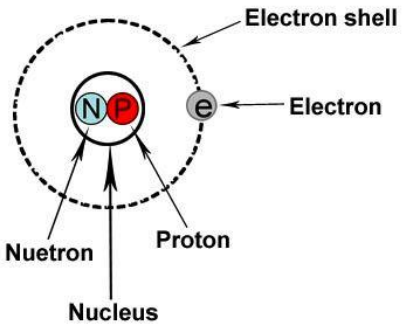
Chapter One: Atoms and Elements

The Atom and The History of the Atom

1. **Draw an atom and label the following parts: electron, proton, shell, neutron, and nucleus.**
   Drawing is to the right.



2. **What charge do protons have? What charge do electrons have?**
   Protons have a positive charge and electrons have a negative charge.

3. **What are the names of the two philosophers who first came up with the concept of the atom?**
   Democritus and Aristotle were the first two philosophers who came up with the concept of the atom.

4. **Explain Dalton's theory of the atomic model**
   Dalton thought of atoms as solid, indivisible balls of different masses.

5. **Explain Thomson's theory of the atomic model**
   Thomson views the atom as a body like a blueberry muffin – a certain amount of muffin dough (positively charged substance), embedded with blueberries (negatively charged particles, namely electrons).

6. **Explain Rutherford's theory of the atomic model**
   Rutherford believed that a small, dense nucleus contains the entire positive charge of the atom, while the electrons, lightweight and negatively charged are scattered randomly in a large space around the nucleus.

7. **Explain Bohr's theory of the atomic model (also referred to as the Rutherford-Bohr model)**
   Bohr added onto Rutherford's theory, and in Bohr's model there is a very small nucleus surrounded by electrons moving in a series of orbits.

8. **What did Chadwick add to the atomic model (also referred to as the Simplified Atomic model)**
   Chadwick added the neutron inside the nucleus to the Rutherford-Bohr model.

Periodic Table

9. **Fill in the following table on the location of the following:**

	Location on Periodic Table
Metals	*To the left of the staircase*
Non-Metals	*To the right of the staircase*
Metalloids	*Along the staircase*
Alkali Metals	*All elements in the first column (except Hydrogen)*
Alkaline Earth Metals	*All elements in the second column*
Halogens	*All elements in the second-last column*
Noble Gases	*All elements in the last column*

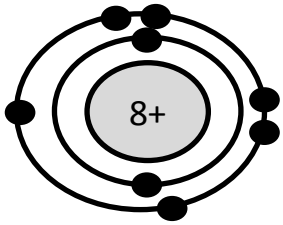
10. **Which element is in the 2nd period and 4th group?**
    Carbon

11. **Which element is in the 4th period and 7th group?**
    Bromine

12. **How can we tell how many valence electrons an atom has?**
    By looking at the group number. The group number corresponds to the number of valence electrons an element has.

13. **Draw Magnesium in Lewis Notation**

14. **Draw the Rutherford-Bohr model of Oxygen**



Chapter Two: Molecules and Solutions

Ions

15. **What is the difference between an atom and a molecule? Give an example of each.**
    An atom is the smallest particle of matter, and it is singular. An element on its own is an atom such as Carbon (C) or Oxygen (O). A molecule is a group of two or more chemically bonded atoms such as water (H_2O) or carbon dioxide (CO_2)

16. **What is the difference between an atom and an ion?**
    An atom is the smallest particle of matter, and it is singular. An element on its own is an atom such as Carbon (C) or Oxygen (O). An ion is an atom that has been electrically charged by losing or gaining one or more electrons.

17. **Why would an atom want to gain or lose electrons?**
    Atoms gain or lose electrons to acquire the configuration of the noble gas closest to them. Atoms would gain or lose electrons so that they can have full valence electron shells.

18. **Do atoms ever gain or lose protons?**
    NO! Atoms never gain or lose protons.

19. **Does a positive ion gain or lose electrons?**
    A positive ion loses electrons.

20. Does a negative ion gain or lose electrons?

A negative ion gains electrons.

21. How many protons and electrons does N^{-3} have?

N^{-3} has 7 protons (since the atomic number of N is 7, and the number of protons never changes), and 10 electrons (because it originally had 7 electrons and it has gained 3 more electrons).

22. What is the symbol for Calcium as an ion? Ca^{+2}

23. What is the symbol for Nitrogen as an ion? N^{-3}

Solutions and Concentration

24. What is an aqueous solution?

An aqueous solution is a solution in which the solvent is water.

