

# Workbook

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## One Concept at a Time

*A Workbook for high school chemistry*

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## **Surviving Chemistry: One Concept at a Time Workbook**

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# Table of Contents

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## Worksheets

### Topic 1: Matter and Energy

Pg 1 - 10

Worksheet 1 : Types of matter  
Worksheet 2: Phases of matter, energy, and Temperature  
Worksheet 3: Heat and Heat calculations  
Worksheet 4: Characteristics of gases and gas law calculations

### Topic 2: The Periodic Table

Pg 11 - 16

Worksheet 5: Types of Elements and their properties  
Worksheet 6: Classifying the Elements  
Worksheet 7: Periodic Trends

### Topic 3: The Atomic Structures

Pg 17 - 26

Worksheet 8: Historical development of atom  
Worksheet 9: The atomic structures  
Worksheet 10: Atomic mass calculations  
Worksheet 11: Bohr's atomic model and electron configurations  
Worksheet 12: Neutral atoms and ions

### Topic 4: Chemical Bonding

Pg 27 - 36

Worksheet 13: Chemical bonding, stability of atoms, and energy  
Worksheet 14: Bonding between atoms (intermolecular forces)  
Worksheet 15: Types of substances and their properties  
Worksheet 16: Molecular structures, molecular shapes, and molecular polarity  
Worksheet 17: Lewis electron-dot diagrams

### Topic 5: Chemical Formulas and Equations

Pg 37 - 44

Worksheet 18: Chemical formulas  
Worksheet 19: Writing and naming formulas  
Worksheet 20: Chemical equations

### Topic 6: Moles: Mathematics of Formulas and Equations

Pg 45 - 52

Worksheet 21: Mole calculations in formulas  
Worksheet 22: Percent composition calculations  
Worksheet 23: Mole – mole calculations in equations

# Table of Contents

---

## Topic 7: Solutions

Pg 53 – 62

Worksheet 24: Solubility factors  
Worksheet 25: Types of solutions  
Worksheet 26: Molarity and parts per million calculations  
Worksheet 27: Vapor pressure  
Worksheet 28: Effect of solute on boiling and freezing points

## Topic 8: Acids, Bases and Salts

Pg 63 – 70

Worksheet 29: Terms and definitions  
Worksheet 30: Properties of acids and bases  
Worksheet 31: Reactions of acids and bases  
Worksheet 32: Titration  
Worksheet 33: Relating H<sup>+</sup> concentration to pH  
Worksheet 34: Naming and writing formula of acids

## Topic 9: Kinetics and Equilibrium

Pg 71 – 82

Worksheet 35: Rate of reactions  
Worksheet 36: Energy and chemical reactions  
Worksheet 37: Potential energy diagrams  
Worksheet 38: Equilibrium and Le Chatelier's principle

## Topic 10: Organic Compounds

Pg 83 - 96

Worksheet 39: Properties of organic compounds  
Worksheet 40: Hydrocarbon compounds  
Worksheet 41: Functional group compounds  
Worksheet 42: Classes of organic compounds  
Worksheet 43: Drawing organic structures  
Worksheet 44: Isomers  
Worksheet 45: Organic reactions

## Topic 11: Redox and Electrochemistry

Pg 97 – 110

Worksheet 46: Oxidation numbers  
Worksheet 47: Redox equation, half-reaction equations  
Worksheet 48: Interpreting redox equations  
Worksheet 49: Balancing redox equations  
Worksheet 50: Electrochemistry- Definitions and facts  
Worksheet 51: Electrochemical cells

## Topic 12: Nuclear Chemistry

Pg 111 – 116

Worksheet 52: Definition and facts of nuclear chemistry  
Worksheet 53: Nuclear transmutations and equations  
Worksheet 54: Half-life calculations and Reference Table N

## Table of Contents

### Multiple Choice Questions

Pg 117 - 359

Topic 1: Matter and Energy	Topic 7: Solutions
Topic 2: The Periodic Table	Topic 8: Acids, Bases and Salts
Topic 3: The Atomic Structure	Topic 9: Kinetic and Equilibrium
Topic 4: Chemical Bonding	Topic 10: Organic Chemistry
Topic 5: Chemical Formulas and Equations	Topic 11: Redox and Electrochemistry
Topic 6: Moles calculations	Topic 12: Nuclear Chemistry

