Chapter # 1

Physical Quantities and Measurement

Q1)Define Physic. Name the branches of Physic

PHYSIC

Physics is the branch of science which observes the nature represents it mathematically and conclude with the experiment.

BRANCHES OF PHYSIC

1. Mechanics
2. Thermodynamics
3. Electricity
4. Magnetism
5. Atomic Physics
6. Optics
7. Sound
8. Nuclear physics
9. Particle physics
10. Astrophysics
11. Plasma physics
12. Geo physics

Q2)Define the branches of physic

MECHANICS

This branch of physics is mainly concerned with the laws of motion and gravitation.

THERMODYNAMICS

Thermodynamics deals with heat and temperature and their relation to energy and work.

ELECTRICITY

Electricity is the study of properties of charges in rest and motion

MAGNETISM

Magnetism is the study of magnetic properties of materials

ATOMIC PHYSICS

Atomic physics deals with the composition structure and properties of the atom

OPTICS

Optics studies physical aspects of light and its properties with the help of optical instruments.

SOUND

Sound is the study of production, properties and applications of sound waves.

NUCLEAR PHYSICS

Nuclear physics deals with the constituents, structure, behavior and interactions of atomic nuclei.

PARTICLE PHYSICS

Particle Physics studies the elementary constituents of matter and radiation, and the interactions between them.

ASTROPHYSICS

The study of celestial objects with the help of laws of physics is known as Astrophysics.

PLASMA PHYSICS

The study of ionized state of mater and its properties is known as Plasma Physics.

GEO PHYSICS

The study of internal structure of earth is known as Geo physics.

Q3)Give some importance of physic.

IMPORTANCE OF PHYSIC

Automobile's technology is based on principles of thermodynamics.

Nuclear energy is used on large scale to produce electric power.

Radar technology is based on the role of physic

Laser are widely used in medical science

Electrical device used as home appliances are based on physic rules and law.

Q4)Define fundamental physical quantities. How many fundamental physical quantities are there? Name them also give their unit and symbol

FUNDAMENTAL PHYSICAL QUANTITIES

Physical quantities which cannot be explained by other physical quantities are called fundamental physical quantities

There are seven fundamental physical quantities

Fundamental quantities	**S.I Unit**	**Symbol of Unit**
Length	meter	m
Mass	Kilogram	kg
Time	second	s
Electric current	Ampere	A
Temperature	Kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

Q5)Define derived Physical quantities. Name some derived Physical quantities also give their unit and symbol

DERIVED PHYSICAL QUANTITIES

Physical quantities which are explained on the basis of fundamental physical quantities are called derived physical quantities.

Derived Quantities	**S.I Unit**	**Symbol of Unit**
Volume	cubic meter	m^3
Velocity	meter per second	ms^{-1}
Force	Newton	N
Density	kilogram per cubic meter	kg/m^3

Acceleration	meter per second square	m/s^2

Q6)Define standard length?

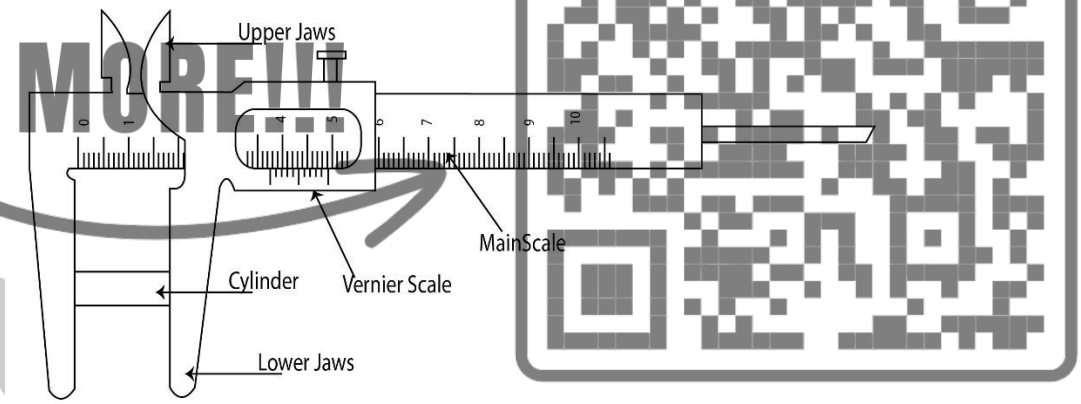
STANDARD LENGTH

The length is defined as the minimum distance between two points lying on same plane

Q7)What is vernier caliper?

VERNIER CALIPER

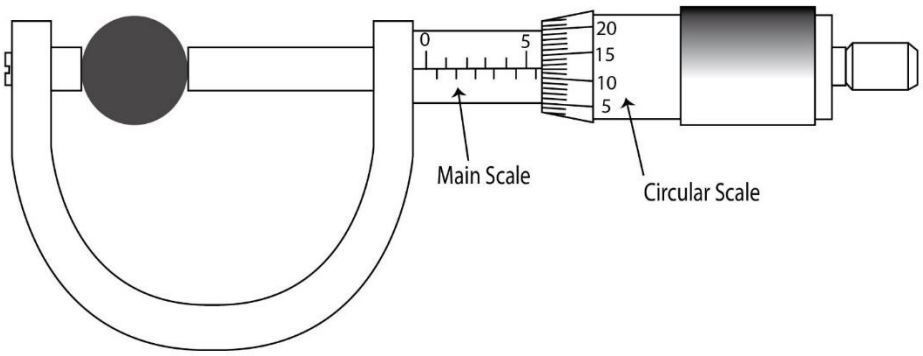
The Vernier Caliper is a precision instrument that can be used to measure internal and external distance extremely accurate. It has both an imperial and metric scale. A Vernier caliper has main jaws that are used for measuring external diameter, as well as smaller jaws that are used for measuring the internal diameter of objects.



Q8)What is Screw gauge?

SCREW GAUGE

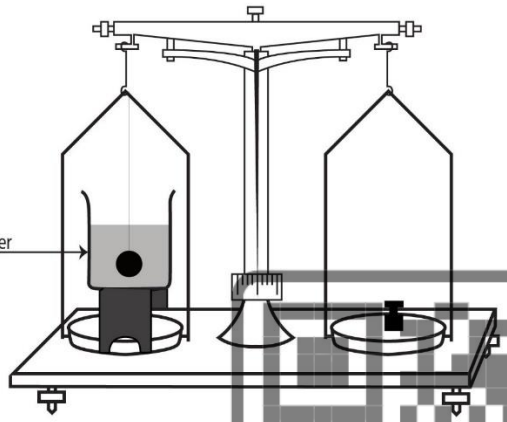
Screw gauge in extensively used in engineering field for obtaining precision measurements. Micrometer screw gauge is used for measuring extremely small dimensions. A screw gauge can even measure dimensions smaller than those measured by a Vernier Caliper



Q9)What is physical balance?

PHYSICAL BALANCE

The **Physical balance** is an instrument used for measurement of mass. It is mostly used in laboratory. It works on the principle of moments.



Q10) What is prefix? List some prefixes.

PREFIX

A **unit prefix** is a specifier. It indicates multiples or fractions of the units.

tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
hecto	h	10^{2}
deka	da	10^{1}
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}

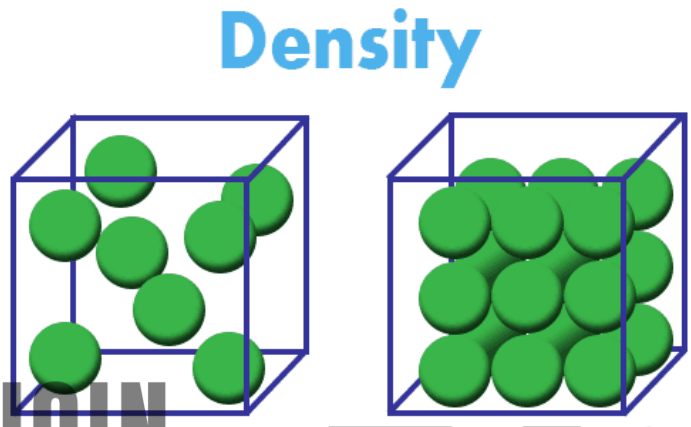
Q11) What is density?

DENSITY

The term density of a substance is defined as mass of substance (m) per unit volume (V). It is denoted by Greek letter ρ (rho)

FORMULA

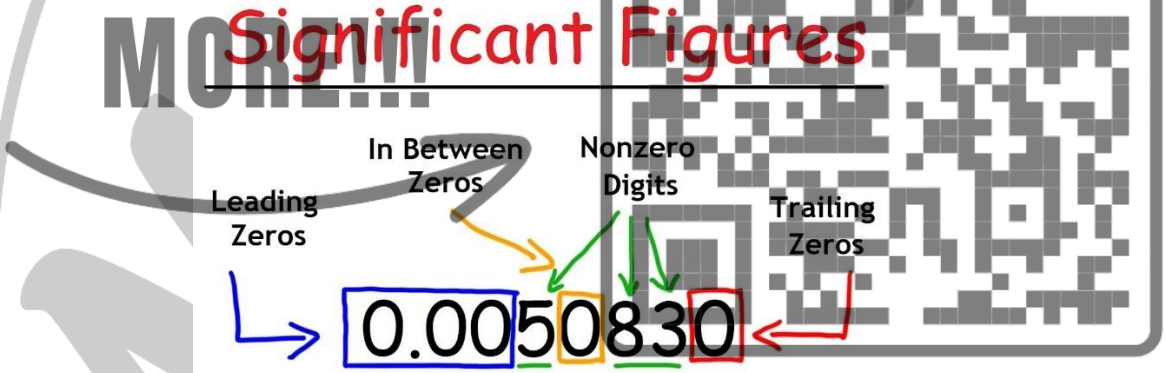
$$\rho = \frac{m}{V}$$



Q12) What is the significant figure discus the rules for significant figure?

SIGNIFICANT FIGURE

The numbers of reliably known digits in a value are known as significant figures.



Rule	Example
1. All non-zeroes are significant	2.25 (3 significant figures)
2. Leading zeroes are NOT significant	0.00000034 (2 significant figures)
3. Trailing zeroes are significant ONLY if an explicit decimal point is present	200 (1 significant figure) 200. (3 significant figures) 2.00 (3 significant figures)
4. Trapped zeroes are significant	0.00509 (3 significant figures) 2045 (4 significant figures)

Numerical / Exercise

Q1. What is the mass a solid iron wrecking ball of radius 18cm. if the density of iron is 7.8 gm/cm^3?

Data

r = 18cm

ρ = 7.8 gm/cm^3

m = ?

Solution

$\rho = m/v$

$V = \frac{4}{3}\pi r^3$

$V = \frac{4}{3}\pi(18)^3$

V = 24432.192 cm^3

7.8 = m/24432.192

7.8 x 24432.192 = m

m =190571.1 gm OR 190.57 kg

Practice of Q1.

What is the mass a solid iron wrecking ball of radius 6cm. if the density of iron is 12.2 gm/cm^3?

Q2. Convert mass of Sun 2 000 000 000 000 000 000 000 000 000 000 kg. into Scientific Notation.

Mass = 2 000 000 000 000 000 000 000 000 000 000 kg

M = 2 x 10^{30}

Practice of Q2.

Convert mass of earth 6 000 000 000 000 000 000 000 000 kg. into Scientific Notation.

Practice of Q2.

Convert velocity of light 3 000 000 00 m/s. into Scientific Notation.

Q3. Convert mass of an electron 9.11 x 10^{-31} kg into standard form.

M = 9.11 x 10^{-31}kg

m = 0. 000 000 000 000 000 000 000 000 000 000911 kg

Practice of Q3.

Convert charge of an proton 9.1 x 10^{-19} C into standard form.

Practice of Q3.

Convert gravitational constant 6.67×10^{-11} Nm^2/kg^2C into standard form.

Q4. How many significant figures are there in the base area of a cylinder whose diameter is 5 cm

Data

d = 5 cm

S.F in area= ?

Solution

$A = \pi r^2$

$R = d/2 = 5/2 = 2.5$ cm

$A = 3.142 \times (2.5)^2$

$A = 19.6375$ cm^2

S.F = 6

Practice of Q4.

How many significant figures are there in the base area of a cylinder whose diameter is 7 cm

Q5. Complete the table

Column A Action	**Column B Branch**
Cooking Bar B.Q	Thermodynamics
Riding a bicycle	
Turning the Bulb on	
Looking for Giant Galaxies	
Producing a loud sound	
Obtaining energy from Earth	
Describing an atom	

Physical Quantity	**S.I Unit**	**Type**
Current	**Ampere**	**Base**
Volume	m^3	**Derived**
Time	Sec	Base
Temperature	**K**	Base
Force	N	**Derived**
Density	Kg per m^3	**Derived**
Acceleration	**ms^{-2}**	**Derived**

Q6. Convert the following values.

1) 230 cm = **2.3** m
2) 250 g = **0.25** kg
3) 0.5 s = **0.0005** ms
4) 0.8 m = **0.0008** mm
5) 350ms = **350000**s
6) 1.2Kg = **1200** g

Q7. Write the correct prefix of notion

1) 75000m = 750 h
2) 2/1000 sec = 2 m
3) 1/1 000 000 g = 1 μ
4) 1000 000 000 m = 1 M

Q8. Write values in standard OR scientific notation

a) The radius of 1st orbit of Hydrogen atom is r = 0.53 A^0 = **0.53 x 10^{-10} m = 0.000 000 000 053 m**

b) 1 light year is 2628 000 000 000m = **2.628 x 10^9 m**

c) Vacuum pressure = 2.7 x 10^{-4} torr = **0.00027** torr

Q9. A wooden piece is made in different shapes take length (l) = radius (r) = 2m Calculate its volume as a:

a) Sphere b) Cube c) Cylinder d) Pyramid

a) Sphere

Data

r = 2m

$V = 4/3\pi r^3$

$V = \frac{4}{3}$ x 3.142 x $(2)^3$

$V = 33.51\ m^3$

b) Cube

l = 2

$V = l^3$

$V = 2^3 = 8m^3$

c) cylinder

$V = \pi r^2 h$

$V = 3.142\ (2)^2 \times 2 = 25.136\ m^3$

d) Pyramid

$V = \frac{l^3}{3} = \frac{2^3}{3} = 2.667\ m^3$

Q10. Find the density of wood as sphere and cube if the mass of wood is 1kg. Is there any change in density due to shape?

Data

M = 1kg

V(sphere) = 33.51 m^3

ρ(sphere) = ?

V(cube) = 8 m^3

ρ(cube) = ?

Solution

$\rho = \frac{m}{v}$

(sphere) $\rho = \frac{1}{33.51} = 0.03\ kg/m^3$

(cube) $\rho = \frac{1}{8} = 0.125 kg/m^3$

Yes, density is different for sphere and cube, because the volume is different.

Q11. Write significant numbers in the following values.

1) 980 has **2** Significant numbers.
2) 91.60 has **4** Significant numbers.
3) 10010.100 has **8** Significant numbers.
4) 0.0086 has **2** Significant numbers.
5) 60 has **1** Significant numbers.
6) 6250 has **3** Significant numbers.
7) 13.20 has **4** Significant numbers.
8) 41.70 has **4** Significant numbers.
9) 80070.700 has **8** Significant numbers.
10) 30200.050 has **8** Significant numbers.
11) 0.0071 has **2** Significant numbers.
12) 0.0092 has **2** Significant numbers.