25. Fruit juices, body fluids and cleaning solutions for contact lenses are all examples of aqueous solutions. What is the solvent in these solutions?

Since they are all aqueous solutions, we know that the solvent in each of them is water.

26. A solution has a volume of 2L and a concentration of 15 g/L, what is the mass of the solution?

V = 2 L
C = 15 g/L
M = ?

$M = C \times V$
$M = 15\ g/L \times 2\ L$
$M = 30\ g$

The mass of the solution is 30 g.

27. You are given a 7 L solution that has 2500 ml of sugar dissolved in it. What is the % (v/v) concentration of the solution?

2500mL = solute
7L = 7000 mL = solvent
x1000

$\frac{\text{Solute}}{\text{Solvent}} \times 100 \rightarrow \frac{2500}{7000} \times 100 \rightarrow 0.35 \times 100 = 35\%$

The concentration is 35%

28. A 200 ml glass of sugar-water contains 0.4 g of sugar. What is the percent of concentration?

0.4 g = solute
200 mL = Solvent

$\frac{\text{Solute}}{\text{Solvent}} \times 100 \rightarrow \frac{0.4}{200} \times 100 \rightarrow 0.002 \times 100 = 0.2\%$

The concentration is 0.2%

29. A solution has a concentration of 15.5 g/L and a mass of 35.65 g.

a) What is the volume of this solution?

C = 15.5 g/L

M = 35.65 g

V = ?

$V = \frac{M}{C}$

$V = \frac{35.65\ g}{15.5\ g/L}$

V = 2.3 L

The volume of the solution is 2.3 L.

b) What is the ppm of this solution?

$\frac{?\ g}{1000\ L} = \frac{35.65\ g}{2.3\ L}$

$2.3 \cdot x = 1000 \cdot 35.65$

$2.3x = 35650$

$x = 35650/2.3$

$x = 15500\ g$

The PPM is 15500.

30. A 30 L sample of river water has 12 g of contaminant in it. What is the PPM concentration of the pond water?

$\frac{?\ g}{1000\ L} = \frac{12\ g}{30\ L}$

$30 \cdot x = 1000 \cdot 12$

$30x = 12000$

$x = 12000/30$

$x = 400\ g$

The concentration is 400 ppm

Electrolytes

31. An apple has a pH value of 3 and a carrot has a pH value of 5. Which of these food items is more acidic?

The apple is more acidic since it has a lower pH value.

32. What colors do blue and red litmus paper turn when put into an acid?

Blue litmus paper will turn red when put into an acid, and red litmus paper will remain red when put into an acidic solution.

33. State whether the following are acids, bases or salts:

	Acid, Base or Salt?		**Acid, Base, or Neutral?**
KOH	*Base*	**Solution with a pH of 6**	*Acid*
HNO_3	*Acid*	**Solution with a pH of 13.9**	*Base*
H_2SO_3	*Acid*	**Solution with a pH of 2**	*Acid*
NaCl:	*Salt*	**Solution with a pH of 7**	*Neutral*

Chapter 3: Different Forms of Energy

34. **Explain why the total amount of energy in a system always remains constant.**
    The amount of energy in a system always remains constant because of the law of conservation of energy. Energy cannot be created or destroyed, it can only be transferred or transformed.

35. **What is the formula to find energy efficiency?**
    $$\frac{\text{Amount of useful energy}}{\text{Amount of consumed energy}} \times 100$$

36. **Why are most substances not 100% efficient?**
    Most substances are not 100% efficient because some of the energy can be lost to the environment. If we think about a candle, some of the heat energy spreads out throughout the room that it is in.

37. **To perform 1200 J of useful energy, a machine consumes 20 000 KJ. What is the energy efficiency of this machine?**
    1200 J = useful
    20 000 kJ = consumed
    x1000 = 20 000 000 J
    $\frac{\text{useful}}{\text{consumed}} \times 100 \rightarrow \frac{1200}{20\,000\,000} \times 100$
    → 0.006 %

38. **An electric lawn mower consumes 30 000 J of energy in order provide 12 500 J of useful energy. What is its percent efficiency?**
    12 500 J = useful
    30 000 J = consumed
    $\frac{\text{useful}}{\text{consumed}} \times 100 \rightarrow \frac{12\,500}{30\,000} \times 100$
    → 41.67 %

39. **What is the difference between heat and temperature?**
    Heat is the transfer of thermal energy between two environments with different temperatures. Heat always passes from the warmer to the cooler environment. Temperature is a measure of the degree of agitation of the particles of a substance.