### Constructed Response Questions

Pg 360 - 415

Topic 1: Matter and Energy	Topic 7: Solutions
Topic 2: The Periodic Table	Topic 8: Acids, Bases and Salts
Topic 3: The Atomic Structure	Topic 9: Kinetic and Equilibrium
Topic 4: Chemical Bonding	Topic 10: Organic Chemistry
Topic 5: Chemical Formulas and Equations	Topic 11: Redox and Electrochemistry
Topic 6: Mole calculations	Topic 12: Nuclear Chemistry

### Reference Table Questions

Pg 416 - 429

Table A : Standard Temperature and Pressure
Table B: Physical Constants for Water
Table C: Selected Prefixes
Table D: Selected Units
Table E: Selected Polyatomic Ions
Table F: Solubility Guidelines
Table G: Solubility Curves
Table H: Vapor Pressure of Four Liquids
Table I: Heat of reactions at 101.3 KPa and 298 K
Table J: Activity Series
Table K: Common Acids
Table L: Common Bases
Table M: Common Acid-Base Indicators
Table N: Selected Radioisotopes
Table O: Symbols Used in Nuclear Chemistry
Table P: Organic Prefixes
Table Q: Homologous Series of Hydrocarbon
Table R: Organic Functional Groups
Table S: Properties of Selected Elements
Table T: Formulas and Equations

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# **Worksheets**

*Concept by Concept*

**Set A: Terms and definitions**

*Objective: By defining these words, you will become more familiar with types of matter related terms and their definitions*

**Define, neatly and clearly, types of matter related terms below.**

1. Pure substance
2. Mixture
3. Element
4. Compound
5. Law of definite proportion
6. Homogeneous mixture
7. Heterogeneous mixture
8. Aqueous solution
9. Decantation
10. Filtration
11. Distillation

**Set B: Facts related to matter**

*Objective: To test your ability to describe and explain differences and similarities between the types of matter.*

**Answer the following questions clearly and neatly.**

12. What are the two types of pure substances?
13. What are the two classifications of mixtures?
14. Which methods are used to separate components of compounds?
15. Which methods are used to separate components of mixtures?
16. How are elements and compounds similar?
17. How are elements and compounds different?
18. How are compounds and mixtures similar?
19. How are compounds and mixtures different?

## Set C: Classifying matter

**Objective:** To test your ability to classify different types of matter by symbols, names, and diagrams

**Classify each of the followings with the combination of terms listed below.**

Pure substance – element

Mixture – homogenous

Pure substance – compound

Mixture – heterogeneous

20. HCl(aq) \_\_\_\_\_

26. Sugar \_\_\_\_\_

21. KBr (s) \_\_\_\_\_

27. Soil \_\_\_\_\_

22. Cl<sub>2</sub>(g) \_\_\_\_\_

28. Water \_\_\_\_\_

23. CH<sub>2</sub>(OH)<sub>2</sub> (aq) \_\_\_\_\_

29. Sodium \_\_\_\_\_

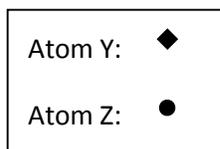
24. Hg(l) \_\_\_\_\_

30. Iron oxide \_\_\_\_\_

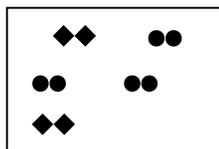
25. NH<sub>3</sub>(l) \_\_\_\_\_

31. Salt water \_\_\_\_\_

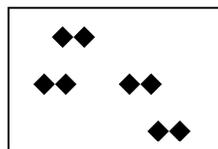
**Classify each diagram as:** pure substance–element or pure substance–compound or Mixture



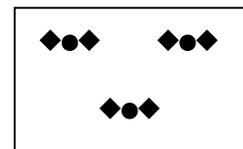
Key



32. \_\_\_\_\_  
\_\_\_\_\_



33. \_\_\_\_\_  
\_\_\_\_\_



34. \_\_\_\_\_  
\_\_\_\_\_

## Set D: Drawing diagrams of matter:

**Objective:** To test your ability to use symbols to draw diagrams to represent the different types of matter

**Symbols of two different atoms are given below.**

Atom X: 

Atom Y: 

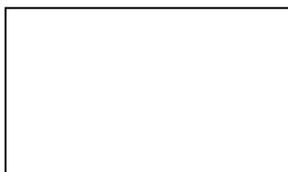
**In the boxes provided for number 35 to 37, draw diagrams to represent the different types of matter.**