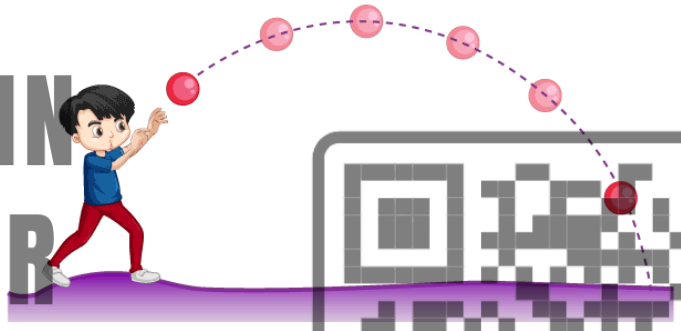
Chapter # 2

Kinematics

Q1)What is kinematics?

KINEMATICS

Kinematics is the branch of Mechanics which deals with motion of objects without reference of force which causes motion.



Q2)Define Rest and motion.

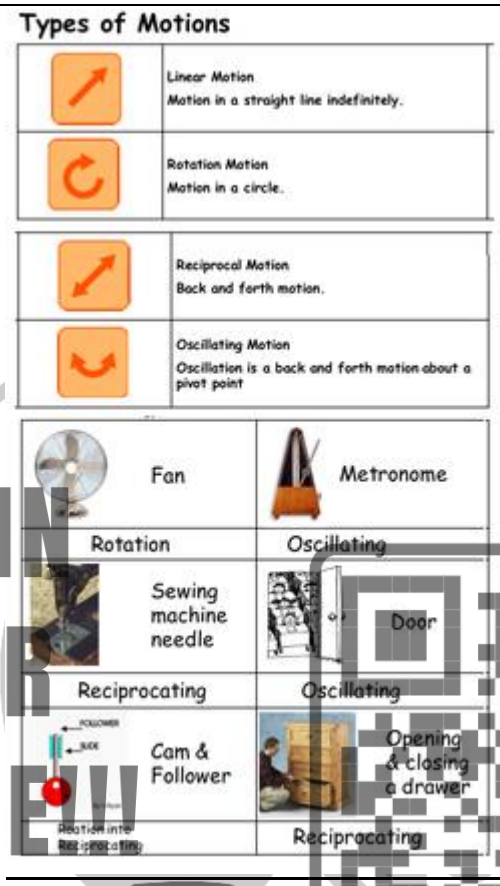
REST

A body is said to be in rest if it does not change its position with respect to its surroundings.

MOTION

A body is said to be in motion if it changes its position with respect to its surroundings.

Q3)Define the types of motion.



TYPES OF MOTION

There are three types of motion

1. Translator motion
2. Rotatory motion
3. Vibratory motion

TRANSLATOR MOTION:

A motion in which all part of body moving in straight line is called translatory motion

EXAMPLE

Motion of car on straight road

ROTATORY MOTION

Rotatory motion can be defined as the movement of any object about an axis

EXAMPLE

Motion of blades of fan

VIBRATORY MOTION

A body moves to and fro about its mean position is called vibratory motion.

EXAMPLE

Motion of pendulum

Q4)What is linear, circular and random motion.

LINEAR MOTION

Motion of a body along a straight line is called linear motion.

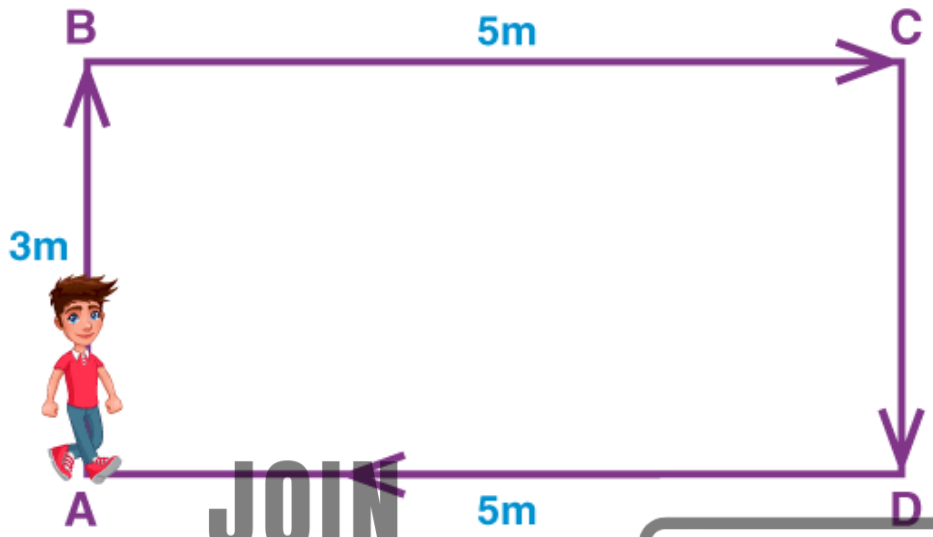
CIRCULAR MOTION

Motion of a body along a circular path is called circular motion

RANDOM MOTION

Irregular motion of an object is called random motion.

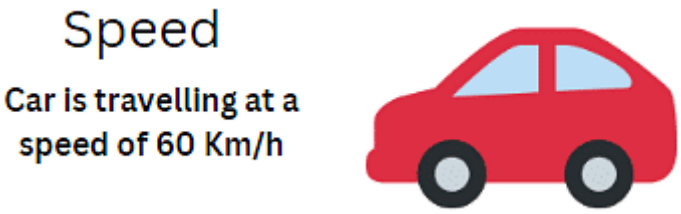
Q5)Differential between distance and displacement.

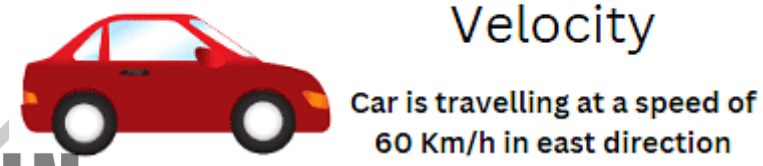


DISPLACEMENT	DISTANCE
Shortest straight-line distance is known as displacement	Total length in any direction is Known as distance
It symbol is $\vec{S}$	It symbol is S
It is a vector quantity	It is a scalar quantity

Q6)Differential between speed and velocity

VELOCITY	SPEED
Displacement covered by the body in unit time is known as velocity	Distance covered by the body in unit time is known as speed.
It formula is $\vec{V} = \frac{\vec{S}}{t}$	It formula is $V = \frac{S}{t}$
Its S.I unit is m/s.	Its S.I unit is m/s.





Q7)Define uniform speed and uniform velocity

UNIFORM SPEED

An object covers an equal distance in equal interval of time its speed is known as uniform speed.

UNIFORM VELOCITY

A body is said to have uniform velocity if it covers equal distance in equal interval of time in a particular direction.

Q8)What is acceleration? Also write its formula and unit.

ACCELERATION

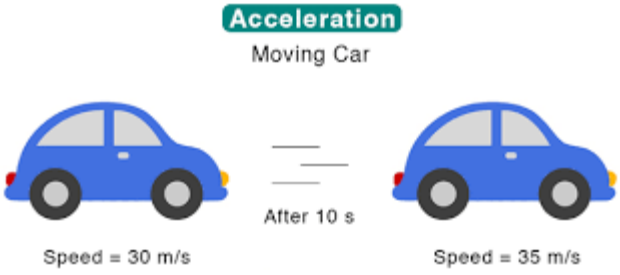
Rate of change of velocity is known as velocity.

FORMULA

$$a = \frac{vf - vi}{t}$$

UNIT

Its S.I unit is m/s^2.



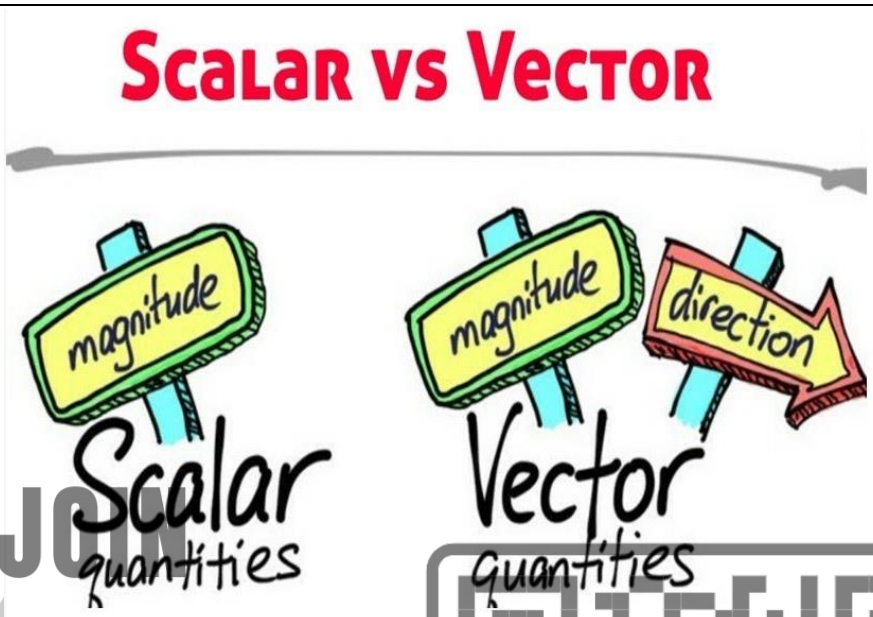
Q9)What is uniform acceleration.

UNIFORM ACCELERATION

A constant rate of change of velocity is called uniform acceleration.

Q10) Differentiate between scalar and vector

SCALAR	**VECTOR**
Quantities having magnitude only are scalar quantities	Quantities having magnitude as well as direction are vector quantities
They are added or subtracted by simple arithmetic method	They are added by graphical method
Time, speed, etc are scalar quantities	Displacement, velocity, etc are vector quantities



Q11) Derive first equation of motion: Vf = Vi + at

Derivation

Suppose a body starts with initial velocity" Vi" after time "t" Its velocity becomes "Vf". Let the change in acceleration be "a" and distance covered by the body in this time by "S"

$$a = \frac{\Delta V}{t}$$

Since, $\Delta V = vf - vi$

$$a = \frac{vf - vi}{t}$$

$$at = vf - vi$$

$$at + vi = vf$$

Or $vf = vi + at$

Q12) Derive second equation of motion: S = Vit + ½ at^2

Derivation

Suppose a body starts with initial velocity" Vi" after time "t" Its velocity becomes "Vf". Let the change in acceleration be "a" and distance covered by the body in this time by "S"

Distance = average velocity **x** time

$S = V_{av}$ **x** t ---------- (A)

As we know that $V_{av} = \frac{Vf + Vi}{2}$

Putting Vav in equation (A)

$$S = \frac{Vf + Vi}{2} \times t$$

By using first equation of motion and putting Vf in above

$$Vf = Vi + at$$

$$S = \frac{Vi+at + Vi}{2} \times t$$

$$S = \frac{2Vi+at}{2} \times t$$

$$S = \frac{2Vi}{2} + \frac{at}{2} \times t$$

$$S = Vit + \frac{1}{2}at^2$$

Q13) Derive third equation of motion: $2aS = Vf^2 - Vi^2$

Derivation

Suppose a body starts with initial velocity" Vi" after time "t" Its velocity becomes "Vf". Let the change in acceleration be "a" and distance covered by the body in this time by "S"

Distance = average velocity **x** time

$$S = V_{av} \textbf{ x } t \text{ ----------(A)}$$

$$\text{As we know that } V_{av} = \frac{Vf + Vi}{2}$$

By using first equation of motion and separating "t"

$$Vf = Vi + at$$

$$t = \frac{Vf - Vi}{a}$$

Putting V_{av} and t in eq (A)

$$S = \frac{Vf + Vi}{2} \times \frac{Vf-Vi}{a}$$

$$S = \frac{(Vf + Vi)(Vf-Vi)}{2a}$$

$$2aS = Vf^2 - Vi^2$$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Numerical # 1

A car travels 700m in 35 seconds what is the speed of car?

Data

S= 700m

t = 35sec

V = ?

Solution

$V = \frac{S}{t}$

$V = \frac{700}{35}$

V = 30 m/s

Practice of Numerical # 1

A bus travels 1210m in 55 seconds what is the speed of car?

Numerical # 2

Calculate the acceleration of a bus that speed up from 20ms^{-1} to 40ms^{-1} in 8 seconds

Data

Vi = 20 ms^{-1}

Vf= 40ms^{-1}

t = 8 sec

a = ?

Solution

$a = \frac{vf - Vi}{t}$

$a = \frac{40 - 20}{8}$

$a = \frac{20}{8}$

a = 2.5 ms^{-2}

Practice of Numerical # 2

Calculate the acceleration of a bus that speed up from 40ms^{-1} to 50ms^{-1} in 5 seconds

Numerical # 3

The speed of train is 108 kmh^{-1}. How much distance will be covered in 2 hours?

Data

V = 108kmh^{-1}

t = 2hour

S = ?

Solution

V= $\frac{S}{t}$ OR S = Vt

S = 108 x 2

S = 216 km

Practice of Numerical # 3

The speed of train is 36 kmh^{-1}. How much distance will be covered in 3 hours?

Numerical # 4

A bus is moving on a road with 15ms^{-1} and it accelerates at 5ms^{-2}. Find the final velocity of bus after 6 seconds.

Data

Vi = 15ms^{-1}

a = 5 ms^{-2}

t = 6sec

Vf = ?

Solution

Vf = Vi + at

Vf = 15 + 5x6

Vf = 15 + 30

Vf = 45 ms^{-1}

Practice of Numerical # 4

A bus is moving on a road with 25ms^{-1} and it accelerates at 8ms^{-2}. Find the final velocity of bus after 3 seconds.

Numerical # 5

A bus start from rest and travels along a straight path its velocity become 15ms^{-1} in 5 seconds. Calculate acceleration of the bus?

Data

Vi = 0(start from rest)

Vf = 15ms^{-1}

t = 5 sec

a = ?

Solution

$a = \frac{15 - 0}{5}$

$a = \frac{15}{5}$

a = 3 ms^{-2}

Practice of Numerical # 5

A bus start from rest and travels along a straight path its velocity become 18ms^{-1} in 3 seconds. Calculate acceleration of the bus?

Numerical # 6

A motorcyclist moving along a straight path applies brakes to slow down from 10ms^{-1} to 3ms^{-1} in 5 seconds. Calculate its acceleration.

Data

Vi = 10 ms^{-1}

Vf= 3 ms^{-1}

t = 5 sec

a = ?

Solution

$a = \frac{3 - 10}{5}$

$a = \frac{-7}{5}$

a = 1.4 ms^{-2}

Practice of Numerical # 6

A motorcyclist moving along a straight path applies brakes to slow down from 14ms^{-1} to 7ms^{-1} in 4 seconds. Calculate its acceleration.

Numerical # 7

A car starts moving from rest with an acceleration of 5ms^{-2}. Find out the time to travel 50m distance.

Data

Vi = 0

a = $5ms^{-2}$

s = 50m

t = ?

Solution

$S = Vit + ½ at^2$

$50 = 0xt + ½ x5xt^2$

$50 = 2.5t^2$

$t^2 = \frac{50}{2.5}$

$t^2 = 20$

$t = \sqrt{20}$

t = 4.47 sec

Practice of Numerical # 7

A car starts moving from rest with an acceleration of $6ms^{-2}$. Find out the time to travel 72m distance.