Chapter 4: Changes in Matter

40. **What is a physical change? Provide two examples.**
    A physical change doesn't alter the nature nor the characteristic properties of matter. The atoms and molecules of the substance do not change. Ripping paper, chopping wood, water freezing and cutting hair are all examples of physical changes.

41. **What is a chemical change? Provide two examples.**
    A chemical change alters the nature and characteristic properties of matter. The bonds between atoms are rearranges and new molecules are formed. Frying an egg and burning wood are examples of chemical changes.

42. What signs point to the occurrence of a chemical change? List 5.

- The release of a gas
- The emission or absorption of heat
- The emission of light
- A change in colour
- The formation of a precipitate

43. What is the law of conservation of mass?

The law of conservation of mass states that the total mass of reactants is always equal to the total mass of products. Whatever the atoms and molecules weighed before the reaction, they will weigh the same thing after the reaction.

44. What is acid-base neutralization?

An acid-base neutralization is a chemical change involving the reaction of an acid with a base, producing a salt and water.

45. What is oxidation?

Oxidation is a chemical change involving oxygen or a substance with properties similar to those of oxygen.

46. What is combustion?

Combustion is a chemical change that is a form of oxidation and releases a large amount of energy.

47. What is cellular respiration?

A chemical change where glucose and oxygen are used to generate energy, the reaction also produces carbon dioxide and water.
Glucose + Oxygen → Energy + Carbon Dioxide + Water

48. What is photosynthesis?

A chemical change that produces glucose and oxygen from solar energy, carbon dioxide and water.
Solar Energy + Carbon Dioxide + Water → Glucose + Oxygen

49. To learn how to control fires, firefighters have to study the three necessary conditions for a fire to start. What are these conditions?

The three necessary conditions for a fire to start are an oxidizing agent (such as oxygen), a fuel (such as gasoline) and an ignition temperature.

50. If 12 grams of water react with salt (NaCL) to create 3 grams of HCl and 20 grams of NaOH, how much salt was needed?

$H_2O + NaCl \rightarrow HCl + NaOH$

$12g + ? \quad 3g + 20g$

$23g \quad 23g$

$23 - 12 = 11g$

11 g of NaCl (salt) is needed.

51. The neutralization of 24.5 g of sulphuric acid (H_2SO_4) requires 42 g of sodium bicarbonate ($NaHCO_3$). This neutralization reaction produces 35.5 g of sodium sulphate Na_2SO_4), 22 g of carbon dioxide (CO_2) and a certain amount of water (H2O).

The balanced equation for this reaction is:

$H_2SO_4 + 2\ NaHCO_3 \rightarrow Na_2SO_4 + 2CO_2 + 2H_2O$

24.5 + 42 = 35.5 + 22g + ?

What is the mass of the water produced during this neutralization reaction?

66.5g

57.5 + ? = 66.5

66.5 − 57.5 = 9

9 g of H_2O is needed.

z

52. Balance the following equations:

a) $2\ Mg + O_2 \rightarrow 2\ MgO$

Mg = X2 | Mg = X2

O = 2 | O = X2

b) $4\ Fe + 3\ O_2 \rightarrow 2\ Fe_2O_3$

Fe = X4 | Fe = 24

O = 26 | O = 36

c) $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$

C = 3

H = 8

O = 210

C = X3

H = 28

O = 26 } 8 10

= X4

d) $2\ KOH + H_2SO_4 \rightarrow K_2SO_4 + 2\ H_2O$

K = X2 | K = 2

O = X2 | O = 4

O = 4 | O = X2

H = X2 | H = 24

H = 2

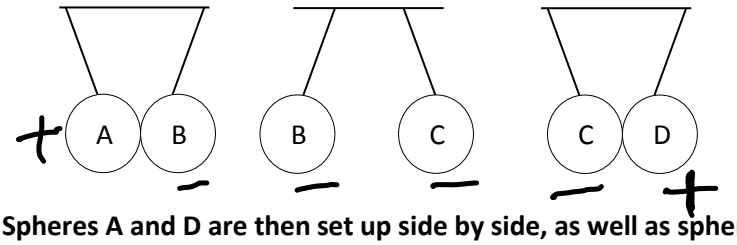
S = 1 | S = 1

Chapter 5: Electricity

53. Complete the following statements:

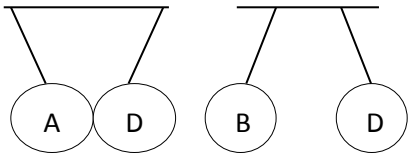
- **Like charges** repel.
- **Opposite charges** attract

54. The following experiment is set up using charged spheres.



Spheres A and D are then set up side by side, as well as spheres B & D. Which diagram below correctly shows what would happen?

