MILITARY TECHNOLOGICAL COLLEGE

Foundation Programme Department

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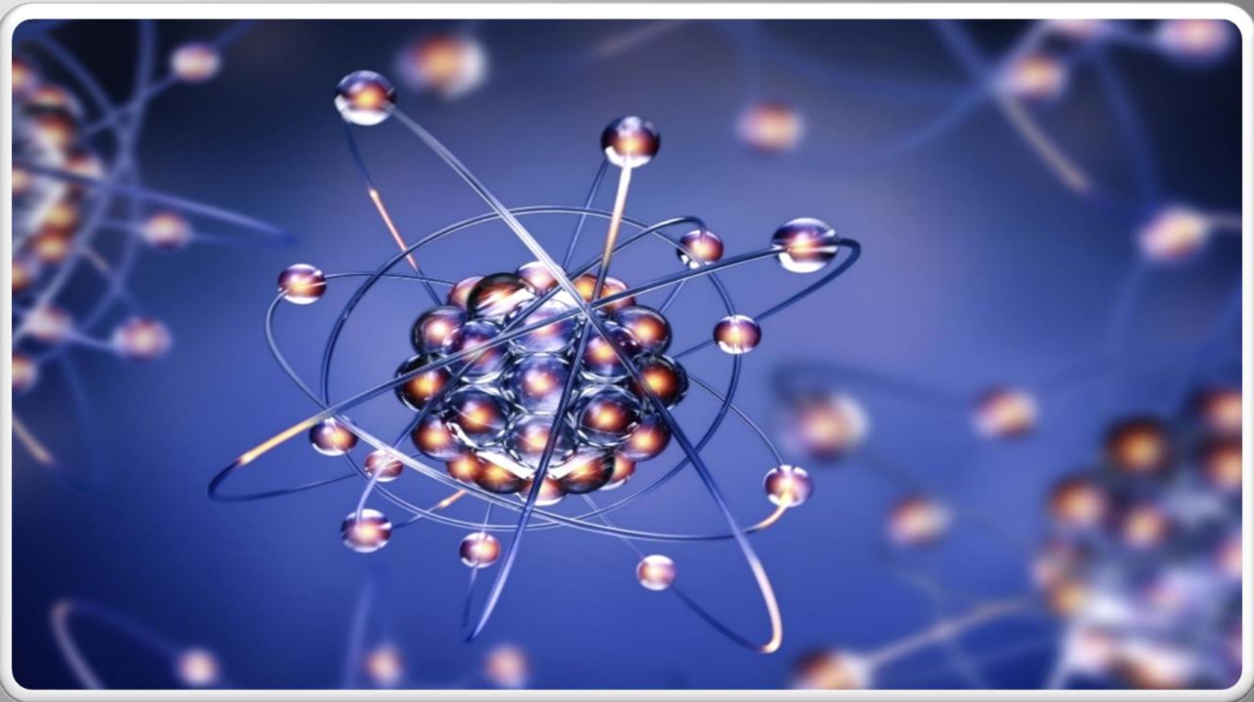


PHYSICS

WORKBOOK-1 **MODULE CODE-MTCG1017**

Term: 2 AY: 2024-2025 FPD

MILITARY TECHNOLOGICAL COLLEGE

Delivery Plan Year 2024-25 [Term 2]

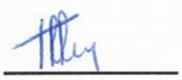
Title / Module Code / Programme	Physics / MTCG1017/Foundation Programme Department (FPD)	Module Coordinator	Dr. Karim Sellami
Lecturers	TBA	Resources & Reference books	Moodle & Workbooks
Duration & Contact Hours	Term 2: 6 hrs. × 11weeks = 66 hrs.		

Week No.	Topics	Hours	Learning Outcome No.
1	**1. Units and unit conversions** 1.1. System of units, base and derived units 1.2. Unit conversions	2	1
	2. Nature of matter 2.1. Matter 2.2. States of matter (solid, liquid gas and plasma), and change of states. 2.3. Structure of an atom: shell, nucleus, electrons 2.4. Chemical Compounds 2.5. Periodic Table	4	
2	**3. Classification of physical quantities** 3.1 Scalar & Vector quantities 3.2 Vector representation in Cartesian plane 3.3 Properties of vectors 3.4 Vector addition and subtraction	4	
	4. Linear Motion 4.1 Distance and displacement 4.2 Speed and velocity 4.3 Accelerated Motion	2	2
3	4.4 Kinematic Equations of motion. 4.5 Motion under the influence of gravity	2	
	5. Force, momentum and impulse 5.1. Fundamental Forces 5.2. Types of Forces (Contact and Non-Contact Forces) 5.3. Mass and weight 5.4. Newton's 1st Law and its application: Equilibrium **Revision Continuous Assessment-1**	4	
	Continuous Assessment-1 (Chapters 1 to 4)		**1**

4	5.5. Newton's 2nd law and its application: Acceleration 5.6. Newton's 3rd law and its application 5.7. Linear Momentum and Impulse 5.8. Conservation of linear momentum 5.9. Friction-Kinetic and Static Friction	2	2
	6. Work, Energy and Power 6.1 Work and Energy 6.2 Types of Mechanical Energy 6.3 Law of Conservation of Energy 6.4 Power	4	
5	6.5 Machines 6.6 Velocity ration, mechanical advantage and efficiency **7. Rotational Motion** 7.1. Linear and angular velocity 7.2. Uniform Circular Motion & Centripetal force 7.3. Moment of Force (Torque)	6	
6	7.4. Moment of Inertia 7.5. Angular Momentum a. Conservation of angular momentum b. Gyroscope	4	
	8. Solids 8.1. Hooke's law Stress, Strain and Young's Modulus **Revision Continuous Assessment-2**	2	3
	Continuous Assessment-2 (Chapters 5 to 8)		2
7	**9. Fluids** 9.1. Fluid statics a. Density b. Relative density c. Hydrometer d. Adhesion e. Cohesion f. Pressure in liquids g. Absolute and gauge pressure h. Measurement of pressure	4	3
	Lab Experiment	2	7
8	i. Buoyancy and Archimedes' Principle j. Pascal's law 9.2 Fluid dynamics a. Types of fluid	6	3

	b. Viscosity c. Fluid resistance and aerodynamic drag d. Bernoulli's Principle & Applications of Bernoulli's Principle **10. Thermodynamics** 10.1. Heat, Temperature, and Temperature Scales		
	Lab Experiment (continuation)		7
9	10.2. Calorimetry a. Specific heat capacity b. Latent Heat 10.3. Types of Heat Transfer 10.4. Thermal Expansion 10.5. Ideal Gas Law	6	4
10	10.6 Laws of Thermodynamics **11. Wave Motion and Sound** 11.1. Waves a. Anatomy of waves Types of waves 11.2. Standing waves 11.3. Fundamental frequency and harmonics 11.4. Sound waves	6	6
11	**12. Optics** 12.1. Introduction to light 12.2. Law of reflection and refraction 12.3. Critical Angle and Total internal reflection 12.4. Fibre Optics **Revision for Final Exam**	6	5
12	**FINAL EXAM (Chapter-9 to Chapter-12)**		**2, 3, 4, 5, 6 & 7**
	Total Hours	**66**	

Indicative Reading		
#	**Title/Edition/Author**	**ISBN**
1	Advanced Level Physics -7th Edition, 1986 By Michael Nelkon and Philip Parker	ISBN-13 : 978-0435923037 ISBN-10 : 043592303X
2	Physics-5th Edition, 2016 by Walker S. James	ISBN-13: 978-0321- 97644-4 ISBN-10: 0-321- 97644-4
3	Advanced Physics for You –2nd Edition, 2015 by Keith Johnson, Simmone Hewett, Sue Holt, John Miller	ISBN: 9780198355991
4	College Physics-11th Edition,2017 By Raymond A. Serway, Jerry S. Faughn	ISBN-13: 978-1305952300 ISBN-10: 9781305952300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Assessment Plan

(Passing Mark: 50 %)

Assessment	Weightage
Continuous Assessment-1	20%
Continuous Assessment-2	30%
Lab Experiments	10%
Final Exam	40%
Total	100%

Attendance Policy:

Warning	Absence
First	10%
Second	15%
Third	20%

Contents

Chapter-1: Units and Unit Conversion

All quantities used to describe the Laws of Physics and whose measurement is essential, are referred to as physical quantities. For example- mass, force, speed etc.,

A unit is defined as a standard (or reference) adopted to measure any physical quantity, which is agreed by all the countries in the world. For example- kilogram (kg), Newton (N), Kelvin (K) etc.

After measurement of any physical quantity the result is written as a number followed by its unit. For example, 3 kg, 5 N, 273 K etc.

1.1 System of Units

The system of units which is at present internationally accepted for measurement is the Système Internationale d'Unites (French for International System of Units), abbreviated as SI. Some other system of units mentioned in table 1.1 below.

S. No.	System of Units	Unit of Length	Unit of Mass	Unit of Time
1	SI (System International)	meter (m)	kilogram (kg)	second (s)
2	CGS (Gaussian System)	centimeter (cm)	gram (g)	second (s)
3	FPS-US Customary/BES Units	foot (ft)	slug (slug)	second (s)

Table 1.1. System of Units

On the basis of the physical quantities and their dependence on one another, units can be divided as **base units** and **derived units**.

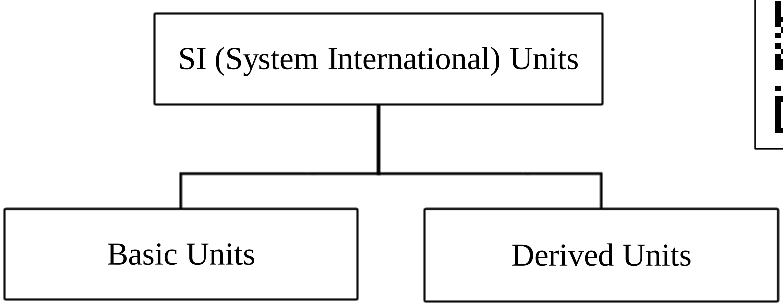


Table 1.2. Types of Units

Base quantities

These physical quantities are defined in an absolute way and do not depend on any other quantity, e.g. length, mass, time, etc. Table 1.3 shows the seven (7) base quantities, their corresponding units and symbols:

BASIC QUANTITIES AND UNITS			
S. No.	**Physical Quantity**	**SI Units**	**Symbols**
1	Length	meter	m
2	Mass	kilogram	kg
3	Time	second	s
4	Temperature	Kelvin	K
5	Electric Current	Ampere	A
6	Amount of substance	Mole	Mol
7	Luminous Intensity	candela	cd

Table 1.3. Base Quantities and Units

Derived quantities

All other physical quantities other than the fundamental / base quantities that are obtained in terms of two or more base quantities are called **derived** quantities. They depend on the base quantities. Some physical quantities and corresponding derived units are given in table 1.4 below.