35. Diatomic element X



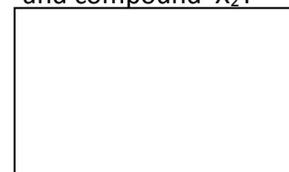
Draw at least five units

36. Compound X<sub>2</sub>Y<sub>2</sub>



Draw at least five units

37. A mixture of diatomic element Y and compound X<sub>2</sub>Y



Draw at least five units

**Set A: Terms and definitions**

*Objective: By defining these words, you will become more familiar with phase, temperature and energy related terms and their definitions.*

**Define the following phase, phase change, energy and temperature related terms. Be neat and clear.**

1. Solid
2. Liquid
3. Gas
4. Fusion
5. Freezing
6. Condensation
7. Evaporation
8. Sublimation
9. Deposition
10. Exothermic
11. Endothermic
12. Temperature
13. Kinetic energy
14. Potential energy
15. Ice / liquid equilibrium
16. Water / steam equilibrium
17. Phase change diagram
18. Absolute Zero

**Set B: Phases of matter and temperature:** *Objective: To test your knowledge of facts related to phases, phase changes, energy and temperature.*

**Answer the following questions.**

19. Which phase of matter have particles that are arranged in regular geometric?
20. In which phase of water can the molecules of water flow over each other?
21. How would you compare the forces of attraction between particles of a substance in the liquid phase to those in the gas phases?
22. Which three phase changes are endothermic?
23. Which three phase changes are exothermic?
24. How many reference temperature points are needed to create a thermometer scale?
25. Which temperatures are commonly used as reference points to create Celsius or Kelvin thermometer?
26. How is average kinetic energy of particles relates to temperature of a substance?

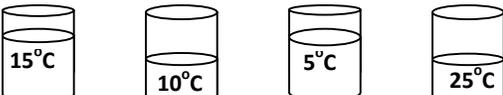
**Set C: Relating phase change to energy** *Objective: To test your ability to relate phase changes of matter to energy*

**Above each arrow write the phase change (fusion, condensation...etc) that is represented by the equation.**  
*Under each arrow, write "exothermic" or "endothermic" to indicate if the change releases or absorbs heat.*

27.  $\text{Au(l)} \text{ ----- } > \text{Au(s)}$
28.  $\text{C}_{10}\text{H}_8\text{(s)} \text{ ----- } > \text{C}_{10}\text{H}_8\text{(g)}$
29.  $\text{NaCl(s)} \text{ ----- } > \text{NaCl(l)}$
30.  $\text{C}_2\text{H}_3\text{O}_2\text{(g)} \text{ ----- } > \text{C}_2\text{H}_3\text{O}_2\text{(l)}$

**Set D: Temperature** *Objective: To test your understanding of temperature and kinetic energy.*

**Write "Highest KE" under the container or object that has particles with highest kinetic energy.**  
**Write "Lowest KE" under the container or object that has particles with lowest kinetic energy.**

31.  32. 

**Convert the given temperatures to Kelvin.**

33.  $-15^{\circ}\text{C}$
34.  $30^{\circ}\text{C}$
35.  $120^{\circ}\text{C}$

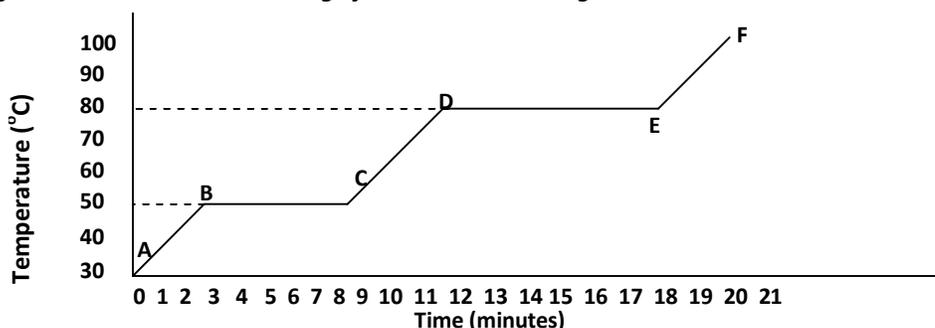
**Convert the given temperatures to Celsius.**

