ENGINEERING PHYSICS I DIPLOMA

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ENGINEERING PHYSICS

(DIPLOMA I YEAR)

UNITS AND DIMENSIONS

1. Define physical quantity, fundamental physical quantity and derived physical quantities.

a. Physical Quantity: The quantity is measurable is called "Physical Quantity'.

Eg: Length, mass, time etc.,

Fundamental Physical Quantity: The physical quantities which are independent of one another are called "Fundamental Physical Quantity".

Eg: Length, mass, time etc.,

Derived Physical Quantity: The physical quantities which can be derived from the fundamental physical quantities are called "Derived Physical Quantity".

Eg: area, volume, speed etc.,

2. What is a unit? Write the characteristics of unit.

a. Definition: The unit is defined as the standard of the measurement of the same kind.

Characteristics of unit:

- It should be well defined without ambiguity.
- It should not vary with respect to place, time, and temperature.
- It should be easily reproduced.
- It should be of convenient size.

3. Define fundamental units and derived units.

a. Fundamental Units: The units that are used measure fundamental physical quantities are called "Fundamental Units".

Eg: metre, kilogram, second, etc.,

Derived Units: The units that are used measure derived physical quantities are called "Derived Units".

Eg: $metre^2$, $metre^3$, $metre\ second^{-1}$, etc.,

4. Define SI units and write the advantages of SI units.

a. SI units: Introduced a new system of units called SI system, SI means international system units.

Advantages of SI units:

- The base and supplementary units covers all branches of science and engineering.
- All the units are well defined without any ambiguity.
- All the derived units can be obtained by simple multiplication and or division of fundamental units.
- Almost all countries in the world have adopted SI system.

5. Write the base (fundamental) and supplementary units of SI systems along with their symbols.

a. There are seven base (fundamental) units and two supplementary units

S.No	Quantity	Unit	Symbol
FUNDAMENTAL UNITS			
1	Length	metre	m
2	Mass	kilogram	kg
3	Time	second	s
4	Electric Current	ampere	A
5	Thermodynamic Temperature	kelvin	K
6	Luminous intensity	candela	cd
7	Amount of substance	mole	mol
SUPPLEMENTARY UNITS			
1	Plane Angle	radian	rad
2	Solid Angle	steradian	sr

6. What are multiples and submultiples of SI system?

a. SI system established multiples and sub multiples are arranged prefixes and symbol to express very large and small value which are lengthy in short form.

MULTIPLES		
Factor	**Prefix**	**Symbol**
10^{18}	exa	E
10^{15}	peta	P
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10^{1}	deca	da

SUB-MULTIPLES		
Factor	**Prefix**	**Symbol**
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a

7. Write the rules of writing SI units.

a. Writing rules:

- The names of a unit may be written in full or its approved symbol may be used.

Eg:

Correct	Incorrect
second	sec

- The beginning letters of the names of units and prefixes should be of lowercase letters.

Eg:

Correct	Incorrect
metre	Metre

- Punctuation marks should not be used surrounding the symbols.

Eg:

Correct	Incorrect
S	"s"

8. Define dimensions and dimensional formula.

a. Dimensions: The dimensions are the powers to which the fundamental units are to be raised to represent a derived unit.

Eg: Velocity = $\frac{\text{displacement}}{\text{time}} = \frac{L}{T} = L^1T^{-1}$

In velocity, the dimension of length is 1 and the dimension of time is -1.

Dimensional Formula: The formula which indicates the relationship between a derived physical quantity and the fundamental physical quantities is known as dimensional formula.

The general form of dimensional formula is $M^pL^qT^r$, where p,q and r are the dimensions of mass, length and time respectively.

9. Define dimensional constants and dimensionless quantities.

a. Dimensional Constants: The quantities which have a constant value and possess dimensions are called dimensional constants.

Eg: Planks constant, universal gas constant, etc.,

Dimensionless Quantities: The quantities which do not posses dimensions are called dimensionless quantities.

Eg: Angle, refractive index, strain, etc.,

10. State the principle of homogeneity of dimensions.

a. Statement: The dimensions of all the terms on both sides of equation must be same.

Eg: Consider the equation

$$v = u + at$$

Final velocity = initial velocity + acceleration x time

$$M^0LT^{-1} = M^0LT^{-1} + LT^{-2} \times T$$

$$M^0LT^{-1} = M^0LT^{-1} + M^0LT^{-1}$$

The validity of equation is proved because all the terms on both sides of equality sign have same dimensions.

11. Write the applications of dimensional analysis.

a. Applications of Dimensional Analysis:

- One system of units can be converted into another system.
- The correctness of an equation can be checked.
- Equation connecting different physical quantities can be derived

12. Write the limitations of dimensional analysis.

a. Limitations of Dimensional Analysis:

- This method is not applicable if an equation contains trigonometric, exponential and logarithmic functions.
- It is difficult to use this method if a physical quantity depends on more than three other physical quantities.
- Numbers and dimensionless quantities cannot be determined by this method.
- This method cannot be applied to derive formulae in cases where proportionality constants have dimensions.

13. Write the dimensional formulas for following physical quantities.

S.No	Physical Quantity	General Formula	Dimensional Formula
1	Area	length x length	$M^0L^2T^0$
2	Volume	length x length x length	$M^0L^3T^0$
3	Density	$\frac{\text{mass}}{\text{volume}}$	$M^1L^{-3}T^0$
4	Speed and velocity	$\frac{\text{distance}}{\text{time}}$	$M^0L^1T^{-1}$
5	Momentum	mass x velocity	$M^1L^1T^{-1}$
6	Acceleration, Acceleration due to gravity, Retardation	$\frac{\text{change in velocity}}{\text{time}}$	$M^0L^1T^{-2}$
7	Force	mass x acceleration	$M^1L^1T^{-2}$
8	Impulse	force x time	$M^1L^1T^{-1}$
9	Work & energy	force x distance	$M^1L^2T^{-2}$
10	Power	$\frac{\text{work}}{\text{time}}$	$M^1L^2T^{-3}$
11	Pressure & stress	$\frac{\text{force}}{\text{area}}$	$M^1L^{-1}T^{-2}$
12	Angle	$\frac{\text{arc}}{\text{radius}}$	$M^0L^0T^0$
13	Angular velocity	$\frac{\text{angular displacement}}{\text{time}}$	$M^0L^0T^{-1}$
14	Angular acceleration	$\frac{\text{angular velocity}}{\text{time}}$	$M^0L^0T^{-2}$
15	Frequency	$\frac{\text{No. of oscillations}}{\text{time}}$	$M^0L^0T^{-1}$
16	Surface tension	$\frac{\text{force}}{\text{length}}$	$M^1L^0T^{-2}$
17	Co-efficient of viscosity	$\frac{\text{force}}{\text{area x velocity gradient}}$	$M^1L^{-1}T^{-1}$
18	Torque	force x distance	$M^1L^2T^{-2}$
19	Gravitational potential	$\frac{\text{work}}{\text{mass}}$	$M^0L^2T^{-2}$
20	Planks constant	$\frac{\text{energy}}{\text{frequency}}$	$M^1L^2T^{-1}$

21	Velocity gradient	$\frac{\text{change of velocity}}{\text{distance}}$	$M^0L^0T^{-1}$
22	Co-efficient of friction	$\frac{\text{force of friction}}{\text{normal reaction}}$	$M^0L^0T^0$
23	Specific heat	$\frac{\text{energy}}{\text{mass x temperature}}$	$M^0L^2T^{-2}K^{-1}$
24	Latent heat	$\frac{\text{energy}}{\text{mass}}$	$M^0L^2T^{-2}$
25	Universal gas constant	$\frac{\text{pressure x volume}}{\text{temperature}}$	$M^1L^2T^{-2}K^{-1}$
26	Thermal capacity	$\frac{\text{quantity of heat (or) energy}}{\text{temperature diffference}}$	$M^1L^2T^{-2}K^{-1}$
27	Electric potential (or) Potential difference	$\frac{\text{work}}{\text{charge}}$	$M^1L^2T^{-3}I^{-1}$
28	Resistance	$\frac{\text{potential difference}}{\text{current}}$	$M^1L^2T^{-3}I^{-2}$
29	Specific resistance	$\frac{\text{resistance x area}}{\text{length}}$	$M^1L^3T^{-3}I^{-2}$
30	Capacitance	$\frac{\text{charge}}{\text{potential}}$	$M^{-1}L^{-2}T^4I^2$
31	Electric intensity	$\frac{\text{force}}{\text{charge}}$	$M^1L^1T^{-3}I^{-1}$
32	Wave length	distance	$M^0L^1T^0$
33	Linear density	$\frac{\text{mass}}{\text{length}}$	$M^1L^{-1}T^0$
34	Magnetic moment	pole strength x length	$M^0L^2T^0I$
35	Magnetic induction	$\frac{\text{force}}{\text{current x length}}$	$M^1L^0T^{-2}I^{-1}$
36.	Universal gravitation constant	$\frac{\text{force x distance}^2}{\text{mass}^2}$	$M^{-1}L^3T^{-2}$
37.	Modulus of elasticity, Elastic consultant, Young's modulus, Rigidity modulus	$\frac{\text{stress}}{\text{strain}}$	$M^1L^{-1}T^{-2}$
Temperature – K, Current - I, Charge - TI (time x current), Pole strength - LI			

KINEMATICS

1. Write and explain about the kinematic equations (Equations of motion in straight line or linear motion). Write the equations of motion of a freely falling body.

a. Equations of motion in straight line: When a body moves along a straight line with uniform acceleration, the velocity of the body and the distance travelled can be represented by a set of equations which are known as "kinematical equations of motion".

Let **u** be the initial velocity, **a** be the uniform acceleration, **t** be the time, **S** be the distance travelled and **v** be the final velocity.

Then the kinematical equations of motion are given by

- $v = u + at$
- $S = ut + \frac{1}{2}at^2$
- $v^2 - u^2 = 2aS$
- $S_n = u + \frac{a}{2}(2n - 1)$ or $S_n = u + a(n - \frac{1}{2})$

Equations of motion for freely falling body: A body was dropped from a height "h" above the ground level. The initial velocity of the body u = 0 and acceleration a = +g.

Hence the equations of motion can be written as

- $v = gt$
- $S = \frac{1}{2}gt^2$
- $v^2 = 2gh$
- $S_n = \frac{g}{2}(2n - 1)$ or $S_n = g(n - \frac{1}{2})$

2. Define acceleration due to gravity (g) and write characteristics of g.

a. Definition: The acceleration of a freely falling body due to earth attraction is called acceleration due to gravity. It is denoted by 'g'.

The dimensional formula of acceleration due to gravity is $\mathbf{M^0L^1T^{-2}}$ and its units is **metre/second^2**

Characteristics of g:

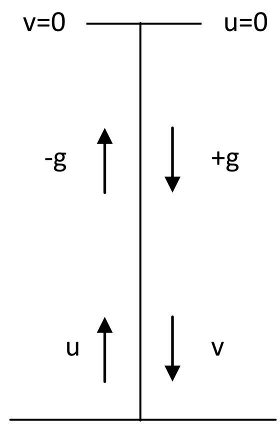
- Its value is same for all bodies at particular place.
- Its value changes from place to place on the surface of earth.

- When a body is falling toward to earth, its velocity increases. Hence g is takes as positive(+).
- When a body is projected upwards, its velocity decreases. Hence g is takes as negative(-).
- The value of g is maximum at poles of the earth. $g_{max} = 9.83\ m/s^2$
- The value of g is minimum at the equator. $g_{min} = 9.78\ m/s^2$
- The average value of g is taken as $9.8\ m/s^2$

3. Derive expressions for maximum height, time of ascent, time of descent, time of flight and velocity on reaching the point of projection of a vertically projected body.

a. Vertical Projection: The projection of a body in a direction perpendicular to the horizontal plane is called "Vertical Projection".

Explanation: Consider a body which is projected vertically upward into air from the ground with an initial velocity u. This velocity decreases with respect to time and become zero at a height and then the body falls down to the ground at the point of projection. While falling its velocity increases with respect to time. Hence the acceleration of the body is -g in the upwards direction and +g in the downward direction.



Maximum Height: When a body is projected vertically upwards from ground, the height at which its velocity becomes zero is called "Maximum Height".

We know that

Initial velocity	$u = u$
Acceleration	$a = -g$
Final velocity	$v = 0$
Maximum height	$S = H$ (say)

Substituting the above values in the equation

$$v^2 - u^2 = 2aS$$

$$0^2 - u^2 = 2(-g)H$$

$$-u^2 = -2gH$$

Maximum height $H = \frac{u^2}{2g}$

Time of Ascent: The time taken by a vertically projected body to reach the maximum height is called "Time of Ascent".

We know that

$$u = u, \quad a = -g, \quad v = 0, \quad t = t_1 \text{ (say)}$$

Substituting the above values in the equation

$$v = u + at$$

$$0 = u - gt_1$$

$$gt_1 = u$$

$$\text{Time of Ascent } t_1 = \frac{u}{g}$$

Time of Descent: The time taken by a vertically projected body to fall on ground from the maximum height is called "Time of Descent".

We know that

$$u = 0, \quad a = +g, \quad S = H = \frac{u^2}{2g}, \quad t = t_2 \text{ (say)}$$

Substituting the above values in the equation

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

$$\frac{u^2}{2g} = (0)\, t_2 + \frac{1}{2}\, gt_2^2$$

$$\frac{u^2}{2g} = \frac{1}{2}gt_2^2$$

$$t_2^2 = \frac{u^2}{g^2}$$

$$\text{Time of Descent } t_2 = \frac{u}{g}$$

Time of Flight: The time interval between the time of the projection and the time of striking ground is called "Time of flight".

Time of flight = Time of ascent + Time of descent

$$T = t_1 + t_2$$

$$T = \frac{u}{g} + \frac{u}{g}$$

$$\text{Time of Flight } T = \frac{2u}{g}$$

Velocity Reaching the Point of Projection: It is the velocity with which the vertically projected body strikes the ground.

We know that

$$u = 0, \quad a = +g, \quad S = H = \frac{u^2}{2g}, \quad v = v \text{ (say)}$$

Substituting the above values in the equation

$$v^2 - u^2 = 2aS$$

$$v^2 - 0^2 = 2g\left(\frac{u^2}{2g}\right)$$

$$v^2 = u^2$$

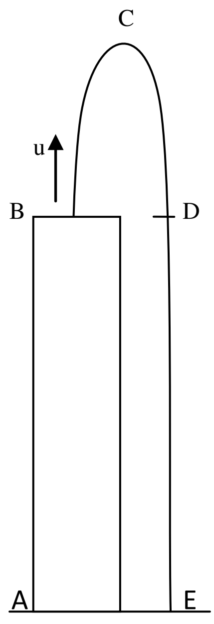
$$v = u$$

Hence the velocity of the body on reaching the ground is equal to the velocity with which it is projected upwards.

4. Derive the expression for height of tower when a body projected vertically up from its top.

a. Derivation for Height of Tower:

Consider a person standing on the top edge of a tower AB of height 'h', who projects a body vertically upwards into air with a velocity u. then the body rises to same height BC and then falls at the foot of the tower E, in a time t. The initial displacement of the body in the upward direction is taken positive and the displacement downward direction is taken negative.



The net displacement of the body = Total of its displacements

$$\begin{aligned} S &= BC + CD + DE \\ &= BC - CD - DE \\ &= BC - BC - AB \\ &= -AB \\ S &= -h \end{aligned}$$

We know that

Initial velocity	$u = u$
Acceleration	$a = -g$
Net displacement	$S = -h$
and time	$t = t$

Substituting the above values in the equation

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

$$-h = ut + \frac{1}{2}(-g)t^2$$

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

Height of Tower $\quad h = -ut + \frac{1}{2}gt^2$

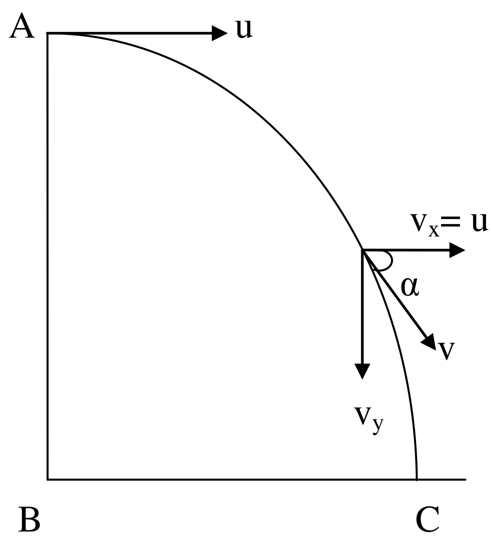
This is the expression for height of the tower, when a body is projected vertically upwards from its top.

5. Derive expressions for time of flight, horizontal range and instantaneous velocity (resultant velocity) of a horizontal projection a body. (OR)

Explain horizontal projection

a. Horizontal Projection: The projection of a body in a direction parallel to the horizontal plane is called "Horizontal Projection".

Explanation: Consider a body which is projected horizontally from the top of a tower AB of height h with uniform velocity u. As soon as the body is release it is influenced by the force of gravity. This force of gravity tries to move the body in the vertically downward direction. At the same time the velocity of a projection tries to move body in the horizontal direction. The combined effort of force of gravity and velocity of projection makes the body to move along a parabolic path and the body falls at C some distance away from the foot of the tower.



Time of Flight: The time taken by the projectile to travel from the point of projection to the ground is called "time of flight".

In the vertically downward direction,

Initial velocity	$u = 0$
Acceleration	$a = +g$
Vertical displacement	$S = h$
Time of flight	$t = T$

Substituting the above values in the equation

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

$$h = (0)T + \frac{1}{2}gT^2$$

$$h = \frac{1}{2}gT^2$$

$$T^2 = \frac{2h}{g}$$

Time of flight $T = \sqrt{\frac{2h}{g}}$

Horizontal Range: The horizontal displacement of the projectile during the time flight is called "horizontal range".

Since the horizontal velocity is uniform, the range is calculated by the formula,

Range = Uniform horizontal velocity x Time of flight

$$R = u\sqrt{\frac{2h}{g}}$$

Instantaneous velocity (or) Resultant velocity : The velocity of the projectile at any instant, certain time after projection, during its flight is called "instantaneous velocity (or) "resultant velocity ".

The velocity of the projectile at any instant after projection can be resolved into two mutually perpendicular components v_x and v_y. v_x is uniform and is equal to the velocity of projection.

We know that $u = 0$, $a = +g$, $v = v_y$, $t = t$

Substituting the above values in the equation

$$v = u + at$$

$$v_y = 0 + gt$$

$$v_y = gt$$

The magnitude of resultant velocity is $v = \sqrt{v_x^2 + v_y^2}$

The resultant velocity $v = \sqrt{u^2 + g^2t^2}$

If the angle between v_x and v is α , then the direction of resultant velocity is

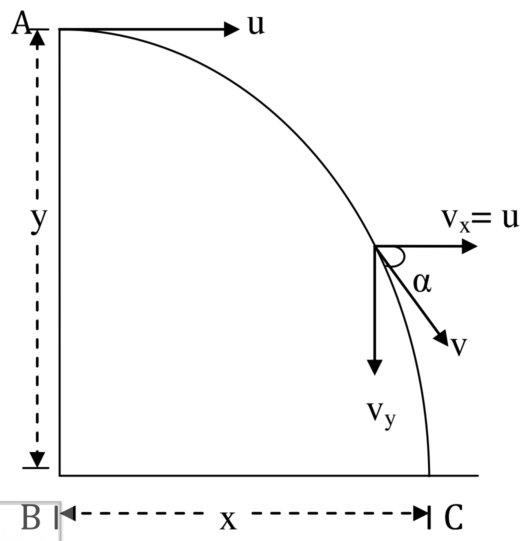
$$\tan\alpha = \frac{v_y}{v_x} = \frac{gt}{u}$$

The direction of resultant velocity $\alpha = \tan^{-1}\left(\frac{gt}{u}\right)$

6. Show that the path of a projectile is parabola in horizontal projection. (OR) Derive the equation of the path of projectile in horizontal projection.

a.

Explanation: consider a tower AB of height y. Let a body be projected from its top with a velocity u in the horizontal direction. Under the combined effect of uniform velocity u in the horizontal direction and the force of gravity in the vertically downward direction the body moves along a path AC and falls after time t at C on the ground.



Let the horizontal range BC be x.

Horizontal direction:
The velocity in the horizontal direction is uniform.

$$\text{horizontal displacement} = \text{horizontal velocity} \times \text{time}$$

$$x = u \times t$$

$$t = \frac{x}{u} \quad \text{-------------(i)}$$

Vertical direction:
In the vertically downward direction,

Initial velocity	u = 0
Acceleration	a = + g
Vertical displacement	S = y
Time	t = t

Substituting the above values in the equation

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

$$y = \frac{1}{2}gt^2 \qquad \text{(where } t=\frac{x}{u} \text{ from equation (i))}$$

$$y = \frac{1}{2}g\left(\frac{x}{u}\right)^2$$

$$y = \frac{g}{2u^2}x^2 \qquad \left(\frac{g}{2u^2} \text{ is constant and let it be A}\right)$$

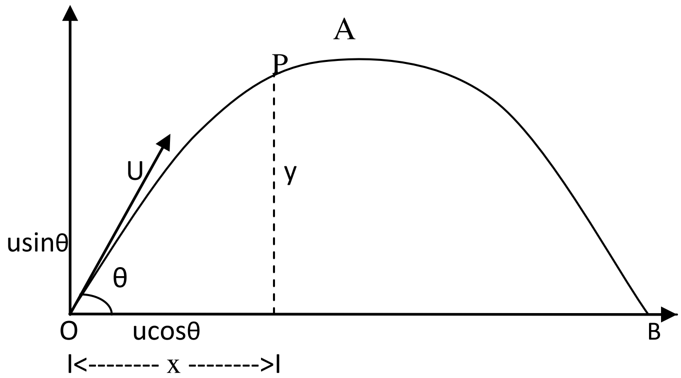
$$y = Ax^2$$

This equation is represents a parabola.
Hence the path of a projectile is parabola in horizontal projection.

7. Show that the path of a projectile is parabola in oblique projection. (OR) Derive the equation of the path of projectile in oblique projection.

a.

Explanation: Let a body be projected obliquely with a velocity u from point O at an angle θ with the horizontal. The body moves the path OAB. The initial velocity u is resolved into two mutually perpendicular components.



The horizontal component of velocity $u_x = u\cos\theta$

The vertical component of velocity $u_y = u\sin\theta$

Let the body be at point P, t seconds after projection and let the horizontal and vertical displacements be x and y respectively

Horizontal direction:

The velocity in the horizontal direction is uniform.

$$\text{horizontal displacement} = \text{horizontal velocity} \times \text{time}$$

$$x = u\cos\theta \times t$$

$$t = \frac{x}{u\cos\theta} \qquad \text{-------------(i)}$$

Vertical direction:

In the vertical direction,

Initial velocity	$u = u\sin\theta$
Acceleration	$a = -g$
Vertical displacement	$S = y$
Time	$t = t$

Substituting the above values in the equation

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

$$y = u\sin\theta \times t + \frac{1}{2}(-g)t^2$$

where $t = \frac{x}{u\cos\theta}$ from equation (i)

$$y = u\sin\theta\left(\frac{x}{u\cos\theta}\right) - \frac{1}{2}g\left(\frac{x}{u\cos\theta}\right)^2$$

$$y = \tan\theta\,(x) - \frac{1}{2}g\,\frac{x^2}{u^2\cos^2\theta}$$

$$y = \tan\theta\,(x) - \frac{g}{2u^2\cos^2\theta}\,(x)^2$$

Since the terms $\tan\theta$ and $\frac{g}{2u^2\cos^2\theta}$ are constants in the above expression,

Let them be A and B respectively $A = \tan\theta$, $B = \frac{g}{2u^2\cos^2\theta}$

$$y = Ax - Bx^2$$

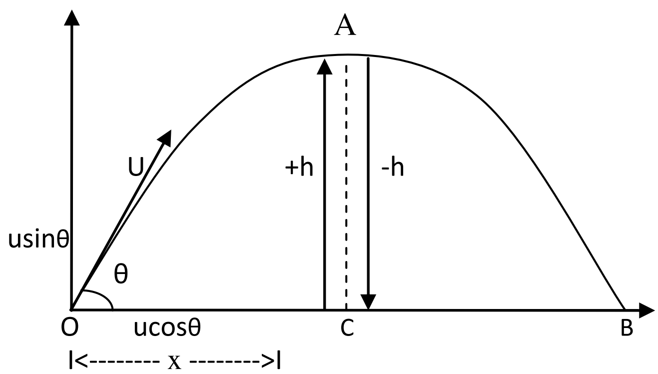
This equation is represents a parabola.