DERIVED QUANTITIES AND UNITS				
	Physical Quantity		**SI Units**	
No.	**Name**	**Symbol**	**Name**	**Symbols**
1	Angular displacement	θ	radian	rad
2	Density	ρ	kilogram per cubic meter	kg/m^3
3	Speed , Velocity	v	meter per second	m/s
4	Acceleration	a	meter per square second	m/s^2
5	Force	F	Newton	N
6	Work , Energy	W or E	Joule	J
7	Power	P	Watt	W
8	Momentum	p	kilogram meter per second	kg m/s
9	Frequency	f	per second or hertz	s^{-1} or Hz
10	Voltage	V	Volt	V
11	Resistance	R	Ohm	Ω

Table 1.4. Some Derived Quantities and Units

Class Activity-1

Choose the correct answer:

1. Which of the given quantities is a base quantity?
A. Force, frequency, volume
B. Candela, Kelvin, Ampere
C. Luminous intensity, mass, temperature

2. Which of the following is all derived units?
A. Current, length, time
B. Work, Power, Energy
C. Hertz, Newton, Watt

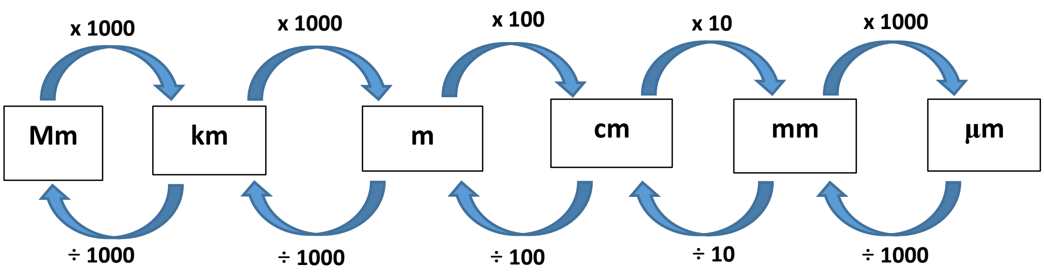
3. Slug is the unit of mass in_______ system.
A. CGS
B. FPS
C. MKS

1.2 Unit conversions

For SI and metric units

For very large or very small numbers, we can use standard prefixes corresponding to the powers of 10. Each prefix has a specific name and abbreviation.

Below is an example of unit conversion with meter:



The main prefixes that you need to know in daily practical life are shown in table 1.5.

PREFIXES					
Prefix	**Symbol**	**Multiplier (×)**	**Prefix**	**Symbol**	**Multiplier (×)**
tera	T	10^{12}	deci	d	10^{-1}
giga	G	10^{9}	centi	c	10^{-2}
mega	M	10^{6}	milli	m	10^{-3}
kilo	k	10^{3}	micro	µ	10^{-6}
			nano	n	10^{-9}
			pico	p	10^{-12}

Table 1.5. Prefixes

Class Activity-2

<u>Choose the correct answer:</u>

1. 56100 µm = _______________ km.

A. 56.1 km

B. 561 $\times 10^{-9}$ km

C. 5.61 $\times 10^{-5}$ km

2. 25 picometer is **not** equal to

A. 0.025 nm

B. 25×10^{-6} µm

C. 25×10^{12} m

3. Mazin buys 20 bottles of Fizzy drink. Each bottle contains 250ml. How many liters does he buy?

A. 3

B. 4

C. 5

4. 800 kg/m^3 = ………. g/cm^3

A. 80

B. 8

C. 0.8

For SI/metric system to customary units

Different units are used in some countries for the measurement of various physical quantities. The table 1.6 below gives the conversion chart of some metric units to customary units.

Metric to Customary Conversions		
Length	**Mass**	**Capacity**
1 centimeter = 0.39 inch	1 gram = 0.035 ounce	1 milliliter = 0.034 fluid ounce
1 meter = 3.28 feet	1 kilogram = 2.2 pounds	1 liter = 1.06 quarts
1 meter = 1.09 yards		1 liter = 0.219 UK gallon
1 kilometer = 0.621 mile		1 liter = 10^{-3} m^3
1 kilometer = 0.54 nautical mile		1 liter = 1.76 Imperial pint

Table 1.6. Unit Conversion

Class Activity-3

A. Choose the correct answer:

1. What is the volume of a 12 oz. can of soda in ml?

A. 352.94 ml
B. 0.408 ml
C. 12 ml

2. Mohammed is 1.82 m tall. His height in feet will be…

A. 182 ft
B. 2.97 ft
C. 5.97 ft

3. Convert 35 $yard^2$ to m^2.

A. 1.09 m^2
B. 29.46 m^2
C. 38.15 m^2

B. Do the following unit conversions:

1) 15 m/s =………km/h

2) 250 mL =……….m^3

3) 1200 cm^2 =……….m^2

4) 33 cm^3 =……….mm^3

Worksheet-1

A. Multiple choice questions:

1. What is the unit of mass in the US Customary system?
A. Slug
B. Kilogram
C. Gram

2. The amount of space taken up by a substance is…
A. volume
B. density
C. mass

3. 2 m is **not** equal to…
A. 2000 mm
B. 200 cm
C. 0.02 km

4. In SI system, the unit of area is…
A. meter per second
B. cubic meter
C. square meter

5. 1 day is equal to…
A. 24 min
B. 3600 hours
C. 86400 s

B. Problem Solving:

1) Nautical miles are used for charting and navigating. A knot is one nautical mile per hour (1 knot = 1.15 miles per hour). Jet aircrafts fly at about 500 knots. What is the speed of the aircraft in m/s?

2) Convert 25 km/h to m/s.

3) The dimensions of a football court are 90 m × 120 m. Express the area of the field in square yard.

4) What is the mass of a 120 lb. person in kilograms?

5) Which is greater 45 miles or 63 km?

<u>C. Fill in the blanks:</u>

1. In CGS system, the unit of length is _______________________.
2. Newton is a ______________________ unit in _______system.
3. The value of prefix μ (micro) is equivalent to _______________________.
4. The units which are obtained by multiplying or dividing base units are called _______________________.
5. The multiplier of nano is ______________.

Chapter-2: Nature of Matter

2.1 Matter

In this universe everything is made up of material which we refer to as “matter”. The air around us, the food we eat, plants and animals, sun, moon, oil or a particle of sand– everything matter. All the things mentioned above occupy space, that is, have volume and mass. Matter is made up of tiny particles called **molecules** which are too small to be seen with the naked eye. These molecules are further made up of smaller particles called **atoms**.

Atom

Atoms are the smallest particles of matter that can take part in chemical reactions. An atom is composed of sub-atomic particles called electrons, protons and neutrons. The structure of an atom will be discussed later in the following sections.

Molecules

When atoms bond together, they form a molecule. Molecules can be made up of a single type of atom or a combination of two or more types of atoms.

Monatomic molecules

A molecule that consists of a single type of atom is called a monatomic molecule. Example: Oxygen gas (O_2), nitrogen gas (N_2) and hydrogen gas (H_2).

Chemical Compound

A molecule that consists of two or more types of atoms is called chemical compound, also known as polyatomic molecule. Example: Water (H_2O), salt (NaCl), and carbon dioxide (CO_2).

Class Activity-1

Choose the correct answer:

1. A molecule consists of…
A. One atom
B. Two or more atoms
C. No atoms at all

2. Which of the following is a monatomic molecule?
A. Salt
B. Sugar
C. Hydrogen gas

3. A molecule that consists of two or more type of elements is called
A. Monatomic molecule
B. Chemical compound
C. Matter

2.2 States of Matter

All matter exists in one of the four physical states. They are: Solid, Liquid, Gas and Plasma.

Solid

Matter in the Solid state maintains a fixed volume and shape, with component particles (atoms, molecules or ions) close together and fixed in place.

Liquid

Matter in the Liquid state maintains a fixed volume but has a variable shape that adapts to fit its container. Its particles are still close together but move freely.

Gas

Matter in the Gaseous state has both variable volume and shape, adapting both to fit its container. Its particles are neither close together nor fixed in place.

Plasma

Plasma is a hot ionized gas consisting of approximately equal numbers of positively charged ions and negatively charged electrons. The characteristics of plasma are significantly different from those of ordinary neutral gases so that plasma is considered as a distinct "fourth state of matter." Examples are fire, lightning, neon lights, etc.

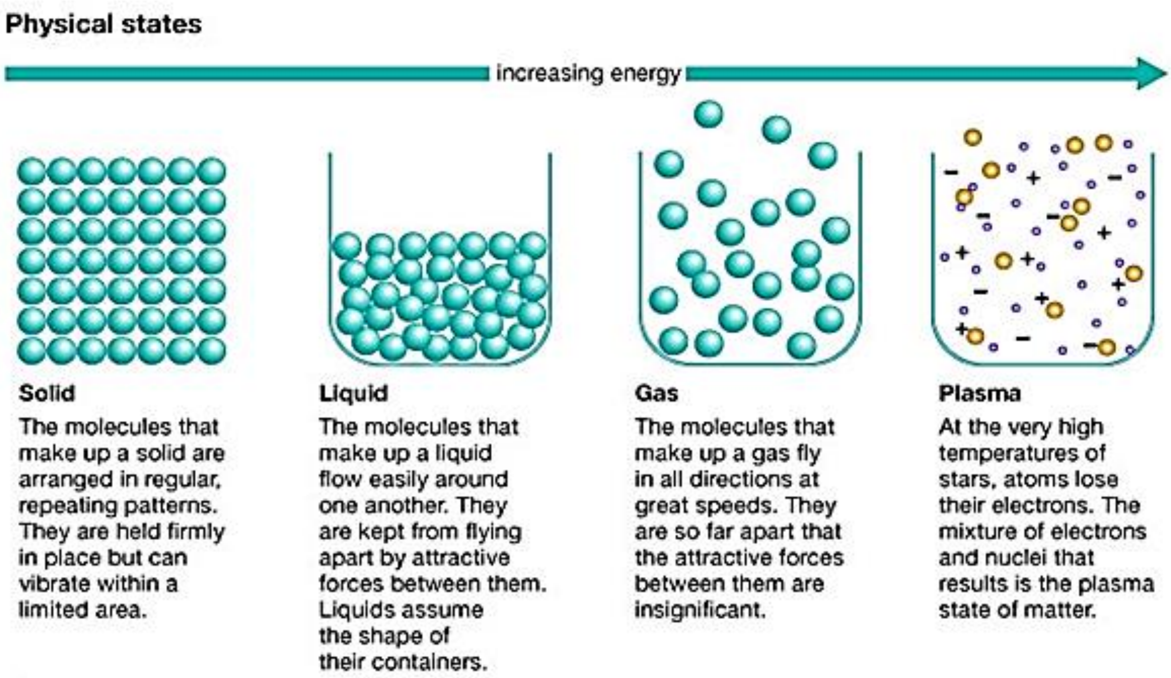


Fig-2.1. States of Matter

Change between States

Melting (or Fusion): Changing the state from Solid to Liquid. Examples: Melting ice-cream, ice, butter, wax etc. Some examples are shown in fig-2.2.

