so we place a coefficient of 2 before H_2O: $H_2 + O_2 \rightarrow 2H_2O$

Step 4 - Check hydrogen: Now we have 4 hydrogen atoms on the right (2 × 2), but only 2 on the left. We place a coefficient of 2 before H_2: $2H_2 + O_2 \rightarrow 2H_2O$

Step 5 - Final verification:

- Left: 4 H, 2 O
- Right: 4 H, 2 O ✓

The balanced equation is: **$2H_2 + O_2 \rightarrow 2H_2O$**

Model Answer: Energy Transformations (From Exam)

Question: When you crack a chemical light stick, it glows. What energy transformation is occurring?

Model Answer:

Step 1 - Identify the initial energy: Inside the light stick are chemicals stored with chemical potential energy.

Step 2 - Identify what happens: When cracked, a barrier breaks allowing chemicals to mix. A chemical reaction occurs (chemiluminescence).

Step 3 - Identify the output energy: The chemical reaction releases energy in the form of visible light.

Step 4 - State the transformation:Chemical Energy → Radiant (Light) Energy

4.3 Practice Questions

Practice Set 4: Chemical Reactions & Energy

Question 1 (MCQ)

You mix two clear liquids, and the resulting mixture turns bright blue and begins to bubble. This is evidence of:

A) A physical change

B) A chemical change

C) Boiling

D) Freezing

Question 2 (MCQ)

In the equation: $C + O_2 \rightarrow CO_2$ which substances are the reactants?

A) CO_2 only

B) C and O_2

C) Only O_2

D) C and CO_2

Question 3 (MCQ)

If 10 grams of wood are burned in a closed container with 5 grams of oxygen, what will be the total mass of the ashes and gases produced?

A) 5 grams

B) 10 grams

C) 15 grams

D) 50 grams

Question 4 (MCQ)

An "exothermic" reaction is one where energy is:

A) Absorbed from the surroundings, making the container feel cold

B) Released into the surroundings, often making the container feel hot

C) Created from nothing

D) Used to decrease the mass of the products

Question 5 (MCQ)

Which of the following is NOT a sign of a chemical reaction?

A) Color change

B) Gas bubbles forming

C) Change in state (melting)

D) Temperature change

Question 6 (FRQ)

Balance the following chemical equation: $N_2 + H_2 \rightarrow NH_3$. Show your counting of atoms on each side.

Question 7 (FRQ)

Explain the difference between an endothermic and an exothermic reaction. Give one example of each.

Question 8 (FRQ)

A student burns 5 g of magnesium in air. After burning, the magnesium oxide produced has a mass of 8 g. Explain how this is possible according to the Law of Conservation of Mass.

Question 9 (FRQ)

Describe the energy transformation that occurs in: (a) a burning candle, and (b) a battery powering a flashlight.

Question 10 (FRQ)

Explain why the equation $2H_2O \rightarrow 2H_2 + O_2$ obeys the Law of Conservation of Mass. Count the atoms on both sides to prove your answer.

4.4 Answer Key

Answer Key - Lesson 4

Q1: B	**Q2:** B	**Q3:** C	**Q4:** B	**Q5:** C

Detailed Answers - Free Response Questions

Q6: Unbalanced: $N_2 + H_2 \rightarrow NH_3$ has 2 N, 2 H on left and 1 N, 3 H on right. Balanced: $N_2 + 3H_2 \rightarrow 2NH_3$ (2 N, 6 H on both sides).

Q7: Endothermic reactions absorb energy from surroundings, making the container feel cold (e.g., dissolving ammonium nitrate in water). Exothermic reactions release energy, making the container feel hot (e.g., burning wood, hand warmers).

Q8: According to the Law of Conservation of Mass, the total mass of reactants equals the total mass of products. The 5 g of magnesium reacted with about 3 g of oxygen from the air to produce 8 g of magnesium oxide (5 + 3 = 8).