Hence the path of a projectile is parabola in oblique projection.

8. Derive expressions for maximum height, time of ascent, time of descent, time of flight, horizontal range and maximum range of a projectile in oblique projection (angle with horizontal direction).

a. Oblique Projection: The projection of a body at an angle with the horizontal direction is called "Oblique Projection".

Explanation: Let a body be projected obliquely with a velocity u from point O at an angle θ with the horizontal. The body moves the path OAB and falls on the ground at distance OB from point projection O. The initial velocity u is resolved into two mutually perpendicular components. The horizontal component is ucosθ and vertical component is usinθ. A is the highest point in the path of the projectile.



Maximum Height: The maximum vertical displacement of the body projected obliquely is called "Maximum Height".

We know that

Initial velocity	$u = u\sin\theta$
Acceleration	$a = -g$
Final velocity	$v = 0$
Maximum height	$S = H$ (say)

Substituting the above values in the equation

$$v^2 - u^2 = 2aS$$

$$0^2 - (u\sin\theta)^2 = 2(-g)H$$

$$-u^2\sin^2\theta = -2gH$$

$$\text{Maximum height} \quad H = \frac{u^2\sin^2\theta}{2g}$$

Time of Ascent: The time taken by an obliquely projected body to reach the maximum height is called "Time of Ascent".

We know that

$$u = u\sin\theta, \quad a = -g, \quad v = 0, \quad t = t_1 \text{ (say)}$$

Substituting the above values in the equation

$$v = u + at$$

$$0 = u\sin\theta - gt_1$$

$$gt_1 = u\sin\theta$$

$$\text{Time of Ascent} \quad t_1 = \frac{u\sin\theta}{g}$$

Time of Descent: The time taken by an obliquely projected body to fall on ground from the maximum height is called "Time of Descent".

We know that

$$u = 0, \quad a = +g, \quad S = H = \frac{u^2\sin^2\theta}{2g}, \quad t = t_2 \text{ (say)}$$

Substituting the above values in the equation

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

$$\frac{u^2\sin^2\theta}{2g} = (0)\,t_2 + \frac{1}{2}gt_2^2$$

$$\frac{u^2\sin^2\theta}{2g} = \frac{1}{2}gt_2^2$$

$$t_2^2 = \frac{u^2\sin^2\theta}{g^2}$$

$$\text{Time of Descent} \quad t_2 = \frac{u\sin\theta}{g}$$

Time of Flight: The time interval between the time of the projection and the time of striking ground is called "Time of Flight".

Time of flight = Time of ascent + Time of descent

$$T = t_1 + t_2$$

$$T = \frac{u\sin\theta}{g} + \frac{u\sin\theta}{g}$$

$$\text{Time of Flight } T = \frac{2u\sin\theta}{g}$$

Horizontal Range: The horizontal displacement of the projectile during the time flight is called "Horizontal Range".

we know that

Horizontal component of velocity = $u\cos\theta$

and time of flight $T = \frac{2u\sin\theta}{g}$

Range = Horizontal component of velocity x Time of flight

$$R = u\cos\theta \times \frac{2u\sin\theta}{g}$$

$$R = \frac{u^2 2\sin\theta\cos\theta}{g}$$

$$\text{Horizontal Range } R = \frac{u^2\sin2\theta}{g}$$

Maximum Range: The range of a projectile is maximum is called "Maximum Range".

The horizontal range in oblique projection is given by $R = \frac{u^2\sin2\theta}{g}$ where u is the velocity of projection and θ is the angle of projection.

when the value of sin2θ is maximum.

The maximum value of sin2θ = 1

$$\sin2\theta = \sin90^0$$

$$2\theta = 90^0$$

$$\theta = 45^0$$

Hence the range of a projectile is maximum when it is projected at an angle 45^0 to the horizontal. $R = \frac{u^2\sin2\theta}{g}$ [$\theta=45^0 \Rightarrow \sin2\theta \Rightarrow \sin2(45^0) \Rightarrow \sin 90^0 \Rightarrow 1$]

$$\text{Maximum Range } R = \frac{u^2}{g}$$

9. Define projectile and write the examples.

a. Projectile: A body projected into air with some velocity at an angle other than 90^0 with the horizontal, which moves in a two dimensional plance only under gravitational field of earth is called projectile.

The projectile motions are two types : i) Horizontal projection

ii) Oblique projection

Examples:

- A bullet fired from a gun.
- A javelin thrown by an athlete.
- A stone thrown by the catapult.
- A cricket ball thrown by a fielder.

(At which point on its path a projectile has the lowest speed ?

The speed of projectile is minimum (lowest) at the maximum height because the vertical component is zero at the maximum height)

WORK, POWER & ENERGY

1. Define work, power and energy. Write its units and dimensional formula.

a. <u>Work</u>: Work is said to be done when a force displaces a body.

Work = Force x displacement

W = F x S

Or W = FScosθ (When angular case)

Units: The SI units of work is "**Joule**"

Dimensional formula: Work = Force x displacement

$= M^1L^1T^{-2} \times L$

The dimensional formula of Work = $\mathbf{M^1L^2T^{-2}}$

<u>Power</u>: The amount of work done in a unit time is called power.

$$\text{Power} = \frac{\text{work done}}{\text{time}}$$

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

Units: The SI units of power is "**Watt**"

Dimensional formula: $\text{Power} = \frac{\text{work done}}{\text{time}}$

$$= \frac{M^1L^2T^{-2}}{T}$$

The dimensional formula of Power = $\mathbf{M^1L^2T^{-3}}$

<u>Energy</u>: The capacity to do work is called energy.

The energy is measured in terms of work done, its units and dimensional formula are same of as that of work.

Units: The SI units of energy is "**Joule**"

Dimensional formula:

The dimensional formula of Energy = $\mathbf{M^1L^2T^{-2}}$

2. Define potential energy. Write its units and dimensional formula and give the examples.

a. Definition: The energy possessed by a body by virtue of its position is called "potential energy". The energy is measured in terms of work done, its units and dimensional formula are same of as that of work.

Units: The SI units of potential energy is "**Joule**"

Dimensional formula:

The dimensional formula of potential Energy = $M^1L^2T^{-2}$

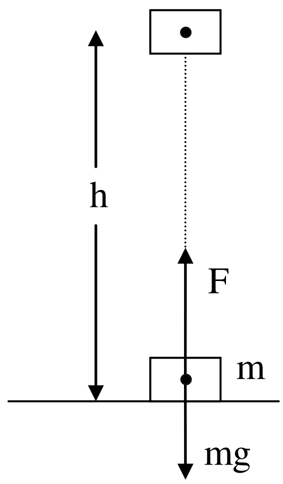
Examples:

- A body at a height above the ground possess potential energy.
- A compressed spring possess potential energy.
- A stretched rubber possess potential energy.

3. Define potential energy (P.E). Derive expression for potential energy.

a. Definition: The energy possessed by a body by virtue of its position is called "potential energy".

Expression for Potential Energy: Consider a body of mass 'm' on the ground. Its weight 'mg' acts in the vertically downward direction. To lift this body a minimum force that is equal to its weight should be applied in the vertically upward direction. If this force displaces the body to a height 'h' , then some work is done against force of gravity.



The Work done = Force x displacement

= F x h

= mgh (where F= mg)

The work done by the force is converted into potential energy of the body.

The Potential Energy **P.E = mgh**

4. Define kinetic energy. Write its units and dimensional formula and give the examples.

a. Definition: The energy possessed by a body by virtue of its motion is called "kinetic energy". The energy is measured in terms of work done, its units and dimensional formula are same of as that of work.

Units: The SI units of kinetic energy is "**Joule**"

Dimensional formula:

The dimensional formula of kinetic Energy = $M^1L^2T^{-2}$

Examples:

- Running a man possess kinetic energy.
- Moving car possess kinetic energy.
- Blowing wind posses kinetic energy.
- Flowing water posses kinetic energy.

5. Define kinetic energy (K.E). Derive expression for kinetic energy.

a. Definition: The energy possessed by a body by virtue of its motion is called "kinetic energy".

Expression for Kinetic Energy: Consider a body of mass 'm' which is at rest. Suppose that a constant force 'F' acts on the body and moves it through a distance 'S'. Let the velocity of the body after travelling a distance S be 'v'.

Initial velocity	$u = 0$
Final velocity	$v = v$
Distance travelled	$S = S$
Acceleration	$a = ?$

Substituting the above values in the equation

$$v^2 - u^2 = 2aS$$

$$v^2 - 0^2 = 2aS$$

acceleration of the body $a = \frac{v^2}{2S}$

Force acting on the body F = mass x acceleration

$$= m \times \frac{v^2}{2S}$$

$$= \frac{mv^2}{2S}$$

The Work done = Force x displacement

$$= \frac{mv^2}{2S} \times S$$

$$= \frac{1}{2} mv^2$$

The work done by the force is converted into kinetic energy of the body.

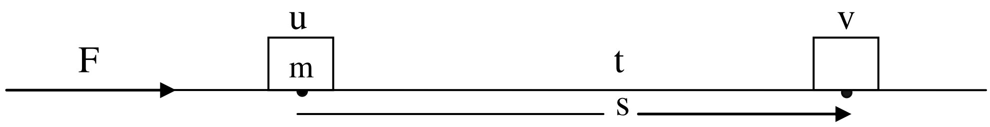
The Kinetic Energy $\mathbf{K.E = \frac{1}{2} mv^2}$

6. State and prove work – energy theorem.

a. Statement: The work done on a body is equal to the change in kinetic energy of the body.

Proof: Consider a body of mass 'm' moving with uniform velocity 'u'. Suppose that a constant force 'F' acts on the body for a time 't' and changes its velocity to 'v'.

Let 'a' be the acceleration produced and 'S' be the displacement during this time.



$$v^2 - u^2 = 2aS$$

Acceleration of the body $a = \frac{v^2-u^2}{2S}$

Force acting on the body F = mass x acceleration

$$F = m\left(\frac{v^2-u^2}{2S}\right)$$

Work done on the body W = Force on the body x displacement

$$W = F \times S$$

$$= m\left(\frac{v^2-u^2}{2S}\right) \times S$$

$$= \frac{1}{2} m\,(v^2 - u^2)$$

$$= \frac{1}{2}mv^2 - \frac{1}{2}mu^2$$

= Final kinetic energy – initial kinetic energy

Work done = change in kinetic energy

Hence, work – energy theorem is verified.

7. Derive the relation between kinetic energy and momentum.

a. Relation between Kinetic Energy and Momentum:

The momentum of a body is defined as the product of its mass and velocity.

If 'm' is the mass and 'v' is velocity of a body,
Then its momentum p = mv --------------------- (i)

The kinetic energy of this body is KE $= \frac{1}{2}mv^2$

$$= \frac{1}{2}mv^2 \times \frac{m}{m}$$

$$= \frac{m^2v^2}{2m} \qquad \text{(from equation (i) } p = mv\text{)}$$

$$KE = \frac{p^2}{2m}$$

8. State and prove the law of conservation of energy in the case of a freely falling body.

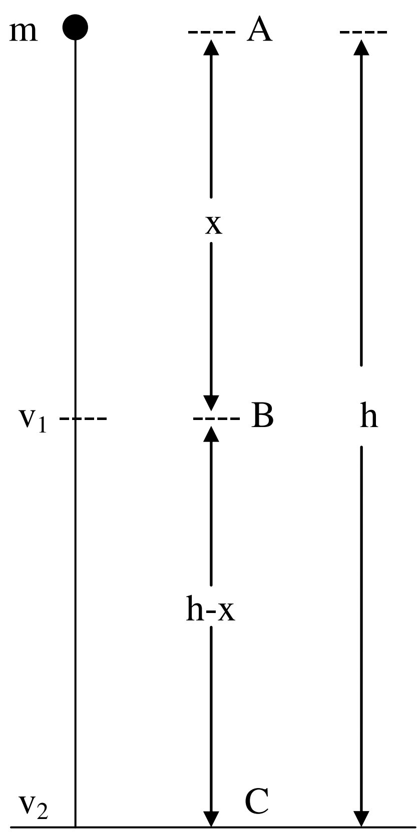
a. Statement: The total energy of a closed system is constant. Energy can neither be created nor destroyed but one form of it can be converted into other.

Law of conservation of energy in the case of a freely falling body:

When a body is allowed to fall freely from a certain height, its potential energy (PE) is gradually converted into kinetic energy (KE) and its total energy (TE) remains constant.

At position A:

Consider a body of mass 'm' at A at a height h above the ground.



Height of the body = h

PE of the body = mgh

The velocity of the body v = 0

KE of the body $= \frac{1}{2}m(0)^2 \Rightarrow 0$

Total energy of the body TE = PE + KE

= mgh + 0

= **mgh**

At position B:

Now suppose that the body is dropped freely. Consider a point B in its path after travelling a distance 'x' where its velocity is v_1.

Height of the body = h-x

PE of the body = mg(h-x)

Initial velocity of the body u = 0

Final velocity at B $v = v_1$

Acceleration a = g

Distance travelled s = x

Using the equation $v^2 - u^2 = 2as$

We get $v_1^2 - 0^2 = 2gx$

$v_1^2 = 2gx$

KE of the body $= \frac{1}{2}mv_1^2 \Rightarrow \frac{1}{2}m(2gx)$

= mgx

Total energy of the body TE = PE + KE

= mg(h-x) + mgx

= mgh – mgx + mgx

= **mgh**

At position C:

Consider a point C, where the body strikes the ground with a velocity v_2

Height of the body = 0

PE of the body = mg(0) => 0

Initial velocity of the body $u = 0$

Final velocity at C $v = v_2$

Acceleration $a = g$

Distance travelled $s = h$

Using the equation $v^2 - u^2 = 2as$

We get $v_2^2 - 0^2 = 2gh$

$v_2^2 = 2gh$

KE of the body $= \frac{1}{2}mv_2^2 \Rightarrow \frac{1}{2}m(2gh)$

= mgh

Total energy of the body TE = PE + KE

= 0 + mgh

= mgh

= **mgh**

Conclusion: The total energy of the body of the freely falling body at positions A, B and C in its path is constant and equal to mgh. Hence, the law of conservation of energy is proved in the case of a freely falling body.

9. State law of conservation of energy and write the examples

a. Statement: The total energy of a closed system is constant. Energy can neither be created nor destroyed but one form of it can be converted into other.

Examples:

- In a dam, PE changes to KE.
- In a motor, electrical energy converts into mechanical energy.
- In a electric bulb, electrical energy converts into heat and light energies.
- In a dynamo, mechanical energy converts into electrical energy.

HEAT & THERMODYNAMICS

1. State and explain the gas laws (OR) State and explain Boyle's law and Charles law.

a. Boyle's law:

Statement: At constant temperature, the volume of a given mass of gas is inversely proportional to its pressure.

Explanation: If the volume of a given mass of gas increases, its pressure decreases

And if the volume of a given mass of gas decreases, its pressure increases.

If V is the volume and P is the pressure, then

$$V \alpha \frac{1}{P}$$

$$V = K \cdot \frac{1}{P}$$

$$PV = K$$

$$P_1V_1 = P_2V_2 = P_3V_3 = K \text{ (constant)}$$

[**Boyle's law in terms of Density:** At constant temperature, the pressure of a given mass of gas is directly proportional to its density. => $P \alpha d$ => $\frac{P_1}{d_1} = \frac{P_2}{d_2} = \frac{P_3}{d_3} = K$ (constant)]

Charles First law (At Constant Pressure):

Statement: At constant pressure, the volume of a given mass of gas is directly proportional to its absolute temperature.

Explanation: If the volume of a given mass of gas increases, its absolute temperature increases

And if the volume of a given mass of gas decreases, its absolute temperature decreases.

If V is the volume and T is the absolute temperature, then

$$V \alpha T$$

$$\frac{V}{T} = K$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} = \frac{V_3}{T_3} = K \text{ (constant)}$$

Charles Second law (At Constant Volume):

Statement: At constant volume, the pressure of a given mass of gas is directly proportional to its absolute temperature.

Explanation: If the pressure of a given mass of gas increases, its absolute temperature increases

And if the pressure of a given mass of gas decreases, its absolute temperature decreases.

If P is the pressure and T is the absolute temperature, then

$$P \alpha T$$

$$\frac{P}{T} = K$$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} = \frac{P_3}{T_3} = K \text{ (constant)}$$

2. Define absolute zero and absolute scale of temperature. (OR)

Write the relation between absolute temperature and centigrade temperature.

a. Absolute zero: The temperature (-273^0C or 0 K) at which the pressure and volume of a given mass of gas becomes zero is called "**Absolute zero**".

Absolute zero temperature = -273^0C =0 K

Absolute scale: A new scale of temperature was established by taking absolute zero as the starting value. This scale is called "**Absolute scale or Kelvin scale**".

The relation between Kelvin scale and Centigrade scale can be established as,

Temperature on Kelvin scale = Temperature on Centigrade scale + 273.

3. Define Ideal gas and derive ideal gas equation (OR) Derive gas equation PV=RT.

a. Ideal Gas: A gas which obeys Boyle's law and Charles law at all temperatures and pressures is called an "**Ideal Gas**".

Derivation of Ideal gas equation: Consider a certain amount of perfect gas in an enclosure having pressure P, volume V at absolute temperature T.

According to Boyle's law at constant temperature, the volume of a given mass of gas is inversely proportional to its pressure.

$$V \ \alpha \ \frac{1}{P} \text{ -----------(i)}$$

According to Charles law at constant pressure, the volume of a given mass of gas is directly proportional to its absolute temperature.

$$V \ \alpha \ T \text{ -----------(ii)}$$

Combining the relations (i) and (ii), we get

$$V \ \alpha \ \frac{T}{P}$$

$$V = (\text{constant}) \frac{T}{P}$$

$$\frac{PV}{T} = \text{constant}$$

This constant is represented by R if one gram mole of gas is considered at NTP, and is known as "Universal gas constant".

$$\frac{PV}{T} = R$$

$$\mathbf{PV = RT}$$

This equation is called Ideal gas equation or Universal gas equation.

If the mass of the gas has 'n' moles then ideal gas equation becomes **PV = nRT**

4. Write the difference (distinguish) between specific gas constant (or) gas constant(r) and universal gas constant(R). (OR) Write the Difference between r and R. (OR) Explain gas constant and universal gas constant.

a.

Specific Gas Constant (or) Gas Constant (r)	Universal Gas Constant (R)
1. It is the value of $r = \frac{PV}{T}$, when the volume of 1 gram of gas is considered at NTP.	1. It is the value of $R = \frac{PV}{T}$, when the volume of 1 gram mole of gas is considered at NTP.
2. Its value is not constant from gas to gas.	2. Its value is constant from gas to gas. The constant value R= 8.31 J mol^{-1} K^{-1}
3. It depends on the gram weight of the gas.	3. It depends on the gram mole weight of the gas.
4. Its SI unit is J kg^{-1} K^{-1}.	4. Its SI unit is J mol^{-1} K^{-1}.
5. Its dimensional formula is $M^0L^2T^{-2}K^{-1}$	5. Its dimensional formula is $M^1L^2T^{-2}K^{-1}$

5. Difference (distinguish) between isothermal and adiabatic process. (OR) Explain isothermal and adiabatic process.

a.

Isothermal Process	Adiabatic Process
1. In this process pressure and volume changes and temperature of the gas remains constant.	1. In this process pressure, volume and temperature of the gas changes.
2. This process should be conducted in a good conducting vessel.	2. This process should be conducted in a non-conducting vessel.
3. Exchange of heat takes place between gas and surroundings.	3. Exchange of heat is not permitted between gas and surroundings.
4. The internal energy of the gas is constant.	4. The internal energy of the gas is changes.
5. It is a slow process.	5. It is a quick process.
6. Since temperature remains constant in isothermal process, the Boyle's law PV= Constant can be applied.	6. Since temperature is changing in adiabatic process, the Boyle's law PV= Constant cannot be applied.

6. **State first law and second law of thermodynamics (OR)**

   Explain laws of thermodynamics.

a. **<u>First law of thermodynamics:</u>**

Statement: The heat energy supplied to a system is equal to the sum of the increase in internal energy of the system and the external work done by the system.

Explanation: If dQ is the amount of heat energy supplied to the system, dU is the increase in internal energy and dW is the external work by the system, then

$$dQ = dU + dW$$

Examples: Working diesel, petrol and steam engines is based on this law.

<u>Second law of thermodynamics:</u>

Statement: Heat by itself cannot transmit from a body at lower temperature to a body at higher temperature without using the external energy.

Explanation: Heat flows from higher temperature to lower temperature. It cannot flow from lower temperature to higher temperature. By using an external agency like air conditioner we can transfer heat energy lower temperature to higher temperature.

Examples: Working of refrigerators and cold storage units is based on this law.

7. **What is specific heat of substance, define specific heats and molar specific heats of gas**

a. **Specific heat of substance:** The amount of heat required to raise the temperature of unit mass of the substance through 1^0C.

Specific heats of gas:

Specific heat of gas at constant pressure (C_p): The amount of heat required to raise the temperature of 1gram of the gas through 1^0C at constant pressure.

Specific heat of gas at constant volume (C_v): The amount of heat required to raise the temperature of 1gram of the gas through 1^0C at constant volume.

Molar Specific heats of gas:

Molar Specific heat of gas at constant pressure (C_p): The amount of heat required to raise the temperature of 1gram mole of the gas through 1^0C at constant pressure.

Molar Specific heat of gas at constant volume (C_v): The amount of heat required to raise the temperature of 1gram mole of the gas through 1^0C at constant volume.

8. Difference (distinguish) between C_p and C_v (OR)

Difference between specific heat at constant pressure & specific heat at constant volume.

a.

Specific Heat at Constant Pressure (C_p)	Specific Heat at Constant Volume (C_v)
1. The amount of heat required to raise the temperature of 1gram of the gas through 1^0C at constant pressure.	1. The amount of heat required to raise the temperature of 1gram of the gas through 1^0C at constant volume.
2. The heat supplied is partly utilised to increase in internal energy of gas and partly to do external work.	2. The heat supplied is utilised only to increase in internal energy of gas.
3. $C_p > C_v$	3. $C_v < C_p$
4. $C_p = C_v$ + External work W.	4. External work done by the gas is zero.

9. Explain why C_p is grater than C_v

a. C_p is grater than C_v ($C_p > C_v$) :

When a gas is heated at constant volume, the heat C_v supplied to it is utilised only to increase the internal energy of the gas.

But when the gas is heated at constant pressure, the heat C_p supplied to it is utilised for two purposes.

- For increasing the internal energy of the gas and
- To do the external work in expansion to keep the pressure constant.

For the same raise in temperature, more heat is to be supplied to the gas at constant pressure than at constant volume. Therefore C_p is always greater than C_v.

10. Derive gas equation in terms of density. (OR)

Derive the relation between universal gas constant and density.

a. From the gas equation, we have the relation $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ for a given mass of gas.

Let M be the mass of the gas let d_1 and d_2 be the densities of the gas corresponding to the volumes V_1 and V_2 respectively. Then $V_1 = \frac{M}{d_1}$ and $V_2 = \frac{M}{d_2}$

Substituting the values V_1 and V_2 i.e., $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \Rightarrow \frac{P_1M}{d_1T_1} = \frac{P_2M}{d_2T_2}$

$$\frac{P_1}{d_1T_1} = \frac{P_2}{d_2T_2}$$

This is the gas equation in terms of density.

11. Derive the equation C_p - C_v = R (OR) Derive the Mayer's equation (OR) Obtain the relation between molar specific heats of gas. (OR) For an ideal gas, Show that the difference of molar specific heat is equal to the universal gas constant.

a. Derivation of $C_p - C_v = R$: Consider one gram mole of an ideal gas pressure P, volume V and absolute temperature T.