Numerical # 8

A car moving on a road with velocity 30 ms^{-1}, when brakes are applied its velocity decreases at a rate of 6 meter per second square. Find the distance it will cover before coming to rest.

Data

Vi = 30 ms^{-1}

Vf = 0

a = $6ms^{-2}$

S = ?

Solution

$2aS = Vf^2 – Vi^2$

$2x6xS = 0^2 – 30^2$

$12S = 0 – 900$

$S = -\frac{900}{12}$

S = 75 m

Practice of Numerical # 8

A car moving on a road with velocity 20 ms^{-1}, when brakes are applied its velocity decreases at a rate of 5 meter per second square. Find the distance it will cover before coming to rest.

Numerical # 9

A motor cycle moving with velocity of 40 ms^{-1}. It gets accelerating at a rate of 8 ms^{-2} . How much distance will it cover in the next 10 seconds.

Data

Vi = 40ms^{-1}

a = 8 ms^{-2}

t = 10 sec

S = ?

Solution

S = 40x 10 + ½ x8 x 10^2

S = 400 + 4 x 100

S = 400 + 400

S = 800m

Practice of Numerical # 9

A motor cycle moving with velocity of 50 ms^{-1}. It gets accelerating at a rate of 4 ms^{-2} . How much distance will it cover in the next 12 seconds.

Numerical # 10

A ball is dropped from a height of 50m. What will be its velocity before touching ground?

Data

h = 50m

vi = 0

g = 10ms^{-2}

Vf = ?

Solution

$2gh = Vf^2 - Vi^2$

$2 \times 10 \times 50 = Vf^2 - 0^2$

$1000 = Vf^2$

$Vf = \sqrt{1000}$

$Vf = 31.62\ ms^{-1}$

Practice of Numerical # 10

A ball is dropped from a height of 70m. What will be its velocity before touching ground?

Numerical # 11

A ball is thrown vertically upward with velocity of 12 ms^{-1} . The ball will be slowing down due to pull of Earth's gravity on it, and will return back to Earth. Find out the time the ball will take to reach the maximum height

Data

$Vi = 12\ ms^{-1}$

$Vf = 0$

$g = -10\ ms^{-2}$

$t = ?$

Solution

$Vf = Vi + gt$

$0 = 12 + (-10) \times t$

$10t = 12$

$t = \frac{12}{10}$

$t = 1.2$ sec

Practice of Numerical # 11

A ball is thrown vertically upward with velocity of 16 ms^{-1} . The ball will be slowing down due to pull of Earth's gravity on it, and will return back to Earth. Find out the time the ball will take to reach the maximum height

Numerical # 12

If a body is thrown up ward with vertical velocity 50ms^{-1}. Calculate maximum height which body can reach.

Data

$Vi = 50\ ms^{-1}$

$Vf = 0$

g = –10 ms^{-2}

h = ?

$2gh = Vf^2 – Vi^2$

$2 \times (–10) \times h = 0^2 – 50^2$

–20h = –2500

$h = \frac{-2500}{-20}$

h = 125 m

Practice of Numerical # 12

If a body is thrown up ward with vertical velocity 30ms^{-1}. Calculate maximum height which body can reach.

Numerical # 13

A ball falls down from top of height of 70m. How much time the ball will take to reach the ground.

h = 70m

vi = 0

g = 10ms^{-2}

t = ?

Solution

$h = Vit + ½ gt^2$

$70 = 0xt + ½ \times 10 xt^2$

$70 = 5t^2$

$t^2 = 70/5$

$t^2 = 70/5$

$t^2 = 14$

$t = \sqrt{14}$

t = 3.74 sec

Practice of Numerical # 13

A ball falls down from top of height of 40m. How much time the ball will take to reach the ground.

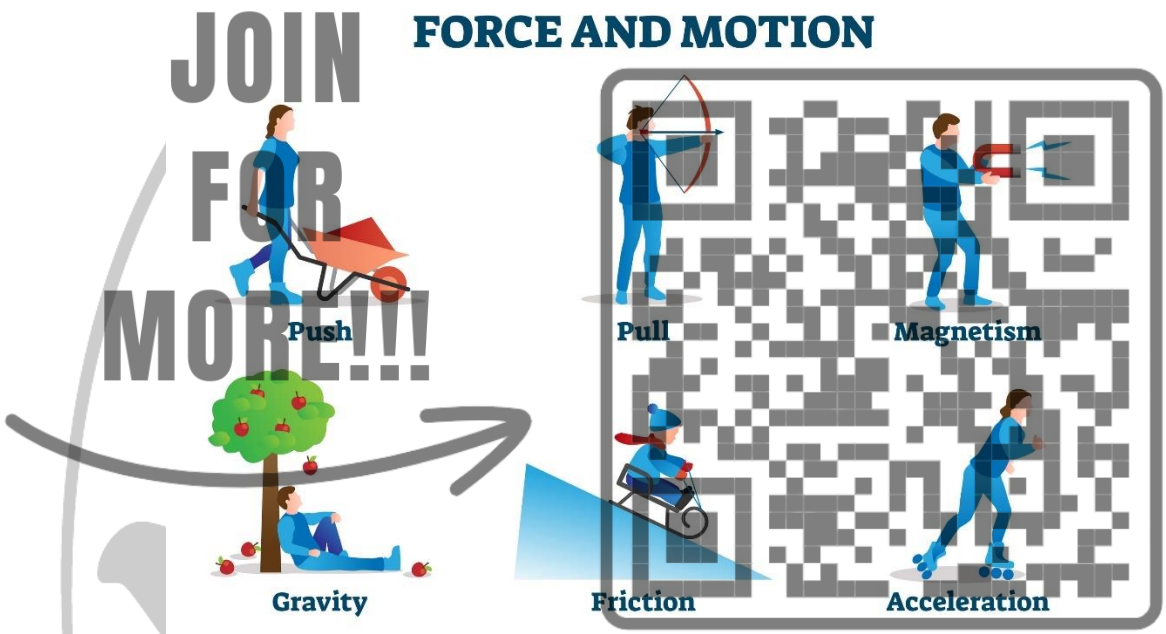
Chapter # 3

DYNAMICS

Q1)Define force. Give its formula and unit

Force

Force is an agent which produce or trend to produce motion in an object. Force can also change the shape of an object.



Formula

F=ma

Unit

It is a vector quantity and S.I unit is $N(kgm/s^2)$

Q2)Define momentum with SI unit.

Momentum

The momentum of an object is equal to the mass multiplied by the velocity of the object

Formula

P=mV

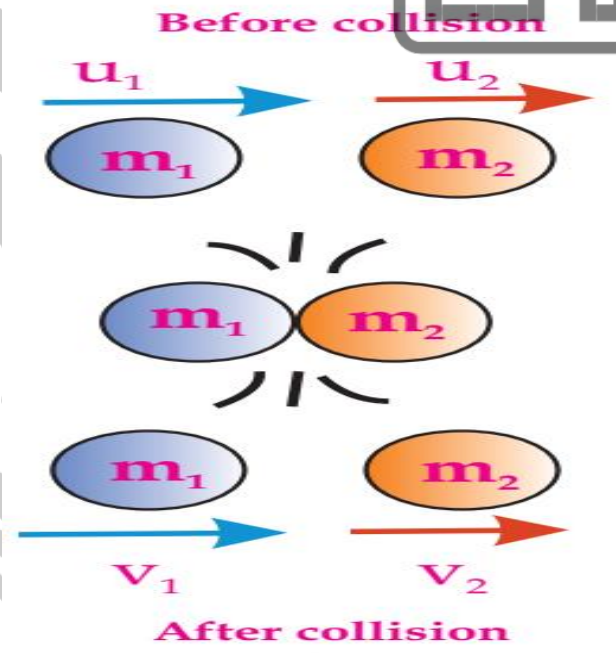
Unit

It is a vector quantity and S.I unit is N.s(kgm/s)

Q3)State and explain Law of Conservation of Momentum.

STATEMENT

Law of conservation of momentum states that when two bodies collides the total momentum is conserved i.e the total momentum after collision and total momentum before collision is same.



MATHEMATICAL EXPRESSION

Suppose, two bodies of mass m_1 and m_2 moves with initial velocity u_1 and u_2 after some time t the collide and then they again began to move with final velocity v_1 an v_2.

Momentum before collision = $m_1u_1 + m_2u_2$

Momentum after collision = $m_1v_1 + m_2v_2$

therefore,

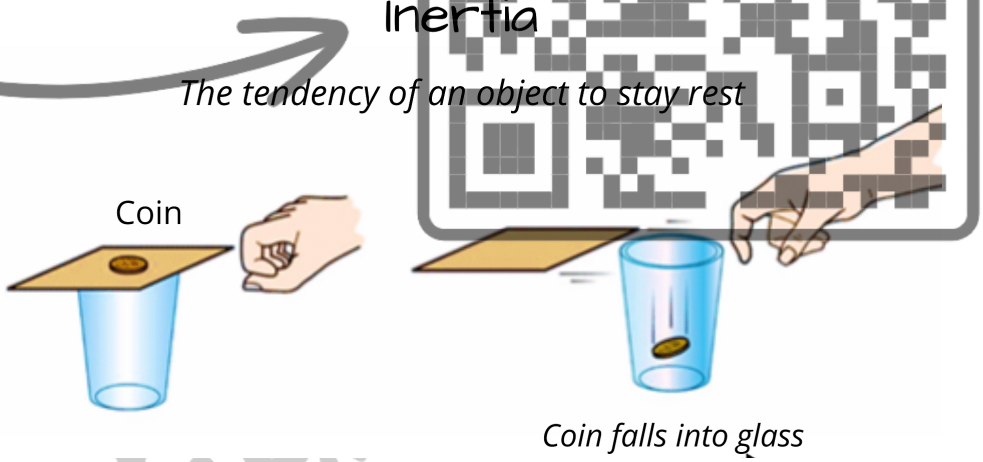
momentum before collision = momentum after collision

$$m_1u_1 + m_2u_{2=} m_1v_1 + m_2v_2$$

Q4)What is inertia? State Newton 1st and 3rd law of motion

Inertia

Inertia is the property of an object due to which it tends to continue its state of rest or motion. Inertia is resistance to change the state.



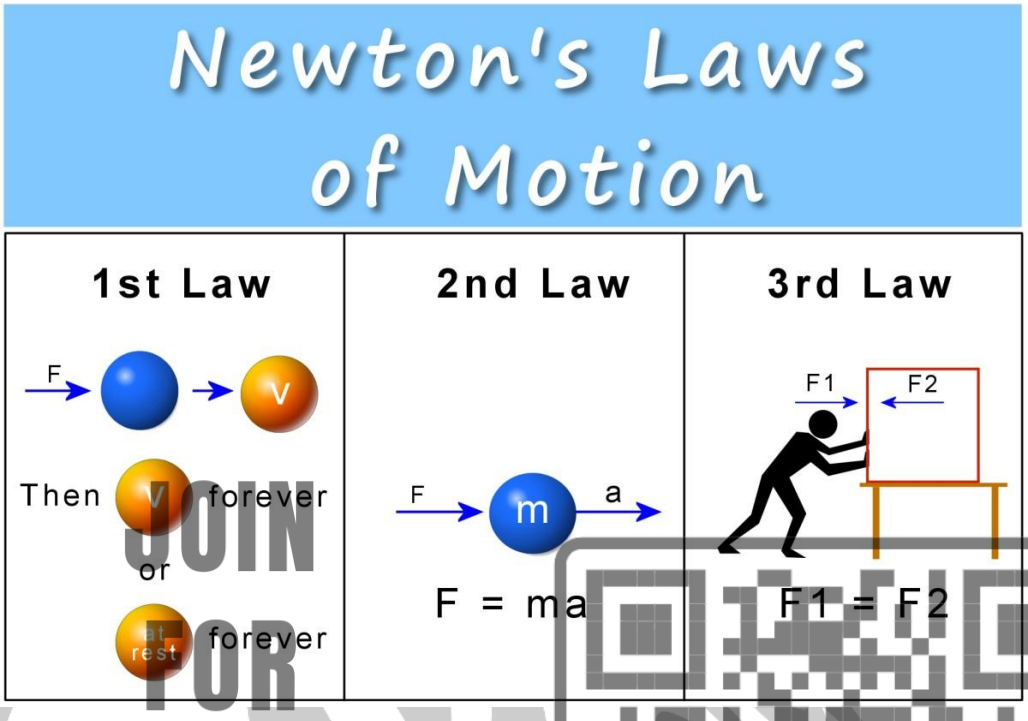
Coin falls into glass

Newton's first law of motion

A body continues its state of rest or of uniform motion in a straight line unless an external force acts on it.

Newton's third law of motion

To every action, there is an equal and opposite reaction



Q5)State Newton 2nd law of motion. Show the relationship between applied force and the acceleration produced in the body.

Newton 2nd law of motion

When a net force acts on a body it produces acceleration in the direction of force. The acceleration is directly proportional to force and inversely proportional to mass of body

Therefore,

$$a \propto F$$

$$a \propto \frac{1}{m}$$

$$a \propto \frac{F}{m}$$

putting the proportionality constant k,

$$a = k\frac{F}{m}$$

$$Fk = ma$$

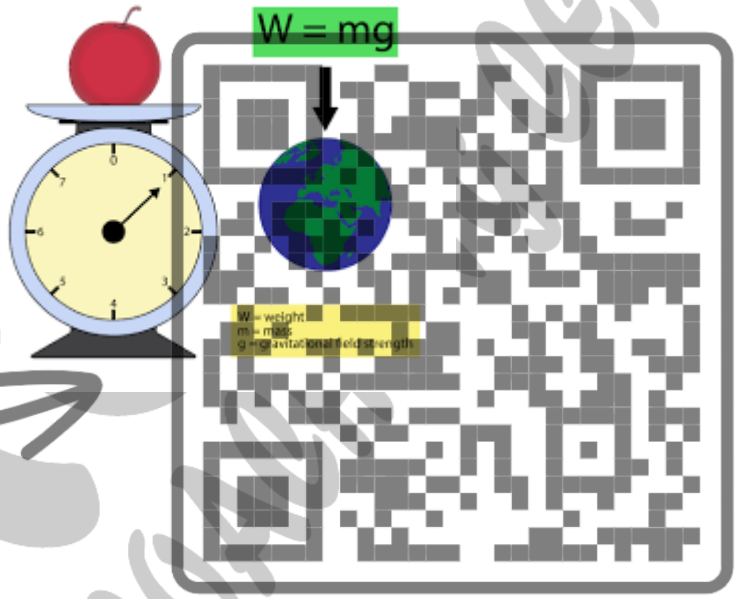
taking value of constant k =1,

$$F = ma$$

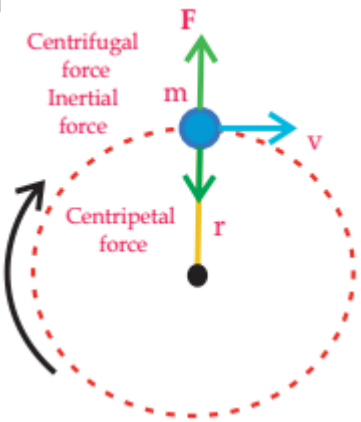
Q6)Enumerate at least three clear differences between mass and weight.