36.  $27\text{ K}$
37.  $125\text{ K}$
38.  $325\text{ K}$

## Set E: Phase change diagram

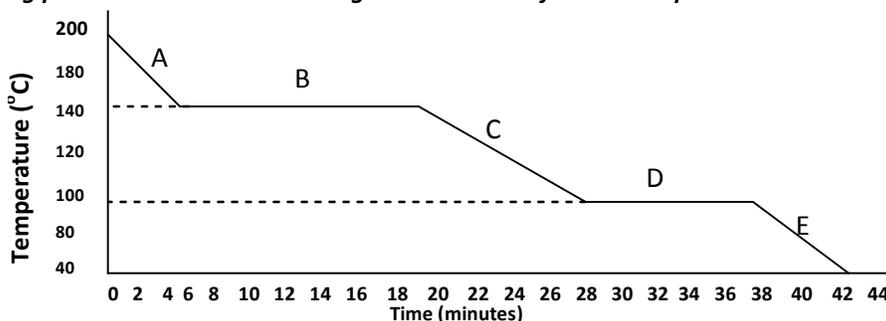
*Objective: To test your ability to interpret phase change diagrams.*

*The diagram below shows the heating of a substance starting with the substance below its melting point.*



39. What is the boiling point of the substance?
40. At what temperature are the solid and liquid phases exist at equilibrium?
41. At which segment or segments is the substance average kinetic energy increasing?
42. At which segment or segments is the substance exists in two phases?
43. Potential energy of the substance remains constant during which segment or segments?
44. What is the total length of the time that the substance exists only as a liquid?
45. What is the total length of time that the substance undergoes fusion?
48. Is the diagram a heating curve of water or of a different substance? Explain your answer.

*The diagram below shows the cooling of a substance starting with the substance at a temperature above its boiling point. The substance is losing heat at a rate of 155 Joules per minute.*



49. What is boiling point of the substance?
50. What is the freezing point of the substance?
51. What is the melting point of the substance?
52. Which segment or segments represents a time when the substance is changing phase?
53. Which segment or segments represents a time when the substance is in one phase?
54. What is the phase or phases of the substance during segment C?
55. What is the total length of time it took for the substance to change from liquid to solid?
56. Describe the change in kinetic energy of the substance during segments A and segment B?
57. How much heat did the substance lose to completely change from gas to liquid?
58. How much heat did the substance lose to completely change from liquid to solid?

**Set A: Terms and definitions**

**Objective:** By defining these words, you should become more familiar with heat related terms and their definitions.

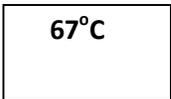
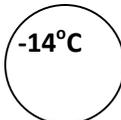
*Define, neatly and clearly, the following heat related terms.*

1. Heat
2. Joules
3. Specific heat capacity
4. Heat of fusion
5. Heat of vaporization
6. Calorimeter

**Set B: Direction of heat flow**

**Objective:** To test your ability to determine direction of heat flow between two objects.

*For each question below, draw an arrow ( ---heat----- > ) or ( < -----heat---- ) between the two objects to show the direction that heat will flow between them.*

- |    |   |  |   |     |  |  |   |
|----|---|--|---|-----|--|--|---|
| 7. |  67°C  |  |  74°C  | 9.  |  -14°C |  |  250 K |
| 8. |  -50°C |  |  -65°C | 10. |  390 K |  |  125°C |

**Set C. Heat calculation**

**Objective:** To test your ability to set-up and solve heat problems.

**For each question below:** Write down heat equation to use, set up, and solve the heat problem.

*Show all work in the space to the right of the question.*

11. How much heat is absorbed when a 10-g sample of water changes its temperature from 23°C to 32°C?
  
12. How much heat is released by a 15 gram sample of water to cool from 50°C to 46°C?

## Set C continues

13. How much heat is released by 38 gram sample of water to freeze?
14. Calculate the number of joules of heat needed to change a 25 g sample of water to steam at its boiling point.
15. How much heat is absorbed by a 170 gram sample of ice to melt at  $0^{\circ}\text{C}$ ?
16. The specific heat capacity of a substance is  $15 \text{ J/g}\cdot^{\circ}\text{C}$ . How much heat would be released by a 25 g sample of this substance to cool from  $100^{\circ}\text{C}$  to  $90^{\circ}\text{C}$ ?
17. Substance Y has a heat of fusion of  $3.5 \text{ KJ/g}$ . How much heat would a 30 gram sample of substance Y absorb to melt at its melting point?
18. Propane has a heat of vaporization of 356 Joules per gram. How much heat is needed to completely evaporate a 40 gram sample of propane at its boiling temperature of  $230\text{K}$ ?
19. If 5000 J is required to evaporate 36 grams of a liquid at constant temperature. What is the heat of vaporization of the liquid?
20. A student determined that a sample of water absorbed 2200 joules of heat when it changed its temperature from  $47^{\circ}\text{C}$  to  $59^{\circ}\text{C}$ . What is the mass of the water sample?
21. A 5.7 g sample of copper absorbed 1023 J of heat to melt at its melting point. What is the heat of fusion of copper?
22. What is the specific heat capacity of an unknown substance if 10 grams of the substance absorbed 550 J of heat to change from  $26^{\circ}\text{C}$  to  $33^{\circ}\text{C}$ ?