For 1^0 rise in temperature, C_p is greater than C_v by and amount equal to the external work by done by gas.

$$C_p - C_v = W$$

Suppose that the gas is heated at constant pressure P to raise the temperature by dT. Let the increase in volume by dV. Then the external work by done by the gas W = PdV

$$C_p - C_v = PdV$$

The heats absorbed by the gas at constant pressure and constant volume for dT rise in temperature are $C_p dT$ and $C_v dT$ respectively.

$$C_p dT - C_v dT = PdV$$

$$(C_p - C_v)dT = PdV$$

For an ideal gas $PV = RT$

$PdV = RdT$ (dV is the increase in volume for dT rise in temperature)

$$(C_p - C_v)dT = RdT$$

$$C_p - C_v = R$$

This relation also known as Mayer's equation.

SOUND

SOUND: Sound is one of the forms of energy which stimulates the sense of hearing.

1. Define wave and wave motion? Write the two types of wave motions with examples?

a. Wave: The disturbance created in a medium by the repeated periodic motion of the particles of the medium is called "wave".

Wave motion: the transportation of the disturbance from one place to another place in the medium is called "wave motion".

Wave motion is two types:

i) Longitudinal Wave Motion:

- Particles of the medium vibrate parallel to the direction of propagation of the wave
- The wave travels in the form of the compressions and rarefactions.
- **Ex:** Sound wave in air.

ii) Transverse Wave Motion:

- Particles of the medium vibrate perpendicular to the direction of propagation of the wave
- The wave travels in the form of the crests and troughs.
- **Ex:** Water wave.

2. Write the difference between Musical sound and Noise?

a.

Musical Sound	Noise
1. A sound is pleasant to hear is called "musical sound".	1. A sound is unpleasant to hear is called "noise".
2. The wave nature is regular.	2. The wave nature is irregular.
3. Vibrations of the particles of the medium are regular.	3. Vibrations of the particles of the medium are irregular.
4. There will be no sudden change in amplitude.	4. There will be sudden change in amplitude.
5. The pitch and loudness are within the specified limits.	5. The pitch and loudness are the no specified limits.
6. Ex: Sound from musical instruments like Veena , Guitar, Harmonium, etc.,	6. Sound from Thunders, Crackers, Ticks of clock, etc.,

3. Define Noise Pollution? Explain causes of noise pollution, Explain effects of noise pollution, and Explain methods of minimizing (reducing) noise pollution.

a. Noise Pollution: The pollution of the environment due to spreading of noise, which interferes with human communication, comfort and health is called “Noise pollution”.

The S.I unit of noise is **decibel** and it’s symbol is **dB.**

Causes of Noise Pollution:

1. The noise produced by thunders, barking of dogs and sounds from birds and animals.
2. The noise produced by shouting of people in public gatherings.
3. The noise produced by televisions, stereos and radios.
4. The noise from loud speakers.
5. The noise produced by crackers during festivals and functions.
6. The noise from cinema theatres, schools, and offices.
7. The noise produced by horns of the vehicles.
8. The noise produced by power generators, air conditioners and vacuum cleaners.

Effects of Noise Pollution:

1. Noise pollution effects human health, comfort and efficiency.
2. It causes impatience and mental disorder.
3. It causes headache and increase in blood pressure.
4. It causes sleeplessness and nervous breakdown.
5. It causes temporary deafness if the noise is very loud it may cause permanent deafness.
6. It causes heart, liver and kidney problems.
7. Noise due to sudden explosives may cause cracks in walls and doors of buildings.
8. Noise like resonance may collapse buildings and bridges.

Methods of Minimizing (Reducing) or Controlling Noise Pollution:

1. The people must be educated about the control of noise pollution.
2. Televisions, record players and stereos should be played with low sound level.
3. Loud speakers should be use with in limited sound level.
4. Crackers and musical entertainment systems should be used limited period in functions.
5. Unnecessary blowing of horns should be avoided.
6. Proper plantation must be done along streets and industrial areas to absorb the noise.
7. ‘Noise free zones’ should be maintained near schools and hospitals.
8. In factories noise creating machinery should be covered with insulating material.

4. Explain the phenomenon of beats? Write the applications of beats.

a. Definition: The periodic increase and decrease of loudness of sound when two sounds of nearly equal frequencies interfere with each other is called the **"phenomenon of beats"**.

Explanation: When two sounding bodies of nearly equal frequency and amplitude are sounded together, the loudness of resultant sound increases and decreases alternatively. One increase and one decrease in loudness is called one beat. If n_1 and n_2 are the frequencies of the sounds that produce beats, then the number of beats heard per second is given by

$$n = n_1 \sim n_2$$

Applications of beats:

1. Beats are used in tuning musical instruments.
2. Beats are used to produce tremulous effects in cine films.
3. Beats are used to detect dangerous gases in mines.
4. Beats are used to determine the frequency of the tuning fork.
5. Beats are used for tuning of radio sets.
6. A unknown frequency of a note can be determined.

5. What is Doppler effect ? Write the applications of Doppler effect .

a. Doppler Effect: The apparent change in frequency of sound due to relative motion between source and observer is called "Doppler effect"

Example:

The frequency produced by moving train, increases when it reaches the observer at rest on platform and decrease when it passes away.

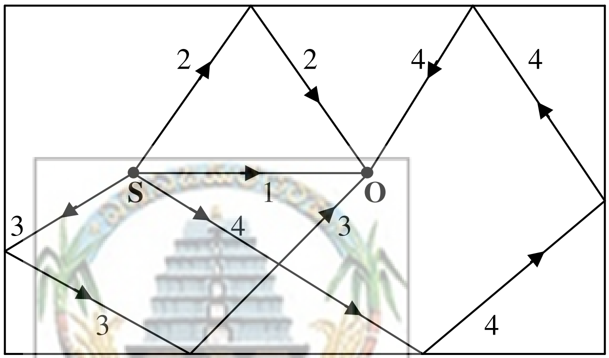
Applications of Doppler Effect:

1. Calculate the speed and direction of motion of submarines.
2. Measure radial speed of satellites.
3. Double stars were discovered using Doppler effect.
4. Saturn's rings were discovered using Doppler effect.
5. Find the velocity of approaching and receding stars.

6. Explain the term reverberation and reverberation time?

a. Reverberation: The persistence of audible sound even after the source has stopped emitting sound is called **"reverberation".**

Explanation: Consider a closed hall. Let **S** be the source of sound and **O** be the observer. Sound produced once by the source travels from S and O by various path due to multiple reflection at walls, ceiling, floor, etc., as shown in figure. Distance travelled by the sound through different path is different. Therefore the sounds reaches the observer one after another.



The observer first listens the direct sound travelled along **path-1**, with maximum loudness. The observer listens the same sound again with diminished loudness because of the sound travelled along **path-2**. In path 2 sound is reflected once at the wall where some sound energy is absorbed by the wall. Hence the loudness decreases. Again the observer listens the same sound with more diminished loudness because of the sound travelled along **path-3** which reflected twice at the walls. Next sound travelled along **path-4,** which reflected thrice at the walls reaches the observer. In this way observer listens the same sound repeatedly with diminishing loudness.

Reverberation Time: The duration of time for which the reverberation exists in a hall is called "**reverberation time".** The reverberation time should neither be too large nor too small. If the reverberation time is too large the clarity of the speech will be lost. If it is too small, there will be no sufficient loudness in the hall.

7. Write Sabine's formula (or) State Sabine's formula for reverberation time?

a. Sabine's formula:

Sabine's formula for reverberation time is given by

$$T = \frac{0.165V}{\sum as}$$

Where T = Reverberation time

V = Volume of the hall

a = Absorption coefficient of a surface

s = Surface area of the surface that absorbs sound.

"$\sum as$" is the total sound energy absorbed by various surfaces in the hall.

$$\sum as = a_1s_1 + a_2s_2 + a_3s_3 + \ldots\ldots.$$

8. Define echo. Write the applications and methods of minimize echos ?

a. Echo: The sound that is repeated once after the original sound due to reflection at large obstacles is called "echo"

Ex: Echo will be heard when a wood cutter hits the tree with axe.

Applications of echos:

1. The depth of seas and oceans can be determined.
2. The position and distance of motion of submarines can be determined.
3. The position and distance of enemy aircraft can be determined.
4. Echo technique is used to identify stone in kidneys.

Methods of minimize echos:

1. Providing good sound absorbing materials.
2. Providing a large number of doors and windows.
3. Constructing rough walls.
4. Having polished and low ceilings.

9. State the conditions of good auditorium ?

a. Conditions of good auditorium:

1. The loudness of sound should be uniform in the entire hall.
2. The reverberation time should be optimum. It should neither be too low nor too high.
3. There should be no echo in the hall.
4. Outside noise should not enter into the hall.
5. There should be no resonance effect in the auditorium.
6. There should not be any focussing effect of sound at any place in the hall.
7. There should not be any air-borne noise.

ELECTRICITY AND MAGNETISM

1. **Define following terms: A)Resistance B)Resistivity C)Conductance D)Conductivity**

a. **A) Resistance:** Electrical resistance is the property of a conductor that opposes the flow of electricity through it.

The ratio between potential difference (V) and current (I).

formula: $R = \frac{V}{I}$, SI unit: ohm (Ω)

B) Resistivity (or) Specific resistance: The electrical resistance offered by unit length and unit area of cross section of a conductor is called Specific resistance (or) Resistivity.

formula: $\rho = \frac{RA}{l}$, SI unit: ohm metre (Ωm)

C) Conductance: The reciprocal of resistance of a conductor is called conductance.

formula: $G = \frac{1}{R} \Rightarrow \frac{I}{V}$, SI unit: mho or ohm^{-1}

D) Conductivity (or) Specific conductance: The reciprocal of resistivity of a conductor is called conductivity (or) specific conductance.

formula: $\sigma = \frac{1}{\rho} \Rightarrow \frac{l}{RA}$, SI unit: mho $metre^{-1}$ or ohm^{-1} $metre^{-1}$

2. **State and explain Ohm's law.**

a. **Ohms law:** At constant temperature the current flowing through a conductor is directly proportional to the potential difference between its ends.

Explanation:

If a current 'i' passes through the conductor due to the potential difference V, then

$$V \propto i$$

$$V = Ri$$

Where R is the proportionality constant and is known as electrical resistance of the conductor. $\therefore V = iR$

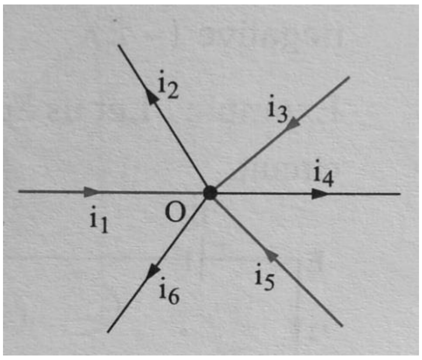
3. **State and explain Kirchoff's laws (or) Explain kirchoff's first law and second law.**

a. **Kirchoff's first law (Kirchoff's current law):**

The sum of the electric currents flowing towards the junction in a circuit is equal to the sum of electric currents flowing out of the junction.

(or) the algebraic sum of currents meeting at junction is zero.

Consider a junction 'O' and suppose that the currents i_1 , i_3 and i_5 are entering it and the currents i_2 , i_4 and i_6 are leaving it as shown in the figure. The sum of the currents entering the junction is $i_1+i_3+i_5$ and the sum of the currents leaving the junction is $i_2+i_4+i_6$



Sum of currents entering into a junction = Sum of currents leaving form the junction.

Therefore, $i_1 + i_3 + i_5 = i_2 + i_4 + i_6$

$$i_1 - i_2 + i_3 - i_4 + i_5 - i_6 = 0$$

$$\therefore \sum i = 0$$

Kirchoff's second law (Kirchoff's voltage law):

In a closed circuit, the algebraic sum of the products of the current and resistance of each part of the circuit is equal to the algebraic sum of the electromotive forces acting in the loop. Thus the algebraic sum of the potential differences around any closed loop is zero

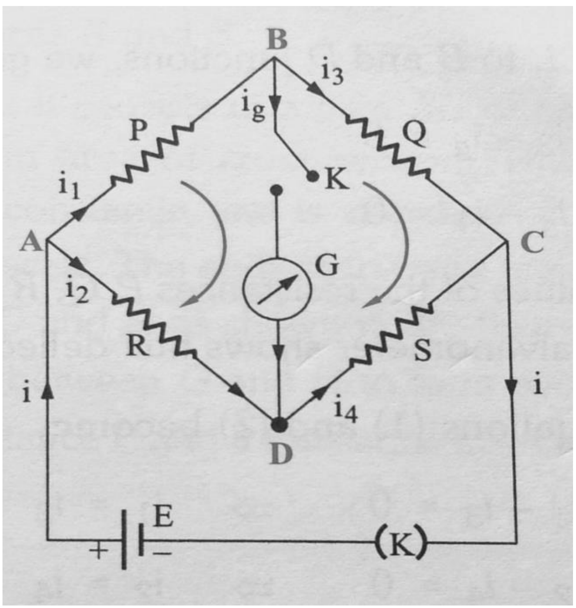
$$\therefore \sum iR - \sum E = 0$$

Or $$\sum V = 0$$

4. State and explain Wheatstone's bridge (or) expression the balancing condition of wheatstone's bridge from kirchoff's laws.

a. Wheatstone bridge:

The bridge consists of four resistances P,Q,R and S which are connected so as to form a quadrilateral ABCD as shown in the figure. The junctions A and C are joined to the terminals of a cell. The other pair of junctions B and D are connected to a galvanometer through the key K.



Balancing of whetstone's bridge based on Kirchhoff's law:

The current i flowing from battery, splits at the junction A and flows as i_1 in AB and as i_2 in AD. At the junction B, i_1 splits up and flows as i_g in BD and as i_3 in BC. At D, i_2 and i_g meet and flow as i_4 in DC . At C, i_3 and i_4 meet and flow as i towards E.

Applying Kirchhoff's current law to B and D junctions, we get

$i_1 - i_3 - i_g = 0$ -----------(1)

$i_2 + i_g - i_4 = 0$ ----------- (2)

When the values of the resistances P, Q, R and S are adjusted so that the galvanometer shows null deflection, then $i_g = 0$

Then the equations (1) and (2) becomes

$i_1 - i_3 = 0 \Rightarrow i_1 = i_3$ -------(3)

$i_2 - i_4 = 0 \Rightarrow i_2 = i_4$ -------(4)

Applying voltage law to the closed loops ABDA and BCDB we get

$i_1P + i_gG - i_2R = 0$--------- (5)

$i_3Q - i_4S - i_gG = 0$ ----------(6)

When the bridge balanced $i_g = 0$

Then the equations (5) and (6) becomes

$i_1P - i_2R = 0 \Rightarrow i_1P = i_2R$ ------- (7)

$i_3Q - i_4S = 0 \Rightarrow i_3Q = i_4S$ ------- (8)

$i_1Q = i_2S$ ------- (9) ($\because i_1 = i_3$ and $i_2 = i_4$)

Dividing equation (7) by equation (9) we get

$$\frac{i_1 P}{i_1 Q} = \frac{i_2 R}{i_2 S}$$

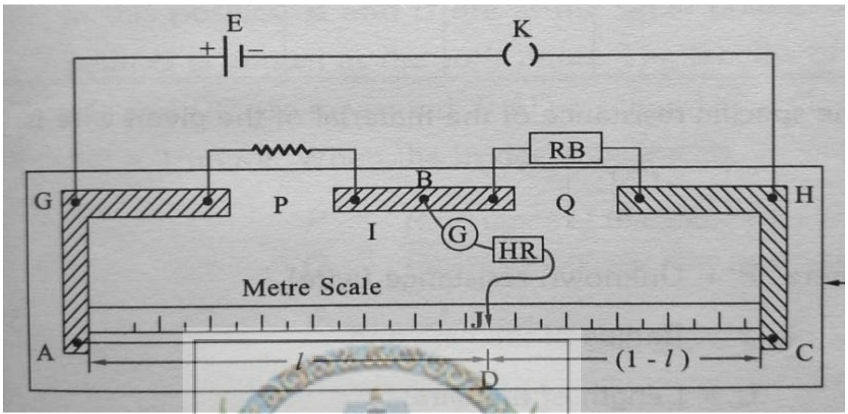
$$\frac{P}{Q} = \frac{R}{S}$$

This is the condition for balancing of whetstone's bridge

5. State and explain Metre bridge (or) determine the specific resistance (unknown resistance) by using metre bridge (or) expression the balancing condition of metre bridge.

a. Metre bridge: Meter bridge is a simple instrument used for the measurement of small resistances. It works on the principle of Wheatstone's bridge and has a uniform wire of one metre length in place of the resistances R and S.

Construction:



In consists of a wire AC of one metre in length and of uniform area of cross-section. The wire is stretched on a wooden board along a metre scale. The ends of the wire are connected to thick copper strips G and H as shown in the figure. Another metallic strip I is fixed between G and H to form two gaps in which an unknown resistance P and the resistance box Q can be connected. A cell E is connected through a key K between the points A and C. The terminal B is joined to one end of the galvanometer whose other end is joined to a jockey J which slided along the wire AC.

Determine specific resistance for metre bridge: A known resistance Q is taken out from the resistance box. Sliding the jockey J along the length of the wire AC, a point D is obtained for which the galvanometer shows no deflection. The lengths of the wire AD and DC are measured. If AD = l then DC = (1 – l) since AC = 1 metre. When the bridge is balanced ,

$$\frac{P}{Q} = \frac{\text{Resistance of the wire of length AD}}{\text{Resistance of the wire of length DC}}$$

$$\frac{P}{Q} = \frac{l}{(1-l)}$$ (this the balancing condition for meter bridge)

$\therefore$ Unknown resistance $P = Q\frac{l}{(1-l)}$

Here Q is a known resistance, l can be measured and there by P can be calculated.

If L is the length of the wire P of unknown resistance and r is its radius, then

$\therefore$ Specific resistance $\rho = \frac{P\pi r^2}{L}$

6. Define following terms: A) Magnetic field B) Magnetic lines of force C) Magnetic moment D) Magnetic induction field strength

a. A) Magnetic field: The region around a magnet in which magnetic properties can be detected is called the magnetic field.

(Uniform magnetic field: The magnetic field in which all the magnetic lines of force are in one direction and equally spaced is known as uniform magnetic field.

Non-Uniform magnetic field: The magnetic field in which all the magnetic lines of force are in different directions and differently spaced is known as uniform magnetic field.)

B) Magnetic lines of force: The path in which a free unit north pole would move in a magnetic field is called magnetic lines of force.

Properties of Magnetic lines of force:

- The magnetic lines of force are closed curves
- Their direction is from north pole to south pole, outside the magnet
- Their direction is from south pole to north pole, inside the magnet
- The lines of force never cross each other

C) Magnetic moment (M): The magnetic moment M is calculated as the product of the pole strength (m) and magnetic length ($2l$).

formula: $M = m \times 2l$, SI unit: joule $tesla^{-1}$

D) Magnetic induction field strength (B): The force acting on a unit north pole at a point in the magnetic field is called the magnetic induction field strength.

According to Coulomb's inverse square law $F = \frac{\mu_0}{4\pi}\frac{m_1 m_2}{d^2}$

For a unit north pole, $m_1 = 1$, let the pole strength of the given magnet be $m_2 = m$.

$\therefore$ Magnetic induction field strength $= B = \frac{\mu_0}{4\pi}\frac{m}{d^2}$

SI unit: tesla (T) (1 tesla = 1 weber $metre^{-2}$) ; Dimensional formula: $M^1L^0T^{-2}I^{-1}$

7. State and explain Coulomb's inverse square law of magnetism.

a. Statement: "The force between two magnetic poles is directly proportional to the product of their pole strengths and inversely proportional to square of the distance between them."

Consider two poles of pole strengths m_1 and m_2 which are separated by a distance d. Then the force F between them is given by

$$F \propto m_1 m_2$$

$$\propto \frac{1}{d^2}$$

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

$$F = K\frac{m_1 m_2}{d^2} \quad \text{(Where K is constant)}$$

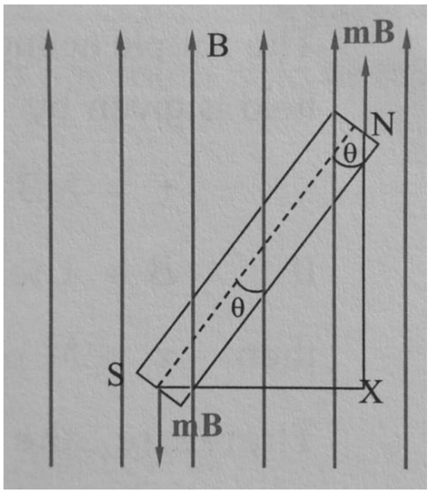
$$F = \frac{\mu}{4\pi}\frac{m_1 m_2}{d^2} \quad \left(K = \frac{\mu}{4\pi} \text{ where } \mu \text{ is the absolute permeability of the medium}\right)$$

or $$F = \frac{\mu_0}{4\pi}\frac{m_1 m_2}{d^2} \quad (\mu_0 \text{ is the absolute permeability of free space (air), } \mu_0 = 4\pi \times 10^{-7}\,\text{Hm}^{-1})$$

8. Derive the expression for the moment of couple on a bar magnet in a uniform magnetic field.

a. Moment of couple on a bar magnet in a uniform magnetic field:

Consider a bar magnet of pole strength 'm' and magnetic length '2l', placed in a uniform magnetic field 'B' at an angle θ with the direction of the field. Each pole of the magnet experiences a force equal to mB in opposite directions. Thus two equal and opposite forces acts on the magnet at its ends constituting a couple. This tries to rotate the magnet so as to align in the direction of the field.



Moment of couple on the bar magnet = force x perpendicular distance between the two forces.

$$\mathcal{T} = mB \times SX$$

$$= mB \times (NS)\sin\theta \quad (\because \sin\theta = \frac{SX}{NS})$$

$$= mB \times (2l)\sin\theta \quad (\because NS = 2l)$$

$$= MB\sin\theta \quad (\because m \times 2l = M)$$

$$\therefore \quad \mathcal{T} = MB\sin\theta$$

Therefore the moment of couple on the bar magnet depends on the angle between the magnetic field B and the axis of the bar magnet.

Case-1: when $\theta = 0$, $\mathcal{T} = MB\sin\theta$

$$= 0 \quad (\because \sin 0 = 0)$$

∴ When magnet is parallel to the direction of the field, the moment couple on the magnet is zero.

Case-2: when $\theta = 90$, $\mathcal{T} = MB\sin\theta$

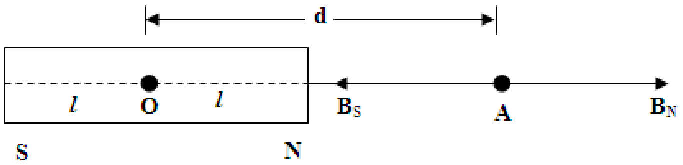
$$= MB \quad (\because \sin 90 = 1)$$

∴ When the magnet is perpendicular to the direction of the field, the moment on the magnet is maximum.

9. Derive an expression for the magnetic induction field strength at a point on the axial line of a bar magnet.

a. Magnetic induction field strength at a point on the axial line:

Axial line of a bar magnet is the line passing through both the poles of the magnet.



Consider a bar magnet of magnetic length '2*l*' and pole strength 'm'. Let 'A' be a point on the axial line at a distance 'd' from the centre 'O' of the magnet.