Mass	Weight

Mass is the quantity of matter in a body regardless of its volume or of any forces acting on it.	Weight is a measurement of the gravitational force acting on an object.
It is scalar quantity	It is vector quantity
Its S.I unit is Kg	Its S.I unit is N
Mass is measured using a pan balance, lever balance or electronic balance	Weight is measured using a spring balance.

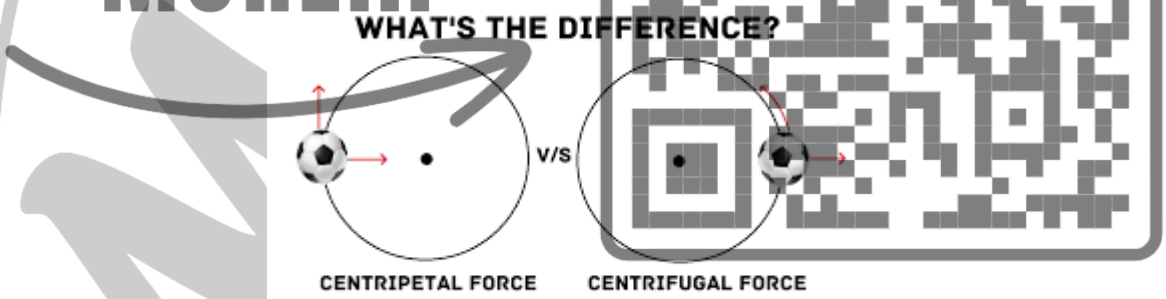


Q7)Draw a figure showing the direction of centripetal force, centrifugal force and velocity of an object along a circular path.



Q8)Differentiate between Centripetal force and Centrifugal force.

Centripetal force	Centrifugal force
The force required to move a body along a circular path is called Centripetal force.	A force that acts outward on a body which moves along a curved path is called centrifugal force.
It is always directed toward the center of curvature.	It is always directed away from center of curvature.
The velocity of the object is constant and perpendicular to a line running from the object to the center of the circle	The magnitude of centrifugal force is equal but opposite in direction to centripetal force.



Q9)List down some purposeful uses of centrifuge that humans are benefitting everyday

Uses of centrifuge

Centrifuge appliances are used to separate heavier particles from lighter particles in liquids

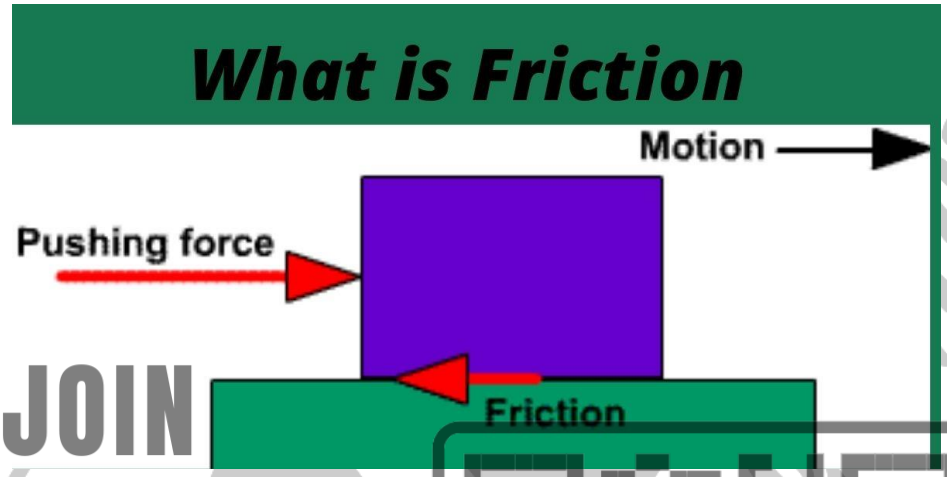
Example

- Sugar crystals are separated from molasses.
- Blood analysis is carried out through a centrifuge process in laboratory.
- Cream separator is used to separate the cream from skimmed milk.
- An ultracentrifuge is used for separating small particle from large molecules.
- Gas centrifuge is used for separation of isotopes.

Q10) What is friction? What is force of friction? Explain with two examples from daily life.

Friction

The force that resists relative motion between two surfaces is called friction.



Force the Friction

The force which opposes the motion of the body is known as frictional force

Examples

Friction Enable us to walk on ground.

Due to friction, we can stop a moving object.

Because of friction in our hand, we can hold objects.

Q11) Discus the types of friction.

Static friction

It is force acting on an object at rest that resists its ability to start moving. The maximum static friction is known as “limiting friction”

Kinetic friction

It is the force that resists the motion of a moving object. It is interesting to know that in almost all situations, static friction is greater than kinetic friction.

Sliding friction

When one body slides over the other body the friction between two surfaces is said to be sliding friction.

Rolling friction

When a body moves on wheels the friction is said to be rolling friction. Rolling friction is much lesser than the sliding friction

Q12) Give some advantages of friction

Advantages of friction

1. Friction enables us to walk on ground.
2. Friction protects from sliding, as sand is thrown to maintain friction on inclined railway tracks during rain.
3. The car brakes slow down the car to stop safely.
4. Threads and grooves are designed on tires to increase the friction and improve grip between road and wheel.

Q13) Give some disadvantages of friction.

Disadvantages of friction

1. A large amount of energy is wasted in the machines due to friction.
2. Friction leads to wear and tear of parts hence increases the service cost.
3. Failure of oil pump in car engine results contact between dry metals which yields high temperature hence the car engine is seized.

Q14) What are some ways reducing friction?

Reducing friction

1. Wheels, pullies, ball bearings, lubricants and graphite are used to overcome the friction
2. Lubricating the motor axel, sewing machine and bicycle chain reduces friction and prevents wear and tear
3. The shape of vehicle is also designed to reduce air resistance.

Numerical # 1

Find the momentum of body of mass 6 kg moving with a velocity of 25 ms^{-1}. What will be the velocity if the momentum becomes 200Ns?

Data

m = 6kg

$v = 25\ ms^{-1}$

P = ?

If, P = 200 N.s

V = ?

Solution

P = mv

P = 6 x 25

P = 150 N.s

P = mV

200 = 6 x V

V = 200/6

$V = 33.33\ ms^{-1}$

Practice of Numerical # 1

Find the momentum of body of mass 8 kg moving with a velocity of 30 ms^{-1}. What will be the velocity if the momentum becomes 300Ns?

Numerical # 2

A body of mass 10 kg is moving with velocity of 10 ms^{-1}. A force acts for 5 seconds to reduce its velocity to 2 ms^{-1}. Find the momentum of body before and after application of the force on it.

Data

m = 10kg

$Vi = 10\ ms^{-1}$

t = 5 sec

$Vf = 2\ ms^{-1}$

Pi = ?

Pf = ?

Solution

P = mVi

P = 10 x 10

P = 100 N.s

P = mVi

P = 10 x 2

P = 20 N.s

Practice of Numerical # 2

A body of mass 8 kg is moving with velocity of 12 ms^{-1}. A force acts for 6 seconds to reduce its velocity to 3 ms^{-1}. Find the momentum of body before and after application of the force on it.

Numerical # 3

A force of 3400 N is applied on a body of mass is 850 kg, find the acceleration produced by the force? How much force should be applied on a body of mass 425kg to produce acceleration same as calculated.

Data

F = 3400N

m = 850 kg

a = ?

IF, m = 425

F = ?

Solution

F = ma

3400 = 850 x a

$a = \frac{3400}{850}$

$a = 4\ ms^{-2}$

F = ma

F = 425 x 4

F = 1700 N

Practice of Numerical # 3

A force of 1400 N is applied on a body of mass is 950 kg, find the acceleration produced by the force?

How much force should be applied on a body of mass 325 kg to produce acceleration same as calculated.

Numerical # 4

Find the mass of a body which is accelerated by applying a force of 200 N, that speeds up it to 36 ms^{-2}.

What should be the acceleration of the same body if the applied force changes to 280N.

Data

F = 200 N

$a = 36\ ms^{-2}$

m = ?

If, F = 280 N

a = ?

F = ma

200 = m x 36

$m = \frac{200}{36}$

m = 5.55 kg

F = ma

280 = 5.55 x a

$a = \frac{280}{5.55}$

$a = 50.45\ ms^{-2}$

Practice of Numerical # 5

Find the mass of a body which is accelerated by applying a force of 300 N, that speeds up it to 40 ms^{-1}. What should be the acceleration of the same body if the applied force changes to 320N.

Numerical # 6

An empty car has 1200 kg mass. Its engine can produce acceleration of 4 ms^{-2}. If 300 kg load is added to mass by passengers and luggage. What acceleration the same engine will produce?

Data

m_1(empty) = 1200 kg

$a = 4\ ms^{-2}$

m_2(load) = 300 kg

a = ? (with load)

Solution

m = 1200 + 300 = 1500 kg

F = ma

F = 1500 x 4

F = 6000 N

Practice of Numerical # 6

An empty car has 1400 kg mass. Its engine can produce acceleration of 5 ms^{-2}. If 250 kg load is added to mass by passengers and luggage. What acceleration the same engine will produce?

Numerical # 7

The mass of an object is 60 kg, find its weight on (i) Earth (ii) Moon (iii) Mars assume the acceleration due to gravity on Earth = 9.8 ms^{-2} on Moon=1.6 ms^{-2} and on Mars= 3.7 ms^{-2}

Data

m = 60kg

$g_{earth} = 9.8\ ms^{-2}$

$g_{moon} = 1.6\ ms^{-2}$

$g_{mars} = 3.7\ ms^{-2}$

$W_{earth} = ?$

$W_{moon} = ?$

$W_{mars} = ?$

Solution

$W_{earth} = mg_{earth}$

$W_{earth} = 60 \times 9.8$

$W_{earth} = 588\ N$

$W_{moon} = mg_{moon}$

$W_{moon} = 60 \times 1.6$

$W_{moon} = 96\ N$

$W_{mars} = mg_{mars}$

$W_{mars} = 60 \times 3.7$

$W_{mars} = 222\ N$

Practice of Numerical # 7

The mass of an object is 70 kg, find its weight on (i) Earth (ii) Moon (iii) Mars assume the acceleration due to gravity on Earth = 9.8 ms^{-2} on Moon=1.6 ms^{-2} and on Mars= 3.7 ms^{-2}

Numerical # 8

A car is running on a circular part of highway having about 1000m radius. The mass of car is 600kg and its velocity is 72 kmh^{-1}. Find (i) Centripetal force exerted by the car. (ii) Centripetal acceleration of car.

r = 1000m

m = 600kg

V = $72kmh^{-1}$ = 72 x 1000 ÷ 3600 = 20 ms^{-1}

Fc = ?

ac = ?

Solution

Fc = $\frac{mv^2}{r}$

Fc = $\frac{600\times20^2}{1000}$

Fc = $\frac{600\times400}{1000}$

Fc = $\frac{240000}{1000}$

Fc = 240 N

ac = $\frac{v^2}{r}$

ac = $\frac{20^2}{1000}$

ac = $\frac{400}{1000}$

ac = 0.4 ms^{-2}

Practice of Numerical # 8

A car is running on a circular part of highway having about 800m radius. The mass of car is 600kg and its velocity is 72 kmh^{-1}. Find (i) Centripetal force exerted by the car. (ii) Centripetal acceleration of car.

Numerical # 9

A block is placed on a wet slippery floor. The mass of block is 15 kg. When it is pulled through a string and spring balance, it shows force equal to 3 N. Find the coefficient of friction. ($F_s = \mu$ mg)

Data

m = 15kg

F = 3N

g = $10ms^{-2}$

μ = ?

Solution

F = μR

R = W = mg

R = 15 x 10

R = 150 N

F = μR

3 = μ 150

μ = 3/150

μ = 0.02

Practice of Numerical # 9

A block is placed on a wet slippery floor. The mass of block is 18 kg. When it is pulled through a string and spring balance, it shows force equal to 4 N. Find the coefficient of friction. ($F_s = \mu$ mg)

Chapter # 4

TURNING EFFECT 0F FORCES

Q1)Define like and unlike forces. Explain using examples

Like parallel forces

The forces that act along the same direction are called like parallel forces.

For Example

You might have seen many people pushing a car to move it Fig4.2. Why do all of them push it together in same direction? All of these forces are called like parallel forces because these are acting along same line.

Unlike parallel forces

The forces that act along opposite directions are called unlike parallel forces

For Example

A ceiling fan suspended in a hook through supporting rod. The forces acting on it are; weight of the fan acting vertically downwards and tension in the supporting rod pulling it vertically upwards. These two forces are also parallel but opposite to each other and acting along the same line. Thus, these forces are called unlike parallel forces.

Q2)What is meant by resolution of forces? How the direction and magnitude of a vector is obtained from its components?

Resolution of forces

The process of splitting of a force into mutually perpendicular components is called resolution of force.

Mathematical Expression

Consider a vector $\vec{F}$ making and angle θ with positive X-axis. Vector $\vec{F}$ is represented by a line OA. From point A draw a perpendicular AB on X-axis. Suppose OB and BA represents two vectors. F_x and F_y respectively. Thus, F_x and F_y are the rectangular components of vector F.

Direction of resultant Vector

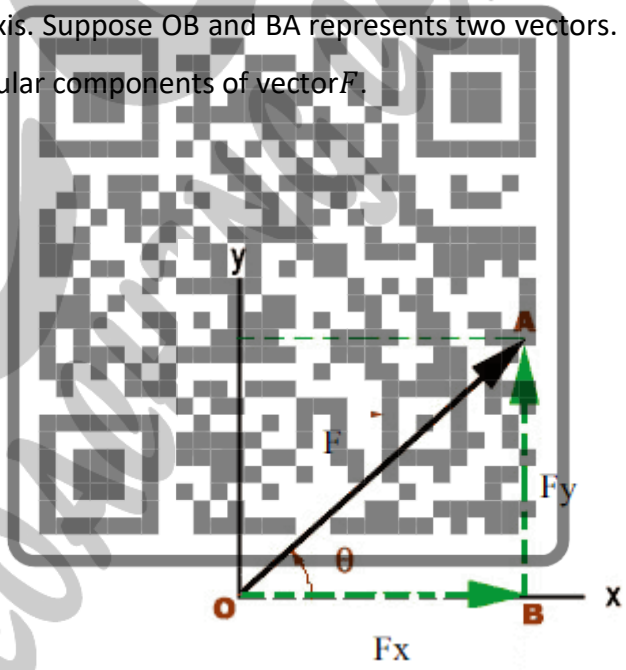
Consider right angled triangle ΔOAB

Using Pythagoras theorem

$Hyp^2 = Per^2 + Base^2$

$F^2 = Fx^2 + Fy^2$

$F = \sqrt{Fx^2 + Fy^2}$



Magnitude of vector

Consider right angled triangle ΔOAB

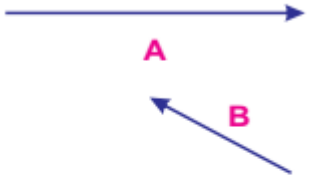
$$\text{Tan}\theta = \frac{Per}{Base}$$

$$\text{Tan}\theta = \frac{Fy}{Fx}$$

$$\theta = \tan^{-1}\left(\frac{OB}{OA}\right)$$

Q3)Which rule is used to find the resultant of more than two forces? Give Steps to add two vectors.