Melting Point: The temperature at which a solid change to a liquid is called the melting point. Example: The melting point of ice is at 0 ºC.

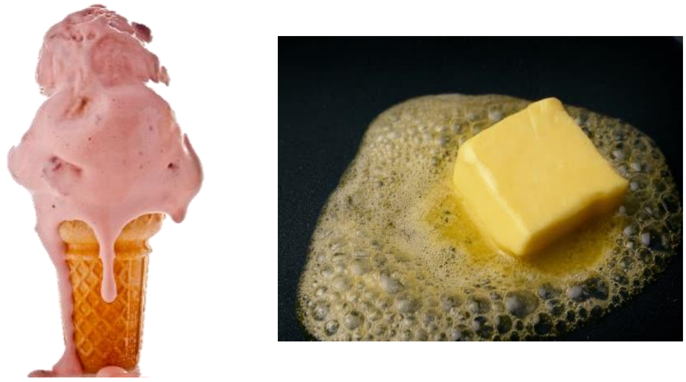


Fig-2.2. Examples of Melting, Melting of Ice-cream and Butter

Freezing (or Solidification): Changing the state from liquid to solid.

Example: Change of water to ice (Fig-2.3), solidification of melted wax etc.,

Vaporization: Changing the state from liquid to gas.

Boiling Point: The temperature at which liquid changes to gas is called the boiling point.

Example: The boiling point of water is 100ºC.

Condensation: Changing the state from gas to liquid.

Fig-2.3. Example of Freezing

Sublimation: Changing the state from solid to vapour without passing through liquid state.

Example: Dry ice, Camphor balls.

Deposition: Change of state from gas to solid without passing liquid state.

Example: Water vapor to ice during winter.

Ionization: Change of state from gas to plasma.

Deionization: Change of state from plasma to gas.

A block diagram (Fig-2.4) is given below to show all change of states.

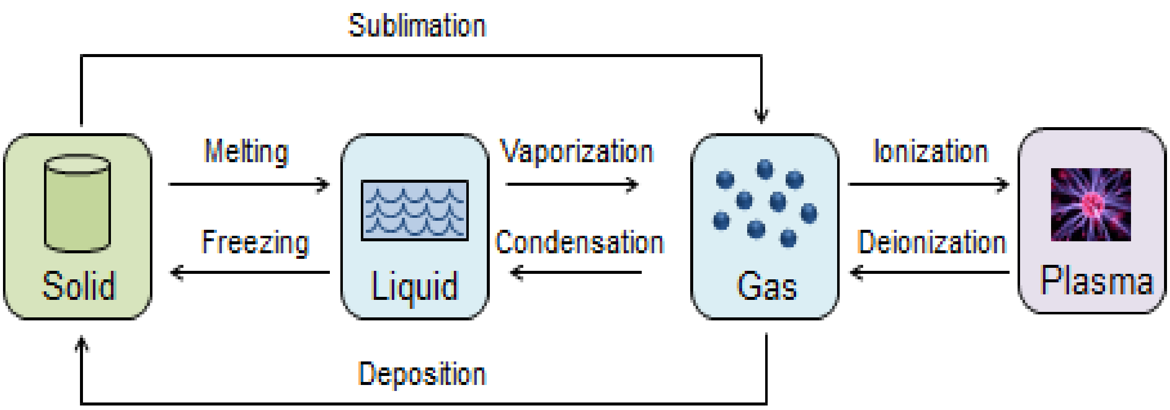


Fig-2.4. Block Diagram, Changes between States

Class Activity-2

A. Choose the correct answer:

1. The freezing point of water is same as…
A. Boiling point of water
B. Melting point of ice
C. Sublimation point

2. When dry ice changes to gas, the process is called…
A. deposition
B. Vaporization
C. sublimation

3. Which state of matter has fixed shape and volume?
A. Liquid
B. Solid
C. Gas

2.3 The Structure of an Atom

The modern structure of an atom is composed of a nucleus at the center with electrons moving around it at specified energy levels (orbits).

A Hydrogen atom is very small, about 10^{-10}m in diameter, but if it could be magnified sufficiently it would be 'seen' to consist of a core or nucleus with a particle called an electron travelling around it in an elliptical orbit.

The nucleus has a positive charge and the electron an equal amount of charge but negative; so, the whole atom is electrically neutral. The electrical attraction keeps the electron circling the nucleus.

Nucleus

Nucleus is the positively charged central core of an atom. It consists of protons and neutrons. The mass of the nucleus is equal to the total mass of protons and neutrons.

Protons

Protons are the positively charged particles in the nucleus. The charge of a proton is equal to

$q_p=1.6 \times 10^{-19}$ C, (e is the elementary charge). The mass of a proton is equal to $m_p=1.672 \times 10^{-27}$ kg.

Neutrons

Neutrons are electrically neutral particles available in the nucleus. The mass of a neutron is equal to $m_n=1.675 \times 10^{-27}$ kg.

Electrons

The electron(s) may be thought of as particle(s) moving in a circular or elliptical path around the nucleus and having negative charge. The charge of an electron is equal to $q_e = -1.6 \times 10^{-19}$ C and mass is equal to $m_e=9.110 \times 10^{-31}$ kg.

Shells (K, L, M, N)

Electrons are moving in discrete regions of space around the nucleus. These regions of space are known as energy levels or shells. The first shell is denoted by the letter K, the second shell by L, M for the third shell, and so on as shown in fig-2.5

Each shell/orbit can contain only a fixed number of electrons. The number of electrons per shell can be found by using the equation $2n^2$, where 'n' represents the shell number.

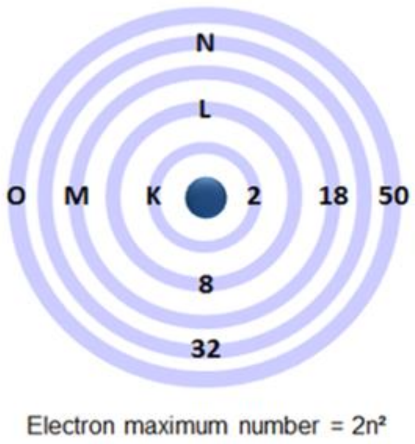


Fig-2.5. Electron Shells, Maximum Number of Electrons

n	1	2	3	4
Shell	K	L	M	N

Valence Shell

The outermost shell of the atom is called the valence shell, and the electrons in this shell are called valence electrons. Under normal conditions, these valence electrons are the ones participating in the chemical reaction. Therefore, understanding the electronic structure of an atom leads to the understanding of how certain atoms will participate in chemical reactions.

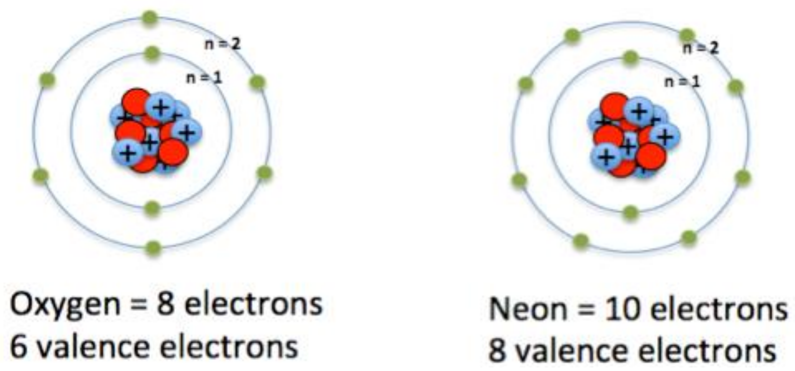


Fig-2.6. Valence Shell Electrons of Oxygen and Neon

Valency

The ability of an atom to participate in chemical reaction can be determined by knowing the number of valence electrons and its valency. Valency is the capacity of an atom to give, accept, or share electrons to achieve the octet state (8 valence electrons). If the outer shell of an atom is full the element becomes stable or inert. Below is the rule for determining the valency of an atom:

If the valence electron is four and below, then the valency is equal to the number of valence electrons. In this case, valency will be negative. For example, Beryllium atom (Be) has 2 electrons in the last shell, then its valency will be negative or -2. Another example, carbon atom (C) has 4 electrons, then its valency will be negative or -4.

However, if the valence electron is more than four then the valency is equal to eight (8) minus the number of the valence electron. In this case, valency = 8 – Number of electrons. For example, nitrogen atom (N) has 5 electrons in the valence shell, then its valency = 8 - 5 = 3 electrons. Another example, fluorine atom (F) has 7 electrons in the last shell, then its valency = 8 – 7 = 1.

Atomic number (Z)

The atomic number of an element relates to the number of protons in its nucleus, and it is equal to the number of electrons in a neutral atom.

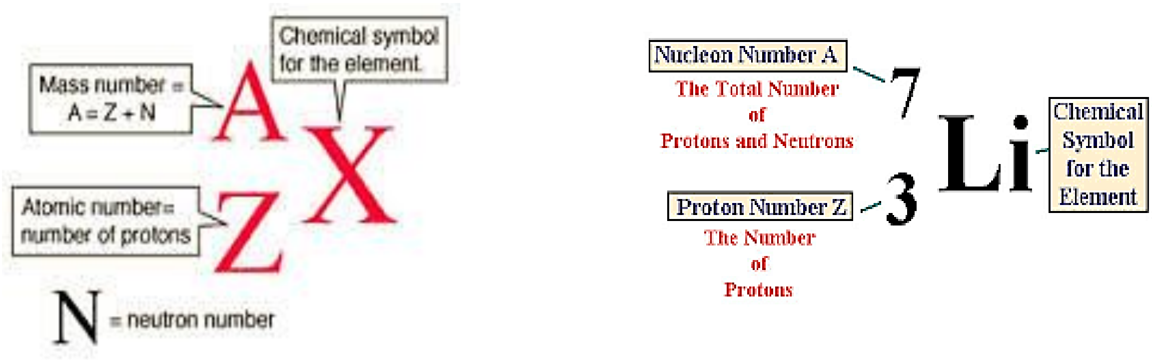


Fig-2.7. Atomic mass and atomic number

Atomic mass (A)

The atomic mass of an element is equal to the mass of the nucleons, that is the sum of mass of neutrons and protons in its nucleus.

Isotopes

Isotopes are atoms of the same element (Fig-2.8) that have the same atomic number but different mass numbers. This is because of the different number of neutrons in the nucleus of the same element.