The magnetic induction B_N at A due to a north pole of the magnet, acting along NA is given by

$$B_N = \frac{\mu_o}{4\pi} \cdot \frac{m}{(NA)2}$$

$$B_N = \frac{\mu_o}{4\pi} \cdot \frac{m}{(d-l)^2} \qquad (\therefore NA = d-l)$$

The magnetic induction B_S at A due to the south pole of the magnet, acting along AS is given by

$$B_s = \frac{\mu_o}{4\pi} \cdot \frac{m}{(SA)2}$$

$$B_s = \frac{\mu_o}{4\pi} \cdot \frac{m}{(d+l)^2} \qquad (\therefore SA = d+l)$$

Therefore the resultant magnetic induction at A along NA is given by

$$B = B_N - B_S$$

$$= \frac{\mu_o}{4\pi} \cdot \frac{m}{(d-l)^2} - \frac{\mu_o}{4\pi} \cdot \frac{m}{(d+l)^2}$$

$$= \frac{\mu_o}{4\pi} m \left[\frac{1}{(d-l)^2} - \frac{1}{(d+l)^2} \right]$$

$$= \frac{\mu_o}{4\pi} m \left[\frac{(d+l)^2-(d-l)^2}{(d^2-l^2)^2} \right]$$

$$= \frac{\mu_o}{4\pi} \cdot \frac{m\,4dl}{(d^2-l^2)^2}$$

$$= \frac{\mu_o}{4\pi} \cdot \frac{m \times 2l \times 2d}{(d^2 - l^2)^2}$$

$$B = \frac{\mu_o}{4\pi} \cdot \frac{2Md}{(d^2 - l^2)^2} \qquad (\therefore m \times 2l = M)$$

Therefore the magnetic induction field strength at any point on the axial line of a bar magnet is

$$B = \frac{\mu_o}{4\pi} \cdot \frac{2Md}{(d^2 - l^2)^2}$$

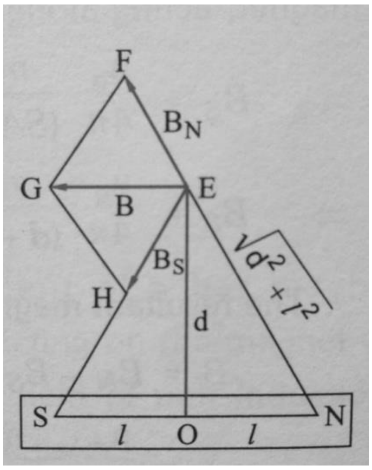
When $l \ll d$ i.e, in the case of a very short bar magnet

$$B = \frac{\mu_o}{4\pi} \cdot \frac{2M}{d^3}$$

10. Derive an expression for the magnetic induction field strength at a point on the equatorial line of a bar magnet.

a. Magnetic induction field strength at a point on the equatorial line:

Equatorial line of a bar magnet is the perpendicular bisector of the axis of the magnet.



Consider a bar magnet of magnetic length '$2l$' and pole strength 'm.' let 'E' be a point on the equatorial line at a distance d from centre 'O' of the magnet.

The magnetic induction B_N at E due to the north pole of the magnet acting along NE is given by B_N

$$B_N = \frac{\mu_o}{4\pi} \cdot \frac{m}{(NE)^2}$$

$$B_N = \frac{\mu_o}{4\pi} \cdot \frac{m}{(d^2 + l^2)} \qquad (\therefore NE = \sqrt{d^2 + l^2})$$

The magnetic induction B_S at E due to the south pole of the magnet acting along ES is given by

$$B_S = \frac{\mu_o}{4\pi} \cdot \frac{m}{(SE)^2}$$

$$B_S = \frac{\mu_o}{4\pi} \cdot \frac{m}{(d^2 + l^2)} \qquad (\because SE = \sqrt{d^2 + l^2})$$

The vectors B_N and B_S are represented by the adjacent sides EF and EH of the parallelogram EFGH. Then the diagonal EG of the parallelogram gives the resultant induction field B.

From the figure the triangles EFG and NES are similar.

$$\therefore \quad \frac{EG}{EF} = \frac{NS}{NE}$$

$$\frac{EG}{NS} = \frac{EF}{NE}$$

$$EG = \frac{EF}{NE} \cdot (NS)$$

$$EG = \frac{B_N \cdot 2l}{\sqrt{d^2 + l^2}}$$

$$B = \frac{\mu_o}{4\pi} \cdot \frac{m}{(d^2 + l^2)} \cdot \frac{2l}{\sqrt{d^2 + l^2}}$$

$$B = \frac{\mu_o}{4\pi} \cdot \frac{M}{(d^2 + l^2)^{3/2}} \qquad (\because M = m \times 2l)$$

When $l \ll d$, i.e., in the case of a very short bar magnet

$$B = \frac{\mu o}{4\pi} \cdot \frac{M}{d^3}$$

PROPERTIES OF MATTER

1. Define Elasticity and Inelasticity.

a. Elasticity: The property of certain materials of returning back to their original size or shape, after removing the deforming force is called elasticity.

Examples: Rubber, crystals.

Inelasticity: A body which cannot regain its original size or shape after the removable of deforming force is called inelasticity or plasticity.

Examples: Wood, glass.

2. Define Stress and Strain.

a. Stress: The deforming force applied per unit area of the body is called stress.

Stress (σ) =deforming / area

= F/A

Units: The SI unit of stress is N/m^2 (or) Pascal., Dimensional formula: $ML^{-1}T^{-2}$

Strain: The change in dimension of a body due to the deforming force is called strain.

Strain = change in dimension / original dimension

Strain does not having any units and dimension formula because both are same physical quantities.

3. Define Hooke's law.

a. Hooke's law: Within an elastic limit, stress is directly proportional to strain produced in a body. i.e., stress α strain

Stress / strain = constant

= E (Where 'E' is called modulus of elasticity.)

The unit and dimensional formula for modulus of elasticity is same as that stress.

Units: The SI unit of stress is N/m^2 (or) Pascal., Dimensional formula: $ML^{-1}T^{-2}$

4. Define Surface Tension and write the examples

a. Surface Tension: The force acting perpendicular to the surface is called surface tension.

Surface Tension (T) = Force / length, units = dynes/cm

Examples: Floating a needle, Insects and Soap bubble.

5. Define Angle of Contact and write its Characteristics.

a. Angle of Contact: The angle between solid surface and the tangent drawn to the surface of the liquid at the point of contact is called "Angle of Contact".

Characteristics:

- The angle of contact may have any value between 0^0 and 180^0
- for most of the liquids with glass, it is less than 90^0
- The angle of contact depends only on the nature of solid and liquid.

6. Define Capillarity, write its examples and formula for surface tension based on capillarity.

a. Capillarity: "The phenomenon of rise or fall of liquid level in a capillary tube is called capillarity." Examples: kerosene lamp, candle

Formula for surface tension: T= hrdg / 2

Where h → capillarity rise in capillary tube
r → radius of the capillary tube
d → density of the liquid.

7. Define Viscosity, write examples and write the Newton's formula for viscous force.

a. Viscosity: The property of a liquid which gives rise to a viscous force that tends to oppose the relative motion between its layers is called viscosity.

Examples:

- Rain drops are slower due to viscosity of air.
- Honey runs slower than water because of high viscosity.
- Due to viscosity of sea water, waves will subside.

Newton's formula for viscous force: $F = \eta \times A\,(dv/dx)$

Where 'η' is called coefficient of viscosity. It is depends only on the nature of the liquid.

8. Define Coefficient of Viscosity, write units& dimensional formula and write the Poiseuille's equation for viscosity.

a. Coefficient of Viscosity: The viscous force acting per unit area when there is unit velocity gradient in the flow of liquid is called coefficient of viscosity (or) dynamic viscosity.

Coefficient of viscosity $(\eta) = F/ A\,(dv/dx)$

Units: The SI unit of coefficient of viscosity is $Nm^{-2}S$., **Dimensional formula:** $ML^{-1}T^{-1}$

Poiseuille's equation for viscosity: $\eta = \pi P r^4 / 8 l v$

(where P = pressure difference between the ends of capillary tube,
r = radius of capillary bore, l = length of the capillary tube, v = volume of the liquid.)

9. Explain about Effect of Temperature on Viscosity of Liquids and Gases.

a. Effect of Temperature on Viscosity of Liquids: The viscosity of the liquids decreases as the temperature increases.

Effect of Temperature on Viscosity of Gases: The viscosity of the gases increases as the temperature increases.

SIMPLE HARMONIC MOTION (S.H.M)

1. Define Periodic motion write its examples.

a. Periodic motion: "The motion which repeats itself in regular interval of time is known as periodic motion or Harmonic motion."

Examples: * The rhythmic beat of heart
* The vibrations of violin string

2. Define Simple harmonic motion write the conditions and examples.

a. Simple harmonic motion : "SHM is a motion of a body such that, its acceleration is always towards the fixed point and directly proportional to its displacement form that point."

Conditions for SHM: * Motion should be periodic.
* Acceleration directly proportional to its displacement.
* The body should move to and pro about the mean the position.

Examples: * Motion of clock pendulum.
* Oscillation of simple pendulum.

3. Define following terms: A) Displacement B) Amplitude C) Time period D) Frequency E) Phase or Epoch

a. A) Displacement: The distance of a particle in a direction from its mean position is called Displacement.

$$y = r\sin(\omega t + \phi)$$

B) Amplitude: The maximum displacement of the oscillating particle on either side of mean position is called Amplitude.

C) Time period: The time taken by the oscillating particle to completer one oscillation is called Time period. $T = \frac{2\pi}{\omega}$

D) Frequency: The number of oscillations per unit time made by a particle is called frequency. $n = \frac{\omega}{2\pi}$

E) Phase or Epoch: The Phase is the vibrating of the particle. The equation which indicates simple harmonic motion is $y = r\sin(\omega t + \phi)$. Hence $\omega t + \phi$ is called Phase, when t=0 called Initial Phase or Epoch.

4. Define Velocity and Acceleration

a. Velocity: The rate of change in displacement is called velocity.

Velocity $V = \omega\sqrt{r^2 - y^2}$

When velocity maximum $V_{max} = r\omega$, velocity minimum $V_{min} = 0$

Acceleration: The rate of change in velocity is called acceleration.

Acceleration $a = -\omega^2 y$

When acceleration maximum $a_{max} = \omega^2 r$, acceleration minimum $a_{min} = 0$

5. Define Simple pendulum and seconds pendulum.

a. Simple pendulum: A heavy point mass suspended to a light inextensible string (or) thread is called simple pendulum.

The time period of simple pendulum $T = 2\pi\sqrt{\frac{l}{g}}$

Seconds pendulum: A simple pendulum whose time period is two seconds is called seconds pendulum.

6. Write the Laws of simple pendulum

a. Laws of simple pendulum:

The time period of simple pendulum $T = 2\pi\sqrt{\frac{l}{g}}$

1. The time period does not depend on shape, size and mass of the bob
2. The period of a simple pendulum is directly proportional to the square root of the length of the pendulum. $T \alpha \sqrt{\ell}$
3. The period of a simple pendulum is inversely proportional to the square root of the acceleration due to gravity at constant length'ℓ'. $T\ \alpha \sqrt{\frac{1}{g}}$

ELEMENTS OF VECTORS

1. Define Scalar and Vector and write the examples.

a. Scalar or Scalar quantities: Those physical quantities which have only magnitude but no direction are called scalar quantities. Examples: mass, length, area, volume, speed.

Vector or Vector quantities: Those physical quantities which have both magnitude and direction and obey the vector laws is called vector quantities.

Examples: displacement, velocity, acceleration, force.

2. State Parallelogram law, Triangle law and Polygon law.

a. Parallelogram law: If two vectors are acting at a point represent in both magnitude and direction by the side of the parallelogram then their represents in magnitude and direction by the diagonal passing through the same point.

Magnitude resultant : $R = \sqrt{P^2 + Q^2 + 2PQ\cos\theta}$

Direction resultant: $\alpha = \tan^{-1}[\frac{Q\sin\theta}{P+QCOS\theta}]$

Triangle law: If two vectors having both magnitude and direction taken as two sides of the triangle in one order, then the resultant represents the closing side of the triangle in reverse order. $\vec{C} = \vec{A} + \vec{B}$

Polygon law: If number of vectors having both magnitude and direction taken as four sides of the polygon in one order, then the resultant represents the closing side of the polygon in reverse order.

3. Explain Multiplication of vectors (or) Define Dot product and Cross product and write the examples (or) Define Scalar product and Vector product.

a. Dot product (or) Scalar product: The dot product of two vectors is defined as product of the magnitudes of two vectors and cosine of the angle between them, whose direction is parallel to plane. Examples**:** work , power

Cross product (or) Vector product: The cross product of two vectors is defined as product of the magnitudes of two vectors and sine of the angle between them, whose direction is perpendicular to plane. Examples: Torque, Linear velocity

MODERN PHYSICS

1. Explain Photo electric effect and write the laws and applications of photo electric effect

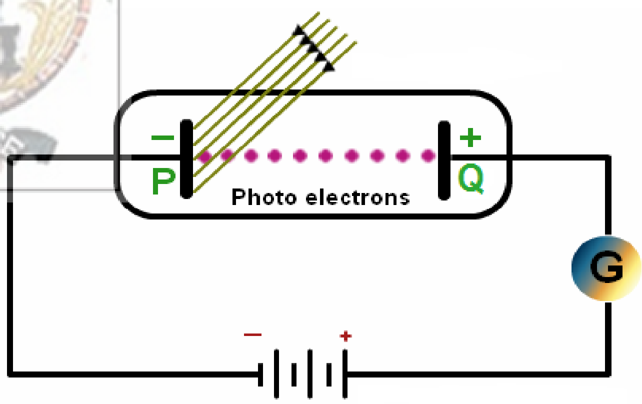
a. Photo electric effect: The phenomenon in which emission of electrons takes place from the surface of certain metals when light of suitable frequency falls on them is called "photo electric effect."

Laws of Photo electric effect:

- The minimum frequency which causes photo electric emission is called threshold frequency and it differs from metal to metal.
- The rate of photo electrons is directly proportional to the intensity of incident light.
- The energy of photo electrons is directly proportional to the frequency of incident radiation.
- The photo electric emission does not depend upon the temperature of the metal.

Applications of Photo electric effect:

- In televisions,
- In counting machines,
- In photo telegraphy,
- As micro ammeters,
- For color identification.
- In production of sound from films.



Photoelectric Cell Circuit

2. Define Refraction light, Critical angle and Total internal reflection.

a. Refraction light: "The phenomenon of bending of light at the boundary between two different medium is called refraction".

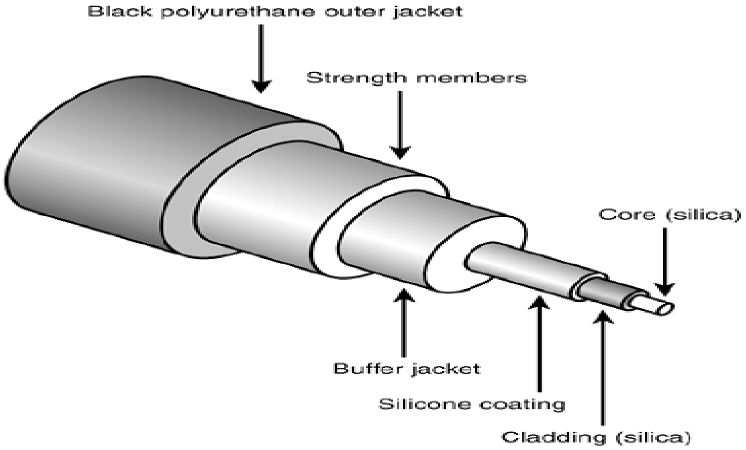
From Snell's law refractive index $\mu = \frac{\sin i}{\sin r}$

Critical angle: "When a light ray passes from a denser medium to rarer medium, the angle of incidence for which the angle of refraction becomes 90^0 is called critical angle".

Total internal reflection: "A light ray gets totally reflected back when it incidents at an angle, greater than the critical angle, on a boundary across which the refractive index decreases. This phenomenon is called total internal reflection".

3. Explain about Optical fiber and write the applications of Optical fiber

a. Optical fiber:"An optical fiber is a dielectric wave guide through which electromagnetic energy in the form of light can be transmitted with very little leakage."



Applications of Optical fibers:

- In cable T.V connections,
- In telecommunications,
- In scientific instruments to illuminate subjects,
- In military communications because of data security,
- As fiber scopes in medical diagnostic equipment.

4. Define Super conductors and Super conductivity and write the applications and properties of Super conductors.

a. Super conductors: The materials whose electrical resistance becomes zero below certain temperature are called super conductors.

Super conductivity: The absence of electrical resistance in some substances below certain temperature is called super conductivity.

Applications of super conductors:

- Super conductors are used in switching devices,
- Super conductors are used in super fast computer switches,
- They are used to amplify very small direct current and voltages,
- Electric current can be transmitted through super conducting cables without resistive losses.
- Super conductors are used in the construction of very sensitive electric measuring instruments like galvanometer.

Properties of super conductors:

- There will be no joule heat when current passes through super conductors,
- All thermo electric effects disappears in super conducting state,
- Thermal expansion and elastic properties do not change in transmission,
- The superconducting property of a super conductor is not lost by adding impurities to it but its critical temperature will be lowered.

PROBLEMS

KINEMATICS

1. A body is allowed to fall freely from a height of 2000 m. Find the time taken to reach the ground. (g = 10 m/s^2)
2. A body when dropped freely from certain height, covers 24.5 m during its last second of its motion. Calculate the height from which the body is dropped freely. (g = 9.8 m/s^2)
3. A stone is allowed to fall freely from the top of a tower 300 m high and at the same time another stone is projected vertically upwards with a velocity of 75 m/s. Find when and where the two stones will meet.
4. An object is thrown vertically up with initial velocity 39.2 m/s. Find the maximum height and time ascent.
5. A body projected vertically upwards from the ground reaches a maximum height of 44.1 meters and falls to the ground. Find the time taken by the body to reach the ground.
6. A body is falling freely from a height of 19.6 m. Find its velocity on reaching the ground.
7. A stone is thrown vertically up with a velocity of 19.6 m/s from the top of a building. If it reaches the ground in 6 seconds, find the height of the building.
8. A balloon rising vertically with uniform velocity releases a body at a height of 18.4 m. If it reaches the ground in 8 seconds, find the initial velocity of the balloon.
9. An aeroplane flying horizontally with a speed of 360 kmph releases a bomb at a height of 490 m from the ground. Find when and where the bomb will strike the ground.
10. A stone is projected with a velocity of 20 m/s at an angle of 30^0 to horizontal. After 1.5 seconds, find its horizontal distance and vertical height from its starting point.
11. A body is projected at an angle of 30^0 with horizontal with a velocity of 19.6 m/s. Calculate the maximum height, time of flight and horizontal range.
12. The range of a projectile is twice its maximum height. Its velocity of projection is 10 m/s. What is the range of the projectile ? (g = 10 m/s^2)
13. The maximum height reached by a projectile is equal to its range. Find the angle of projection.
14. A stone is dropped from a balloon ascending with an uniform vertical velocity of 23.2 m/s and reaches ground in 10 seconds. Find the height of the balloon when the stone reaches the ground. Take the value g as 9.8 m/s^2

WORK, POWER & ENERGY

1. A body of mass 20 kg is lifted to a height 3 m form the ground. Find the work done.
2. The work done by a person in carrying a box of mass 20 kg through a vertical height of 5 m is 4900 J. Find the mass of the person.
3. A force of 8 N pulled a body at an angle 30^0 with the horizontal and displaced it by 10 m. Find the work done.
4. Find the power of electric machine, if it lifts 200 kg of water from a well depth 120 m in 9.8 seconds.
5. An engine is used to lift water from a well 50 m deep to fill a tank of dimensions 5 m X 5 m X 10 m in 50 minutes. Find the power of the engine.
6. A machine gun fires 240 bullets per minute with a velocity of 500 m/s. If the mass of each bullet is 3 gm. Find the power of the machine gun.
7. A machine gun fires 240 bullets per minute. Mass of each bullet is 10 grams. If the power of the gun is 7.2 kW, find the velocity of the bullet.
8. An engine lifts 4000 kg of water per minute from a well 5 m depth. If 20 % energy is wasted, then find the power of the engine.
9. A person of mass 60 kg lifts a mass of 40 kg to the top a building of 10 m in 50 s. Find power of the person.
10. A lift carried 10 persons each weighing 60 kg to the top storey of the building 100 m high. Calculate the potential energy acquired by the persons.
11. A bullet of mass 10 grams is fired with a velocity of 300 m/s. Find its kinetic energy.
12. If the mass of a body is reduced to half and the velocity is doubled, how does its KE changes?
13. A force acts on a body of mass 2 kg increase its velocity from 5 m/s to 10 m/s. Find the work done by it.
14. The momentum of a body of mass 2 kg is 50 kg m/s. Find its kinetic energy.
15. If the momentum of a body is doubled, how does its kinetic energy change ?
16. A body of mass 100 kg is allowed to fall from a height of 50 m from the ground. Calculate its potential and kinetic energy at a height of 30 m from the ground.

HEAT & THERMODYNAMICS

1. Normal human body temperature is 37^0 C. Convert into absolute scale of temperature.
2. One litre of air is heated form 27^0 C to 177^0 C at constant pressure. Find the increase in volume of the gas.
3. A gas at 30^0 C has its temperature raised so that volume is doubled. The pressure reaming constant, what is its final temperature ?
4. The pressure of gas at temperature 27^0 C is 70 mm of Hg. Find its pressure at temperature 227^0 C, if it is heated at constant volume.
5. A gas occupies 25 litres under a pressure of 72 cm of Hg at 37^0 C. What will be the volume when 75 cm of Hg pressure is applied at 27^0 C ?
6. A cylinder contains 90.3 cc of gas at 17^0 C and 735 mm of Hg pressure. Find its volume at NTP.
7. Density of air at 0^0 C and 760 mm of pressure is 1.293 kg m^{-3}. Find its density at 30^0 C and 750 mm of pressure.
8. A gas at a pressure of 10^5 Nm^{-2} is allowed to expand isothermally until its volume is doubled. Find its final pressure.
9. A gas at a pressure of 100 Nm^{-2} is compressed to half the original volume. Calculate the pressure if the compression is adiabatic and $\gamma = 1.4$
10. When heat energy of 2000 joules is supplied to a gas at constant pressure 2×10^5 Nm^{-2} , there was an increase in its volume equal to 0.004 m^3. Calculate the increase in internal energy of the gas.
11. The volume of a gas is 20 cc. at 27^0 C. Pressure reaming constant, what is the temperature at which the volume of the gas is 40 cc.?
12. 1 litre of air at 27^0 C is heated until the pressure and volume are doubled. Find the final temperature.
13. The pressure of a given mass of gas enclosed in a bulb increases by three time and the volume reduced by 1/5 of its initial volume. If the gas is initially at 27^0 C, what will be its final temperature ?
14. Calculate the value of universal gas constant for one gram mole of a gas at NTP.
    (OR) Evaluate the ideal gas constant.
15. The ratio of two specific heats of a gas is 1.4 . Its molar specific heat at constant volume Cv is 4.96 J^{-1} mol^{-1} K^{-1}. Find the value of universal gas constant

ELECTRICITY AND MAGNETISM

1. Calculate the potential difference to be applied across a conductor of resistance 20 Ω, so that a current of **2 A** may flow through it.
2. Calculate the resistance of a conductor when a current of **10^{-2} A** flows between its ends under a potential difference of **20 V**.
3. Determine the current flowing through the filament of a lamp having a constant resistance of 440 Ω and connected across **200 V** mains.
4. The resistance of copper wire of 200 metres long is 21 ohms. If the diameter is 0.04 cm, determine its specific resistance.
5. A copper wire of cross sectional are 0.01 mm^2 is used to prepare a resistance of 1 kilo ohm. If the resistivity of copper is 1.7×10^{-8} ohm metre, find the length of the wire.
6. Calculate the resistance of 500 metres of a cable, if its area of cross-section and resistivity are 100 mm^2 and 1.7×10^{-8} Ω m respectively.
7. The resistance of a wire is 8 ohms. What is the resistance of another wire of same material having same length but double area of cross section ?
8. Three currents 1 mA, 3mA and i_3 mA are flowing towards the junction and two currents 2 mA and 3 mA are flowing away from the junction. Find the value of i_3.
9. The values of resistances P,Q,R are 50 ohms, 10 ohms, 15 ohms respectively in the balanced condition of Weatstone's bridge. Find the unknown resistance S.
10. If 10 ohms and 30 ohms are connected in left and right gaps in meter bridge experiment, find the balancing length. **(OR)** In the metre bridge experiment , if the resistance in the left and right are in the 10 : 30, find the balancing point is obtained.
11. A balance point in a metre bridge experiment is obtained at 30 cm from the left. If the right gap contains 3.5 ohms, what is the resistance in the left gap ?
12. A wire of length 0.25 m and diameter 3.286×10^{-5} m is connected in the left gap of a metre bridge. The other resistances at the balanced conditions are Q = 10 Ω, R = 33 Ω and S = 66 Ω. Find the specific resistance of the wire.