A)



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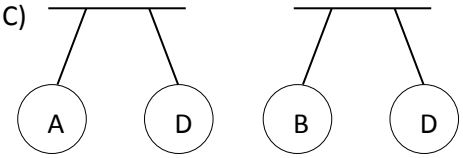

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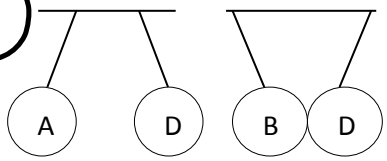

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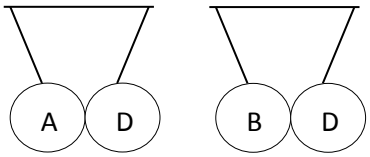

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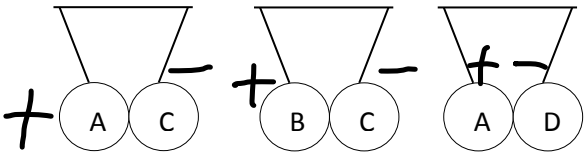

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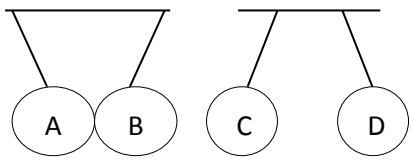
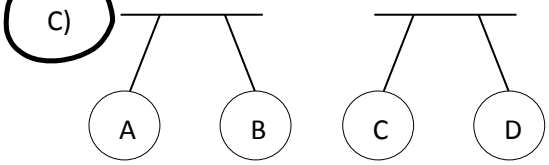
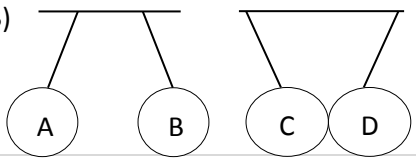


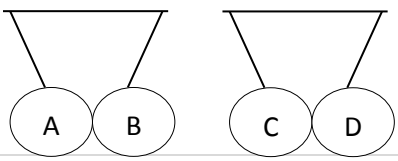
C)



B)



D)



TENDENCY	SUBSTANCE
Acquire a Negative Charge	Rubber
	Ebonite
	Polyethylene (Plastic)
	Cotton
	Silk
	Wool
	Glass
	Acetate
Acquire a Positive Charge	Fur

56. What charges will ebonite and wool acquire if they are rubbed together?

Ebonite will acquire a negative charge while wool will acquire a positive charge.

57. What charges will wool and glass each acquire if they are rubbed together?

Wool will acquire a negative charge while glass will acquire a positive charge.

58. Explain why your hair sticks up after pulling off a wool hat in the winter.

The wool takes electrons from the arm hair leaving the arm hair with a positive charge. Like charges repel so all of the arm hairs (which are now all positive) try to repel each other and all stick up in different directions.

Ohm's Law

59. Find the applied voltage of a circuit that draws 0.2 amperes through a 4800-ohm resistance.

I = 0.2 amperes
R = 4800 ohms
V = ?

V = IR
V = 0.2 A × 4800 ohms
V = 960 volts

The applied voltage is 960 volts.

60. A 20-volt relay has a coil resistance of 200 ohms. How much current does it draw?

V = 20 volts
R = 200 ohms
I = ?

$I = \frac{V}{R}$

$I = \frac{20\ V}{200\ \Omega}$

I = 0.1 A

The current intensity is 0.1 amps.

61. Find the resistance of a circuit that draws 0.06 amperes with 12 volts applied.

I = 0.06 amps
V = 12 volts
R = ?

$R = \frac{V}{I}$

$R = \frac{12\ V}{0.06\ A}$

R = 200 Ω

The resistance is 200 ohms.