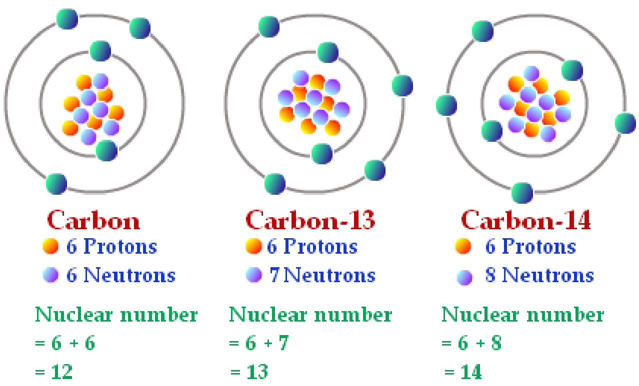


Fig-2.8. Atomic mass and atomic number

Examples: $^{1}_{1}H$, $^{2}_{1}H$, $^{3}_{1}H$ $(Hydrogen)$ $^{12}_{6}C$, $^{13}_{6}C$, $^{14}_{6}C$ $(Carbon)$

Class Activity-3

A. Choose the correct answer:

1. The maximum number of electrons in the inner most shell of an atom is
A. 18
B. 8
C. 2

2. If the outer shell of an atom is full, then the element is…
A. unstable / reactive
B. a good conductor
C. practically inert

3. The mass of a proton is almost equal to the mass of a …
A. Neutron
B. Nucleus
C. Electron

4. The number of neutrons in the isotopes $^{1}_{1}\text{H}$, $^{2}_{1}\text{H}$ *and* $^{3}_{1}\text{H}$ of Hydrogen respectively are
A. n=1, n=2 and n=3
B. n=0, n=1 and n=2
C. n=1, n=1 and n=1

B. Complete the table below by writing the number of protons, neutrons, electrons, valence electrons and valency of each given element.

Element	No. of protons	No. of neutrons	No. of electrons	Valence electrons	Valence shell	Valency
$^{28}_{14}Si$						
$^{26}_{13}Al$						
$^{40}_{18}Ar$						
$^{19}_{9}F$						

2.4 Ions

If an atom or a molecule gain or loses one electron or more, this atom or molecule will be called an ion. So, unlike the neutral atom, an ion is an atom or group of atoms in which the number of electrons is different from the number of protons.

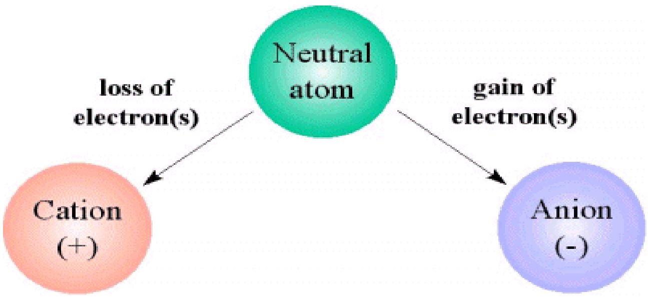


Fig-2.9. Cation and Anion

If the number of electrons is less than the number of protons, the particle is a positive ion, also called a **cation**. If the number of electrons is greater than the number of protons, the particle is a negative ion, also called an **anion**.

Example: Sodium and Chorine ions as shown in Fig 2.10.

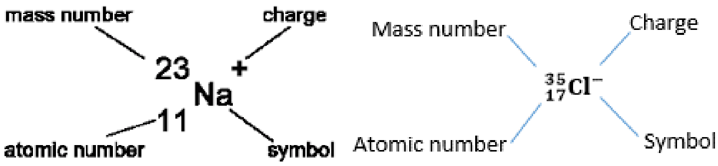


Fig-2.10. Ions of Sodium and Chlorine

2.5 Chemical Compounds

When atoms bond together, they form a **molecule**. Generally, there are two types of molecules. Those molecules that consist of a single type of atom, for example the hydrogen normally exists as a molecule of two atoms of hydrogen joined together and has the chemical symbol **H_2**.

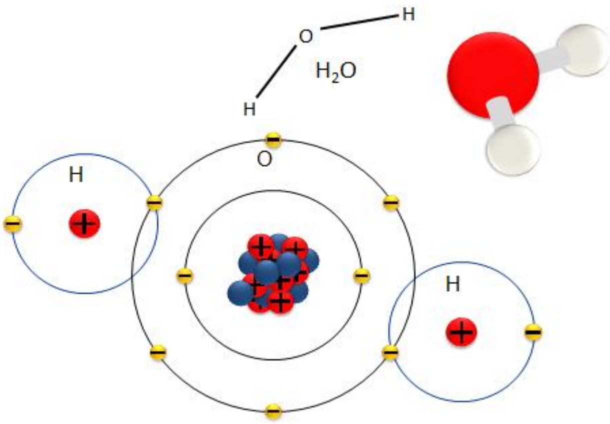


Fig-2.11. Water Molecule

A molecule that consists of a single element is called a **monatomic molecule**. All other molecules are made up of two or more atoms and are known as **chemical compounds**.

Indeed, when atoms bond together to form a molecule, they share electrons. Water (H_2O) is made up of two atoms of hydrogen and one atom of oxygen. In the example of H_2O, the oxygen atom has six electrons in the outer or valence shell. As there is room for eight electrons, one oxygen atom can combine with two hydrogen atoms by sharing a single electron from each hydrogen atom.

2.6 Periodic Table

When the elements are listed in the order of increasing atomic number, elements with similar chemical and physical properties repeat at regular intervals, like metals, non-metals, metalloids, etc. The periodic table is a way of arranging the elements to exhibit these regularities. In a periodic table the vertical columns are called **groups**, and horizontal rows are called **periods**.

The elements in the same **group** have the same number of valence electrons. For example, Beryllium (Be), Magnesium (Mg), and Calcium (Ca) belong to **group 2A.** Therefore, the number of valence electrons of Be, Mg and Ca is 2.

On the other hand, elements in the same **period** have the same highest energy level. For example, Sodium (Na), Magnesium (Mg), and Aluminium (Al) belong to period 3. Therefore, the highest energy level of Na, Mg, and Al is 3.

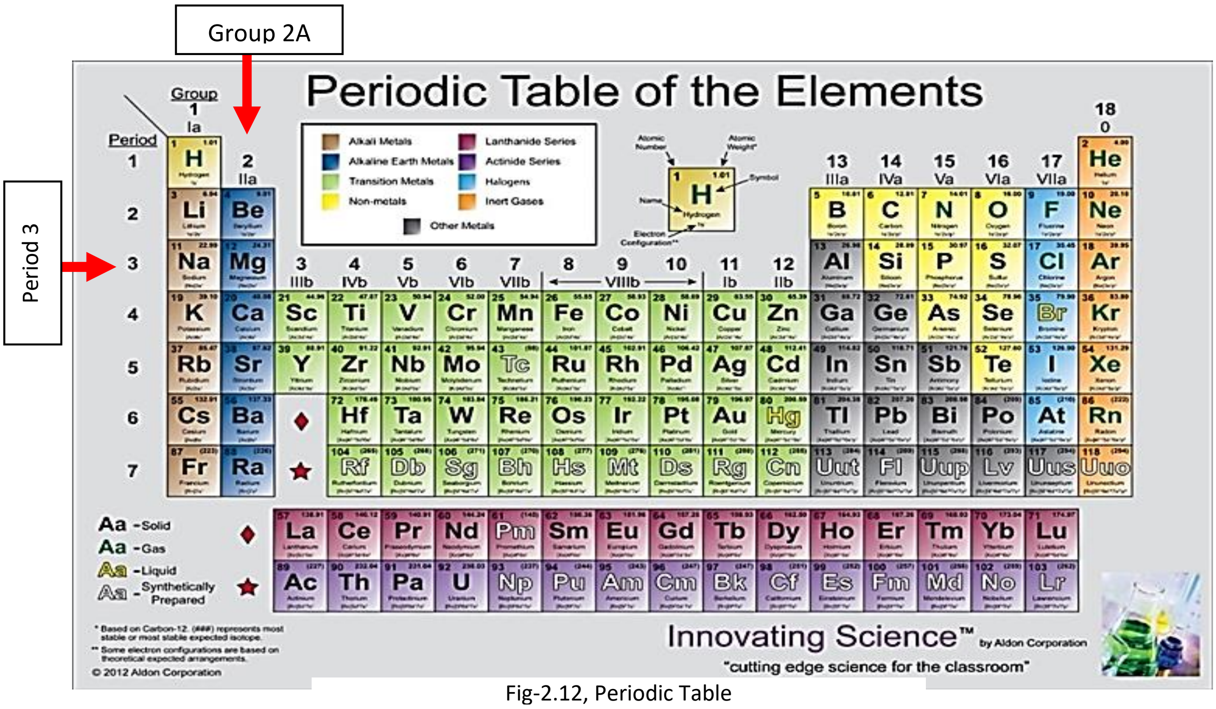


Fig-2.12, Periodic Table

Fig-2.10. Periodic Table

Class Activity-4

A. Choose the correct answer:

1. Which of the following is not a chemical compound?
A. Sugar
B. Hydrogen gas
C. Carbon dioxide gas

2. An Aluminum ion $^{27}_{13}Al^{3+}$has…
A. 27 protons and 30 electrons
B. 24 protons and 16 electrons
C. 13 protons and 10 electrons

3. The sodium ion Na^{+} has 11 protons. How many electrons does it has?
A. 12
B. 11
C. 10

4. Which of the statements is **false** about periodic table?
A. Elements are arranged in order to increase mass number.
B. Elements in the same group have the same number of valence electrons.
C. Elements in the same period have the same highest energy level.

B. Problem Solving

1. Which of the following ions has a greater number of electrons? Explain:

$^{40}_{20}Ca^{2+}$ *or* $^{35}_{17}Cl^{-}$

Worksheet-2

A. Choose the correct answer:

1. A neutron has ______________ charge.
A. positive
B. negative
C. neither positive nor negative

2. The mass number of an element is the number of…
A. electrons plus protons in the atom in the atom
B. neutrons plus protons in the atom
C. neutrons plus electrons in the atom

3. An isotope of an element will have more/less number of __________ than usual.
A. neutrons
B. electrons
C. protons

4. If a neutral atom has 2 protons, how many electrons will it have?
A. 1
B. 4
C. 2

5. What is the atomic number of the element $^{3}_{2}\mathbf{X}$?
A. 2
B. 3
C. 5

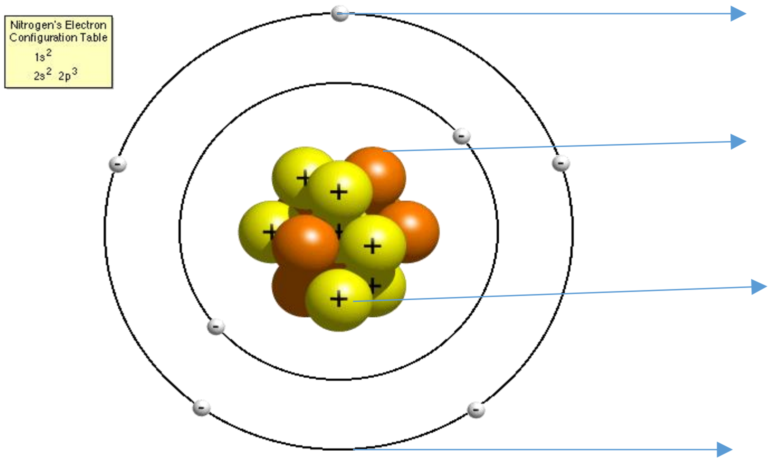
6. The number of subatomic particles present in four species W, X, Y and Z are given in the table below.