13. Two magnetic poles of strength 40 Am and 20 Am are separated by a distance of 0.2 m in air. Calculated the force between them.
14. The force between two short magnets if **F** . When the poles strengths are doubled and distance between the magnets is halved, what is the force between them ?
15. The force of repulsion between two poles separated by a distance of 5 cm is **10 N**. What is the repulsion between the same poles separated by a distance of 4 cm ?
16. A bar magnet of length 20 cm and pole strength 5 Am makes an angle of 30^0 with a uniform magnetic field of induction 100 tesla. Find the magnetic moment and Find the moment of couple on it.

SIMPLE HARMONIC MOTION (S.H.M)

1. The simple harmonic motion of a body is given by equation y = 4 sin $\left[100t + \frac{\pi}{4}\right]$. Find

   a. Angular velocity
   b. Time period
   c. Initial displacement
   d. Amplitude
   e. Frequency
   f. Initial phase (or) Epoch
   g. Maximum velocity
   h. Maximum acceleration

2. A particle is performing S.H.M with an amplitude of 0.5 m and has an angular velocity of 1000 rad/s. Find its velocity at a distance of 0.3 m from the mean position.
3. Calculate the length of the seconds pendulum at a place where the value of g is 9.8 m/s^2.
4. Find the value of acceleration due to gravity at a place where the length of the seconds pendulum is 0.9 m.

SOUND

1. Two notes of frequencies 500 Hz and 200 Hz are sounded together simultaneously. Find the number of beats produced per second.
2. Find the minimum distance required between obstacle and observer to hear an echo. (velocity of sound v = 340 m/s).
3. A boy hears an echo of his own voice form a distant hill after 2 seconds. If the velocity of sound is 340 m/s, what is the distance of the hill from the boy ?
4. Calculate the velocity of sound in air if an observer at a distance of 425 m from a building hears an echo after 2.5 s.

ELEMENTS OF VECTORS

1. A force of 150 N acts on a particle at angle of 30^0 to the horizontal. Find the horizontal and vertical components of force.
2. Two forces 30 N and 40 N act at a point simultaneously at right angles to each other. Find the magnitude and direction of the resultants.
3. A force of $2\vec{i} + 3\vec{j} + 4\vec{k}$ N acts on a body for 4 s and produces a displacement of $3\vec{i} + 4\vec{j} + 5\vec{k}$. Calculate the work and power.
4. Find the area of parallelogram and triangle formed by two vectors $\vec{A} = 2\vec{i} + 3\vec{j} + \vec{k}$ and $\vec{B} = \vec{i} - 2\vec{j} + 2\vec{k}$ as two adjacent sides.
5. A force of ($3\vec{i} + 12\vec{j} + 6\vec{k}$) newtons acts on a particle having position vector ($2\vec{i} + 3\vec{j} + 5\vec{k}$) with reference to an axis. Find the torque.
6. Find the dot product and cross product of two vectors $\vec{A} = 2\vec{i} + 3\vec{j} + 4\vec{k}$ and $\vec{B} = 4\vec{i} - 2\vec{j} + 3\vec{k}$.
7. Find the magnitude and unit vector in the direction of $3\vec{i} + 6\vec{j} - 2\vec{k}$.

SYLLABUS PATTERN

Subject Title : Engineering Physics

Subject Code : 103

S.No	Major Topics	Weightage of Marks	Short Type	Essay Type
1.	Units and Dimensions	03	1	-
2.	Elements of Vectors	13	1	1
3.	Kinematics	13	1	1
4.	Friction	10	-	1
5.	Work, Power and Energy	10	-	1
6.	Simple Harmonic Motion	13	1	1
7.	Heat & Thermodynamics	13	1	1
8.	Sound	13	1	1
9.	Properties of matter	06	2	-
10.	Electricity & magnetism	13	1	1
11.	Modern Physics	03	1	-
	Total:	**110**	**10**	**8**

ENGINEERING PHYSICS MODEL PAPER

PART—A

3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

1. Units and Dimensions
2. Elements of Vectors
3. Kinematics
4. Simple Harmonic Motion
5. Heat & Thermodynamics
6. Sound
7. Properties of Matter
8. Properties of Matter
9. Electricity & Magnetism
10. Modern Physics

PART—B

10×5=50

Instructions : (1) Answer any **five** questions.

(2) Each question carries **ten** marks.

11. Elements of Vectors
12. Kinematics
13. Friction
14. Work, Power and Energy
15. Simple Harmonic Motion
16. Heat & Thermodynamics
17. Sound
18. Electricity & Magnetism

KINEMATICS

Formulas:-

Vertical projection

Maximum height	$v^2-u^2=2as$	$H=\frac{u^2}{2g}$
Time ascent	$v=u+at$	$t_1=u/g$
Time descent	$s=ut+1/2at^2$	$t_2=u/g$
Time of flight	TA+TD	$t=\frac{2u}{g}$
Resultant velocity	$v^2-u^2=2as$	$v=u$
Height of the tower	$s=ut+1/2at^2$	$h=-ut+1/2gt^2$

Horizontal projection

Time of flight	$s=ut+1/2at^2$	$T=\sqrt{\frac{2h}{g}}$
Horizontal range	R = UHV X TF	$R=u\sqrt{\frac{2h}{g}}$
Instantaneous velocity (or) Resultant velocity	$v=u+at$ (or) $V=\sqrt{v_x^2+v_y^2}$	$v=\sqrt{u^2+g^2t^2}$

* path of projectile in horizontal projection

Horizontal displacement = horizontal velocity x time

$$t=\frac{x}{u}$$

$$S=ut+1/2at^2$$

$$y=Ax^2$$

Oblique projection

Maximum height	$v^2-u^2=2as$	$H=\frac{u^2\sin^2\theta}{g}$
Time ascent	$v=u+at$	$t_1=\frac{u\sin\theta}{g}$
Time descent	$S=ut+1/2at^2$	$t_2=\frac{u\sin\theta}{g}$
Time of flight	TA+TD	$t=\frac{2u\sin\theta}{g}$

Horizontal range $R = UHV \times TF$ $R = \frac{U^2 \sin\theta}{g}$

Maximum range HR $R = U^2/g$

* path of projectile in oblique

Horizontal displacement = Horizontal velocity X time

$$t = \frac{x}{u\cos\theta}$$

$$S = ut + 1/2\,at^2$$

$$y = Ax - Bx^2$$

Conditions:-

velocity, Intial velocity (u), final velocity (v) = m/s

Height (h), distance (S), displacement (S) = m (meters)

Time (t) = seconds, angle = ° (degrees)

acceleration due to gravity (a or g) = m/s^2

1. Given,

Intial velocity (u) = 0

Height (H) = S = 2000m

Acceleration due to gravity $a = g = 10 m/s^2$

substituting the values in the equation

$$S = ut + 1/2\,at^2$$

$$2000 = 10(t) + \frac{1}{2}(10)(t^2)$$

$$2000 = 5t^2$$

$$\frac{2000}{5} = t^2$$

$$t^2 = 400$$

$$t = \sqrt{400} = 20 \text{ seconds}$$

∴ The taken time (t) = 20 seconds.

2. Given,

Intial velocity $u = 0$

acceleration $g = 9.8\ m/s^2$

The distance travelled by n seconds, $S_n = 24.5m$

$$S_n = u + \frac{1}{2}a(2n-1)$$

$$S_n = 0 + \frac{1}{\cancel{2}}(\cancelto{4.9}{9.8})(2n-1)$$

$$24.5 = 0 + 4.9(2n-1)$$

$$\frac{24.5}{4.9} = 2n-1$$

$$5 = 2n-1$$

$$2n = 5+1$$

$$2n = 6$$

$$n = 6/2$$

$$n = 3$$

The time taken t is 3 seconds

$$S = ut + 1/2\,at^2$$

$$S = 0(3) + 1/\cancel{2}\,(\cancelto{4.9}{9.8})(3)^2$$

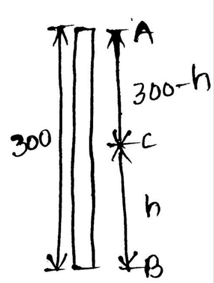
$$S = 4.9(9)$$

$$\boxed{S = 44.1m}$$

∴ The distance $S = 44.1m$

3. Given,

The stone fall freely from tower $(\overline{AC})$



Intial velocity $u = 0$

Height $= 300-h$

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

$$300-h = (0)(t) + 1/\cancel{2}\,(\cancelto{4.9}{9.8})(t^2)$$

$$300-h = 4.9t^2$$
$$-h = -300+4.9t^2$$
$$h = 300-4.9t^2 \quad —①$$

Stone is projected vertically upwards direction ($\overline{BC}$)

Intial velocity = 75m/s

Acceleration $g = a = -9.8\, m/s^2$

Height = h

$$S = ut + \tfrac{1}{2}at^2$$
$$h = 75(t) + \tfrac{1}{2}(-9.8)t^2$$
$$h = 75t - 4.9t^2 \quad —②$$

from eq ① & ②

$$\Rightarrow 75t - \cancel{4.9t^2} = 300 - \cancel{4.9t^2}$$
$$75t = 300$$
$$t = \frac{300}{75}$$
$$\boxed{t = 4 \text{ seconds}}$$

from eq ①

$$h = 300 - 4.9t^2$$
$$= 300 - 4.9(4)^2$$
$$= 300 - 4.9(16)$$
$$= 300 - 78.4$$
$$\boxed{h = 221.6\, m}$$

The stones are meet at 221.6 mts height from the ground.

4. Given,

Intial velocity (u) = 39.2 m/s

Acceleration due to gravity $g = 9.8\, m/s^2$

Substituting the values in the equation maximum height $H = \frac{U^2}{2g}$

$$H = \frac{(39.2)^2}{2(9.8)}$$

$$= \frac{1536.64}{19.6}$$

$$H = 78.4$$

The maximum height $H = 78.4\ m$

Time ascent $t = \frac{u}{g}$

$$t = \frac{39.2}{9.8}$$

$$\boxed{t = 4\text{seconds}}$$

The time ascent $t = 4$seconds.

5. Given

maximum height $H = 44.1\ m$

Acceleration due to gravity $= 9.8\ m/s^2$

Maximum height $H = \frac{U^2}{2g}$

$$44.1 = \frac{U^2}{2(9.8)}$$

$$u^2 = 44.1 \times 19.6$$

$$u = \sqrt{864.36}$$

$$u = 29.4\ m/s$$

Time taken by the body to reach the ground

$$t = \frac{2U}{g}$$

$$t = \frac{2(29.4)}{9.8}$$

$$t = \frac{58.8}{9.8} = 6\text{ seconds}$$

$\therefore$ Time taken $t = 6$seconds.

6. Intial velocity $u = 0$

height $H = S = 19.6m$

Acceleration due to gravity $a = 9.8m/s^2$

substituting the values in the equation

$$v^2 - u^2 = 2as$$

$$v^2 - (0)^2 = 2(9.8)(19.6)$$

$$v^2 = (19.6)(19.6)$$

$$v^2 = 384.16$$

$$v = \sqrt{384.16}$$

$$\boxed{v = 19.6}$$

The velocity is $v = 19.6 m/s$.

7. Given,

The intial velocity $u = 19.6m/s$

and time $t = 6seconds$

Acceleration due to gravity $g = 9.8m/s^2$

substituting the values in the equation.

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

$$h = -(19.6)(6) + \frac{1}{\cancel{2}}(\overset{4.9}{\cancel{9.8}})(6)^2$$

$$h = -117.6 + 4.9(36)$$

$$h = -117.6 + 4.9(36)$$

$$h = -117.6 + 176.4$$

$$\boxed{h = 58.8m}$$

The height of building is $58.8m$

8. Given,

Height $H = 18.4m$

time t = 8seconds

Acceleration due to gravity $a = g = 9.8 m/s^2$

Substituting the values in the equation

$$h = -ut + \frac{1}{2} g t^2$$

$$18.4 = -u(8) + \frac{1}{2}(\overset{4.9}{\cancel{9.8}})(8)^2$$

$$18.4 = -8u + 4.9(64)$$

$$18.4 = -8u + 313.6$$

$$18.4 - 313.6 = -8u$$

$$-295.2 = -8u$$

$$u = \frac{295.2}{8}$$

$$\boxed{u = 36.9 m/s}$$

The intial velocity is $u = 36.9 m/s$.

9. Given,

Velocity = 360kmph

$= 360 \times \frac{5}{18}$

$= 100 m/s$

Height $= H = S = 490m$

Acceleration due to gravity $= 9.8 m/s^2$

Substituiting the values in equation

$$S = ut + \frac{1}{2} a t^2$$

$$490 = (0)t + \frac{1}{2}(\overset{4.9}{\cancel{9.8}}) t^2$$

$$490 = 4.9(t^2)$$

$\frac{490}{4.9} = t^2$

$t^2 = 100$

$t = \sqrt{100}$

$t = 10$ seconds.

Horizontal displacement = horizontal velocity × time

$= u \times t$

$= 100 \times 10$

$= 1000$ mts

∴ The bomb will strike at ground reached in 10 seconds at 1000 mts.

10. Given

Intial velocity $u = 20 m/s$

Angle of projection $\theta = 30°$

time $t = 1.5$ seconds

Horizontal displacement = horizontal velocity × time

$= u\cos\theta \times t$

$= 20 \times \cos 30° \times 1.5$

$= \overset{10}{\cancel{20}} \times \frac{\sqrt{3}}{\cancel{2}} \times 1.5$

$= 25.98 m$

Vertical height :-

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

$u = u\sin\theta$, $a = -9.8$;

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

$= u\sin\theta(1.5) + \frac{1}{2}(-9.8)(1.5)^2$

$= u\sin 30(1.5) + \frac{1}{\cancel{2}}(\overset{4.9}{\cancel{-9.8}})(1.5)^2$

$= 20\left(\frac{1}{2}\right)(1.5) - 4.9(2.25)$

$= \overset{10}{\cancel{20}}\left(\frac{1}{\cancel{2}}\right)(1.5) - 4.9(2.25)$

$= 10(1.5) - 4.9(2.25)$

$= 3.975m$

Vertical height is 3.975 m

The horizontal distance is 25.98m.

11. Intial velocity $u = 19.6m/s$

Angle $\theta = 30°$

Acceleration $a = g = 9.8m/s^2$

Maximum height

$= \frac{(19.6)^2 (\sin 30)^2}{2(9.8)}$

$= \frac{(384.76)\left(\frac{1}{2}\right)^2}{19.6}$

$= \frac{(\overset{19.6}{\cancel{384.76}})\left(\frac{1}{4}\right)}{\cancel{19.6}}$

$= 19.6 \times \frac{1}{4}$

$= \frac{19.6}{4}$

$= 4.9 m.$

Time of flight $= \frac{2u\sin\theta}{g}$

$= \frac{2(19.6)\sin 30}{19.6}$

$= 2$seconds

Horizontal range:-

$R = \frac{u^2 \sin 2\theta}{g}$

$$= \frac{(19.6)^2 \sin 2(30)}{9.8}$$

$$= \frac{332.69}{9.8}$$

$$= 33.94m.$$

12. Given,

velocity of projection $u = 10m/s$

Acceleration due to gravity $a = g = 10m/s^2$

$$R = 2H$$

$$\frac{\cancel{u^2}\sin 2\theta}{\cancel{g}} = \cancel{2}\frac{\cancel{u^2}\sin^2\theta}{\cancel{2}\cancel{g}}$$

$$\sin 2\theta = \sin^2\theta$$

$$2\cancel{\sin\theta}\cos\theta = \sin^{\cancel{2}}\theta$$

$$2\cos\theta = \sin\theta$$

$$2 = \frac{\sin\theta}{\cos\theta}$$

$$2 = \tan\theta$$

$$\theta = \tan^{-1}(2)$$

$$\boxed{\theta = 63.43^\circ}$$

Range:-

$$R = \frac{u^2 \sin 2\theta}{g}$$

$$= \frac{(10)^2 \sin(2 \times 63.43^\circ)}{10}$$

$$= 8 \text{ metres}$$

∴ The range of projectile is 8m.

13. Given,

$H = R$

$\frac{u^2 \sin^2\theta}{2g} = \frac{u^2 \sin 2\theta}{g}$

$\sin^2\theta = 2(\sin 2\theta)$

$\sin^2\theta = 2(2\sin\theta \cdot \cos\theta)$

$\sin\theta = 4\cos\theta$

$\frac{\sin\theta}{\cos\theta} = 4$

$\tan\theta = 4$

$\theta = \tan^{-1}(4)$

$= 75.96°$

∴ The angle of projection is 75.96°

14. Given,

The intial velocity $(u) = 0$

time $t = 10$ seconds

Acceleration $a = 9.8 m/s^2$

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

$S = (0)(10) + \frac{1}{2}(9.8)(10)^2$

$S = 4.9 \times 100$

$S = 490m$

∴ The height of the ballon when the stone reaches the ground is 490mts.

WORK, POWER & ENERGY

Formulae :-

* Work = Force x displacement
  $= F \times S$
  $(F = mg)$
  $= FS\cos\theta$ (In case of angle)
* power $= \frac{\text{work done}}{\text{Time}} = \frac{w}{t}$
* potential energy (P.E) = mgh
* Kinetic energy (K.E) $= \frac{1}{2}mv^2$
* work energy $\Rightarrow \frac{1}{2}m(v^2 - u^2)$
* Momentum & kinetic $\Rightarrow \frac{P^2}{2m}$

Units

* work - Joules (J)
* power - watts (W) (or) kilowatts (KW)
* energy - Joules (J)
* momentum (P) = $kg \cdot ms^{-1}$

Conditions

* (m) mass (or) weight = kg
* (t) time = seconds
* (S or h) height (or) distance = meters.
* 1kg = 1000g
* $1g = 10^{-3}kg \left(\frac{1}{1000}\right)$
* 1kW = 1000W
* $1W = 10^{-3}kW$
* $1m^3 = 1000kg$.

1. Given,

A body of mass $(m) = 20kg$

The height $(h) = 3m$

Acceleration due to gravity $g = 9.8 m/s^2$

work done $= F \times S$

$= mg \times h$

$= 20 \times 9.8 \times 3$

$= 588$ Joules.

$\therefore$ The work done is 588 Joules.

2. Given,

Mass of the box is 20kgs

Height $(h) = 5m$

work $(W) = 4900J$

A person mass $= M$ (say)

Total mass $m = (M+20)$

$W = F \times S$

$4900 = mg \times h$

$4900 = (M+20)(9.8)(5)$

$$\frac{4900}{9.8 \times 5} = M+20$$

$100 = M+20$

$\Rightarrow M = 100-20$

$M = 80kg$

$\therefore$ A person mass is 80kg.

3. Given,

Force of the body $(F) = 8N$

Angle $\theta = 30°$

Displacement(S) = 10m

$$\text{work done} = F \times S \cos\theta$$
$$= 8(10)\cos 30^\circ$$
$$= 80\left(\frac{\sqrt{3}}{2}\right)$$
$$= 40\sqrt{3}$$
$$= 69.28 \text{ Joules}$$

$\therefore$ work done by the body is 69.28 Joules.

4. Given,

Mass of the Water = 200kg

water from a well of depth = 120m

time (t) = 9.8 seconds.

$$\text{power} = \frac{\text{work done}}{\text{time}}$$

$$W = F \times S$$
$$= mg \times h$$
$$= 200 \times 9.8 \times 120$$
$$= 2,35,200$$

time = 9.8

$$\text{Power} = \frac{2,35,200}{9.8}$$
$$= 24000W$$

$\therefore$ power of electric machine is 24000W (or) 24KW

5. Given,

Depth (h) = 50m

Tank dimensions of mass $5m \times 5m \times 10m$ = 250kg

$= 250 \times 1000$

$= 2,50,000$

$(1m^3 = 1000kg)$

$t = 50$ minutes

$= 3000$ seconds.

$$\text{power} = \frac{\text{workdone}}{\text{time}}$$

$W = F \times S$

$= mg \times h$

$= (250000)(9.8)(50)$

$= 122{,}500000$ Joules

$$\text{power} = \frac{1{,}22{,}50{,}000}{3{,}000}$$

$= 40{,}833.3$ watts

$\therefore$ The power of engine is 40.833 kW

6. Given,

velocity of bullet $v = 500$ m/s

Mass of each bullet $m = 3g \Rightarrow 3 \times 10^{-3}$ kg

Time $t = 1$ minute $\Rightarrow 60$ seconds

energy of work $= \frac{1}{2} mv^2$

$= \frac{1}{2}(3 \times 10^{-3})(500)^2$

$= \frac{1}{2}(3 \times 10^{-3})(250000)$

1 bullet work $(W) = 375$ Joules

240 bullets work $W = 240 \times 375$

$= 90{,}000$ J

$$\text{power} = \frac{\text{workdone}}{\text{time}}$$

$$= \frac{90{,}000}{60}$$

$= 1500$ W

$= 1.5$ kW

$\therefore$ The power of machine gun is 1500 W (or) 1.5 kW

7. Given,

Mass of each bullet $m = 10\text{grams} = 10\times10^{-3}\,kg$

time $t = 1\text{minute} = 60\text{seconds}$.

power $P = 7.2kW \Rightarrow 7.2\times10^{3}\,W$

$$\text{power} = \frac{\text{work}}{\text{time}}$$

$$\text{work} = \text{power} \times \text{time}$$

$$= (7.2\times10^{3})\times 60$$

$$W = 4,32,000J$$

each bullet work $W = \frac{4,32000}{240}$

$$W = 1800J$$

$$\frac{1}{2}mv^2 = \text{work}$$

$$\frac{1}{2}(10\times10^{-3})(v^2) = 1800$$

$$v^2 = \frac{1800\times2}{10\times10^{-3}}$$

$$= \frac{1800\times2\times10^{3}}{10}$$

$$v^2 = 3,60,000$$

$$v = \sqrt{3,60000}$$

$$\boxed{v = 600m/s}$$

$\therefore$ velocity of each bullet $= 600m/s$

8. Given,

Mass of water $m = 4000kg$

time $t = 1\text{minute} = 60\text{seconds}$.

Depth $(h) = 5m$

Power of engine $= P$ (say)

wasted energy is 20%

used of energy is 80% i.e power (p) = $P \times \frac{80}{100}$

$$\text{power} = \frac{\text{work}}{\text{time}}$$

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

$$P \times \frac{80}{100} = \frac{(4000)(9.8)5}{60}$$

$$P \times \frac{80}{100} = 3266.66$$

$$P = \frac{3266.66 \times 100}{80}$$

$$P = 4083.33\ W$$

$$P = 4.083\ kW$$

∴ power of the engine is 4.083 kW

9. Given,

Mass of the person = 60 kgs

Other mass = 40 kgs

Total mass m = 60 + 40

= 100 kgs

Height h = 10 mts

time t = 50 seconds

$$\text{power} = \frac{\text{work}}{\text{Time}}$$

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

$$= \frac{(100)(9.8)(10)}{50}$$

P = 196 watts

= 0.196 kW

∴ power of the person is 0.196 kW.

10. Total persons is 10

each person weight is 60kg.

Height h = 100m

Total mass = 60×10 = 600 Kg

potential energy $p = mgh$

$= 600 \times 9.8 \times 100$

$= 5{,}88{,}000$ Joules

∴ potential energy acquired by the persons is 5,88,000 J.

11. Given,

Mass of bullet (m) = 10grams

⇒ 10×10^{-3} kg

velocity of bullet $V = 300$ m/s

Kinetic energy $= \frac{1}{2} mV^2$

$= \frac{1}{2} (10 \times 10^{-3}) (300)^2$

$= \frac{1}{2} (0.01) (300)^2$

$= \frac{1}{2} (900)$

$= 450$ Joules

Kinetic energy is 450 Joules.