HEAD TO TAIL RULE

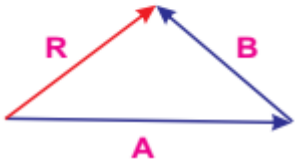


Step 1

Choose a suitable scale

Step 2

Draw all the force vectors according to scale. Vectors A and B in this case.



Step 3

Now take any vector as first vector and draw next vector in such a way that its tail coincides with head of the previous. If number of vectors is more than two, then continue the process till last vector is reached.

Step 4

Use a straight line with arrow pointed towards last vector to join the tail of first vector with the head of last vector. This is the resultant vector.

Q4)Define resolution of vector. Derive expression for rectangular component of vector.

Resolution of forces

The process of splitting of a vector into mutually perpendicular components is called resolution of vector.

Rectangular component of vector

Consider a vector $\vec{F}$ making and angle θ with positive X-axis. Vector $\vec{F}$ is represented by a line OA. From point A draw a perpendicular AB on X-axis. Suppose OB and BA represents two vectors. F_x and F_y respectively. Thus, F_x and F_y are the rectangular components of vector F.

HORIZONTAL COMPONENT

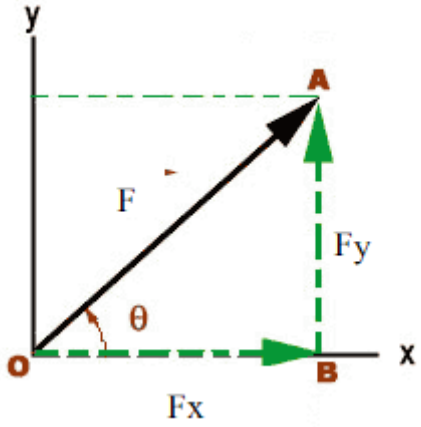
Consider right angled triangle ΔOAB

$\text{Cos}\theta = \frac{Base}{Hyp}$

$\text{Cos}\theta = \frac{OB}{OA}$

$\text{Cos}\theta = \frac{Fx}{F}$

$F \cos\theta = Fx$



MAGNITUDE OF VERTICAL COMPONENT

Consider right angled triangle ΔOAB

$\text{Sin}\theta = \frac{per}{Hyp}$

$\text{Sin}\theta = \frac{AB}{OA}$

$\text{Sin}\theta = \frac{Fy}{F}$

$F \sin\theta = Fy$

Q5)Define torque. Give its formula and unit. Also List the factors on which moment of force depends.

Torque

Turning effect of force is known as torque

Formula

Torque = force x moment arm

$\tau = F \times d$

Unit

Its S.I unit is N.m

It depends upon:

A. The magnitude of force.

B. The perpendicular distance of the point of application of force from the Pivot or fulcrum.

Q6)State principle of moment. Give three examples in which principle of moment is observed.

Principle of moment

The sum of the clockwise moments about a point is equal to the sum of the anticlockwise moments about that point.

Example

Sea saw

Opening a cap of bottle

To tightening or losing a screw

Q7)How is the see- saw balanced?

Two children playing on the see-saw. Fatima is sitting on right side and Faheem on the left side of the pivot. When the clockwise turning effect of Fatima is equal to the anticlockwise turning effect of Faheem, then see-saw balances. In this case they cannot swing. When the sum of all the clockwise moments on a body is balanced by the sum of all the anticlockwise moments, this is known as principle of moments.

Q8)What is center of gravity? Give center of gravity of some regular shape object.

Centre of gravity

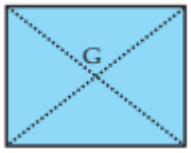
A body behaves as if its whole mass is concentrated at one point, called its centre of mass or centre of gravity

Center of Gravity of Some Regular Shaped objects

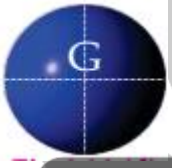
The Center of gravity of regular shaped uniform objects is their geometrical Center.

The Center of gravity of uniform rod is its midpoint

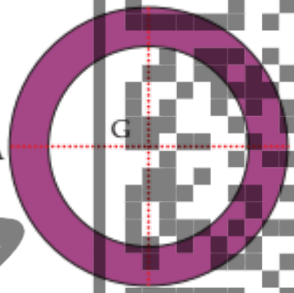
The Center of gravity of uniform square or a rectangular sheet is the point of intersection of its diagonals.



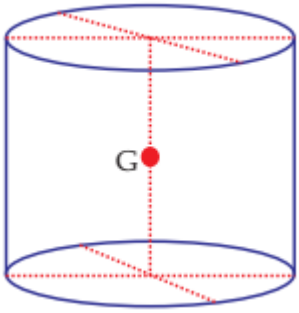
The Center of gravity of solid or hollow sphere is the Center of the sphere



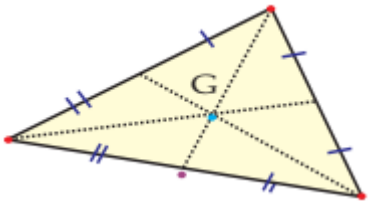
The Center of gravity of uniform circular ring is the Center of ring



The Center of gravity of a uniform solid or hollow cylinder is the mid-point on its axis



The Center of gravity of a uniform triangular sheet is the point of intersection of its medians



Q9)What is couple? Write three necessary conditions for two forces to form a couple.

Couple

Two unlike parallel forces of the same magnitude but not acting along the same line form a couple.

Conditions

1. To form a couple, two forces must be:
2. Equal in magnitude u Parallel, but opposite in direction
3. Separated by a distanced.

Q10) Define Equilibrium. Also discuss its types

Equilibrium

When a body does not possess any acceleration neither linear nor angular it is said to be in equilibrium.

For example,

A book lying on table in rest

A paratrooper moving downwards with terminal velocity

A chair lift hanging on supporting ropes

Types of equilibrium

There are two types of equilibrium.

1. Static Equilibrium
2. Dynamic Equilibrium

Static Equilibrium

A body at rest is said to be in static equilibrium.

Dynamic Equilibrium

A moving object that does not possess any acceleration neither linear nor angular is said to be in dynamic equilibrium.

Q11) State and explain Condition of equilibrium

Conditions for Equilibrium

A body must satisfy certain conditions to be in equilibrium. There are two conditions for equilibrium

First Condition for Equilibrium

According to this condition for equilibrium sum of the all forces acting on a body must be equal to zero.

$$F_1 + F_2 + F_3 + \ldots\ldots\ldots\ldots + F_n = 0$$

OR

$$\Sigma F = 0$$

In terms of x and y components of the forces acting on the body first condition for the equilibrium can be expressed as:

$$F_{1x} + F_{2x} + F_{3x} + \ldots\ldots\ldots\ldots + F_{nx} = 0$$

$$F_{1y} + F_{2y} + F_{3y} + \ldots\ldots\ldots\ldots + F_{ny} = 0$$

$$\Sigma F_x = 0$$

$$\Sigma F_y = 0$$

Second Condition of Equilibrium

Sum of all clockwise and anticlockwise torques acting on a body is zero. Mathematically,

$$\Sigma \tau = 0$$

Q12) What are states of equilibrium. Also write their conditions.

States of Equilibrium

There are three states of equilibrium:

1. Stable equilibrium
2. Unstable equilibrium and
3. Neutral equilibrium

Stable Equilibrium

A body is in stable equilibrium if when slightly displaced and then released it returns to its previous position.

Unstable Equilibrium

A body is said to be in unstable equilibrium when slightly tilted does not return back to its previous position.

Neutral Equilibrium

A body is said to be in neutral equilibrium when displaced from previous position remains in equilibrium in new position

Numerical # 1

A pair of like parallel forces 15N each are acting on a body. Find their resultant.

$F_1 = 15N$

$F_2 = 15N$

F = ?

$F = F_1 + F_2$ (for like parallel forces)

F = 15 +15

F = 30 N

Practice of Numerical # 1

A pair of like parallel forces 28N each are acting on a body. Find their resultant.

Numerical # 2

A pair of like parallel forces 10N and 20 N each are acting on a body. Find their resultant.

$F_1 = 10$ N

$F_2 = 20$ N

F = ?

$F = F_1 + F_2$ (for like parallel forces)

F = 10 + 20

F = 30 N

Practice of Numerical # 2

A pair of like parallel forces 120N and 600 N each are acting on a body. Find their resultant.

Numerical # 3

Two unlike parallel forces 10 N each acting along same line. Find their resultant.

$F_1 = 10$ N

$F_2 = 10$ N

F = ?

$F = F_1 - F_2$ (for unlike parallel forces)

F = 10 – 10

F = 0

Practice of Numerical # 3

Two unlike parallel forces 9 N each acting along same line. Find their resultant.

Numerical # 4

Two unlike parallel forces 8 N and 5N each acting along same line. Find their resultant.

$F_1 = 8$ N

$F_2 = 5$ N

F = ?

$F = F_1 - F_2$ (for unlike parallel forces)

F = 8 – 5

F = 3N

Practice of Numerical # 4

Two unlike parallel forces 13 N and 10N each acting along same line. Find their resultant.

Numerical # 5

A gardener is driving a lawnmower with a force of 80 N that makes an angle of 40° with the ground.

i) Find its horizontal component ii) Find its vertical component (Cos45 0.707 , Sin45 = 0.707)

Data

F = 80N

$\theta = 40^o$

Fx = ?

Fy = ?

Solution

$Fx = F\cos\theta$

Fx = 80Cos45

Fx = 80 x 0.707

Fx = 56.56 N

$Fx = F\sin\theta$

Fx = 80sin45

Fx = 80 x 0.707

Fx = 56.56 N

Practice of Numerical # 5

A gardener is driving a lawnmower with a force of 90 N that makes an angle of 60° with the ground.

i) Find its horizontal component ii) Find its vertical component

Numerical # 6

Horizontal and vertical components of a force are 4 N and 3 N respectively. Find

i) Resultant force ii) Direction of resultant

Data

Fx = 4N

Fy = 3N

F = ?

θ = ?

Solution

$F = \sqrt{Fx^2 + Fy^2}$

$F = \sqrt{4^2 + 3^2}$

$F = \sqrt{16 + 9}$

$F = \sqrt{25}$

F = 5N

Practice of Numerical # 6

Horizontal and vertical components of a force are 8 N and 6 N respectively. Find

i) Resultant force ii) Direction of resultant

Numerical # 7

A spanner of 0.3 m length can produce a torque of 300Nm. i) determine the force applied on it ii) What should be the length of the spanner if torque is to be increased to 500Nm with same applied force

Data

d = 0.3 m

τ = 300 N.m

F = ?

If τ = 500 N.m

d = ?

Solution

$\tau = Fd$

300 = F x 0.3

F = 300/0.3

F = 1000 N

$\tau = Fd$

500 = 1000 x d

d = $\frac{500}{1000}$

d = 0.5 m

Practice of Numerical # 7

A spanner of 0.5 m length can produce a torque of 450Nm. i) determine the force applied on it

ii) What should be the length of the spanner if torque is to be increased to 600Nm with same applied force

Numerical # 8

A mechanic uses a double arm spanner to turn a nut. He applies a force of 15 N at each end of the spanner and produces a torque of 60 Nm. What is the length of the moment arm of the couple? If he wants to produce a torque of 80Nm with same spanner then how much force he should apply?

Data

F = 15 N

τ = 60 N.m

d = ?

If, τ = 80 N.m

F = ?

Solution

τ = Fd

60 = 15 x d

d = $\frac{60}{15}$

d = 4m

τ = Fd

80 = F x 4

F = $\frac{80}{4}$

F = 20N

Practice of Numerical # 8

A mechanic uses a double arm spanner to turn a nut. He applies a force of 20 N at each end of the spanner and produces a torque of 75 Nm. What is the length of the moment arm of the couple? If he wants to produce a torque of 90Nm with same spanner then how much force he should apply?

CHAPTER # 5

FORCES AND MATTER

Q1)State and explain Hooke's law.

HOOKE'S LAW

Hooke's law states that:

Within elastic limit, the displacement produced in the spring is directly proportional to the force applied.

EXPLANATION

Mathematically if 'F' is the applied force and 'x' is the displacement (extension) in the spring then the equation for Hooke's law may be written as:

$$F \alpha x$$

or

$$F = kx$$

where k is spring constant (stiffness of spring).

Q2)Write two properties of spring

Properties of spring

1. Spring are useful in making balances. Hooke wanted to make a very sensitive and accurate weight machine or balance.
2. He also realized that a spiral spring could be used to control a clock or wrist watch.

Q3)Define pressure, give its formula and S.I unit.

Pressure

The force acting normally per unit area on the surface of a body is called pressure.

Formula

$$Pressure = \frac{Force}{\text{Area}}$$

$$P = \frac{F}{A}$$

Unit

S.I unit is N/m^2

Q4)Discus the factors affecting pressure.

Factors affecting pressure

Pressure P is proportional to the depth, the deeper one dives into water, greater will be the pressure. Twice the depth means twice the pressure.

Similarly, pressure also depends upon the density of the material. If a material is five times denser than water, the pressure will be five times greater. At a depth h in a fluid of density ρ, the pressure p can be written as:

Pressure = depth **x** density **x** acceleration due to gravity

$p = d\rho g$

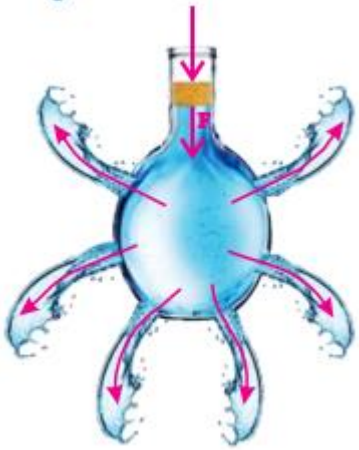
Q5)State Pascal's law. Explain with the help of an example

Pascal Law

The pressure applied externally at any point of a liquid enclosed in a container is transmitted equally to all parts of the liquid in container.

Example

It can be demonstrated with the help of a water filled glass vessel having holes around its surface. When you apply force through the piston the water rushes out of the holes with the same pressure. The force applied on the piston exerts pressure on water. This pressure is transmitted equally throughout the liquid in all directions. In general, this law holds good for fluids both for liquids as well as gases



Q6)What is hydraulic machine? Write down the names of four machines that you have seen working on the principle of pascal's law

Hydraulic machine

The machine in which force is transmitted by liquids under pressure is known as hydraulic machine. By the application of relatively small force they produce greater force.

Examples

Hydraulic brakes

Car lifts

hydraulic

Jacks

Q7)Describe the construction and working of hydraulic press.

Hydraulic press

A hydraulic press is made of two pistons connected by a liquid-filled pipe

A force of magnitude F_1 is applied to a small piston of surface area A_1. The pressure is transmitted through an incompressible liquid to a larger piston of surface area A_2. Because the pressure must be the same on both sides.

$$P = \frac{F_1}{A_1} = \frac{F_2}{A_2}$$

Therefore, the force F_2 is greater than the force F_1 by a factor A_2/A_1.

By designing a hydraulic press with appropriate areas A_1 and A_2, a large output force can be applied by means of a small input force.

Each side of this equation is the work done by the force. Thus, the work done by F_1 on the input piston equals to the work done by F_2 on the output piston. Thus, the principle of conservation of energy applies in the hydraulic press.

Q8)Define density. Describe density in brief. Give it formula and unit.