Species	Number of Protons	Number of Neutrons	Number of Electrons
W	19	20	18
X	19	20	19
Y	20	20	18
Z	20	22	20

Which of these species are isotopic?

A. W and X
B. Y and Z
C. X and Z
D. W and Y

B. Label the following diagram. Show the protons, neutrons, electrons and valence shell.



C. The atomic number of carbons is 6 and its mass number is 13. Fill in the blanks below:

- The number of electrons in it is _______________.
- The number of protons in it is _______________.
- The number of neutrons in it is_______________.
- Number of valence electrons ________________.
- The valence electrons are in shell ________________.
- Valency of carbon is ________________.

D. Fill in the blanks bellow:

1) In nature, the atoms are electrically _______ .

2) Electrons and Protons have same amount of charge, but _______sign

3) The changing of solid matter directly into gas state is called________.

4) All isotopes of an element have the same number of ________ and __________.

5) Salt (NaCl) is ____________________.

6) Protons mass is approximately ___________times greater than electrons.

7) Total mass of atom concentrated in_________.

8) Electrons in the outermost orbit are called ___________.

9) Noble gases are chemically _______________.

10) If the number of electrons is more than the number of protons, the particle is called an____**.**

Chapter-3: Classification of Physical Quantities

4.1 Scalar and Vector Quantities:

Physical quantities in general can be classified as scalars and vectors. A **scalar** quantity is a physical quantity that has only magnitude (size) and has no specific direction.
Examples: mass, distance, speed, work, energy, volume, frequency, temperature etc.
A **vector** quantity is a physical quantity that has both magnitude and specific direction.
Examples: weight, displacement, velocity, acceleration, force, an airplane flies due south 25 km, etc.

4.2 Vectors Representation in Cartesian plane:

Vector, as defined below, is a specific mathematical structure. It has numerous physical applications, which result mainly from its ability to represent **magnitude** and **direction** simultaneously.

A vector quantity is represented by an arrowed line that has a length proportional to the vector quantity, drawn to a suitable scale.

Note that either bold capital letter or with an arrow on the top will be used to name vectors. For example, a force vector could be written as **F** or $\vec{F}$

The length of the line represents the size of the quantity, and the arrow indicates the direction in which the quantity acts.

For example, $\vec{A} = 10km, N\ 30^0\ E$ can be represented as follows,

$\vec{A} = 10km, N\ 30^0\ E$

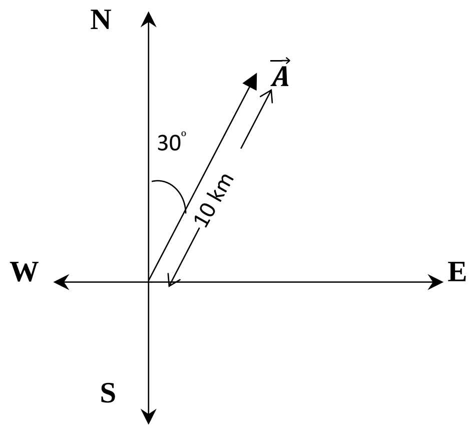


Fig-3.1. Vector Representation

Class Activity-1

A. Choose the correct answer:

1. A quantity which has magnitude, but no direction is called ________.

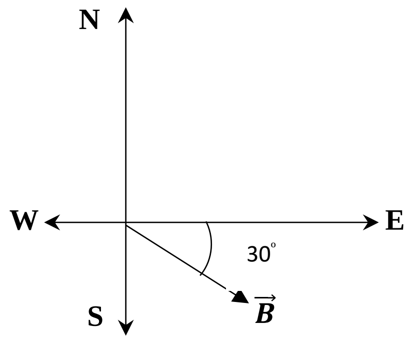
A. scalar
B. moment
C. vector

2. Which of the following is a vector quantity?

A. Speed
B. Acceleration
C. Temperature

3. The correct representation vector B is_______

A. $S\ 30^0\ E$
B. $E\ 30^0\ S$
C. $N\ 30^0\ E$



B. Sketch the graph of the following vectors:

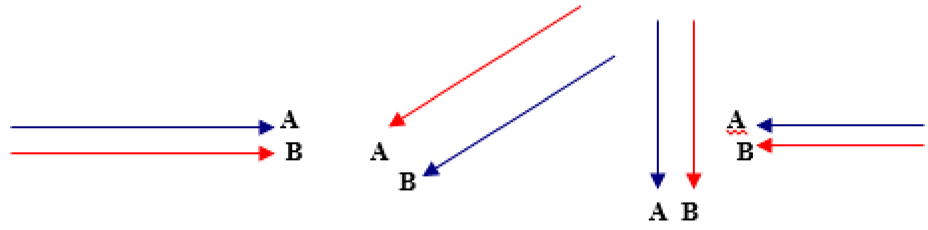
$\vec{\boldsymbol{B}} = 50\frac{m}{s}, S\ 45^0\ W$

$\vec{\boldsymbol{C}} = 100\ N, W\ 60^0\ N$

3.3Properties of Vectors:

Equality of Two Vectors:

Two vectors **A** and **B** are equal if they have the same magnitude and the same direction.



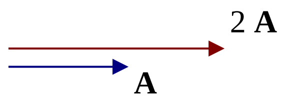
Using this property, any vector can be moved parallel to itself without being affected.

Multiplying or Dividing a Vector by a Scalar:

The multiplication or division of a vector $\vec{A}$ *by a scalar real number* ***n*** *<u>gives a vector</u>.*

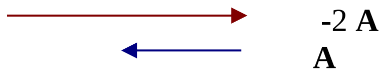
● If vector **A** is multiplied by the scalar number 2, the result is 2**A**, is a vector with a magnitude twice that of **A,** pointing in the same direction as **A.**

2 (scalar) x A (vector) = 2A (vector)



● If multiplied by a scalar – 2, the result is -2 **A**, is a vector with a magnitude twice that of **A**, pointing in the direction opposite **A** (because of the negative sign)

- 2 (scalar) x A (vector) = - 2 **A** (vector)



If a vector **A** is divided by the scalar number **2,** the result is ½ **A**, is a vector with a magnitude half that of vector **A**, pointing in the same direction.

So we can write in general that: $\|\alpha\vec{A}\| = |\alpha| \times \|\vec{A}\|$; where α is a real number, and $\vec{A}$ a vector.

3.4Vector Addition and Subtraction:

The summing up of two or more vectors to find the resultant vector is called the addition of vectors. We can add vectors in two methods, namely: graphical and analytical methods. There are many graphical (using ruler and protractor) and analytical methods, but we will only discuss analytical methods as introductory part.

Analytical Method:

Two analytical methods will be discussed here namely: Component method and the Triangle Law. These methods are done by computation.

Component Method:

In a Cartesian coordinate system, any vector can be resolved into a pair of perpendicular vectors, horizontally and vertical along the x and y directions.

The vector **A** in the rectangular coordinate system as shown below in Fig-3.2 is resolved into two perpendicular vectors $\mathbf{A}_x$ parallel to x-axis and $\mathbf{A}_y$ parallel to y-axis, that is

$\mathbf{A} = \mathbf{A}_x + \mathbf{A}_y$; Where: $\mathbf{A}_x$ and $\mathbf{A}_y$ are called the components of vector **A**.

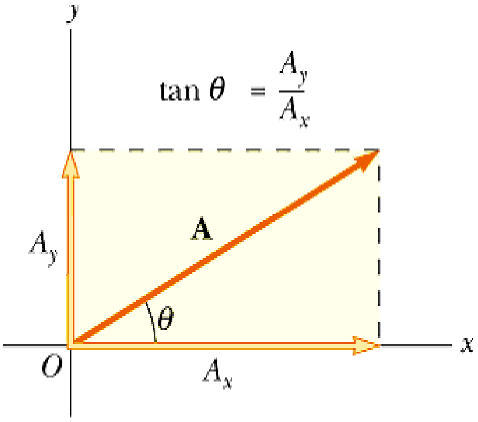


Figure-3.2. x and y components of vector A.

Using trigonometry, the magnitudes of $\mathbf{A}_x$ and $\mathbf{A}_y$ are given by the equations:

$\mathbf{A}_x = A \cos \theta$ and $\mathbf{A}_y = A \sin \theta$

Where 'θ' is the angle between the vector A and positive x-axis.

These two components form two sides of a right-angle triangle, the hypotenuse of which has a magnitude of 'A'.

$$A = \sqrt{A_x^2 + A_y^2}$$

and angle (θ) = $\tan^{-1}(\mathbf{A}_y / \mathbf{A}_x)$. These components can be either positive or negative numbers with its unit.

The $\mathbf{A}_x$ and $\mathbf{A}_y$ components are called rectangular components of vector A and the process is called the resolution of a vector.

So, for the magnitude of vector A, we can write $|\boldsymbol{A}| = \sqrt{A_x^2 + A_y^2}$ or $|\boldsymbol{B}| = \sqrt{B_x^2 + B_y^2}$

The magnitude of the resultant vector is given by:

$$|\boldsymbol{R}| = \sqrt{R_x^2 + R_y^2}$$

Where, $R_x = A_x + B_x$ and $R_y = A_y + B_y$

While the direction of the resultant vector is given by:

$tan\ \theta = \frac{R_y}{R_x}$ or

$$\theta = tan^{-1}\frac{R_y}{R_x}$$

Example 1: Taking the example from above, $\vec{A} = 20km, E\ 30^0\ N$ and $\vec{B} = 50\ km, E\ 45^0\ N$. Find $\vec{R} = \vec{A} + \vec{B}$ using component method.