12. Given,

Mass is reduced to half, velocity is doubled

Mass $m_2 = \frac{1}{2} m_1$

velocity $V_2 = 2V_1$

$$\frac{K.E_2}{K.E_1} = \frac{\cancel{\frac{1}{2}} m_2 V_2^2}{\cancel{\frac{1}{2}} m_1 V_1^2}$$

$$= \frac{m_2 v_2^2}{m_1 v_1^2} \Rightarrow \frac{(\frac{1}{2} m_1)(2v_1)^2}{m_1 v_1^2}$$

$$= \frac{\frac{1}{2} \cancel{m_1} 4 \cancel{v_1^2}}{\cancel{m_1} \cancel{v_1^2}}$$

$$\frac{K.E_2}{K.E_1} = 2$$

$$K.E_2 = 2\,K.E_1$$

∴ Kinetic energy is doubled.

13. Given,

Mass $M = 2kg$

Intial velocity $u = 5m/s$

Final velocity $v = 10m/s$

$$\text{work done} = \frac{1}{2} m(v^2 - u^2)$$

$$= \frac{1}{\cancel{2}} (\cancel{2})(10^2 - 5^2)$$

$$= 100 - 25$$

$$= 75J$$

∴ Work done is 75 J

14. Given,

Mass $M = 2kg$

Momentum(p) $= 50 kgms^{-1}$

$$\text{Kinetic energy} = \frac{p^2}{2m}$$

$$= \frac{(50)^2}{2(2)}$$

$$= \frac{2500}{4}$$

$$= 625J$$

∴ Its Kinetic energy is 625 J

15. if momentum is doubled,

momentum $P_2 = 2P_1$

Mass $m = m$

kinetic energy $= \frac{P^2}{2m}$

$$\frac{K \cdot E_2}{K \cdot E_1} = \frac{\frac{P_2^2}{\cancel{2m}}}{\frac{P_1^2}{\cancel{2m}}}$$

$$= \frac{P_2^2}{P_1^2}$$

$$= \frac{4\cancel{P_1^2}}{\cancel{P_1^2}}$$

$$\frac{K \cdot E_2}{K \cdot E_1} = 4$$

$$K \cdot E_2 = 4 K \cdot E_1$$

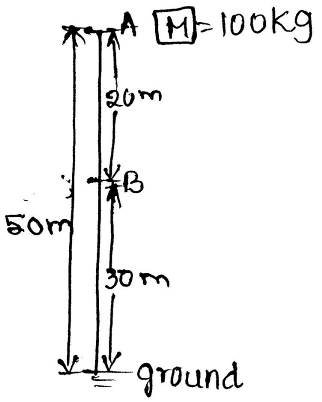
∴ If the momentum is doubled its kinetic energy is increases four times.

16. Given

mass $M = 100kg$

Height from the ground

$h = 50m$



At position B :-

Height from the ground

$h = 30m$

And distance travelled $s = 20m$

Acceleration due to gravity a(or) $g = 9.8 m/s$

potential energy :- mgh

$= 100(9.8)(30)$

$= 29,400J$

Kinetic energy :- $\frac{1}{2} mv^2$

$v^2 - u^2 = 2as$

$v^2 - 0^2 = 2(9.8)(20)$

$v^2 = 392$

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

$= \frac{1}{2} \times (100)(392)$

$K.E = 19,600J$

∴ Its potential energy is 29,400J

And kinetic energy is 19,600J

The total energy is $T.E = P.E + K.E$

$= 29,400 + 19,600$

$= 49,000J$

HEAT & THERMODYNAMICS

Formulaes:-

* $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

* $\frac{P_1}{d_1T_1} = \frac{P_2}{d_2T_2}$ (density)

* $T\mathring{A}$ (or) $K = 273 + {}^\circ c$

* $dQ = du + dw$

  ($dw = PdV$)

dQ = Total energy

du = Internal energy

dw = external work.

Conditions:-

Temperature (T) = k

Volume(V) = 1 litre (or) etc

pressure(P) = mm of Hg

cm of Hg (or) Nm^{-2}

At NTP

$P = 760$ mm of Hg (or) 76 cm of Hg

$T = 273 K$

$V = 22.4$ litre

energy = Joules.

1. Given,

Temperature $t = 37^\circ c$

$T\mathring{A}$ (or) $K = 273 + T^\circ c$

$= 273 + 37^\circ c$

$= 310 K$

∴ The absolute scale temperature is 310 kelvin.

2. Given,

temperature $T_1 = 27°c$

$\Rightarrow 273+27$

$\Rightarrow 300k$

$T_2 = 177°c$

$\Rightarrow 273+177$

$\Rightarrow 450k$

$V_1 = 1$ litre

At constant pressure

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$V_2 = \frac{V_1 T_2}{T_1}$$

$$= \frac{1 \times 450}{300}$$

Final volume $(V_2) = 1.5$ litre

Increased volume $= V_2 - V_1$

$= 1.5 - 1$

$= 0.5$ litre

∴ Final volume is 1.5 litre.

∴ Increased volume is 0.5 litre.

3. Given,

temperature $T_1 = 30°c$

$= 273+30° = 303k$

Intial volume $V_1 = V$

Final volume $V_2 = 2V$

At constant pressure

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{V_1}{T_1 V_2} = \frac{1}{T_2}$$

$$T_2 = \frac{T_1 V_2}{V_1}$$

$$= \frac{303 \times 2\cancel{V}}{\cancel{V}}$$

$$= 606k$$

$$T_2 = 606 - 273$$

$$T_2 = 333^\circ c$$

$\therefore$ Final temperature $T_2 = 333^\circ c$.

4. Given,

Temperature $T_1 = 27^\circ c$

$= 273 + 27 \Rightarrow 300k$

Temperature $T_2 = 227^\circ c$

$= 273 + 227 \Rightarrow 500k$

pressure $P_1 = 70mm$ of Hg

At constant volume

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$P_2 = \frac{P_1 T_2}{T_1}$$

$$= \frac{70 \times 500}{300}$$

$$P_2 = 116.66 \text{ mm of Hg.}$$

$\therefore$ At constant volume pressure $P_2 = 116.66$ mm of Hg.

5. Given,

pressure P_1 = 72cm of Hg

Volume V_1 = 25 litres

Temperature $T_1 = 37°c \Rightarrow 273+37 = 310k$

pressure P_2 = 75cm of Hg

Temperature $T_2 = 27°c \Rightarrow 273+27 = 300k$

volume V_2 = ?

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$V_2 = \frac{P_1V_1T_2}{T_1P_2}$$

$$= \frac{72 \times 25 \times 300}{310 \times 75}$$

$$V_2 = 23.225 \text{ litre}$$

$\therefore$ volume V_2 = 23.225 litre.

6. Given,

Volume V_1 = 90.3cc at NTP V_2 = ?

Temperature $T_1 = 17°c \Rightarrow 273+17 = 290k$

Pressure P_1 = 735mm of Hg

AT NTP pressure P_2 = 760 mm of Hg

AT NTP Temperature T_2 = 273k

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$V_2 = \frac{P_1V_1T_2}{T_1P_2}$$

$$= \frac{735 \times 90.3 \times 273}{290 \times 760}$$

$$V_2 = 82.210cc$$

$\therefore$ volume $V_2 = 82.210cc$

7. Given,

temperature $t_1 = 0^\circ c \Rightarrow 273 + 0 = 273^\circ c$

temperature $t_2 = 30^\circ c \Rightarrow 273 + 30 = 303$

Pressure $P_1 = 760mm$ of Hg

$P_2 = 750mm$ of Hg

density $d_1 = 1.293 kg m^{-3}$

$$\frac{P_1}{d_1 T_1} = \frac{P_2}{d_2 T_2}$$

$$\frac{1}{d_2} = \frac{P_1 T_2}{P_2 d_1 T_1}$$

$$d_2 = \frac{P_2 d_1 T_1}{P_1 T_2}$$

$$= \frac{750 \times 1.293 \times 273}{760 \times 303}$$

$$= 1.149 kg m^{-3}$$

$\therefore$ Final density $d_2 = 1.149 kg m^{-3}$

8. Given,

Pressure $P_1 = 10^5 Nm^{-2}$

Volume $V_1 = V$

$V_2 = 2V$

For an isothermal process,

$$P_1 V_1 = P_2 V_2$$

$$P_2 = \frac{P_1 V_1}{V_2}$$

$P_2 = \frac{10^5 \times V}{2V} = 0.5 \times 10^5 Nm^{-2}$

$\therefore$ pressure $P_2 = 0.5 \times 10^5 Nm^{-2}$

9. $\gamma = 1.4$

pressure $P_1 = 100 Nm^{-2}$

volume $V_1 = V$

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

For an adiabatic process

$P_1 V_1^\gamma = P_2 V_2^\gamma$

$P_2 = \frac{P_1 V_1^\gamma}{V_2^\gamma} = P_1 \left(\frac{V_1}{V_2}\right)^\gamma$

$= 100 \left(\frac{V}{V/2}\right)^{1.5} = 100(2)^{1.4} = 263.9 Nm^{-2}$

$\therefore$ pressure $P_2 = 263.9 Nm^{-2}$

10. Given,

Heat of energy $dQ = 2000J$

pressure $P = 2 \times 10^5 Nm^{-2}$

Increase volume $v = 0.004 m^3$

$dQ = du + dw \quad (dw = pdv)$

$dQ = du + pdv$

$\cancel{dQ}$ $du = dQ - pdv$

$= 2000 - (2 \times 10^5 \times 0.004)$

$= 2000 - 800$

$= 1200J$

$\therefore$ The internal energy $du = 1200J$

11. Given

Volume $V_1 = 20cc$

volume $V_2 = 40cc$

Temperature $T_1 = 27^\circ c = 273 + 27 = 300K$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{V_1}{T_1 V_2} = \frac{1}{T_2}$$

$$T_2 = \frac{T_1 V_2}{V_1}$$

$$= \frac{300 \times 40}{20}$$

$$= 600K$$

$$= 600 - 273$$

$$= 327^\circ c$$

$\therefore$ Temperature t_2 is $327^\circ c$

12. Given

Volume $V_1 = 1$ litre

$V_2 = 2$ litre (doubled)

Pressure $P_1 = P$

$P_2 = 2P$ (doubled)

Temperature $= 27^\circ c$

$= 273 + 27$

$= 300k$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\frac{P_1 V_1}{T_1 P_2 V_2} = \frac{1}{T_2}$$

$$T_2 = \frac{T_1 P_2 V_2}{P_1 V_1}$$

$$= \frac{300 \times 2P \times 2}{P \times 1}$$

$P_2 = 1200$

$P_2 = 1200 - 273$

$= 927^{\circ}c$

$\therefore$ Temperature t_2 is $927^{\circ}c$.

13. Given,

pressure $P_1 = P$

$P_2 = 3P$

volume $V_1 = V$

$V_2 = V/5$

Temperature $T_1 = 27^{\circ}c \Rightarrow 27 + 273 = 300K$

$T_2 = ?$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\frac{P_1 V_1}{T_1 P_2 V_2} = \frac{1}{T_2}$$

$$T_2 = \frac{T_1 P_2 V_2}{P_1 V_1}$$

$$= \frac{300 \times 3P \times V/5}{P \times V}$$

$$= \frac{300 \times 3 \times V}{V \times 5}$$

$$= \frac{900}{5} = 180$$

$T_2 = 180K$

$= 180 - 273$

$= -93^{\circ}c$

$\therefore$ Temperature $t_2 = -93^{\circ}c$.

14. Given,

At NTP pressure $P = 760mm$ of Hg

$= 760 \times 10^{-3} \times 13.6 \times 9.8$ Pa

Temperature $T = 273K$

volume $V = 22.4$ litre

universal gas constant $= \frac{PV}{T}$

$$= \frac{760 \times 10^{-3} \times 13.6 \times 9.8 \times 22.4}{273}$$

$$R = 8.31 J\,mol^{-1} K^{-1}$$

$\therefore$ The value of universal gas constant for one gram at NTP is $8.31 J\,mol^{-1} K^{-1}$!

15. The ratio of two specific heats $\gamma = 1.4$

Molar specific heat at constant volume

$C_V = 4.96 J \cdot mol^{-1} K^{-1}$

we know that

$$\gamma = \frac{C_P}{C_V}$$

$$C_P = \gamma \cdot C_V$$

$$= 1.4 \times 4.96$$

$$= 6.944 J\,mol^{-1} K^{-1}$$

we know that

$$C_P - C_V = R$$

$$6.944 - 4.96 = R$$

$$\therefore R = 1.984 J\,mol^{-1} K^{-1}$$

The value of universal gas constant is $1.984 J\,mol^{-1} K^{-1}$

ELECTRICITY & MAGNETISM

Formulas:-

* $V = iR$
* Specific resistance (or) Resistivity $\rho = \frac{\rho \pi r^2}{l}$ (or) $\rho = \frac{RA}{l}$
* Area of cross section $A = \pi r^2$
* Meter bridge (or) Balancing condition
  $$\frac{P}{Q} = \frac{l}{1-l}$$
* Wheatstone bridge $\frac{P}{Q} = \frac{R}{S}$
* Kirchoff current law - entering = leaving
* magnetic moment $M = m \times 2l$.
* moment of couple bar magnet $\tau = MB\sin\theta$
* Force b/w two magnetic poles $F = \frac{\mu_0}{4\pi} \frac{m_1 m_2}{d^2}$

Conditions:-

* current (i) = Ampere (A), Resistance (R) = ohms (Ω)
* voltage (or) potential difference (V) = volts (V).
* specific resistance (ρ) = (Ωm) ohm meter
* Radius and length = meter (m)
* Area of cross section = m^2
* Left gap = P, right gap = Q
* Magnetic length (2l) = m, magnetic induction B = tesla.
* magnetic moment = Am^2, pole strength = Am
* Force (F) = Newtons (N)
* Moment of couple bar magnet = Nm
* $\mu_0 = 4\pi \times 10^{-7} Hm^{-1}$

1. Given,

Resistance $R = 20\Omega$

current $i = 2A$

Potential difference $V = iR$

$V = 2 \times 20$

$V = 40V$

$\therefore$ The potential difference $V = 40$ volts.

2. Given,

current$(i) = 10^{-2}$ A

potential difference $= 20V$

Resistance $R = \frac{V}{i}$

$= \frac{20}{10^{-2}}$

$= 20 \times 10^{2}$

$= 2000\Omega$

$\therefore$ The resistance $R = 2000\Omega$

3. Given,

Resistance $(R) = 440\Omega$

Potential difference $= 220V$

current $i = \frac{V}{R}$

$= \frac{220}{440}$

$i = 0.5A$

$\therefore$ current flowing through the filament $= 0.5A$

4. Given,

length of the wire $(l) = 200m$

Resistance $R = 21\Omega$

Diameter $D = 0.04cm$

$$D = \frac{0.04}{100} \Rightarrow 0.0004m$$

$$\text{Radius} = \frac{D}{2} = \frac{0.0004}{2} \Rightarrow 0.0002m$$

Area of cross section $A = \pi r^2$

$$= (3.14)(0.0002)^2$$

$$= 1.256 \times 10^{-7} m^2$$

specific resistance $\rho = \frac{RA}{l}$

$$= \frac{21 \times (1.256 \times 10^{-7})}{200}$$

$$= 1.3188 \times 10^{-8} \Omega m$$

$\therefore$ specific resistance is $1.3188 \times 10^{-8} \Omega m$.

5. Area of cross section $A = 0.01mm^2$

$$= 0.01 \times 10^{-6} m^2$$

Resistance $R = 1$ kilo ohm

$$= 1 \times 1000\Omega$$

$$= 1000\Omega$$

Resistivity $\rho = 1.7 \times 10^{-8} \Omega m$

Resistivity $\rho = \frac{RA}{l}$

length of the wire $l = \frac{RA}{\rho}$

$$= \frac{1000 \times 0.01 \times 10^{-6}}{1.7 \times 10^{-8}}$$

$$= 588.235 \text{ meters.}$$

$\therefore$ The length of the wire $l = 588.235$ meters.

6. Given,

Area of cross section $A = 10mm^2$

$= 10 \times 10^{-6} m^2$

length of the cable $l = 500$ meters.

resistivity $\rho = 1.7 \times 10^{-8} \Omega m$.

Resistivity $\rho = \frac{RA}{l}$

Resistance $R = \frac{\rho l}{A}$

$= \frac{1.7 \times 10^{-8} \times 500}{10 \times 10^{-6}}$

$= 0.85 \Omega$

$\therefore$ The resistance $R = 0.85 \Omega$

7. Given,

Resistance $R_1 = 8$ ohms.

Another resistance $R_2 = ?$

Area of cross section $A_1 = A$

Another area of cross section $A_2 = 2A$

length $l_1 = l$

$l_2 = l$

$\frac{R_1 A_1}{l_1} = \frac{R_2 A_2}{l_2}$

$\frac{8A}{l} = \frac{R_2 2A}{l}$

$2R_2 = 8$

$R_2 = 8/2$

$R_2 = 4 \Omega$

$\therefore$ The another resistance $R_2 = 4 \Omega$

8. Towards the junction current are

$i_1 = 1mA$

$i_2 = 3mA$

$i_3 = i_3 mA$

Away from the junction current are

$i_4 = 2mA$

$i_5 = 3mA$

Kirchoff's law

$i_1 + i_2 + i_3 = i_4 + i_5$

$1 + 3 + i_3 = 2 + 3$

$4 + i_3 = 5$

$i_3 = 5 - 4$

$i_3 = 1mA$

$\therefore$ The value of $i_3 = 1mA$

9. Given,

Resistance of $P = 50\Omega$

Resistance of $Q = 10\Omega$

Resistance of $R = 15\Omega$

Balanced condition of wheatstone bridge $\frac{P}{Q} = \frac{R}{S}$

$$\frac{P}{Q} = \frac{R}{S}$$

$$S = \frac{QR}{P} \Rightarrow \frac{10 \times 15}{50} = 3\Omega$$

$\therefore$ The unknown resistance $S = 3\Omega$.

10. Given,

left gap $P = 10\Omega$

Right gap $Q = 30\Omega$

Balancing condition for meter bridge $\frac{P}{Q} = \frac{l}{(1-l)}$

$$\frac{10}{30} = \frac{l}{(1-l)}$$

$$10(1-l) = 30l$$

$$10 - 10l = 30l$$

$$10 = 30l + 10l$$

$$10 = 40l$$

$$l = \frac{10}{40} = \frac{1}{4}$$

$$l = 0.25 \text{ meters.}$$

$\therefore$ The balancing length for meterbridge $l = 0.25m$.

11. Given

length(l) $= 30cm$

$= 0.3m$

Right gap $(Q) = 3.5\Omega$

Balancing condition for meter bridge $\frac{P}{Q} = \frac{l}{(1-l)}$

$$P = Q\left(\frac{l}{1-l}\right)$$

$$= 3.5\left(\frac{0.3}{1-0.3}\right)$$

$$P = 1.5\Omega$$

$\therefore$ The resistance in the left gap $P = 1.5\Omega$

12. Given

length of the wire $= 0.25 m$

diameter $d = 3.286 \times 10^{-5} m$

radius $r = \frac{d}{2} \Rightarrow \frac{3.286 \times 10^{-5}}{2}$

$r = 1.643 \times 10^{-5} m$

The left gap resistance $= P$ (say)

Balancing condition for P, Q, R, S i.e $\frac{P}{Q} = \frac{R}{S}$

$R = 33\Omega$, $Q = 10\Omega$, $S = 66\Omega$

$P = \frac{QR}{S}$

$P = \frac{10 \times 33}{66}$

$P = 5\Omega$

The resistance of the wire $P = 5\Omega$

The specific resistance $\rho = \frac{P\pi r^2}{l} \Rightarrow \frac{5\pi(1.643 \times 10^{-5})^2}{0.25}$

$\Rightarrow \frac{5 \times 3.14 \times (1.643 \times 10^{-5})^2}{0.25}$

$\Rightarrow 1.695 \times 10^{-8} \Omega m$

$\therefore$ The specific resistance of the wire is $1.695 \times 10^{-8} \Omega m$.

13. Given

Pole strength $m_1 = 40 Am$

Pole strength $m_2 = 20 Am$

Distance $d = 0.2 m$

$\mu_0 = 4\pi \times 10^{-7} Hm^{-1}$

Force b/w two poles $F = \frac{\mu_0}{4\pi}\frac{m_1 m_2}{d^2}$

$$= \frac{4\pi \times 10^{-7}}{4\pi} \times \frac{40 \times 20}{(0.2)^2}$$

$$= 2 \times 10^{-3} \text{ Newtons}$$

The force b/w two poles $F = 2\times10^{-3}$ N.

14. The force b/w two short magnets $F_1 = F$

Intial pole strength $m_1 m_2 = m$

Final pole strength $m_3 m_4 = 2m$

Distance $d_1 = d$

Distance $d_2 = d/2$

$$F_1 = \frac{\mu_0}{4\pi}\frac{m_1 m_2}{d_1^2} \text{ --- } (1)$$

$$F_2 = \frac{\mu_0}{4\pi}\frac{m_3 m_4}{d_2^2} \text{ --- } (2)$$

(2) ÷ (1)

$$\frac{F_2}{F_1} = \frac{\cancel{\mu_0}}{\cancel{4\pi}}\frac{m_3 m_4}{d_2^2} \times \frac{\cancel{4\pi}}{\cancel{\mu_0}}\frac{d_1^2}{m_1 m_2}$$

$$\frac{F_2}{F} = \frac{(2m)(2m)}{\left(\frac{d}{2}\right)^2} \times \frac{d^2}{(m)(m)}$$

$$= \frac{4\cancel{m^2}}{\frac{\cancel{d^2}}{4}} \times \frac{\cancel{d^2}}{\cancel{m^2}}$$

$$\frac{F_2}{F} = 4 \times 4 = 16 \Rightarrow F_2 = 16F$$

The another force 16 times of F

15. Given,

distance $d_1 = 5cm$

$= 0.05m$

distance $d_2 = 4cm$

$= 0.04m$

Force $F_1 = 10N$

The poles are same so $m_1m_2 = m_3m_4 \Rightarrow m$

$$F_1 = \frac{\mu_0}{4\pi}\frac{m_1m_2}{d_1^2}, \quad F_2 = \frac{\mu_0}{4\pi}\frac{m_3m_4}{d_2^2}$$

$$\frac{F_2}{F_1} = \cancel{\frac{\mu_0}{4\pi}}\frac{m_3m_4}{d_2^2} \times \cancel{\frac{4\pi}{\mu_0}}\frac{d_1^2}{m_1m_2}$$

$$\frac{F_2}{10} = \frac{\cancel{m.m}}{(0.04)^2} \times \frac{(0.05)^2}{\cancel{m.m}}$$

$$\frac{F_2}{10} = 1.5625$$

$$F_2 = 1.5625 \times 10$$

$$F_2 = 15.625\,N$$

$\therefore$ The force $F_2 = 15.625N$.

16. length of the magnet $= 20cm$

$\Rightarrow (2l) = 0.2m$

Pole strength $m = 50$ Am

magnetic induction $B = 100$ tesla

Angle $\theta = 30^\circ$

magnetic moment M $= m \times 2l$

$= 5 \times 0.2$

$= 1 Am^2$

Couple of the bar magnet $\tau = MB\sin\theta$

$= 1(100)\sin 30^\circ$

$= 100\left(\frac{1}{2}\right)$

$= \frac{100}{2}$

$= 50Nm$

$\therefore$ The magnetic moment $= 1Am^2$

couple of the bar magnet $= 50Nm.$

SIMPLE HARMONIC MOTION (S.H.M)

Formulae:-

$$y = r\sin(\omega t + \phi)$$

y - Displacement

r - Amplitude

ω - Angular velocity

φ - phase (or) epoch.