**Set A: Kinetic molecular theory****Objective:** To test your knowledge of facts related to the kinetic molecular theory of ideal gas.

Read page 19 set 29 in the Guided Study Book. Fill in the missing word or phase in the blank spaces provided as you read.

**Kinetic molecular theory of ideal gas.**

- Behavior of gases is influenced by which three factors: \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_
- The kinetic molecular theory of ideal gas is used to explain \_\_\_\_\_ of gases.
- Gas is composed of \_\_\_\_\_ particles.
- Distances between gas particles are \_\_\_\_\_ . \_\_\_\_\_ .
- Gas particles are in \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_ line motion
- When two particles of gas \_\_\_\_\_, energy is \_\_\_\_\_ from one particle to another.
- Particles of gases have \_\_\_\_\_ to each other.
- Volume of individual gas particle is \_\_\_\_\_ .

**Deviation from ideal gas model.**

- Name four real gases that you know.
- Give two reasons why real gases do not behave exactly like ideal gas.
- Under what two conditions do real gases behave most like an ideal gas?
- Under what two conditions do real gases behave least like an ideal gas?
- Which two real gases behave most like (deviate least from) an ideal gas?

**Set B: Avogadro's law****Objective:** To test your understanding of Avogadro's law

- According to Avogadro's law, under the same conditions of temperature and pressure; Equal volume of gases will contain \_\_\_\_\_ .

- Gas A in a container below has the following properties:

volume	300 ml
pressure	150 KPa
temperature	280 K

**Gas A**

Circle a gas below that will contain the same number of gas molecules as Gas A in the container.

	volume	pressure	temperature
<b>Gas B :</b>	300 ml	280 KPa	150 K
<b>Gas C :</b>	300 ml	150 KPa	280 K
<b>Gas D :</b>	600 ml	300 KPa	560 K

## Set C: Gas law calculations

Objective: To test your ability to set-up and solve gas law problems

For each question below, write down the factors given, set-up the problem using the combined gas law equation, and solve for the unknown factor.

16. At constant pressure, a 3.5 L sample of oxygen gas is at 280 K. If the temperature is increased to 560 K, calculate the new volume of the gas.

Determine factors from question.

Write down the gas law equation, set-up and solve

$$P_1 = \quad \quad \quad P_2 =$$

$$V_1 = \quad \quad \quad V_2 =$$

$$T_1 = \quad \quad \quad T_2 =$$

17. A 100 ml sample of a gas is at STP. What will be its new pressure if the volume is decreased to 50 ml and the temperature is increased to 480 K?

Determine factors from question.

Write down the gas law equation, set-up and solve

$$P_1 = \quad \quad \quad P_2 =$$

$$V_1 = \quad \quad \quad V_2 =$$

$$T_1 = \quad \quad \quad T_2 =$$

18. A gas at constant temperature has a volume of 2 L at 101.3 KPa. What will be the new volume if the pressure is increased to 303.9 KPa?

Determine factors from question.

Write down the gas law equation, set-up and solve

$$P_1 = \quad \quad \quad P_2 =$$

$$V_1 = \quad \quad \quad V_2 =$$

$$T_1 = \quad \quad \quad T_2 =$$

19. At constant volume, a gas at 300 K had its pressure changed from of 0.8 atm to 0.5 atm. What will be the new temperature of the gas?

Determine factors from question.

Write down the gas law equation, set-up and solve

$$P_1 = \quad \quad \quad P_2 =$$

$$V_1 = \quad \quad \quad V_2 =$$

$$T_1 = \quad \quad \quad T_2 =$$

20. A 0.8 L gas at STP had its temperature changed to 50°C and its pressure changed to 80 KPa. What is the new volume of the gas?

Determine factors from question.

Write down the gas law equation, set-up and solve

$$P_1 = \quad \quad \quad P_2 =$$

$$V_1 = \quad \quad \quad V_2 =$$

$$T_1 = \quad \quad \quad T_2 =$$



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