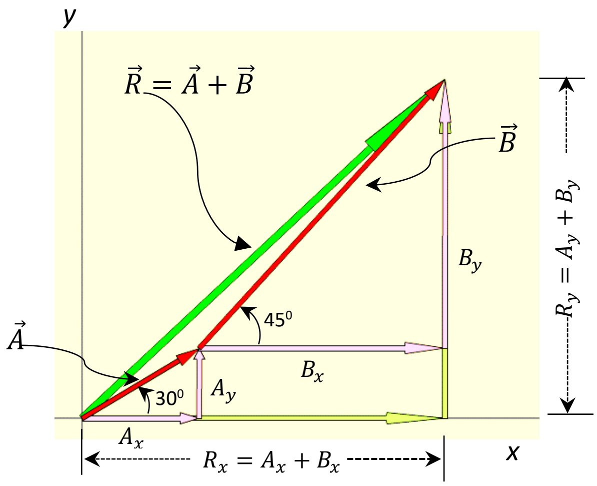


Fig-3.3. Component Method

Solution:

Get the value of the components of $\vec{R}$,

$R_x = A_x + B_x$

$since\ A_x = Acos\theta = 20km(cos30^0) = 17.32\ km$

$B_x = Bcos\theta = 50km(cos45^0) = 35.35\ km$

Then, $\boldsymbol{R_x = 17.32\ km + 35.36\ km = 52.68\ km}$

Also, $R_y = A_y + B_y$

$since\ A_y = Asin\theta = 20km(sin30^0) = 10\ km$

$B_y = Bsin\theta = 50km(sin45^0) = 35.36\ km$

Then, $\boldsymbol{R_y = 10\ km + 35.36\ km = 45.36\ km}$

The magnitude is given by,

$$|R| = \sqrt{(R_x)^2 + (R_y)^2} = \sqrt{(52.67km)^2 + (45.36km)^2} = \boldsymbol{69.5\ km}$$

And the direction is given by,

$$tan\theta = \frac{R_y}{R_x}$$

$$\theta = tan^{-1}\left(\frac{45.35}{52.67}\right) = \boldsymbol{E\ 40.7°\ N}$$

Triangle law of vector addition:

Consider two vectors $\vec{A}$ and $\vec{B}$ represented in order of magnitude and direction by the sides OA and AB, respectively of the triangle OAB. Let **R** be the resultant of vectors A and B. Then magnitude of **R** is given by:

$|\boldsymbol{R}| = \sqrt{|A^2| + |B^2| + 2AB\ Cos\ \theta}$, In triangle ANB with θ as the angle between **A** and **B**

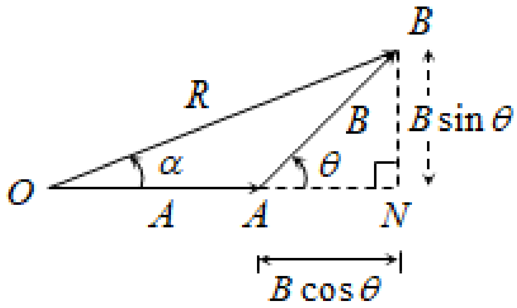


Fig-3.4. Triangle Law of Vector Addition

Example - Taking the example from above, $\vec{A} = 20km, E\ 30^0\ N$ and $\vec{B} = 50\ km, E\ 45^0\ N$. Find $\vec{R} = \vec{A} + \vec{B}$ using triangle law of vector addition.

Here the angle between $\vec{A}$ and $\vec{B}$ will be 15^o, then

$$|R| = \sqrt{|A^2| + |B^2|\ + 2AB\ Cos\ \theta}$$

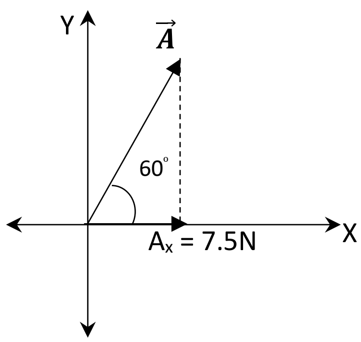
$$|R| = \sqrt{|20^2| + |50^2|\ + 2\ \times\ 20\ \times 50\ Cos\ 15}$$

$$|R| = \boldsymbol{69.5\ km}$$

Class Activity-2

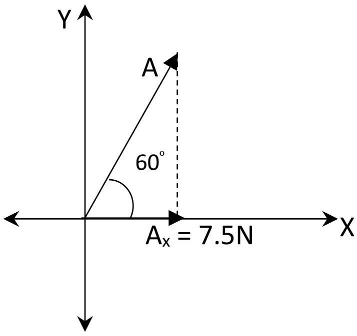
Choose the correct answer:

1) The magnitude of the vector **A** given below is…



A. 7.5 N
B. 15 N
C. 30 N

2) The y-component of vector **A** given below approximately is…



A. 7.5 N
B. 13 N
C. 15 N

3) Two vectors are at 0° and 180° to each other having magnitudes of 4N and 3N. Then, resultants will be:

A. 0N and 5N
B. 7N and 1 N
C. 7N and 5 N

4) A force has magnitude 20N. If one of the rectangular components is 12N, the other rectangular component must be…

A. 8N
B. 16 N
C. 32 N

5) At what angle should the two force vectors 5N and 12 N be added to get a resultant vector of 13 N?

A. 0º
B. 30º
C. 90º

B. Problem Solving

1. Two forces $\mathbf{F_1}$ and $\mathbf{F_2}$ act on a body. One of the forces is double of the other force. The resultant of these forces is equal to the larger force. What is the angle between the forces?

2. From the given vectors below,

$\vec{A} = 32.5\ km, E\ 40°\ N$

$\vec{B} = 15\ km, W\ 68°\ N$

$\vec{C} = 59\ km, South$

Find the resultant vector:

a) $\vec{R} = \vec{A} + \vec{B}$ (Using component method)

b) $\vec{R} = \vec{B} + \vec{C}$ (Using triangle law of vector addition)

Worksheet-3

A. Choose the correct answer:

1) A vector is a quantity that has _____________.

A. magnitude and time
B. magnitude and direction
C. time and direction

2) Which among the following is set of scalar quantity?

A. Displacement, speed and force
B. Weight, force and displacement
C. Mass, distance and power

3) Two vectors of the same magnitude are added, one going to the east and the other one to the west. The magnitude of the resultant vector is equal to:

A. 0
B. 1
C. -1

4) Two forces $\overrightarrow{F_1}$ and $\overrightarrow{\boldsymbol{F_2}}$ that are perpendicular to each other act on a point mass. The resultant force in the point mass is given by:

A. $\sqrt{F_1 \; + F_2}$
B. $\sqrt{F_1^2} + \sqrt{F_2^2}$
C. $\sqrt{F_1^2 + F_2^2}$

5) If $\mathbf{A}_x$ = 5 units and $\mathbf{A}_y$ = 12 units. The magnitude and direction of vector A will be_____

A. 13 units and E 47.5º N
B. 17 units and E 57.6º N
C. 13 units and E 67.4º N

B. Problem Solving:

1. Using cosine law, find the resultant of two forces of 4.0 N and 5.0 N acting at an angle of 45º to each other?

2. From the given vectors below,

$\vec{A} = 50\ km, E\ 30°\ N$

$\vec{B} = 20\ km, W\ 60°\ N$

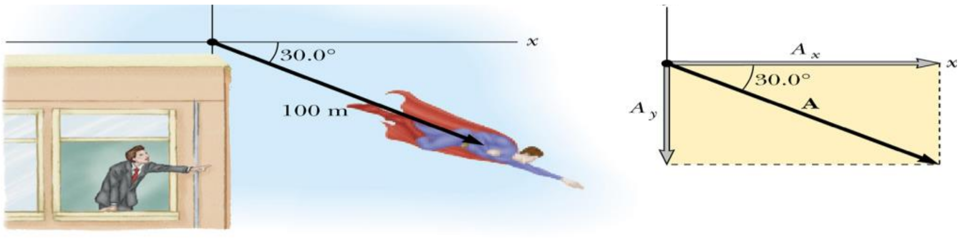
$\vec{C} = 45\ km, North$

Find the resultant vector:

$\vec{R} = \vec{A} + \vec{B}$ (Using component method)

$\vec{R} = \vec{B} + \vec{C}$ (Using triangle law of vector addition)

2. Find the horizontal and vertical components of the **100.0 m** displacement of a superman who flies from the top of a tall building along the path shown in Figure below.



(a) (b)

3. Find the magnitude and direction of force having **X** and **Y**-components of -5 N and 3 N respectively.

4. If two forces are acting opposite to each other, produce the resultant as 8 N and in the same direction gives12 N, find the individual forces.

C. Fill in the blanks:

1) A physical quantity that has only ________________and has no specific direction is called a scalar quantity

2) In a Cartesian coordinate system, all vectors can be resolved into its _______________.

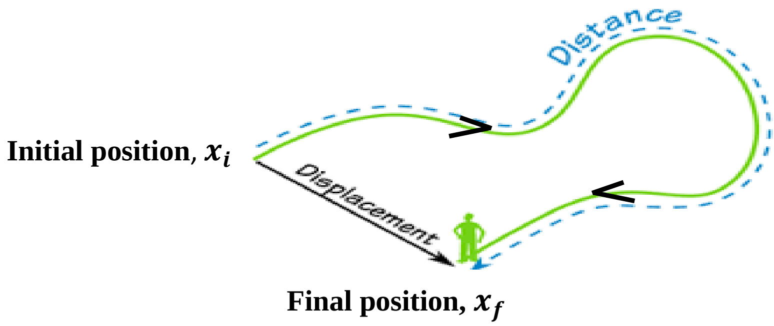
3) The sum of two or more vectors is equivalent to a single vector called_________.

4) A vector quantity is represented by an _________________.

5) The length of the arrow line represents the ____________ of the physical quantity

Chapter 4: Linear Motion

4.1 Distance and Displacement:

Distance	Displacement
It is the length of the actual path followed by the body between the initial and final position.	It is the shortest distance between the initial and final position of the body. It is the change in position of a body.
 *Fig-4.1. Distance and Displacement*	
It is a scalar quantity	It is a vector quantity
The actual path travelled between the two points, the initial x_i and x_f the final position tells exactly how the object moved between these two points.	Displacement between two points does not tell exactly how the object moved between these two points.
There could be many distances (many paths) between x_i and x_f because distance depends on the paths.	There is only one (path) displacement between x_i and x_f
Distance is always positive.	Displacement can be positive or negative.

Note: Units of both distance and displacement will be same. Distance ≥ displacement.

4.2 Speed and Velocity:

Speed

Speed, being a scalar quantity, is the rate at which an object covers distance. The average speed is the ratio between distance and time. Speed is a physical quantity that tells us how fast an object is moving.

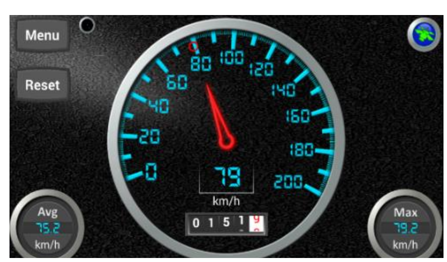


Fig-4.2. Speedometer

For example, a speedometer (which we can see in car) is a device that measures and displays the instantaneous speed of a vehicle. It doesn't give any information about the direction of the motion of the vehicle.