Density

The term density of a substance is defined as mass of substance (m) per unit volume (V). It is denoted by Greek letter ρ (rho)

Density tells us how tightly matter is packed together.

Formula

$$\rho = \frac{m}{V}$$

Unit

Its S.I unit is kg/m^3

Numerical # 1

An elastic spring is 20cm long. When it is stretched by hanging some load its length increases to 60cm. Calculate its extension?

Data

$x_1 = 20cm$

$x_2 = 60cm$

$x = ?$

$x = x_2 - x_1$

$x = 60 - 20$

$x = 40cm$

Practice of Numerical # 1

An elastic spring is 40cm long. When it is stretched by hanging some load its length increases to 80cm. Calculate its extension?

Numerical # 2

A spring has spring constant k = 30 Nm^{-1}. What load is required to produce an extension of 4 m?

Data

K = 30 Nm^{-1}

x = 4m

F = ?

Solution

F = Kx

F = 30 x 4

F = 120 N

Practice of Numerical # 2

A spring has spring constant k = 50 Nm^{-1}. What load is required to produce an extension of 5 m?

Numerical # 3

How much force is needed to pull a spring to a distance of 30cm, the spring constant is 15 Nm^{-1}?

Data

x = 30cm = 30 ÷ 100 = 0.3 m

K = 15 Nm^{-1}

F = ?

Solution

F = Kx

F = 15 x 0.3

F = 1.5 N

Practice of Numerical # 3

How much force is needed to pull a spring to a distance of 40cm, the spring constant is 16 Nm^{-1}?

Numerical # 4

Calculate the pressure at a depth of 3m in a swimming pool? (density of water = 1000kgm^{-3})

Data

d = 3m

ρ = 1000 kgm^{-3}

g = 9.8 ms^{-2}

P = ?

Solution

$P = \rho gd$

P = 1000 x 9.8 x 3

P = 29400 N/m^2

Practice of Numerical # 4

Calculate the pressure at a depth of 6m in a swimming pool? (density of water = 1000kgm^{-3})

Numerical # 5

A boy is digging a hole with spade of edge 0.1 cm^2. Calculate the pressure when he is exerting the force of 1000N onto the spade.

Data

A = 0.1 cm^2 = 0.1 ÷ 10000 = 0.00001 m^2

F = 1000 N

P = ?

Solution

$P = \frac{F}{A}$

P = 1000/0.00001

P = 100000000 N/m^2

Practice of Numerical # 5

A boy is digging a hole with spade of edge 0.2 cm^2. Calculate the pressure when he is exerting the force of 3000N onto the spade.

Numerical # 6

A wooden block of dimensions 0.5m×0.6m×1.0m kept on the ground has a mass of 200kg. Calculate the maximum pressure acting on the ground.

Data

dimensions = 0.5m×0.6m×1.0m

l = 0.5 m

b = 0.6 m

h = 1 m

m = 200 kg

g = 9.8 ms^{-2}

P = ?

P = $\frac{F}{A} = \frac{W}{A}$

A = l x b

A = 0.5 x 0.6

A = 0.3 m^2

W = mg

W = 200 x 9.8

W = 1960 N

$P = \frac{W}{A}$

$P = \frac{1960}{0.3}$

$P = 6533.33\ N/m^2$

Practice of Numerical # 6

A wooden block of dimensions 0.4m×0.7m×1.2m kept on the ground has a mass of 150kg. Calculate the maximum pressure acting on the ground.

Numerical # 7

If the density of sea water is 1150 kgm^{-3}, calculate the pressure on a body of 50m below the surface of sea?

Data

$\rho = 1150\ kgm^{-3}$

$d = 50m$

$g = 9.8\ ms^{-2}$

$P = ?$

$P = \rho gd$

$P = 1150 \times 9.8 \times 50$

$P = 563500\ N/m^2$

Practice of Numerical # 7

If the density of sea water is 1950 kgm^{-3}, calculate the pressure on a body of 40m below the surface of sea?

Numerical # 8

In a hydraulic lift system, what must be the surface area of a piston. If a pressure of 300 kpa is used to provide an upward force of 2000 N?

Data

P = 300 kpa = 300 x 1000 = 300000 pa

F = 2000 N

A = ?

Solution

P = $\frac{F}{A}$ OR A = $\frac{F}{P}$

A = $\frac{2000}{300000}$

A = 0.00667 m^2

Practice of Numerical # 8

In a hydraulic lift system, what must be the surface area of a piston. If a pressure of 250 kpa is used to provide an upward force of 3000 N?

Numerical # 9

In a hydraulic press, a force of 100 N is applied on the pump of cross-sectional area 0.01m^2. Find the force that compresses a cotton bale placed on larger piston of cross-sectional area 1m^2.

Data

F_1 = 100 N

A_1 = 0.01m^2

A_2 = 1m^2

F_2 = ?

Solution

$\frac{F_1}{A_1} = \frac{F_2}{A_2}$

$\frac{100}{0.01} = \frac{F_2}{1}$

F_2 = 10000 N

Practice of Numerical # 9

In a hydraulic press, a force of 150 N is applied on the pump of cross-sectional area 0.02m^2. Find the force that compresses a cotton bale placed on larger piston of cross-sectional area 1.5m^2.

Numerical # 10

Calculate the spring constant for a spring which extends by a distance of 3.5cm when a load of 14N is hung from its end.

Data

x = 3.5 cm = 3.5 ÷ 100 = 0.035 m

F = 14N

K = ?

Solution

F = Kx

14 = K x 0.035

$K = \frac{14}{0.035}$

K = 400 N/m

Practice of Numerical # 10

Calculate the spring constant for a spring which extends by a distance of 2.5cm when a load of 20N is hung from its end.

Numerical # 11

A boy is pressing a thumbtack into a piece of wood with a force of 20 N. The surface area of head of thumbtack is 1cm^2 and the cross-section area of the tip of the thumbtack is 0.01cm^2. Calculate a) The pressure exerted by boy's thumb on the head of thumbtack. b) The pressure of the tip of the thumbtack on the wood.

Data

F = 20N

A_1 (head of thumbtack) = 1 cm^2

A_2 (tip of the thumbtack) = 0.01 cm^2

P_1 = ?

P_2 = ?

Solution

P = F/A

P = 20/1

P = 20 N/cm^2

P = F/A

P = 20/0.01

P = 2000 N/cm^2

Practice of Numerical # 11

A boy is pressing a thumbtack into a piece of wood with a force of 30 N. The surface area of head of thumbtack is 2cm^2 and the cross-section area of the tip of the thumbtack is 0.02cm^2 . Calculate a) The pressure exerted by boy's thumb on the head of thumbtack. b) The pressure of the tip of the thumbtack on the wood.

Numerical # 12

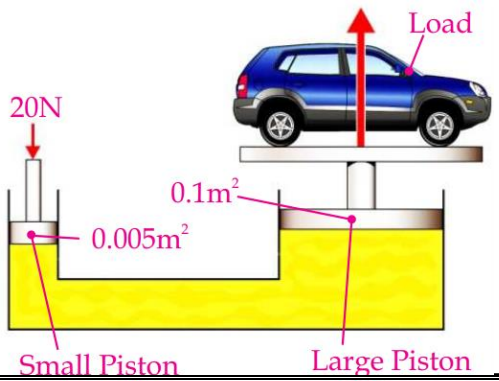
The Fig shows a basic hydraulic system that has small and large pistons of cross section area of 0.005 m^2 and 0.1 m^2 respectively. A force of 20N is applied to small piston. Calculate a) The pressure transmitted into hydraulic fluid. b) The force at large piston.

Data

F_1 = 20 N

A_1 = 0.005m^2

A_2 = 0.1m^2



F_2 = ?

Solution

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

$$\frac{20}{0.005} = \frac{F_2}{0.1}$$

F_2 = 4000 x 0.1

F_2 = 400 N

CHAPTER 6

GRAVITATIONAL

Q1. State and explain Newton law of gravitational

NEWTON LAW OF GRAVITATIONAL

STATEMENT

Everybody in the universe attracts every other body with a force which is directly proportional to the product of their masses and inversely proportional to the square of the distance between their center.

EXPLANATION

Consider two bodies of masses m_1 and m_2. The distance between their centers is r.

According to the statement force of attraction between two bodies is directly proportional to the product of their masses. Therefore,

$$F \propto m_1 m_2$$

The gravitational force of attraction is inversely proportional to the square of the distance between the centers of the masses of the bodies. Therefore,

$$F \propto \frac{1}{r^2}$$

Combining equation (i) and equation (ii)

$$F \propto \frac{m_1 m_2}{r^2}$$

$$F = G \frac{m_1 m_2}{r^2}$$

Where 'G' is constant of proportionality known as "Universal gravitational constant".

The value of 'G' in S.I unit is $6.673 \times 10^{-11}\ Nm^2kg^{-2}$

Q2. Differentiate between G and g

G	g
It is universal gravitational constant	It is acceleration due to gravity which determines the gravitational force acting per unit mass.
It has same value everywhere in the universe	It has different values at different places

Its value is 6.673×10^{-11} Nm^2kg^{-2}	It near earth's surface has value $10ms^{-2}$ or 10 Nkg^{-1}

Q3. Give characteristics of Gravitational Force

CHARACTERISTICS OF GRAVITATIONAL FORCE

Gravitational force has following characteristics:

i) It is always present between every two objects because of their masses.

ii) It exists everywhere in the universe.

iii) It forms an action-reaction pair.

iv) It is independent of the medium between the objects.

v) It is directly proportional to the product of the masses of objects.

vi) It is inversely proportional to the square of the distance between the center of the objects.

vii) Hence it follows the "Inverse Square Law".

Q4. Define Gravitational Field.

GRAVITATIONAL FIELD

"A gravitational field is a region in which a mass experiences a force due to gravitational attraction".

Q5. List gravity at different planets.

Planet	Value of g in ms^{-2}
Earth	10
Moon	1.62
Venus	8.87
Mars	3.77
Jupiter	25.95
Sun	274

Mercury	3.59
Saturn	11.08
Uranus	10.67
Neptune	14.07

Q6. Different between Natural and artificial satellite

NATURAL SATELLITE	ARTIFICIAL SATELLITE
The planet which revolves around another planet naturally is called "Natural Satellite".	The object which are sent into space by scientists to revolve around the Earth or other planets are called "Artificial Satellite".
E.g Moon is a natural satellite because it revolves around the Earth naturally.	E.g. Sputnik-1, Explorer-1 are amongst the artificial satellites.

Q7. Define orbital velocity

ORBITAL VELOCITY

The velocity required to keep the satellite into its orbit is called "Orbital Velocity".

Q8. List where artificial satellite is being used

USES OF ARTIFICIAL SATELLITES

Artificial satellites are used for different purposes like

For communication.

For making star maps.

For making maps of planetary surfaces.

For collecting information about weather.

For taking pictures of planets, etc.

Q9. List the orbits where artificial satellite been launched

Artificial satellites have been launched into different orbits around the Earth. There are different types of orbits like:

1. Low- Earth orbit.
2. Medium- Earth orbit.
3. Geostationary orbit.
4. Elliptic orbit

Q10. Derive relation for mass of earth with the help of newton law of gravitational formula. Also calculate the mathematical value of mass of earth

MASS OF THE EARTH

Consider a body of mass 'm' placed on the surface of the earth. Let the mass of the earth is 'M_e' and radius of earth is 'R_e'.

ACCORDING TO NEWTON LAW OF GRAVITATIONAL

Gravitational force of attraction between earth and body is

$$F = \frac{GmM_e}{Re^2}$$

We know that the force of attraction of the earth on a body is equal to weight the weight of body.

i.e

$$F = W = mg$$

$$mg = \frac{GmM_e}{Re^2}$$

$$g = \frac{GM_e}{Re^2}$$

$$\frac{Re^2 g}{G} = Me$$

$$Me = \frac{Re^2 g}{G}$$

Since,

$g = 9.8\ m/s^2$

$R_e = 6.4 \times 10^6\ m$

$G = 6.67 \times 10^{-11}\ N\text{-}m^2/kg^2$

on solving these values, we get

$$M_e = \frac{9.8 \times (6.4 \times 10^6)^2}{6.67 \times 10^{-11}}$$

$$M_e = 6 \times 10^{24} \text{ kg}$$

Q11. Derive $V^2 = \frac{GM}{R+h}$

DERIVATION

Let us consider the motion of a satellite which is revolving around the Earth

m → Mass of the satellite.

M → Mass of Earth.

R → Radius of Earth

h → Height(altitude) of satellite from the surface of Earth.

r = R + h → Radius of orbit.

Then, as we already discussed:

Centripetal force = Gravitational force

$$F_C = F_G$$

$$F_C = \frac{mv^2}{r}$$

$$F_G = \frac{GMm}{r^2}$$

$$\frac{mv^2}{r} = \frac{GMm}{r^2}$$

$$v^2 = \frac{GM}{r}$$

Since, r = R + h

$$v^2 = \frac{GM}{R+h}$$

$$V = \sqrt{\frac{GM}{R+h}}$$

Q12. Derive $T = 2\pi\sqrt{\frac{r^3}{GM}}$

DERIVATION

The time required for a satellite to complete one revolution around the Earth in its orbit is called its time period "T". The time period of a satellite can be calculated as

$$T = \frac{2\pi r}{V}$$

The velocity of satellite is given by

$$V = \sqrt{\frac{GM}{R+h}}$$

$$T = \frac{2\pi r}{\sqrt{\frac{GM}{r}}}$$

$$T = 2\pi\sqrt{\frac{r^3}{GM}}$$

NUMERICALS

Numerical # 1

Determine the gravitational force of attraction between two spherical bodies of masses 500kg and 800kg. Distance between their centers is 2 meters.

Data

m_1 = 500 kg

m_2 = 800 kg

r = 2 m

G = 6.67 x 10^{-7} Nm^2/Kg^2

F = ?

Solution

$F = \frac{Gm_1m_2}{r^2}$

$F = \frac{6.67 \times 10^{-7} \times 500 \times 800}{2^2}$

$F = \frac{2704000 \times 10^{-7}}{4}$

F = 676000 x 10^{-7}N

Numerical # 2

Calculate the weight of Rumaisa, who has a mass of 65kg standing at the ground. The strength of gravitational field on Rumaisa is 10 Newton per kilogram?

Data

m = 65kg

g = 10 N/kg

W = ?

Solution

W = mg

W = 65 x 10

W = 650 N

Numerical # 3

Calculate the acceleration due to gravity on a planet that has mass two times to the mass of Earth and radius 1.5 times to the radius of Earth. If the acceleration due to gravity on the surface of Earth is 10ms^{-2}. Calculate acceleration due to gravity on the planet?

Data

m_p = 2 of earth mass = $2m_e$

R_p = 1.5 of earth radius = $1.5R_e$

g = 10 ms^{-2}

g_p = ?

Solution

$g = \frac{Gm_e}{R^2}$

$g_p = \frac{Gm_p}{R_p^2}$

$g_p = \frac{G2m_e}{(1.5R_e)^2}$

$g_p = \frac{2Gm_e}{2.25{R_e}^2}$

g_p = 0.8 g

g_p = 0.8 x 10

g_p = 8 ms^{-2}

Numerical # 4

Calculate the speed of a satellite which orbits the Earth at an altitude of 1000 kilometers above Earth's surface?