1. $y = r\sin(\omega t+\phi) \Rightarrow y = 4\sin\left(100t + \frac{\pi}{4}\right)$

i) Angular velocity

$y = 4\sin\left(100t + \frac{\pi}{4}\right)$

$\omega = 100\ \text{rad/sec}$

ii) Time period

$T = \frac{2\pi}{\omega} \Rightarrow \frac{2(3.14)}{100}$

$\Rightarrow 0.0628\ \text{sec}$

iii) Intial displacement

when $t=0$

$y = 4\sin\left(100(0) + \frac{\pi}{4}\right)$

$y = 4\sin\left(\frac{\pi}{4}\right)$

$y = 0.054\text{m}$

iv) Amplitude

$r = 4\text{m}$

v) Frequency

$\frac{1}{T} = \frac{\omega}{2\pi} = \frac{100}{2(3.14)} = 15.9\ \text{Hz}$

vi) phase (or) epoch

$$\phi = \frac{\pi}{4}$$

$$= 0.785 \text{ radians}$$

vii) Maximum velocity

$$V = \omega r$$

$$= 100 \times 4$$

$$V = 400 m/s$$

viii) Maximum acceleration

$$a = r\omega^2$$

$$= 4(100)^2$$

$$a = 40{,}000 m/sec^2$$

2. Given,

Amplitude $r = 0.5m$

Angular velocity $\omega = 1000 rad/s$

Distance $y = 0.3m$

Velocity

$$V = \omega\sqrt{r^2 - y^2}$$

$$= 1000\sqrt{(0.5)^2 - (0.3)^2}$$

$$= 1000(0.4)$$

$$= 400 m/s$$

3. Given,

Seconds pendulum time $T = 2$ seconds

Acceleration due to gravity $g = 9.8\,m/s^2$

Time period $T = 2\pi\sqrt{\frac{l}{g}}$

$$l = \frac{gT^2}{4\pi^2}$$

$$= \frac{(9.8)(2)^2}{4(3.14)^2}$$

$$= \frac{(9.8)\cancel{4}}{\cancel{4}(3.14)^2}$$

$$l = 0.993m$$

∴ The length of the seconds Pendulum $l = 0.99m$.

4. Given,

length of seconds pendulum $l = (0.9)m$

seconds pendulum time $T = 2sec$

Time period $T = 2\pi\sqrt{\frac{l}{g}}$

$$g = 4\pi^2\frac{l}{T^2}$$

$$= 4(3.14)^2\frac{(0.9)}{(2)^2}$$

$$= 4(3.14)^2\frac{(0.9)}{4}$$

$$g = 8.87\,m/s^2$$

∴ The acceleration due to gravity $g = 8.87\,m/s$

SOUND

Formulae:-

$n = n_1 \sim n_2$

$2d = v \times t$

$d = \frac{v \times t}{2}$

1. Given,

frequency $n_1 = 500Hz$

frequency $n_2 = 200Hz$

no. of beats $n = n_1 \sim n_2$

$n = n_1 \sim n_2$

$n = 500 - 200$

$n = 300Hz$

$\therefore$ No. of beats $n = 300Hz$

2. Given,

Minimum time Obstacle and observer $t = 0.1sec$

velocity of sound $v = 340m/sec$

$2d = v \times t$

$d = \frac{v \times t}{2}$

$d = \frac{340 \times 0.1}{2}$

$d = 17m$

The distance of the Obstacle is 17m

3. Given,

Time $t = 2sec$

Velocity of sound $v = 340m/sec$

$$2d = v \times t$$

$$d = \frac{v \times t}{2}$$

$$d = \frac{340 \times 2}{2}$$

$$d = 340m$$

$\therefore$ The distance of the hill is 340m

4. Given

distance $d = 425m$

time $t = 2.5s$

$$2d = v \times t$$

$$v = \frac{2d}{t}$$

$$v = \frac{2(425)}{2.5}$$

$$v = 340m/sec$$

$\therefore$ Velocity of sound $v = 340m/sec$.

ELEMENTS OF VECTORS

Formulas:-

* Horizontal component of force = $F\cos\theta$
* Vertical component of force = $F\sin\theta$
* magnetic resultant $R = \sqrt{P^2+Q^2+2PQ\cos\theta}$
* Direction resultant $\alpha = \tan^{-1}\left(\frac{Q\sin\theta}{P+Q\cos\theta}\right)$
* work $\vec{w} = \vec{F}\cdot\vec{s}$
* Power = $\frac{\text{workdone}}{\text{Time}}$
* Torque $\tau = \vec{r}\times\vec{F}$
* parallelogram $\Rightarrow |\vec{A}\times\vec{B}|$ $(\Rightarrow\sqrt{i^2+j^2+k^2})$
* Triangle $\Rightarrow \frac{1}{2}|\vec{A}\times\vec{B}|$
* dot product $\Rightarrow \vec{A}\cdot\vec{B}$
* cross product $\Rightarrow \vec{A}\times\vec{B}$
* Magnitude of A $\Rightarrow |\vec{A}|$

Example: $\vec{A}\cdot\vec{B}$ (dot) $\quad (\vec{i}\cdot\vec{i})=1$, $(\vec{j}\cdot\vec{j})=1$, $(\vec{k}\cdot\vec{k})=1$

$(3i+2j+4k)\cdot(i+3j+2k)$

$= (3x1)(\vec{i}\,.\vec{i}\,) + (2x3)(\vec{j}\,.\vec{j}\,) + (4x2)(\vec{k}\,.\vec{k}\,)$

$= 3+6+8 = 17$

$\vec{A}\times\vec{B}$ (cross) $= \begin{vmatrix} i & j & k \\ 3 & 2 & 4 \\ 1 & 3 & 2 \end{vmatrix}$

$= i(4-12) - j(6-4) + k(9-2)$

$= -8i - 2j + 7k$

1\. Given,

Force $F = 150$ Newtons

Angle $\theta = 30^\circ$

Horizontal component of force $= F\cos\theta$

vertical component of force $= F\sin\theta$

$F\cos\theta \Rightarrow 150\cos 30^\circ$

$\Rightarrow 129.90\,N$

$F\sin\theta \Rightarrow 150\sin 30^\circ$

$\Rightarrow 75\,N$

∴ Horizontal and Vertical Components are 129.9 N and 75 N

2\. Given,

Two forces $P = 30N$

$Q = 40N$; Angle $\theta = 90^\circ$

Magnitude resultant $R = \sqrt{P^2+Q^2+2PQ\cos\theta}$

Direction resultant $\alpha = \tan^{-1}\left(\frac{Q\sin\theta}{P+Q\cos\theta}\right)$

$R = \sqrt{(30)^2+(40)^2+2(30)(40)\cos 90^\circ}$

$= \sqrt{2500+2400(0)}$

$= \sqrt{2500}$

$\boxed{R = 50\ N}$

$\alpha = \tan^{-1}\left(\frac{40(\sin 90^\circ)}{30+40(\cos 90^\circ)}\right)$

$\Rightarrow \tan^{-1}\left(\frac{40}{30}\right)$

$\boxed{\alpha = 53^\circ 13'}$

∴ Magnitud resultant 50N, Direction Resultant $53^\circ 13'$

3. Given,

$F = \overrightarrow{2i} + \overrightarrow{3j} + \overrightarrow{4k}$ N

$S = \overrightarrow{3i} + \overrightarrow{4j} + \overrightarrow{5k}$, Time $= 4$ s

work $\vec{W} = \vec{F} \cdot \vec{S}$

$= (\overrightarrow{2i} + \overrightarrow{3j} + \overrightarrow{4k}) \cdot (\overrightarrow{3i} + \overrightarrow{4j} + \overrightarrow{5k})$

$= (2\times3)(\vec{i}\cdot\vec{i}) + (3\times4)(\vec{j}\cdot\vec{j}) + (4\times5)(\vec{k}\cdot\vec{k})$

$= 6 + 12 + 20$

$\vec{W} = 38$ J

power $= \frac{\text{work}}{\text{Time}}$

$= \frac{38}{4}$

$P = 9.5$ W

4. Given

$\vec{A} = \overrightarrow{2i} + \overrightarrow{3j} + \vec{k}$

$\vec{B} = \vec{i} - \overrightarrow{2j} + \overrightarrow{2k}$

Parallelogram $|\vec{A} \times \vec{B}| = \begin{vmatrix} i & j & k \\ 2 & 3 & 1 \\ 1 & -2 & 2 \end{vmatrix}$

$= i(6+2) - j(4-1) + k(-4-3)$

$= 8i - 3j - 7k$

$= \sqrt{(8)^2 + (-3)^2 + (-7)^2}$

$= 11.04$ sq. units.

Triangle $\frac{1}{2}|\vec{A} \times \vec{B}| = \frac{1}{2}\begin{vmatrix} i & j & k \\ 2 & 3 & 1 \\ 1 & -2 & 2 \end{vmatrix}$

$= \frac{1}{2}(i(6+2) - j(4-1) + k(-4-3))$

$= \frac{1}{2}(8i - 3j - 7k)$

$= \frac{1}{2}\sqrt{(8)^2 + (-3)^2 + (-7)^2}$

$= \frac{1}{2}(11.04)$

$= 5.52$ sq. units.

5. Given,

$\vec{r} = \vec{2i} + \vec{3j} + \vec{5k}$

$\vec{F} = \vec{3i} + \vec{12j} + \vec{6k}$

Torque $\tau = \vec{r} \times \vec{F}$

$$= \begin{vmatrix} i & j & k \\ 2 & 3 & 5 \\ 3 & 12 & 6 \end{vmatrix}$$

$= i(18-60) - j(12-15) + k(24-9)$

$= -42i + 3j + 15k$

6. Given,

$\vec{A} = \vec{2i} + \vec{3j} + \vec{4k}$

$\vec{B} = \vec{4i} - \vec{2j} + \vec{3k}$

Dot Product $\Rightarrow \vec{A} \cdot \vec{B}$

$= (\vec{2i} + \vec{3j} + \vec{4k}) \cdot (\vec{4i} - \vec{2j} + \vec{3k})$

$= 8(\vec{i} \cdot \vec{i}) - 6(\vec{j} \cdot \vec{j}) + 12(\vec{k} \cdot \vec{k})$

$= 8 - 6 + 12$

$= 2+12$

$= 14$ units

cross product $\Rightarrow \vec{A} \times \vec{B}$

$$= \begin{vmatrix} i & j & k \\ 2 & 3 & 4 \\ 4 & -2 & 3 \end{vmatrix}$$

$$= i(9-(-8)) - j(6-16) + k(-4-12)$$

$$= i(17) + j(10) - k(16)$$

$$= 17i + 10j - 16k$$

7. Given,

$\vec{A} = 3\vec{i} + 6\vec{j} - 2\vec{k}$

Magnitude

$$|\vec{A}| = \sqrt{(3)^2 + (6)^2 + (-2)^2}$$

$$= 7$$

$$\text{unit vector} = \frac{\text{vector}}{\text{magnitude}}$$

$$= \frac{3i + 6j - 2k}{7}$$

* 4051 *

C14–M–103/C14–CHOT–103/C14–RAC–103

4051

BOARD DIPLOMA EXAMINATION, (C–14)

MARCH/APRIL—2016

DME–FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. Write the dimensional formulae of *(a)* latent heat, *(b)* momentum and *(c)* acceleration.

2. State triangle law of vectors. Draw a diagram for it.

3. Derive an expression for maximum height for a body projected vertically up.

4. Find the value of acceleration due to gravity at a place where the length of the seconds pendulum is 0·9 m.

5. Define *(a)* gas constant and *(b)* universal gas constant.

6. Write any three characteristics of musical sound.

7. Define surface tension. Write any one example of it.

8. Write the Newton's formula for viscous force and hence define coefficient of viscosity.

9. State the Kirchhoff's laws.

10. Define critical angle and total internal reflection.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* Define dot product of two vectors. 2

(b) Write any four properties of dot product. 4

(c) If a vector $\vec{A} = 2\vec{i} + \vec{j} - 2\vec{k}$ and $\vec{B} = 2\vec{i} - 3\vec{j} + 2\vec{k}$ are two adjacent sides of a parallelogram, find the area of parallelogram. 4

12. *(a)* Show that the path of a horizontally projected body is a parabola. 6

(b) A bullet is fired at an angle of 45° with horizontal with a velocity of 49 m/sec. Find the time of flight and horizontal range. 4

13. *(a)* Derive the expression for acceleration of a body moving down the rough inclined plane with diagram. 5

(b) Write any four advantages of friction. 5

14. *(a)* Define work done, power and energy. Write their SI units. 6

(b) An engine is used to lift water from a well 50 m deep to fill a tank of dimensions 5 m × 5 m × 10 m in 50 minute. Find the power of the engine. 4

15. *(a)* Derive the expression for velocity and acceleration in simple harmonic motion. 6

(b) A particle executing SHM with a period of 10 seconds and amplitude 1·5 m. Calculate the maximum velocity. 4

16. *(a)* Prove $C_p - C_v = R$. 6

(b) The volume of a gas is 20 c.c. at 27 °C. Pressure remaining constant. What is the temperature at which the volume of the gas is 40 c.c.? 4

17. *(a)* Define echo. 2

(b) What is Doppler effect? Write any four applications of it. 6

(c) Write Sabine's formula. 2

18. *(a)* State and explain Ohm's law. 4

(b) Derive an expression for magnetic induction field strength (B) at a point on the axial line of a bar magnet. 6

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C14–EE–103/C14–CHPP–103

4042

BOARD DIPLOMA EXAMINATION, (C–14)
MARCH/APRIL—2016
DEEE–FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. Write the base and supplementary units of SI system along with their symbols.

2. Define scalars and vectors and give one example for each.

3. A body is thrown up vertically with a velocity of 19·6 m/s. Find the maximum height reached by the body.

4. State the conditions of SHM.

5. Write any three differences between specific gas constant and universal gas constant.

6. Define beats and write any two applications of beats.

7. Define capillarity and give two examples.

8. Define coefficient of viscosity and write its SI unit and dimensional formula.

9. Define magnetic lines of force and magnetic field.

10. Write any three applications of optical fibers.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* Define scalar product. Mention any five properties of scalar product. 2+5

(b) A force of $(3\hat{i}+2\hat{j}+5\hat{k})$ N acts on a body and produces a displacement of $(3\hat{i}-2\hat{j}+\hat{k})$ m. Calculate the work done. 3

12. *(a)* Derive the expression for maximum height and time of flight of a projectile in oblique projection. 6

(b) A stone is projected upwards from the top of a tower with a velocity of 9·8 m/s. It reaches the ground in 4 seconds. Find the height of the tower. 4

13. *(a)* State any three laws of friction. 3

(b) Write any two advantages of friction. 2

(c) Derive the expression for acceleration of a body projected up on a rough inclined plane with necessary diagram. 5

14. *(a)* State work-energy theorem. 2

(b) Derive an equation for the kinetic energy of a body. 4

(b) A machine gun fires 360 bullets per minute and each bullet travels with a velocity of 600 m/s. If the mass of each bullet is 5 gram, find the power of the machine gun. 4

15. *(a)* Derive the expression for velocity and time period of a particle executing SHM. 7

(b) The displacement of a particle executing SHM is given by the equation $y = 5\sin[2\pi t + \pi/6]$. Find in SI units—

(i) amplitude;

(ii) initial displacement;

(iii) epoch. 3

16. *(a)* Prove that $C_p - C_v = R$. 6

(b) State the first and second laws of thermodynamics. 4

17. *(a)* Define longitudinal wave motion. 2

(b) Define echo. Write any two applications of echo. 4

(c) Calculate the velocity of sound in air if an observer at a distance of 425 m from a building hears an echo after 2·5 s. 4

18. *(a)* State Kirchhoff's laws of electricity. 4

(b) Derive an expression for the balancing condition of Wheatstone's bridge with circuit diagram. 6

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* 4035 *

C14–EC–103/C14–CHPC–103/C14–PET–103

4035

BOARD DIPLOMA EXAMINATION, (C–14)

MARCH/APRIL—2016

DECE—FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. Write any three limitations of dimensional analysis.

2. Define scalars and vectors. State whether the following are scalars or vectors :

(a) Mass

(b) Velocity

3. Derive an expression for time of descent for a body in vertical motion.

4. The displacement of a particle in SHM formulated $y = 6\sin\left(4\pi t + \frac{\pi}{3}\right)$. Calculate its amplitude, angular velocity and time period.

5. In the gas equation $PV = RT$, what is R? Write ideal gas equation for n moles.

6. Write Sabine's formula and name its factors of influence.

7. Define surface tension and any two examples.

8. Write Poiseuille's expression for coefficient of viscosity of a liquid and write the dimensional formula for coefficient of viscosity.

9. The resistance of a wire is 8 Ω, what is the resistance of the another wire of same material having same length but of double area of cross section?

10. What is an optical fiber? Name different types of optical fiber.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* Define vector product of two vectors. 2

(b) Write the properties of vector product. 4

(c) A force of 200 N is inclined at an angle 30° to the horizontal. Find the components in the vertical and horizontal directions. 4

12. *(a)* Show that the path of the horizontal projectile is parabola. 4

(b) A football is projected into air with velocity 10 m/s and angle 30° with the earth surface. Find its maximum height, time of ascent and range. Take $g = 10\ m/s^2$. 6

13. *(a)* Write any four methods to minimize friction. 4

(b) Define static friction, kinetic friction and rolling friction. 6

14. *(a)* State the law of conservation of energy. Write any two examples of it. 4

(b) An engine lifts 4000 kg of water per minute from a wll 5 m depth If 20% energy is wasted, then find the power of the engine. 3

15. *(a)* Define the terms time period, frequency and amplitude. 3

(b) Derive the expression for period of oscillation of a simple pendulum. 7

16. *(a)* Define the two molar specific heats of a gas. 3

(b) Prove that $C_p - C_v = R$. 7

17. *(a)* State six methods of controlling noise pollution. 6

(b) Define Doppler Effect and write its applications. 2+2=4

18. *(a)* Derive an expression for magnetic induction field strength at a point on the axial line of a bar magnet. 6

(b) Derive formula for the moment of couple acting on bar magnet placed inside uniform magnetic field. 4

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4016

C14–C–103/C14–CM–103

4016

BOARD DIPLOMA EXAMINATION, (C–14)

MARCH/APRIL—2016

DCE–FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. Write the dimensional formulae for the following physical quantities :

(a) Force

(b) Universal gravitational constant

(c) Coefficient of friction

2. A force of $(2\vec{i} + 3\vec{j} + 5\vec{k})\, n$ acts on a particle having the position vector $(3\vec{i} + 12\vec{j} + 6\vec{k})\, m$. Find the torque.

3. Define projectile. Give two examples.

4. Define SHM and give one example.

5. Write any three differences between gas constant and universal gas constant.

6. Define beats. Write two applications of beats.

7. Define surface tension and capillarity. Give one example for each.

8. Write the Poiseuille's equation for coefficient of viscosity and explain the terms involved.

9. State and explain Coulomb's inverse square law of magnetism.

10. Write any three applications of optical fibres.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* State the parallelogram law of vector addition, derive the expression for magnitude and direction of resultant vector. 7

(b) If $\vec{A} = \vec{i} + 2\vec{j} + x\vec{k}$ and $\vec{B} = 4\vec{i} + 2\vec{j} - 2\vec{k}$ are perpendicular vectors, find the value of *x*. 3

12. *(a)* Show that in the case of body thrown up vertically, the time of ascent is equal to time of descent. 6

(b) An aeroplane flying horizontally with a speed of 360 kmph releases a bomb at a height of 490 m from the ground. When and where will the bomb strike the ground? 4

13. *(a)* Define friction and write any two advantages of friction. 3

(b) Explain any four methods to reduce the friction. 4

(c) A body is sliding down a rough inclined plane which makes an angle 30° with the horizontal. Calculate the acceleration if coefficient of friction $\mu = 0{\cdot}1$. 3

14. *(a)* State law of conservation of energy and verify it in the case of freely falling body. 7

(b) A force acts on a body of mass 2 kg increases its velocity from $5\ \text{ms}^{-1}$ to $10\ \text{ms}^{-1}$. Find the work done by it. 3

15. *(a)* Derive the expression for velocity and acceleration of a particle executing simple harmonic motion. 6

(b) The time period of a simple pendulum of length 50 cm is 1·41 second. Find the value of *g* at that place. 4

16. *(a)* Define ideal gas and write ideal gas equation in terms of density. 2

(b) Explain why universal gas constant is same for all gases. 4

(c) A gas at a pressure of $10^5\ \text{N-m}^{-2}$ is allowed to expand isothermally until its volume is doubled. Find its final pressure. 4

17. *(a)* What is echo? Write two applications of echo. 3

(b) Write Sabine's formula and explain the terms. 3

(c) Write any four effects of noise pollution. 4

18. *(a)* Define magnetic moment and magnetic induction field strength. 4

(b) Derive the balancing condition for Wheatstone's bridge. 6

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* 4051 *

C14–M/CHOT/RAC–103

4051

BOARD DIPLOMA EXAMINATION, (C–14)

OCT/NOV—2016

DME–FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. What are the applications of dimensional analysis?

2. Define scalars and vectors. Write two example for each.

3. Define time of flight and range of a projectile.

4. Write any three conditions of SHM.

5. What is the relation between centigrade scale and Kelvin scale? Find the boiling point of water on Kelvin scale.

6. Define reverberation and reverberation time.

7. Define surface tension. Write two examples.

8. Write about Newton's formula for viscous force.

9. Each pole of a bar magnet experiences a force of 4×10^{-4} N when placed in a uniform magnetic field of induction 2×10^{-5} N/A-m. Calculate the pole strength of the bar magnet.

10. Write any three laws of Photoelectric effect.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* Define scalar product. 2

(b) State and explain polygon law of addition of vectors. 4

(c) Find the resultant of forces 3 N and 4 N acting at right angles to each other. 4

12. *(a)* Show that the path of a projectile in oblique projection is parabola. 6

(b) A gun fires a bullet horizontally with a certain velocity from an elevation of 9·8 m. If it hits the ground at a distance 9·8 m from the foot of elevation, find the velocity of the bullet at the beginning. 4

13. *(a)* Write any four methods of reducing friction. 4

(b) Derive equation for acceleration of a body sliding down on a rough inclined plane. 6

14. *(a)* State and prove law of conservation of energy in case of a freely falling body. 2+5=7

(b) The potential energy acquired by a body when it is carried to a height of 80 m is 7840 J. Find the mass of the body. 3

15. *(a)* Derive equation for time period of a simple pendulum. 8

(b) Define SHM with two examples. 2

16. *(a)* Derive ideal gas equation $PV = nRT$. 6

(b) State 1st law and 2nd law of thermodynamics. 4

17. *(a)* Write any six effects of noise pollution. 6

(b) Define Doppler effect. Write its two applications. 4

18. *(a)* Derive expression for balancing condition of Wheatstone bridge. 6

(b) A balancing point in a metre bridge experiment is obtained at 30 cm from the left. If the right gap contains 3·5 ohm, what is the resistance in the left gap? 4

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* 4042 *

C14–EE–103/C14–CHPP–103

4042

BOARD DIPLOMA EXAMINATION, (C–14)

OCT/NOV—2016

DEEE—FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. State the applications of dimensional analysis.

2. A force of 40 N is inclined at an angle of 60° to the vertical. Find its horizontal and vertical components of force.

3. When a stone is dropped into a well, the splash of sound is heard after 3·91 s. If the depth of the well is 67·6 m, find the velocity of sound.

4. Write the laws of simple pendulum.

5. Calculate the value of universal gas constant, R.

6. Write any three differences between musical sound and noise.

7. Define stress, strain and Hooke's law.

8. Write about Poiseuille's formula of coefficient of viscosity.

9. Define specific resistance and write equation for it.

10. Explain the working of optical fiber.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* State parallelogram law of addition of vectors, and derive equation for magnitude of resultant of two vectors. 6

(b) Two vectors $2\hat{i}+a\hat{j}+\hat{k}$ and $3\hat{i}-\hat{j}-\hat{k}$ are perpendicular to each other. Calculate the value of a. 4

12. *(a)* Derive equations for *(i)* range and *(ii)* time of flight of projectile in oblique projection. 6

(b) In oblique projections for what angle of projection, the maximum height is equal to range? 4

13. *(a)* Define static friction, kinetic friction and rolling friction. 6

(b) Write any four laws of friction. 4

14. *(a)* State and prove law of conservation of energy. 6

(b) A stone of mass 10 kg is allowed to fall freely from a height of 10 m. Find the kinetic energy on reaching the ground. 4

15. *(a)* Derive equations for *(i)* velocity and *(ii)* acceleration of a particle in SHM. 6

(b) The acceleration of a particle in SHM is 4 units, when its displacement is 1 unit. Find its frequency of oscillation. 4

16. *(a)* Define specific heats of a gas at constant volume and at constant pressure. 4

(b) Show that $C_p - C_v = R$. 6

17. *(a)* Define Doppler effect and write any three applications. 5

(b) Write any five methods of reducing noise pollution. 5

18. *(a)* Derive equation for magnetic induction field strength at a point on the equitorial line of a bar magnet. 6

(b) Define magnetic field strength and magnetic moment. 4

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4035

C14–EC–103/CHPC/PET–103

4035

BOARD DIPLOMA EXAMINATION, (C–14)

OCT/NOV—2016

DECE—FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. Write three limitations of dimensional analysis.