Velocity

It is the rate of change of displacement of a body called velocity. It is a vector quantity (it has magnitude and direction). Its SI unit is m/s (m.s^{-1}).

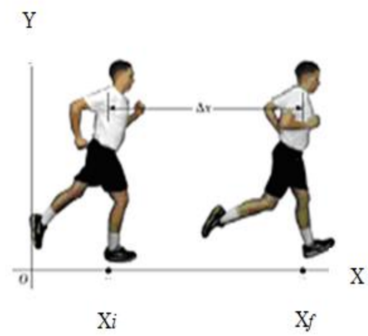


Fig-4.3. Displacement

The velocity ($\vec{v}$) of the jogger is equal to

$$\vec{V} = \frac{Displacement}{Time} = \frac{\Delta\vec{x}}{\Delta t} = \frac{x_f - x_i}{\Delta t}$$

Where, Δx is the displacement of the jogger which is equal to $\overrightarrow{\Delta x} = x_f - x_i$, where x_i and x_f are the initial and final position of the person respectively. Where, Δt is the time of travel.

Class Activity-1

<u>A. Choose the correct Answer:</u>

1) Which of the following statements is correct?
A. Speed and velocity have same units
B. Speed is vector and velocity is scalar
C. Speed and velocity are always equal

2) Rate of change in displacement is also known as:
A. Acceleration
B. Speed
C. Velocity

3) Which of the following may be zero if a particle is in motion for some time?
A. Distance
B. Displacement
C. Speed

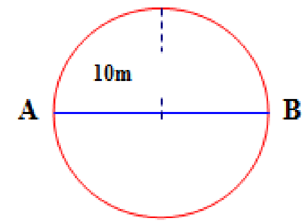
4) The numerical value of ratio between displacement to distance of a moving object is…
A. always equal to 1
B. always less than or equal to 1
C. always more than or equal to 1

B. Problem solving

1. Find the distance and displacement of a body in the following cases:

a) A car completes a half circle of radius 10.0 m.

b) A car completes a full circle of radius 10.0 m.

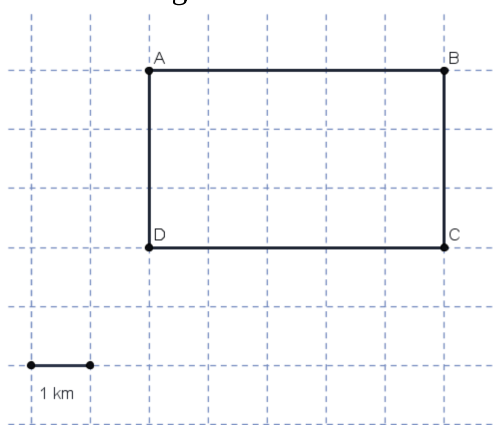


2. A man walks for 1 minute at a speed of 1 m/s and then runs for 1 minute at 3 m/s along a straight track. What is the average speed of the man?

3. An object moves from point A to point C along the rectangle shown in the figure below.

   a) Find the distance covered by the moving object.

   b) Find the magnitude of the displacement of the object.



4.3 Accelerated Motion:

Acceleration (a):

The acceleration, (a) of a body is defined as "the rate of change of **velocity**" and it is a vector quantity. Let change of velocity as Δv, and the time interval as Δt.

$$a = \frac{\Delta v}{\Delta t} = \frac{v - u}{t_f - t_i}$$

Its SI unit is m/s^2 (or $m.s^{-2}$).

Relationship between Velocity and Acceleration

Case (i) If a car moves with constant velocity (uniform motion), then it has no acceleration or $a = 0\ m/s^2$. The length of arrows are the same in size as shown in the figure below.

Fig-4.4a. Constant Velocity

*Velocity is uniform (covers equal distance in equal time).

*Acceleration equals zero, $a = 0\ m/s^2$ (because change in velocity is zero).

Example: A person driving his car on a highway at a constant speed of 120 km/h.

Case (ii) If the car is moving with a positive velocity and a constant positive acceleration in the same direction, then the speed of the car increases as shown in the figure below.

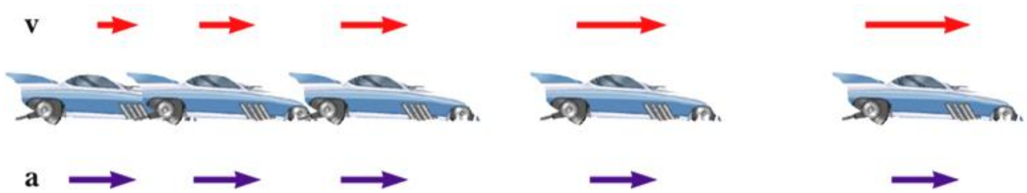


Fig-4.4b, Increasing Velocity

*The velocity and acceleration are in the same direction.

* The velocity is increasing (upper arrows are getting longer)

*The acceleration is uniform (lower arrows maintain the same length)

Example: When a car driver is speeding up after stopping at a red traffic light, his motion is an accelerated motion as his velocity is increasing.

Case (iii) If the car is moving with a positive velocity but with a negative acceleration then the speed of car decreases with time. Sometimes decrease in speed with time is called negative acceleration or deceleration or retardation.

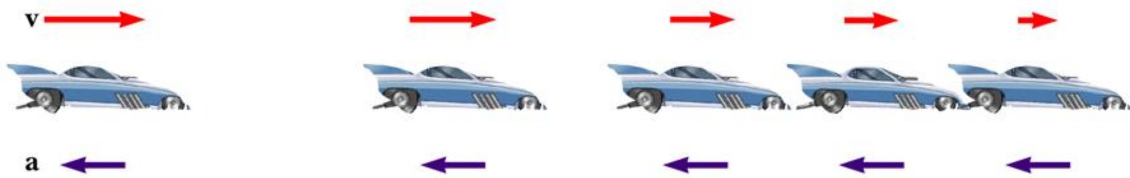


Fig-4.4c. Decreasing Velocity

*The acceleration and velocity are in opposite directions

*The velocity is decreasing (upper arrows are getting shorter)

*The acceleration is uniform (lower arrows maintain the same length)

Example: This type of motion happens when a car comes to a stop after applying brakes

4.4 Kinematic Equations of Motion:

Kinematic equations are set of equations that can be utilized to predict unknown information about an object's motion if other information is known. The equations can be utilized for any motion that can be described as either a constant velocity motion (an acceleration of 0 m/s^2) or a constant acceleration motion. The four kinematic equations for accelerated motion (2^{nd} column) will be reduced to the equation for non-accelerated motion (1^{st} column) when acceleration is zero, a=0.

Non-accelerated motion **(velocity is constant; a=0)**	**Accelerated Motion** **(velocity is NOT CONSTANT; a≠0)**
$v = \frac{s}{t}$	$v = u + at$ $v^2 = u^2 + 2as$ $s = ut + \frac{1}{2}at^2$ $s = \left(\frac{v+u}{2}\right)t$

Where: $v = final\ velocity$

$u = initial\ velocity$

s = *displacement*

a = *acceleration*

t = *time*

Class Activity-2

A. Choose the correct Answer:

1. If a car is moving with uniform velocity, then its acceleration will be…

A. Positive
B. Negative
C. Zero

2. An aircraft accelerates from rest to 200 km/h in 25 seconds. Its acceleration is equal to:

A. 2.22 m/s^2
B. 8 m/s^2
C. 200 m/s^2

3. A ball hits a wall horizontally at 6 m/s. It rebounds horizontally at 4.4 m/s. The ball is in contact with the wall for 0.040 s. What is the magnitude of acceleration of the ball?

A. 40 m/s^2
B. 260 m/s^2
C. 660 m/s^2

B. Problem Solving:

1. Starting from rest, an airplane takes off after covering 0.7 km on the runway. If it takes off at 42 m/s, calculate

a) the acceleration

b) the time for which it moves on the runway

2. A car is travelling at a speed of 90 km/h. Brakes are applied to produce a uniform acceleration of – 0.5 m/s^2. Find out how far the car will go before it is brought to rest.

3. The average distance between Muscat and Barka is around 65 km. If you leave Muscat at 7:25 am and are travelling at constant velocity of 110 km/hr., at what time will you arrive in Barka?

4.5 Motion under the influence of gravity (g):

An object moving under the influence of gravity has a constant acceleration equal to g = -9.8 m/s^2. The negative sign indicates that the direction of acceleration is towards the earth or downward. We will consider the upward direction as positive. Furthermore, when the motion is affected by the gravitational force only, it is called a free fall. Also, when we refer to free fall, air friction is neglected.

The equation of motion for free fall is the same as the kinetics equations of motion. However, some quantities will be changed to fit its description. In this case,

Quantities	**Accelerated motion**	**Free fall**
displacement	S	h
acceleration	A	g = -9.8 m/s^2

And so, the kinematic equations for free fall are given by:

Accelerated Motion **(velocity is NOT CONSTANT; a≠0)**	**Free fall** **(velocity is NOT CONSTANT; a=g=-9.8m/s^2)**
$v = u + at$ $v^2 = u^2 + 2as$ $s = ut + \frac{1}{2}at^2$ $s = \left(\frac{v+u}{2}\right)t$	$v = u + gt$ $v^2 = u^2 + 2gh$ $h = ut + \frac{1}{2}gt^2$ $h = \left(\frac{v+u}{2}\right)t$

There are a few concepts of free fall motion that will be significant in analyzing problems in free fall.

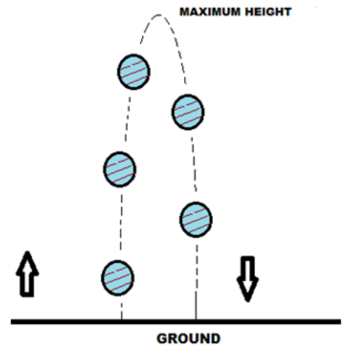
- The acceleration due to gravity is always negative whether the object is moving upward or downward.
- When the object is travelling upwards, the velocity is positive and decreases. And when it is travelling downwards, the velocity is negative and increasing.
- When the object is projected upwards, its velocity is zero at the maximum height.

- When the object is being dropped, its initial velocity is zero.

Example 1: The opposite figure shows an object thrown vertically upwards with an initial velocity of 12 m/s^2. Find:

A) The maximum height reached by the ball.

B) The time to reach the maximum height.