Data

h = 1000 km = 1000x1000 = 1000000m = 1 x 10^6 m

G = 6.67 x 10^{-7} Nm^2/Kg^2

M = 6 x 10^{24} kg

R = 6.4 x 10^6 m

Solution

$$V = \sqrt{\frac{GM}{R+h}}$$

$$V = \sqrt{\frac{6.67\times10^{-7}6\times10^{6}}{6.4\times10^{6}+1\times10^{6}}}$$

$$V = \sqrt{\frac{40.02\times10^{-7+6}}{7.4\times10^{6}}}$$

$$V = \sqrt{\frac{40.02\times10^{-1}}{7.4\times10^{6}}}$$

$$V = \sqrt{5.408\times10^{-1-6}}$$

$$V = \sqrt{5.408\times10^{-7}}$$

$$V = \sqrt{54.08\times10^{-8}}$$

V = 7.35 x 10^{-4} m/s

Numerical # 5

Determine the gravitational force of attraction between Urwa and Ayesha standing at a distance of 50m apart. The mass of Urwa is 60kg and that of Ayesha is 70kg.

Data

m_1 = 60 kg

m_2 = 70 kg

r = 50 m

G = 6.67 x 10^{-7} Nm^2/Kg^2

F = ?

Solution

$F = \frac{Gm_1m_2}{r^2}$

$F = \frac{6.67 \times 10^{-7} \times 60 \times 70}{50^2}$

$F = \frac{28014 \times 10^{-7}}{2500}$

$F = 11.2056 \times 10^{-7}$ N

Numerical # 6

Weight of Rani is 450N at the surface of Earth. Find her mass?

Data

W = 450N

m = ?

$g = 10ms^{-2}$

Solution

W = mg

450 = m x 10

$m = \frac{450}{10}$

m = 45kg

Numerical # 7

Weight of Naveera is 700N on the Earth's surface. What will be Naveera's weight at the surface of Moon? ($g_m = 1.62ms^{-2}$)

Data

$W_e = 700N$

$g_m = 1.62ms^{-2}$

$g_e = 10ms^{-2}$

$W_m = ?$

Solution

$W_e = mg_e$

700 = m 10

$m = \frac{700}{10}$

m = 70 kg

$W_m = mg_m$

W_m = 70 x 1.62

W_m = 113.4 N

Numerical # 8

A planet has mass four times of Earth and radius two times that of Earth. If the value of "g" on the surface of Earth is 10ms^{-2}. Calculate acceleration due to gravity on the planet.

Data

m_p = 4 of earth mass = $4m_e$
R_p = 2 of earth radius = $2R_e$
g = 10 ms^{-2}
g_p = ?

Solution

$g = \frac{Gm_e}{R^2}$

$g_p = \frac{Gm_p}{R_p^2}$

$g_p = \frac{G \times 4m_e}{(2R_e)^2}$

$g_p = \frac{4Gm_e}{4{R_e}^2}$

g_p = 1 x g
g_p = 1 x 10
g_p = 10 ms^{-2}

Numerical # 9

Calculate the speed of a satellite which orbits the Earth at an altitude of 400 kilometers above Earth's surface.

Data

h = 400 km = 400x1000 = 400000m = 1 x 10^5 m
G = 6.67 x 10^{-7} Nm^2/Kg^2
M = 6 x 10^{24} kg
R = 6.4 x 10^6 m

Solution

$$V = \sqrt{\frac{GM}{R+h}}$$

$$V = \sqrt{\frac{6.67\times10^{-7}6\times10^{6}}{6.4\times10^{6}+4\times10^{5}}}$$

$$V = \sqrt{\frac{6.67\times10^{-7}6\times10^{6}}{6.4\times10^{6}+0.4\times10^{6}}}$$

$$V = \sqrt{\frac{40.02\times10^{-7+6}}{6.8\times10^{6}}}$$

$$V = \sqrt{\frac{40.02\times10^{-1}}{6.8\times10^{6}}}$$

$$V = \sqrt{5.88 \times 10^{-1-6}}$$

$$V = \sqrt{5.88 \times 10^{-7}}$$

$$V = \sqrt{58.8 \times 10^{-8}}$$

V = 7.66 x 10^{-4} m/s

CHAPTER 7

PROPERTIES OF MATTER

Q1. Discus the kinetic postulate of solid

KINETIC POSTULATE OF SOLID

1. The molecules are closely packed together and occupy minimum space.
2. The molecules usually arranged in a regular pattern called lattice.
3. There is a large number of particles per unit volume. That is why solids have the highest densities.
4. The forces of attraction between particles are very strong.
5. The particles are not able to change positions.
6. The particles vibrate about fixed positions thus are not entirely stationary.
7. This explains why solids have fixed shapes and volumes.

Q2. Discus the kinetic postulate of liquid

KINETIC POSTULATE OF LIQUID

1. The molecules are slightly further apart compared to that of solids.
2. The molecules occur in clusters
3. There is slightly less number of particles per unit volume compared to solids.
4. This why liquids have relatively high densities.
5. The forces of attraction between particles are strong.
6. The particles are free to move about within the liquid.
7. These features explain why liquids have fixed volumes, but take the shape of the container.

Q3. Discus the kinetic postulate of gas

KINETIC POSTULATE OF GAS

1. The molecules are very far apart.
2. The molecules are arranged randomly and are free to move with very high speeds.
3. There is small number of particles per unit volume.
4. The forces of attraction between particles are negligible. The particles are able to move freely in random directions at very high speeds.
5. The particles occupy any available.

Q4. What is Brownian motion

BROWNIAN MOTION

He observed the irregular motion of pollen grains suspended in water and deduced that the water molecules were in constant, random motion. This irregular motion caused by water molecules is called "Brownian motion" named after the scientist.

Q5. State Boyle's Law

BOYLE'S LAW

The volume of a fixed mass of a gas is inversely proportional to its pressure, provided its temperature remains constant.

Q6. In which state of matter the molecules are widely separated?

Ans. In gasses

Q7. In which state of matter the molecules are most closely packed?

Ans. In liquid state

Q8. In which state of matter molecules can move freely at high speed?

Ans. In solid

NUMERICAL

Numerical # 1

The pressure on $9cm^3$ of oxygen gas is doubled at a fixed temperature. What will its volume become?

Data

$V_1 = 9cm^3$

$P_1 = P$

$P_2 = Double = 2P$

$V_2 = ?$

Solution

$P_1V_1 = P_2V_2$

$P \times 9 = 2P \times V_2$

$\frac{9}{2} = V_2$

$V_2 = 4.5\ cm^3$

Numerical # 2

A container holds $30m^3$ of air at a pressure of 150000Pa. If the volume changed to $10m^3$ by decreasing load on the piston. What will the pressure of the gas become? Assume that its temperature remains constant.

Data

$V_1 = 30m^3$

$P_1 = 150000\ pa$

$V_2 = 10m^3$

$P_2 = ?$

Solution

$P_1V_1 = P_2V_2$

$150000 \times 30 = P_2 \times 10$

$4500000 = 10P_2$

$P_2 = \frac{4500000}{10}$

$P_2 = 450000\ pa$

Numerical # 3

Air at atmospheric pressure of 760 mm of Hg is trapped inside a container available with a moveable piston. When the piston is pulled out slowly so that the volume is increased from 100dm^3 to 150dm^3, the temperature remaining constant. What will be the pressure of the air becomes?

Data

P_1 = 760 mm of Hg

V_1 = 100dm^3

V_2 = 150dm^3

P_2 = ?

Solution

$P_1V_1 = P_2V_2$

760 x 100 = P_2 x 150

$P_2 = \frac{76000}{150}$

P_2 = 506.66 mm of Hg

Numerical # 4

A cylinder contains 60cm^3 of air at a pressure of 140kPa. What will its volume be if the pressure on it is increased to 420 kPa?

Data

P_1 = 140 kPa

V_1 = 60 cm^3

P_2 = 420 KPa

V_2 = ?

Solution

$P_1V_1 = P_2V_2$

140 x 600 = 420 x V_2

$V_2 = \frac{84000}{420}$

V_2 = 200 cm^3

Numerical # 5

Air at a pressure of 1.0 x 10^5 Pa is contained in a cylinder fitted with a piston. The air is now compressed by pushing the piston, so that the same mass of air now occupies one-fifth the original volume without any change in temperature. Calculate the pressure of the air.

Data

$P_1 = 1.0 \times 10^5$ Pa

$V_1 = V$

$V_2 = \frac{1}{5} V = 0.2V$

$P_2 = ?$

$P_1V_1 = P_2V_2$

$1 \times 10^5 \times V = P_2 \times 0.2\ V$

$\frac{100000}{0.2} = P_2$

$P_2 = 500000$ Pa OR 5×10^5 Pa

Chapter 8

Q1. Define Work. Give if formula and unit

WORK

a force is said to do work if, when acting, there is a displacement of the point of application in the direction of the force.

FORMULA

W = F.d

W = F d CosϴJOIN FOR MORE!!!

UNIT

It S.I unit is joules.

Q2. Define energy.

ENERGY:

Ability of a body to do work is known as Energy.

Q3. Differentiate between Kinetic energy and potential energy.

K.E	P.E
Energy possess by body by virtue of its motion is known as kinetic energy	Energy possess by body by virtue of its position is known as kinetic energy
Its formula is : K.E = $1/2mV^2$	Its formula is : P.E = mgh
It value increase with the increase in velocity	It value increase with the increase in altitude(height)

Q4. State law of conservation of energy

STATEMENT:

Energy can neither created nor destroyed but it can change from one form to another.

Q5. Write short note on

FOSSIL FUEL ENERGY

Fossil fuel energy is formed from decayed plants and animals that have been converted to crude oil, coal, natural gases or heavy oils by exposure to heat and pressure in the Earth's crust over hundreds of millions of years. Fossils fuels have stored chemical energy. This energy is converted by oxidation through burning. Thus, on burning a fossil fuel like charcoal, produce heat energy and light energy

HYDROELECTRIC ENERGY

Hydro electricity is the term referring to electricity generated by hydro power by using gravitational force of falling or flowing water. Most common type of hydroelectric power plants uses a dam on a river to store water in a reservoir. Water releases from the reservoir flows through a turbine, spinning it, which in turn runs a generator to produce electricity

SOLAR ENERGY

The energy radiated from the sun is known as solar energy. This is the most available source of energy throughout Pakistan. There are many devices which are capable of absorbing solar energy, which is then converted into electrical energy or heat energy. These devices may be photovoltaic solar panels and solar cells. Which convert the sun rays into electricity for different uses

NUCLEAR ENERGY

The energy released during a nuclear reaction such as fission or fusion reaction. All radioactive materials store nuclear energy. For example, Uranium, Radium etc. It is released from the nucleus in the form of radiation in addition to heat and light. A nuclear power plant utilizes nuclear energy to produce steam to turn a turbine and generate electricity

GEO THERMAL ENERGY

Geothermal energy is stored in the Earth as its natural heat. Deep in the Earth, there is hot molten part called magma. Water closes to magma changes to steam due to high temperature. This thermal energy is conducted to the surface of Earth. This energy is called geothermal energy

WIND ENERGY

The energy obtained by the wind is called wind energy. It is generated by wind mills. A wind mill consists of a turbine which rotates due to wind. Kinetic energy is produced due to the motion of turbine. Wind turbines convert this kinetic energy into the mechanical power. A generator converts that mechanical power into electricity.

BIO MASS ENERGY

Biomass is the organic material that comes from plants and animals. Biomass consists of stored energy from Sun, garbage, wastes, sugarcane etc. Solid biomass, such as wood, organic material and garbage, can be burned directly to produce heat

TIDAL ENERGY

It is a form of hydro power that converts the energy obtained from tides into useful form of power; mainly electricity as the Earth uses the gravitational forces of both the moon and the sun every day to move vast quantities of water around the oceans and seas producing tides and, in this way, energy is produced called tidal energy

Q6. Differentiate between Renewable and non-renewable energy sources.

Renewable	Non- Renewable
The renewable sources can be consumed and used again and again.	Non-renewable resources are limited and will finish once used
Solar energy, wind energy, tidal energy and geothermal energy are renewable sources.	Coal, petroleum and natural gases are nonrenewable sources
Most renewable resources have low carbon emissions and low carbon footprint	Non-renewable energy has a comparatively higher carbon footprint and carbon emissions.
Renewable resources cannot be depleted over time	Non-renewable resources deplete over time

Requires a large land/ offshore area, especially for wind farms and solar farms	Comparatively lower area requirements

Q7. Define efficiency. Give formula for efficiency

EFFICIENCY

The ratio of output to the input is called efficiency.

FORMULA

$$E = \frac{output}{input} \times 100$$

Q8. Define power. Give it formula and unit

POWER

The rate of doing work is known as power

FORMULA

$$P = \frac{W}{t}$$

UNIT

In SI system unit of power is Watt (joules/sec).

Q9. Derive K.E = ½ mV^2

Let's take an object of mass m which is at rest. A force F is applied to it in such a way that its final velocity becomes V and the displacement made by it in the direction of the applied force is S.
The object has gained kinetic energy due to the motion caused by the applied force. So, we can say that the work done by the force **F** on the object equals the kinetic energy gained by the object.
Work Done on the object by the force

$$W = FS \text{ ----- } 1$$

According to newton 2nd law

$$F = ma$$

By using third equation of motion

$$2aS = Vf^2 - Vi^2$$

But,

Vf = V

Vi = 0

then,

$$2aS = V^2 - 0^2$$

$$S = \frac{V^2}{2a}$$

Putting F and S in eq 1

W = FS

$$W = ma \times \frac{V^2}{2a}$$

$$W = m \times \frac{V^2}{2}$$

W = work done = K.E

$$K.E = \frac{1}{2}mV^2$$

Q10. Derive P.E = mgh

Derivation of Gravitational Potential Energy

To derive the expression for gravitational potential energy, let us consider an object of mass "m" which is raised up through height "h" from the ground. The work done in lifting it to height "h" is stored in it as its gravitational potential energy "P·E", i.e.

P·E = Work done

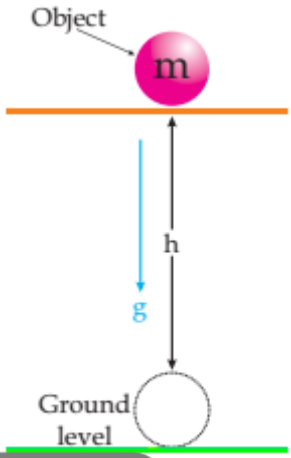
P·E = W

P·E = F·d

P·E = (mg)·h

Therefore equation becomes:

P·E = mgh



An object of mass 'm' raised to height 'h'.

NUMERICALS

Numerical # 1

How much work is needed to move horizontally a body 20m by a force of 30N, the angle between the body and the horizontal surface is 60°?($\cos\theta = 0.5$)

Data

d = 20m

F = 30 N

$\theta = 60^o$

W = ?

Solution

$W = Fd\cos\theta$

$W = 30 \times 20 \times \cos 60^o$

$W = 600 \times 0.5$

$W = 300$ j

Numerical # 2

Find the work done when a force of 50N is applied to move a trolley at a shopping mall through a distance of 200m? Assume the angle to be of 0° between the force and the distance the trolley moved.

$\cos 0^o = 1$

Data

F = 50N

D = 200m

$\theta = 0^o$

W = ?