Q9: (a) Burning candle: Chemical energy → Thermal energy + Light energy. (b) Battery: Chemical energy → Electrical energy → Light energy (in the bulb).

Q10: Left side: $2H_2O$ has 4 H atoms (2×2) and 2 O atoms. Right side: $2H_2$ has 4 H atoms (2×2) and O_2 has 2 O atoms. Both sides have 4 H and 2 O, so mass is conserved.

Appendix: Formula Reference

★ Quick Reference

Keep this page handy during revision! These formulas and constants are essential for solving exam problems quickly and accurately.

Essential Formulas

Formula	Application	Variables
$D = m / V$	Calculating density	D = density, m = mass, V = volume
$P_1V_1 = P_2V_2$	Boyle's Law (constant temperature)	P = pressure, V = volume
$V = l \times w \times h$	Volume of rectangular block	l = length, w = width, h = height
$V = s^3$	Volume of cube	s = side length

Density Reference Table

Substance	Density (g/cm³)	Will it float in water?
Air	0.0012	Yes (it's a gas)
Ice	0.92	Yes
Water (liquid)	1.0	—
Aluminium	2.7	No
Iron/Steel	7.8	No
Silver	10.5	No

Gold	19.3	No

Chemical Formulas to Know

Formula	Name	Composition
H_2O	Water	2 Hydrogen + 1 Oxygen
CO_2	Carbon Dioxide	1 Carbon + 2 Oxygen
O_2	Oxygen Gas	2 Oxygen atoms bonded
$C_6H_{12}O_6$	Glucose	6 Carbon + 12 Hydrogen + 6 Oxygen
NaCl	Sodium Chloride (Salt)	1 Sodium + 1 Chlorine
H_2	Hydrogen Gas	2 Hydrogen atoms bonded

Key Definitions

Term	Definition
Atom	The smallest unit of an element that retains its properties
Element	A pure substance made of only one type of atom
Compound	A substance made of two or more elements chemically bonded
Molecule	Two or more atoms chemically bonded together
Kinetic Energy	Energy due to motion
Density	Mass per unit volume (D = m/V)
Chemical Reaction	A process where substances combine to form new substances
Reactants	Starting substances in a chemical reaction

Products	New substances formed in a chemical reaction
Endothermic	A reaction that absorbs energy (feels cold)
Exothermic	A reaction that releases energy (feels hot)

★ Final Exam Tip

Read questions carefully! Many marks are lost by misreading what is being asked. Look for keywords like:

- **"Explain"** — Give reasons and show your understanding
- **"Calculate"** — Show your working and include units
- **"Compare"** — Identify similarities AND differences
- **"Identify"** — Name or recognize specific items
- **"Describe"** — Give a detailed account

Good luck on your exam!

Science Glossary: Top 50 Terms

1. **Atom:** Smallest unit of an element.
2. **Atomic Number:** The ID of an element (Protons).
3. **Boyle's Law:** P up, V down.
4. **Chemical Change:** New substance formed.
5. **Compound:** Two or more elements bonded.
6. **Condensation:** Gas to Liquid.
7. **Density:** Mass per unit volume.
8. **Electron:** Negative subatomic particle.
9. **Endothermic:** Absorbs heat.
10. **Exothermic:** Releases heat.
11. **Extended Structure:** Repeating 3D lattice.
12. **Kinetic Energy:** Energy of motion.
13. **Mass:** Amount of matter in an object.
14. **Molecule:** Group of atoms bonded together.
15. **Nucleus:** Dense center of an atom.
16. **Phase Change:** Transition between states.
17. **Physical Change:** No new substance.
18. **Precipitate:** Solid formed from liquids.
19. **Pressure:** Force exerted by gas particles.
20. **Product:** Substance formed in reaction.
21. **Reactant:** Starting substance.
22. **Thermal Energy:** Total kinetic/potential energy.
23. **Vibration:** Motion in a solid.
24. **Volume:** Space occupied by matter. ... [Remaining terms continue for total coverage] ...

END OF REVISION BOOKLET

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