Solution:

A.) Using equation 2,

$v^2 = u^2 + 2gh$ at $h_{max} = v = 0$ then,

$0 = (12m/s)^2 + 2(-9.8m/s^2)(h_{max})$

$$h_{max} = \frac{(12m/s)^2}{2(9.8m/s)}$$

h_{max} =7.35 m/s

B.) Using equation 1,

$v = u + gt$

$0 = 12m/s + (-9.8m/s^2)t$

$$t = \frac{12m/s}{9.8m/s^2}$$

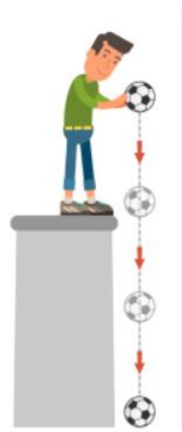
$t = 1.22\ s$

Example 2. A ball is dropped from the top of a building at a height of 20 m.

A) At what time will it reach the ground?

B) What is the final velocity of the object when it reaches the ground?

C) If a second ball of double the mass of the first one is dropped from the same height, at what time will it reach the ground.



Solution:

A.) We can use the equation (3) to solve for time,

$$h = ut + \frac{1}{2}gt^2$$

$$h = 0 + \frac{1}{2}gt^2$$

$$t = \sqrt{\frac{2h}{g}}$$

$$t = \sqrt{\frac{2(20m)}{9.8m/s^2}} = \sqrt{\frac{40m}{9.8m/s^2}}$$

$t = 1.42\ s$

B.) We will use the following equation of motion:

$v = u + gt$

$v = 0 + \left(-9.8\frac{m}{s^2}\right)(1.42s)$

$v = -14\, m/s$

*the negative sign indicates that the direction of the object is downward.

C) Since the balls are in free fall they will both reach the ground at the same time

Class Activity-3

A. Choose the correct answer:

1. When you throw a ball upward, the velocity at the highest point is:

A. 9.8 m/s
B. 0 m/s
C. 19.6 m/s

2. A ball is thrown upwards with an initial velocity of 3 m/s. Which of the following statements is true about its motion?

A. The velocity of the ball is constant all the time.
B. The velocity and acceleration of the ball have different directions.
C. The ball travels 9.8 m in every second.

3. When you throw a ball directly upward, its acceleration is...

A. Zero all the time
B. 9.8 m/s^2 all the time
C. Constant when going up and zero when going down.

B. Problem Solving:

1. A ball is thrown directly downward with an initial speed of 8 m/s from a height of 30 m. After what interval does the ball hit the ground?

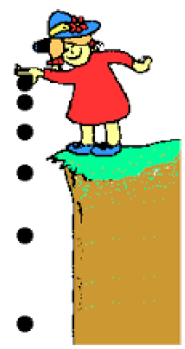
2. An object is being thrown vertically upwards with initial velocity of 16 m/s. Find:

a) maximum height

b) time to reach the maximum height

3. **A**n object is being dropped from a cliff at a height of 50 m.

a) At what time will it reach the ground?



b) What is the final velocity of the object when it reached the ground?

Worksheet- 4

A. Choose the correct answer:

1. Ibrahim jogs 10 km south, 5 km east and then he needs to come back to his starting point using the same path. Which of the following statements is TRUE?

a) The total distance covered is zero.
b) The total distance covered is 15 km.
c) The displacement is zero

2. If a body starts from rest and reaches 84 m/s in 3 s, its acceleration is ____________.

A. 28 m/s^2
B. 14 m/s^2
C. 252 m/s^2

3. A bicycle's brakes can produce a deceleration of 2.5 m/s^2. How far will the bicycle travel before stopping, if it is moving at 10 m/s when brakes are applied?

A. 10 m
B. 20 m
C. 30 m

4. How long will it take for a car moving at constant speed of 60 km/hr. to travel 90 km?

a) 40 minutes
b) 75 minutes
c) 90 minutes

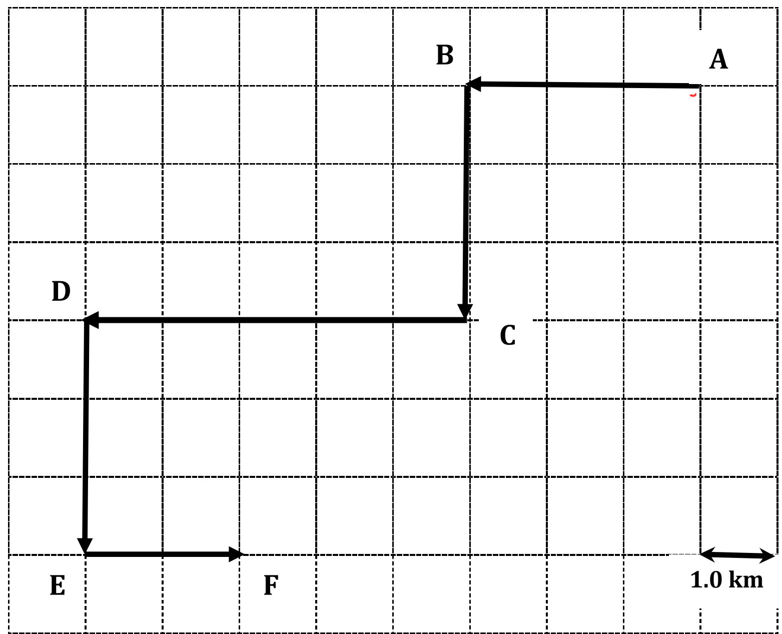
5. Two bodies of masses 1 kg and 2 kg are thrown upwards with the same velocity of 19.6 m/s. Then the ratio of the maximum height reached by the two bodies is _____________.

a) 1:1
b) 1:2
c) 2:1

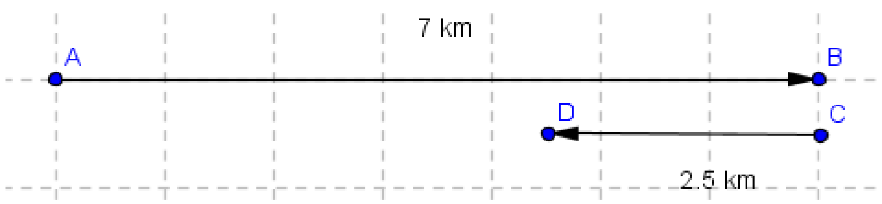
B. Problem Solving

1. An aircraft accelerates from rest to 200 km/h in 25 seconds. What is its acceleration in m/s^2?

2. An object moves along the grid through points A, B, C, D, E, and F as shown below. Find the distance covered by the moving object and the magnitude of the **displacement.**



3. A man walks 7 km East in 2 hours and then 2.5 km West in 1 hour as shown below.
a) What is the man's average speed for the whole journey?
b) What is the man's average velocity for the whole journey?



4. If an aircraft slows down from 160 km/h to 10 km/h with a uniform retardation of 5 m/ s^2,

a) How long will it take to reach this speed?

b) What distance the aircraft has travelled on that change of speed?

5. A super-deluxe car accelerates uniformly from rest to a speed of 38.9 m/s in 8 s. Find the displacement of the car in 8 s.

6. A car accelerates uniformly from 0 to 20 m/s in 11.5 seconds. What is the distance covered by the by the time it reaches the velocity of 20 m/s?

ARABIC TRANSLATION OF PHYSICS TECHNICAL TERMS
ترجمة المصطلحات الفيزيائية إلى اللغة العربية (الجزء الأول)

Chapter 1

Acceleration: التسارع
Angular displacement: الإزاحة الزاوية
Base units: وحدات أساسية
Conversion: التحويل
Convert: حول
Density: الكثافة
Derived units: وحدات مشتقة
Electric current: التيار الكهربائي
Force: القوة
Frequency: التردد
Heat Energy: الطاقة الحرارية
Length: الطول
Luminous intensity: شدة الإضاءة
Mass: الكتلة
Momentum: كمية الحركة أو الزخم
Multiplier: مضاعف
Physical quantity: كمية فيزيائية
Power: القدرة
Prefixes: البادئات
Pressure: الضغط
Resistance: المقاومة
Speed: السرعة
Sphere: كرة
Circular loop: حلقة دائرية
System of Units: نظام الحدات
Temperature:الحرارة
Time: الزمن
Unit of length: وحدة الطول
Unit of mass: وحدة الكتلة
Unit of time: وحدة الزمن
Value: قيمة
Velocity: السرعة المتجهة
Voltage: فرق الجهد
Volume: الحجم
Work: الشغل

Chapter 2

Anion: أنيون
Atom: الذرة
Atomic mass: العدد الكتلي
Atomic number: العدد الذري
Boiling point: نقطة الغليان
Cation كاتيون:
Chemical bonds: الروابط الكيميائية
Classification of matter: تصنيف المادة
Combinations: مزج
Compound: مركب
Condensation: التكثف
Covalent bond: الرابطة التساهمية
Deposition: الترسب
Electrons: الإلكترونات
Element: عنصر
Evaporation: التبخر
Freezing: تجميد
Gain of electrons: اكتساب إلكترونات
Gas: غاز
Heterogeneous: غير متجانس
Homogeneous: متجانس
Ionic bonds: الروابط الأيونية
Isotopes: النظائر
Liquid: سائل
Loss of electrons: فقدان إلكتروتات

Matter: المادة
Melting point: نقطة الذوبان
Melting: ذوبان
Mixture: خليط
Nature of matter: طبيعة المادة
Neutral atom ذرة متعادلة:
Neutrons: النوترون
Nucleus: النواة
Periodic table: الجدول الدوري
Plasma: بلازما
Protons: البروتون
Pure substance: مادة نقية
Ratio: نسبة
Shell الهيكل أو الغلاف:
Solid: صلب
Solidification: تصلب
Structure of an Atom: بنية الذرة
Sublimation: التسامي
Valence electron: إلكترون تكافؤي
Valence shell: مدار تكافؤ أو غلاف تكافؤ
Wet sand: رمل مبلل

Chapter 3

Adding: جمع
Cartesian plane: المستوى الديكارتي
Component of a vector: مكونات المتجه
Direction: إتجاه
Displacement: الإزاحة
Distance: المسافة
Dividing: قسمة
East: الشرق
Equality of vectors: مساواة متجهين
Magnitude: مقدار
Multiplying: ضرب
North: الشمال
Perimeter of circle: محيط الدائرة
Properties: خصائص
Resultant: محصلة
Scalar quantity: كمية عددية
South: الجنوب
Subtracting: طرح
Vector quantity: كمية متجهة
Vector representation: تمثيل المتجهات
Vector: متجه
Weight: الوزن
West: الغرب

Chapter 4

Accelerated motion: حركة متسارعة
Center of gravity: مركز الجاذبية(الثقل)
Cliff: جرف
Final velocity: السرعة النهائية
Free fall: السقوط الحر
Gravity: الجاذبية
Initial velocity: الحركة الإبتدائية
Kinematic equations of motion: معادلات الحركة
Motion: حركة
Non-accelerated motion: حركة غير متسارعة

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