Solution

$W = Fd\cos\theta$

$W = 50 \times 200 \times \cos 0^o$

$W = 1000 \times 1$

$W = 1000$ j

Numerical # 3

How much work is done, if a crate is moved at a distance of 50m, when a force of 30N is applied along the surface.

Data

d = 50 m

F = 30N

W = ?

Solution

W = Fd

W = 30 x 50

W = 1500

Numerical # 4

A ball of mass 400 gram, strikes the wall of velocity 4m/sec. How much is the kinetic energy of the ball at the time it strikes the wall?

Data

m = 400gm = 400÷1000 = 0.4kg

v = 4m/s

K.E = ?

Solution

K.E = ½ mV^2

K.E = ½ x 0.4 x 4^2

K.E = 0.2 x 16

K.E = 8 J

Numerical # 5

If LED screen of mass 10kg is lifted up and kept it on a cupboard of height 2m. Calculate the potential energy stored in the LED screen.

Data

m = 10 kg

h = 2 m

g = 9.8 m/s^2

P.E = ?

Solution

P.E = mgh

P.E = 10 x 9.8 x 2

P.E = 196 J

Numerical # 6

Calculate the potential energy of 3kg water raised to the tank at the roof of a home 4m high.

Data

m = 3 kg

h = 4 m

g = 9.8 m/s^2

P.E = ?

Solution

P.E = mgh

P.E = 3 x 9.8 x 4

P.E = 117.6 J

Numerical # 6

A ball of mass 50 gram is raised to a height of 7m from the ground. Calculate its gravitational potential energy?

Data

m = 50gm = 50 ÷ 1000 = 0.05kg

h = 7 m

g = 9.8 m/s^2

P.E = ?

Solution

P.E = mgh

P.E = 0.05 x 9.8 x 7

P.E = 3.43 J

Numerical # 7

Calculate the efficiency of a machine which consumes 200J of energy and performs 50J of work.

Data

Consume energy = input = 200J

Perform energy = output = 50J

E = ?

Solution

E = $\frac{Output}{Input} \times 100$

E = $\frac{50}{200} \times 100$

E = 25%

Numerical # 8

Calculate the power of a machine. If the machine performs 900 joules of work in 30 minutes.

Data

W = 900j

t = 30min = 30 x 60 = 1800 sec

P = ?

Solution

P = $\frac{W}{t}$

P = 900/1800

P = 0.5 watt

Numerical # 9

If the efficiency of a machine is 70% and its output is 100 J then calculate its input.

Data

E = 70%

Output = 100j

Input = ?

Solution

E = $\frac{Output}{Input} \times 100$

70 = $\frac{100}{Input} \times 100$

Input = $\frac{100}{70} \times 100$

Input = 7000 J

Numerical # 10

Which machine is more efficient, machine "A" which has an output of 200J after consuming 400J of energy or machine "B" which has an output of 300J after consuming 450J of energy?

Data

Output (A) = 200 J

Input (A) = 400 J

Output (B) = 300 J

Input (B) = 440 J

E(A) = ?

E(B) = ?

Solution

$E = \frac{Output}{Input} \times 100$

$E(A) = \frac{200}{400} \times 100$

E(A) = 50%

$E(B) = \frac{300}{450} \times 100$

E(B) = 66.67%

machine "B" Has more efficiency

Numerical # 11

The energy of 600J dissipated by a bulb in 50 minutes. Find the power of the bulb.

Data

W = 600 J

t = 50 min = 50 x 60 = 3000 sec

P = ?

Solution

$P = \frac{W}{t}$

$P = \frac{600}{3000}$

P = 0.2 watt

Numerical # 12

Calculate the power of a machine, if it does 40 Joules of work in 10 sec.

Data

W = 40 J

t = 10 sec

P = ?

Solution

P = $\frac{W}{t}$

P = $\frac{40}{10}$

P = 4 watt

Numerical # 13

A student of weight 400N takes 5 sec to climb up an obstacle of height 2m. Calculate the power consumed?

Data

W = 400N

t = 5 sec

h = 2 m

P = ?

Solution

P = $\frac{Work}{time} = \frac{Fd}{t} = \frac{Wh}{t}$

P = $\frac{400 \times 2}{5}$

P = 160 watt

Numerical # 14

If a machine consumes 250J of energy per hour then what will be its power?

Data

W = 250 J

t = 1hour = 1 x 3600 = 3600 sec

P = ?

Solution

P = $\frac{W}{t}$

P = $\frac{250}{3600}$

P = 0.069 watt

Chapter 9

THERMAL PROPERTIES OF MATTER

Q1. Differentiate between heat and Temperature

HEAT	TEMPERATURE
Heat is the amount of energy in a body.	Temperature is the measure of the intensity of heat.
It can be measure as Total kinetic and potential energy contained by molecules in an object.	It can be measure as Average kinetic energy of molecules in a substance.
Flows from hotter object to cooler object.	Rises when heated and falls when cooled.
Its S.I unit is Joules	Its S.I unit is Kelvin
Its symbol is "Q"	Its symbol is "T"

Q2. Write short note on thermometer

THERMOMETER

Thermometer is a device, used to measure temperature.

FOR EXAMPLE

A clinical thermometer is used to measure the temperature of human body

Thermometers have different scales to measure temperature

There are three scales of temperature

1. Celsius scale (Mostly used for environmental measurements)
2. Fahrenheit scale (Mostly used for clinical measurements)
3. Kelvin scale (Mostly used for industrial measurements)

Q3. Define and give formula of heat capacity

HEAT CAPACITY

Amount of heat required to raise the temperature of a substance through 1°C is called heat capacity of that substance

FORMULA

$$C = \frac{\Delta Q}{\Delta T}$$

UNIT

Its SI unit is joule per Kelvin (J K^{-1}).

Q4. Define and give formula of specific heat capacity

SPECIFIC HEAT CAPACITY

Amount of heat required to raise the temperature of 1 kg of a substance through 1°C is called specific heat capacity of that substance

FORMULA

$$c = \frac{\Delta Q}{m\Delta T}$$

UNIT

Its SI unit is joule per kilogram per Kelvin (J kg^{-1} K^{-1}).

Q5. Define heat of fusion, heat of vaporization

HEAT OF FUSION

The heat absorbed by a unit mass of a solid at its melting point in order to convert solid into liquid without change of temperature is called “heat of fusion”.

HEAT OF VAPORIZATION

The amount of heat energy required to change the state of a substance from liquid to vapor form, without changing its temperature is called “heat of vaporization”.

Q6. Differentiate between evaporization and boiling

EVAPORATION	BOILING
1· It takes place without supply having external heat source.	1· It only takes place without on supply external heat source.
2· It occurs at any temperature below boiling point.	2· It occurs only at certain temperature called "Boiling point".
3· It causes cooling.	3· It do not cause cooling.
4· It is relatively slow.	4· It is relatively fast.
5· It takes place only at the liquid surface.	5· I t takes place throughout the liquid.
6· No formation of bubbles.	6· Bubbles are formed.

Q7. Discus the factor of surface evaporization

FACTORS WHICH INFLUENCING SURFACE EVAPORATION

A. TEMPERATURE:

With the increase in temperature the rate of evaporation also increases.

B. WIND SPEED:

Rate of evaporation also increases with the increase in wind speed.

C. SURFACE AREA OF LIQUID:

Rate of evaporation increases with the increase in surface area of liquid.

D. HUMIDITY:

The rate of evaporation decreases with increase in humidity.

E. NATURE OF LIQUID:

Nature of liquid also effect the rate of evaporation. Liquid with lower boiling point have grater vapor pressure and evaporate more rapidly.

F. SOLUTE CONCENTRATION:

Salty water evaporates more slowly than pure water.

Q8. Define thermal expansion. List down its example.

THERMAL EXPANSION

The expansion of substance on heating is called thermal expansion.

EXAMPLES OF THERMAL EXPANSION.

Expansion in railway tracks in summer.

Expansion in electric wires in summer.

Expansion in bridges in summer.

Q9. Define linear thermal expansion. Derive $\Delta L = \alpha L \Delta T$

LINEAR THERMAL EXPANSION

The expansion in length of a solid object on heating is called linear expansion.

DERIVATION

Suppose a rod of some material with original length L, at initial temperature T, is heated through a certain temperature T', then its length increase and becomes L'.

Therefore,

Change in temperature = $\Delta T = T' - T$ -------(i)

Change in length = $\Delta L = L' - L$ ----------(ii)

It has been experimental proved that change in length is directly proportional to the original length and change in temperature. Therefore

ΔL = (constant) L ΔT ----------(iii)

This constant is denoted by α, and is called coefficient of linear expansion. It depends upon the nature of the material.

Therefore equation (iii) can be written as

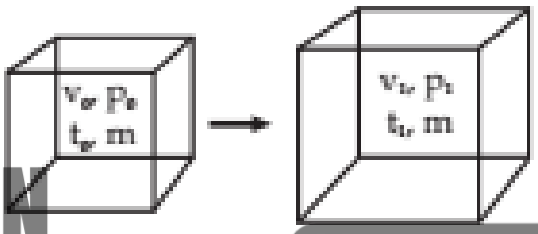
$$\Delta L = \alpha L \Delta T$$

Q10. Define volumetric thermal expansion. Derive $\Delta V = \beta V \Delta T$

VOLUMETRIC THERMAL EXPANSION

The expansion in volume of a solid object on heating is called volume expansion.

DERIVATION



It is three-dimensional expansion as it occurs along the length, width and height of the object. Consider a solid body having volume V, at some initial temperature T. When the body is heated its temperature changes from T to T' and its volume becomes V'.

Therefore,

Change in temperature = $\Delta T = T' - T$ -------(i)

Change in volume = $\Delta V = V' - V$ ---------- (ii)

It has been experimentally proved that change in volume is directly proportional to the original volume and change in temperature.

ΔV = (constant) V ΔT ---------(iii)

This constant is denoted by "β" and is called coefficient of volume expansion. It depends upon the nature of material.

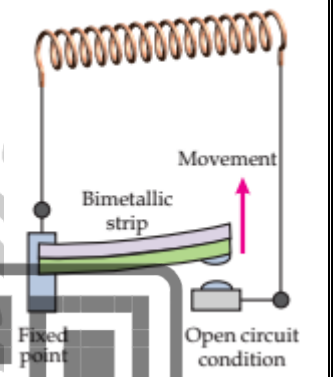
Therefore equation (iii) can be written as:

$$\Delta \mathbf{V} = \boldsymbol{\beta} \mathbf{V} \Delta \mathbf{T}$$

Q11. Write short note on bimetallic thermostat.

BIMETAL THERMOSTAT

Bimetallic thermostat is used to control temperature of ovens, irons water heaters, refrigerators, air conditioners and so on. It is designed to bend when it becomes hot. Two metals with different coefficient of linear expansion are joined firmly to make it. When it is heated, metal with large value of coefficient of linear expansion more than the other, causing the strip to bend. In this way, it cuts off the current supply. The current supply to the circuit is restored again when it cools down.



Q12. What do you know about Rivets?

RIVETS

Rivets are used in shipbuilding and other industries to join metal plates. A red-hot rivet is passed through holes in two metal plates and hammered until ends are rounded. The rivet contracts on cooling and pulls the two plates tightly together. A metal rim can be fixed on a wooden wheel of a bull cart. The diameter of metal rim is set little bit smaller than the diameter of wooden wheel. The diameter of metal rim increases on heating and can easily be put over the wooden wheel. It contracts on cooling and holds wooden wheel tightly.

NUMERICALS

Numerical # 1

Convert 30°C into Kelvin and Fahrenheit Scale.

Data

T = 30°C

T = ? (Kelvin)

T = ? (Fahrenheit)

Solution

°C in to K (+273)

T = 30+273 = 303K

°C in to F: T(F) = 1.8T°C +32

T(F) = 1.8(30) +32

T(F) = 54 + 32

T(F) = 86F

Numerical # 2

Convert 212°F into Celsius and Kelvin.

Data

T = 212F

T = °C = ?

T = K = ?

Solution

F in to °C: T°C = $\frac{T(F)-32}{1.8}$

T°C = $\frac{212-32}{1.8} = \frac{180}{1.8} = 100$°C

K in to °C (–273)

T(K) = 100 – 273 = –173K

Numerical # 3

The temperature of Hyderabad on a hot day is 45 degree Celsius (45°C). What will be its equivalent temperature on Fahrenheit Scale?

Data

T = 45°C

T = F = ?

Solution

^oC in to F: $T(F) = 1.8T^oC + 32$

$T(F) = 1.8 \times 45 + 32$

$T(F) = 81 + 32$

$T(F) = 113F$

Numerical # 4

The thermal energy required to raise the temperature of 50g of water from 40^oC to 70^oC is 6300 Joules. Calculate the specific heat capacity of water.

Data

$m = 50g = 50 \div 1000 = 0.05\ kg$

$T_1 = 40^oC$

$T_2 = 70\ ^oC$

$\Delta Q = 6300\ j$

C = ?

Solution

$\Delta Q = mC\Delta T$

$\Delta T = T_2 - T_1 = 70 - 40 = 30^oC = 30K$

$6300 = 0.05 \times C \times 30$

$6300 = 1.5C$

$C = \frac{6300}{1.5}$

$C = 4200\ J\ Kg^{-1}\ K^{-1}$

Numerical # 5

2kg of copper requires 2050J of heat to raise its temperature through 10^oC. Calculate the heat capacity of the sample.

Data

$m = 2\ kg$

$\Delta T = 10^oC = 10K$

$\Delta Q = 2050\ j$

c = ?

Solution

$\Delta Q = c\Delta T$

$2050 = c \times 10$

$C = \frac{2050}{10}$

$C = 205\ J\ K^{-1}$

Numerical # 6

An iron block of volume $3m^3$ is heated, so that its temperature changes from 25°C to 100°C. If the coefficient of linear expansion of iron is $11x10^{-6}\ °C^{-1}$. What will be the new volume of the iron block after heating?

Data

$V_1 = 3m^3$

$T_1 = 20°C$

$T_2 = 100\ °C$

$\alpha = 11x10^{-6}\ °C^{-1}$

$V_2 = ?$

Solution

$\Delta T = T_2 - T_1 = 100 - 20 = 80°C = 80K$

$\beta = 3\alpha$

$\beta = 3 \times 11x10^{-6}$

$\beta = 33 \times 10^{-6}$

$V_2 = V_1(1 + \beta\Delta T)$

$V_2 = 3(1 + 33x10^{-6} \times 80)$

$V_2 = 3(1 + 0.000033 \times 80)$

$V_2 = 3(1 + 0.00264)$

$V_2 = 3(1.00264)$

$V_2 = 3.00792\ m^3$

Numerical # 7

A copper rod 15m long is heated, so that its temperature changes from 30°C to 85°C. Find the change in the length of the rod. The coefficient of linear expansion of copper is $17 \times 10^{-6}\ °C^{-1}$.

Data

$L_1 = 3m$

$T_1 = 30°C$

$T_2 = 85\ ^oC$

$\alpha = 17x10^{-6}\ ^oC^{-1}$

$\Delta L = ?$

Solution

$\Delta T = T_2 - T_1 = 85 - 30 = 55^oC = 55K$

$\Delta L = \alpha L_1 \Delta T$

$\Delta L = 17x10^{-6} \times 3 \times 55$

$\Delta L = 0.000017 \times 165$

$\Delta L = 0.002805\ m$