2. A force of 50 N is acting on a body at an angle of 30° to the horizontal. Find its horizontal and vertical components.

3. Define projectile and give examples.

4. State the laws of simple pendulum.

5. Define absolute zero and write the relation between absolute temperature and centigrade temperature.

6. Write any three differences between musical sound and noise.

7. Define stress and strain. State Hooke's law.

8. Define angle of contact and write the formula for surface tension based on capillarity.

9. Define magnetic induction field strength and write its SI unit.

10. Write any three applications of superconductivity.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* Define vector product. Mention any five properties of vector product. 2+5

(b) Find the vector product of two vectors $\vec{A} = 2\vec{i} - 3\vec{j} + 4\vec{k}$ and $\vec{B} = \vec{i} - 6\vec{j} + 5\vec{k}$. 3

12. *(a)* Derive the expression for height of a tower when a body is projected vertically upwards from the top of a tower. 6

(b) An aeroplane flying horizontally with a speed of 360 km/hr releases a bomb at a height of 490 m from the ground. When and where will the bomb strike the ground? 4

13. *(a)* Obtain an expression for the displacement and time taken for a body to come to rest on rough horizontal surface. 6

(b) A body is sliding down a rough inclined plane which makes an angle of 30° with the horizontal. Calculate the acceleration if the coefficient of friction is 0·25. 4

14. *(a)* Define work, power and energy, and write their SI units. 6

(b) A man weighing 80 kg lifts a weight of 20 kg to the top of a building of 30 m height in 131 seconds. Find the work done and the horsepower. 4

15. *(a)* Derive the formula for time period in case of simple pendulum. 7

(b) The acceleration of a particle executing SHM is 0·09 m/s^2 at a displacement of 0·25 m from the mean position. Find the time period. 3

16. *(a)* State gas laws. 3

(b) Derive the ideal gas equation. 5

(c) Why is universal gas constant same for all gases? 2

17. *(a)* Define Doppler effect. 2

(b) Write any four applications of Doppler effect. 4

(c) State the conditions of good auditorium. 4

18. *(a)* State Ohm's law and define specific resistance. 4

(b) Describe meter bridge with a legible sketch. 6

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* 4016 *

C14–C/CM–103

4016

BOARD DIPLOMA EXAMINATION, (C–14)

OCT/NOV—2016

DCE–FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. Define dimensional formula of a physical quantity. Write the dimensional formula of force.

2. Define scalar and vector quantities and give two examples of each.

3. Derive an expression for maximum height reached by a vertically projected body.

4. Define the terms amplitude, frequency and time period of a particle executing simple harmonic motion.

5. Define isothermal process and adiabatic process.

6. Mention any three conditions for a good auditorium.

7. Define angle of contact and capillarity.

8. Write Poiseuille's formula for coefficient of viscosity and name the terms involved in it.

9. State Coulomb's inverse square law of magnetism. Write the equation for it.

10. Write any three applications of superconductors.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* Define dot product. 2

(b) Write any four properties of dot product. 4

(c) Find the work done by a force $\vec{F} = 3\vec{i} + 5\vec{j} + \vec{k}$ which produces a displacement of $\vec{S} = 2\vec{i} + \vec{j} + 4\vec{k}$. 4

12. *(a)* Define acceleration due to gravity. 1

(b) Derive an equation for the height of a tower, when a body is projected vertically upwards from the top of the tower. 5

(c) A body is thrown up vertically with a velocity of 9·8 m/s from the top of a tower and reaches the ground in 4 seconds. Find the height of the tower. 4

13. *(a)* Define static, kinetic and rolling friction. 3

(b) State laws of friction. 3

(c) Derive expression for acceleration of a body on a rough horizontal surface. 4

14. *(a)* Write relation between kinetic energy and momentum. 1

(b) Derive the expression for kinetic energy of a body of mass *m* moving with a velocity *v*. 5

(c) A gun fires 200 bullets per minute. If the mass of each bullet is 3 gm and velocity is 500 m/s, find the power of the gun. 4

15. *(a)* Derive an expression for the time period of oscillations of a simple pendulum. 6

(b) A simple pendulum of length 0·5625 m has a period of 1·5 seconds. Find the length of the seconds pendulum. 4

16. *(a)* Show that $C_p - C_v = R$. 6

(b) A gas at 13 °C has its temperature raised so that its volume is doubled, the pressure remaining constant. Calculate the final temperature. 4

17. *(a)* Write any two causes and four effects of noise pollution. 6

(b) Write any four differences between musical sound and noise. 4

18. *(a)* State Kirchhoff's first and second laws. 4

(b) Apply Kirchhoff's laws to Wheatstone bridge and obtain the formula for balancing condition. 6

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* 4051 *

C14–M/CHOT/RAC–**103**

4051

BOARD DIPLOMA EXAMINATION, (C–14)

MARCH/APRIL—2017

DME—FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.
(2) Each question carries **three** marks.
(3) Assume required data.

1. Write base quantities and their units in SI system.

2. If $\vec{A} = 4\vec{i} + 3\vec{j} + 6\vec{k}$ and $\vec{B} = \vec{i} + 3\vec{j} + 2\vec{k}$, find $\vec{A}.\vec{B}$.

3. Write the equations of motion for a freely falling body.

4. Define amplitude, time period and frequency in SHM.

5. Write three differences between isothermal and adiabatic changes.

6. Define Doppler effect. Mention two examples.

7. Define stress and strain.

8. Define coefficient of viscosity. Mention its SI unit.

9. State Kirchhoff's current law and write its mathematical form.

10. Define superconductor. Mention two applications.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.
(2) Each question carries **ten** marks.
(3) Assume required data.

11. *(a)* State parallelogram law of vectors. Derive the expression for the magnitude of the resultant vector. 6

 (b) Two equal forces 100 N each are acting at right angles. Find their resultant. 4

12. *(a)* Show that the path of a projectile is a parabola in oblique projection. 6

 (b) A warplane flying with a velocity of 100 m/s releases a bomb from a height of 490 m. Find when and where the bomb will strike the ground ($g = 9 \cdot 8\,\text{m/s}^2$). 4

13. *(a)* State the laws of limiting friction. 4

 (b) Derive the expression for the acceleration of a body sliding down a rough inclined plane with neat diagram. 6

14. *(a)* Define work, power and energy. 3

 (b) Derive $PE = mgh$. 3

 (c) A person carries a rice bag of 100 kg to a height of 18 m in 5 minutes. Calculate the work done and power developed. 4

15. *(a)* State four conditions of SHM. 4

 (b) Derive the expressions for velocity and acceleration of a particle in SHM. 6

16. *(a)* Derive ideal gas equation $PV = RT$. 6

 (b) Calculate the value of universal gas constant at NTP. 4

17. *(a)* Define noise pollution. State four methods of control of noise pollution. 5

 (b) State three conditions of a good auditorium. 3

 (c) State two applications of beats. 2

18. *(a)* State Coulomb's law of magnetism and write its mathematical form. 3

 (b) Draw Wheatstone bridge circuit and derive the formula for its balanced condition. 7

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* 4042 *

C14–EE/CHPP–103

4042

BOARD DIPLOMA EXAMINATION, (C–14)
MARCH/APRIL—2017
DEEE–FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.
(2) Each question carries **three** marks.
(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. Write the dimensional formulae of *(a)* work done, *(b)* momentum and *(c)* specific heat.

2. Find the dot product of two vectors $\vec{A} = 2\vec{i} + 3\vec{j} + 4\vec{k}$ and $\vec{B} = \vec{i} - 2j + \vec{k}$.

3. If a body is thrown up with a velocity of 100 m/sec, find the time of ascent and time of descent ($g = 10\,\text{m/s}^2$).

4. Calculate the length of a seconds pendulum at the equator where the value of g is 9·78 ms^{-2}.

5. Why $C_p > C_v$? Answer briefly.

6. Write three applications of beats.

7. Define elasticity. Name any two elastic substance.

8. Write the Newton's formula for a viscous force and name the symbols in the equation.

9. Define specific resistance and write its SI unit.

10. Write any three applications of optical fiber.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.
(2) Each question carries **ten** marks.
(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* Define vector product and write any four properties of vector product. 6

(b) A force of 200 N is acting on a body at an angle of 60° to the horizontal. Find the horizontal and vertical components of force. 4

12. *(a)* Define projectile, give three examples. 5

(b) A stone is projected vertically upwards from the top of a tower with a velocity of 4·9 ms^{-1}. If it reaches the ground after 5 seconds, find the height of the tower. 5

13. *(a)* Write the advantages of friction. 5

(b) Define and derive the angle of friction, $\tan\theta = \mu_s$. 5

14. *(a)* Define potential energy. Give two examples. 4

(b) If F is the force and S is the displacement then find the work done when $\theta = 0°$, $\theta = 90°$ and $\theta = 180°$. 6

15. *(a)* Show that the motion of the projection of a point in circular motion is simple harmonic in nature.

(b) The displacement of a particle in SHM is given by $y = 6\sin(2\pi t + \pi/3)$m. Find—
(i) amplitude;
(ii) initial phase;
(iii) angular velocity;
(iv) initial displacement.

16. *(a)* Define absolute zero temperature. 2

(b) Calculate the value of universal gas constant and write its units and dimensional formulae. 4

(c) State the first and second laws of thermodynamics. 4

17. Define noise pollution. Write the *(a)* 3 causes of noise pollution, *(b)* 3 effects of noise pollution and *(c)* 4 methods to reduce noise pollution. 10

18. *(a)* Derive an expression for balancing of Wheatstone Bridge by using Kirchhoff's laws and show $P/Q = R/S$. 6

(b) Derive the equation for moment of couple on a bar magnet placed in a uniform magnetic field. 4

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* 4035 *

C14–EC/CHPC/PET–**103**

4035

BOARD DIPLOMA EXAMINATION, (C–14)

MARCH/APRIL—2017

DECE—FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answer should be brief and straight to the point and shall not exceed *five* simple sentences.

1. Write any three limitations of dimensional analysis.

2. State and explain the triangle law of vectors.

3. Define projectile and give two examples.

4. A body is executing SHM with an acceleration of $0{\cdot}4\ m/s^2$ at a displacement of 0·6 m. Find its acceleration at a displacement of 0·4 m.

5. Define absolute zero and absolute scale of temperature.

6. Define echoes and write two applications.

7. Define capillarity and write two applications.

8. What is the effect of temperature on surface tension of a liquid viscosity of liquids and gases?

9. Explain Coulomb's inverse square law of magnetism.

10. Write any three applications of superconductor.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* Write any three properties of *(i)* scalar product and *(ii)* vector product. 6

(b) Find the unit vector in the direction of $3\vec{i}+6\vec{j}-2\vec{k}$. 4

12. *(a)* Derive equations for *(i)* maximum height and *(ii)* time of ascent in case of oblique projection. 6

(b) A stone is thrown up vertically with a velocity of 98 m/s. Find the total distant travelled before it reaches the ground. 4

13. *(a)* Define angle of friction and angle of repose. 4

(b) Derive an equation for acceleration of a body sliding down a rough horizontal surface with a neat diagram. 6

14. *(a)* Derive $KE=\frac{1}{2}mv^2$. 6

(b) The mass of a body is reduced to half and the velocity is doubled. What is the kinetic energy of the body? 4

15. *(a)* Show that the path followed by the tip of projection of a body in circular path along the diameter of the circle is SHM. 6

(b) The length of a simple pendulum is 50 cm. Find the time period and frequency of oscillation. 4

16. *(a)* Explain isothermal process and adiabatic process. 6

(b) A cylinder contains 90·3 cc of a gas at 17 °C and 735 mm of Hg pressure. Find its volume at NTP. 4

17. *(a)* Define 'beats' and write any three applications. 5

(b) Write any five conditions of good auditorium. 5

18. *(a)* Derive an equation for magnetic induction field strength at a point on the axial line of a bar magnet. 6

(b) State Kirchhoff's 1st law and 2nd law. 4

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* 4016 *

C14–C/CM–103

4016

BOARD DIPLOMA EXAMINATION, (C–14)
MARCH/APRIL—2017
DCE–FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. Write the advantages of the SI units.

2. Find the unit vector in the direction of $2\vec{i} - 3\vec{j} + 4\vec{k}$.

3. A ball is thrown at an angle of 30° to the horizontal with an initial velocity of 20 m/s. Find its maximum height reached.

4. Define seconds pendulum. Determine the length of seconds pendulum on the surface of earth, where value of g is 10 m/s^2.

5. State Boyle's law and write it in terms of density.

6. Define Sabine's formula. Write the equation for it.

7. Define stress and strain.

8. Define surface tension and give two examples.

9. Define specific resistance and state its SI units.

10. Define photoelectric effect. Write two applications of photoelectric cell.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* State parallelogram law of vectors. Derive the equation for magnitude of the resultant. 2+4=6

 (b) Find the dot product and cross-product of two vectors $A = 2\vec{i} + 3\vec{j} + 4\vec{k}$ and $B = 4\vec{i} - 2\vec{j} + 3\vec{k}$ 2+2=4

12. *(a)* Derive expression for the maximum height range of a projectile in oblique projection. 3+3=6

 (b) A bullet is projected with a velocity of 196 m/s at an angle of 30° to the horizontal. Find the greatest height attained and its time of flight. 2+2=4

13. *(a)* State the laws of static friction. 3

 (b) Derive the expression for acceleration of a body sliding down on a rough inclined plane. 7

14. *(a)* Define potential energy and give two examples. 3

 (b) Derive expression for kinetic energy. 4

 (c) A bullet of mass 10 grams is fired with a velocity 300 m/s. Find its kinetic energy. 3

15. *(a)* Define SHM and give two examples. 3

 (b) Define the terms amplitude time period, phase of a particle in SHM. 3

 (c) Derive expression for *(i)* displacement and *(ii)* velocity of a body in SHM. 4

16. *(a)* State gas laws. Derive the ideal gas equation $PV = RT$. 7

 (b) The volume of a gas at 30 °C is 200 cc. What is the volume of the gas if the temperature of the gas is raised to 100 °C at constant pressure? 3

17. *(a)* Explain the effects of noise pollution. 5

 (b) Explain the methods of reducing of noise pollution. 5

18. *(a)* Derive the condition for balancing point in Wheatstone bridge. 6

 (b) State Coulomb's inverse square law of magnetism. Write the equation for couple acting on a bar magnet placed in a uniform magnetic field. Explain the terms. 2+2=4

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* 6053 *

C16–M/CHOT/RAC–103

6053

BOARD DIPLOMA EXAMINATION, (C–16)

MARCH/APRIL—2017

DME—FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.
(2) Each question carries **three** marks.
(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. Write the dimensional formulae for the following physical quantities :

(a) Force

(b) Power

(c) Stress

2. State triangle law of vectors.

3. A stone is dropped from a balloon ascending with uniform vertical velocity of 23·2 m/s and reaches the ground in 10 s. Find the height of the balloon when the stone reaches the ground. Take the value of g as 9·8 m/s^2.

4. A particle is performing SHM with an amplitude of 0·5 m and has an angular velocity 1000 rad/s. Find its velocity at a distance 0·3 m from the mean position.

5. Define two molar specific heats of a gas.

6. Define echo and give two applications.

7. Define Hooke's law and angle of contact.

8. Write Newton's formula for viscous force. Name the symbols.

9. Define specific resistance and conductance.

10. Write any three applications of photoelectric effect.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.
(2) Each question carries **ten** marks.
(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* Define vector product and write properties of vector product. 6

(b) Two vectors $A = 3i + aj + 3k$ and $B = 3i - j - k$ are perpendicular to each other. Calculate the value of constant a. 4

12. *(a)* Show that the path is parabola in the case of body projected horizontally from the top of a tower. 6

(b) An object is thrown vertically up with initial velocity 39·2 m/s. 4

13. *(a)* Explain methods of reducing friction. 4

(b) Derive expression for acceleration of a body, sliding down on smooth inclined plane. 6

14. *(a)* State the law of conservation of energy and prove it in the case of a freely falling body. 7

(b) If the mass of a body is reduced to half and velocity is doubled, how does its KE change? 3

15. *(a)* Define second's pendulum. 2

(b) Derive expression for displacement of a body in SHM. 5

(c) Calculate the length of the second's pendulum at a place where the value of g is 9·8 m/s^2. 3

16. *(a)* State any five differences between isothermal process and adiabatic process. 5

(b) Define absolute zero temperature. 2

(c) One litre of air is heated from 27 °C to 177 °C at constant pressure. Find the increase in volume of the gas. 3

17. *(a)* Write any six causes for noise pollution. 6

(b) Define beats and write two applications of beats. 4

18. *(a)* Explain 'Wheatstone bridge' and derive expression while bridge is balanced. 6

(b) State Coulomb inverse square law of magnetism. 4

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* 6036 *

C16–EE/CHPP–103

6036

BOARD DIPLOMA EXAMINATION, (C–16)

MARCH/APRIL—2017

DEEE—FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A

3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. State the limitations of dimensional analysis.

2. Define dot product. Give one example.

3. A stone is thrown vertically up with an initial velocity of 14 m/s. Find its maximum height.

4. Define SHM and give two examples.

5. State any three differences between *r* and *R*.

6. Define reverberation and reverberation time.

7. Define capillarity and angle of contact.

8. Define viscosity and give two examples of viscosity.

9. Define magnetic field and magnetic induction field strength.

10. Write any three properties of superconductors.

PART—B

10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* State parallelogram law of addition of vectors and derive the expression for the magnitude and direction of resultant vector. 7

(b) A force of $2i + 10j - 6k$ N produces displacement $8i + 2j + k$ m. Find the work done. 3

12. *(a)* Show the path of the projectile is parabola in the case of oblique projection. 6

(b) A body is projected at an angle of 30° with horizontal with a velocity of 19·6 m/s. Calculate *(i)* maximum height *(ii)* time of flight. 4

13. *(a)* State the laws of friction. 4

(b) Derive the expression for acceleration of a body, sliding up on rough inclined plane. 6

14. *(a)* Define kinetic energy. 2

(b) Derive an expression for the KE. 5

(c) A body of mass 20 kg is lifted to the height 3 m from the ground. Find the work done. 3

15. *(a)* Derive an expression for the time period of simple pendulum. 7

(b) Calculate *(i)* amplitude, *(ii)* angular velocity, *(iii)* time period of a particle in SHM whose displacement is $y = 5\sin(10t + 60°)$. All values are in SI unit. 3

16. *(a)* Show that $C_p - C_v = R$. 6

(b) The pressure of gas at temperature 27 °C is 70 mm of Hg. Find its pressure at temperature 227 °C, if it is heated at constant volume. 4

17. *(a)* Write the six methods of controlling noise pollution. 6

(b) Write four applications of Doppler effect. 4

18. *(a)* State and explain Ohm's law. 4

(b) Derive an expression for magnetic induction filed strength at a point on the equatorial line of a bar magnet. 6

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6029

C16–EC/CHPC/PET–103

6029

BOARD DIPLOMA EXAMINATION, (C–16)

MARCH/APRIL—2017

DECE—FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. Write three advantages of SI units.

2. A force is acting on a body making an angle 60° to the horizontal. The value of vertical component is 150 N. Find the actual force and horizontal component of force.

3. Define time of flight and range of a projectile.

4. State three conditions of simple harmonic motion.

5. State Charles' 1st law and 2nd law. What is the boiling point of water on Kelvin scale?

6. List three applications of Doppler effect.

7. Define stress and strain. Write their SI units.

8. Define surface tension. Write its SI unit.

9. State Ohm's law. Draw a neat sketch of Wheatstone's bridge indicating the directions of current flowing in different parts of the circuit.

10. State the laws of photoelectric effect.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* Define dot product of two vectors. Express work done by a force as dot product. 2+2

(b) Two forces 30 N and 40 N act at a point simultaneously at right angles to each other. Find the magnitude and direction of the resultant. 6

12. *(a)* Derive an expression for the height of a tower when a body is projected vertically upwards from the top of the tower with a velocity u and reaches the foot of the tower in a time t. 5

(b) A stone is thrown vertically up with a velocity of 19·6 m/s from the top of a building. If it reaches the ground in 6 seconds, find the height of the building. 5

13. *(a)* Define normal reaction. 2

(b) State the laws of friction. 4

(c) What is the work done in dragging a body of mass 200 kg through a distance of 80 m on a level road, if the coefficient of friction is 0·25? 4

14. *(a)* Verify the law of conservation of energy in case of a freely-falling body. 6

(b) A body of mass 100 kg is allowed to fall from a height of 50 m from the ground. Calculate its potential and kinetic energy at a height of 30 m from the ground. 4

15. *(a)* State the laws of simple pendulum. 3

(b) Derive the expression for the time period of oscillations of a simple pendulum with necessary diagram. 7

16. *(a)* State Boyle's law. 2

(b) Write four differences between isothermal and adiabatic processes. 4

(c) A cylinder contains 90·3 cc of gas at 17 °C and 735 mm pressure. Find its volume at NTP. 4

17. *(a)* Write any four methods to control noise pollution. 4

(b) State the conditions of a good auditorium. 4

(c) A boy hears an echo of his own voice from a distant hill after 2 seconds. If the velocity of sound is 340 m/s, what is the distance of the hill from the boy? 2

18. *(a)* Define magnetic moment and magnetic induction field strength. 4

(b) Derive the expression for moment of couple on a bar magnet placed in a uniform magnetic field. 6

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* 6018 *

C16–C/CM–103

6018

BOARD DIPLOMA EXAMINATION, (C–16)

MARCH/APRIL—2017

DCE—FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. Write the dimensional formulae of the following :

(a) Velocity

(b) Force

(c) Frequency

2. Write three properties of scalar product.

3. Define projectile. Give two examples.

4. The simple harmonic motion of a body is given by the equation $y = 4\sin\left(100t + \frac{\pi}{4}\right)$. Find *(a)* angular velocity, *(b)* time period and *(c)* initial displacement.

5. State first and second laws of thermodynamics.

6. Write three differences between musical sound and noise.

7. Define stress and strain. State Hooke's law.

8. Obtain Newton's formula for viscous force.

9. State and explain Coulomb's inverse square law of magnetism.

10. List three applications of optical fiber.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* Derive the expression for magnitude of resultant of two vectors using parallelogram law of vectors. 6

(b) A force of 150 N acts on a particle at an angle of 30° to the horizontal. Find the horizontal and vertical components of force. 4

12. *(a)* Show that path of a projectile is a parabola in case of oblique projection. 6

(b) A stone is projected with a velocity of 20 m/s at an angle of 30° to horizontal. After 1·5 seconds, find its horizontal distance and vertical height from its starting point. 4

13. *(a)* State any five advantages of friction. 5

(b) A body is sliding down a rough inclined plane which makes an angle of 30° with the horizontal. Calculate the acceleration if the coefficient of friction is 0·25. 5

14. *(a)* Derive the expression for kinetic energy. 5

(b) A machine gun fires 240 bullets per minute with a velocity of 500 m/s. If the mass of each bullet is 3 gm, find the power of the machine gun. 5

15. *(a)* Define simple harmonic motion. Give three examples. 5

(b) Derive an expression for velocity of a particle performing simple harmonic motion. Draw necessary diagram. 5

16. *(a)* Define the two molar specific heats of a gas. 4

(b) Derive the ideal gas equation. 6

17. *(a)* Define noise pollution. 2

(b) Write any four effects of noise pollution. 4

(c) State four applications of beats. 4

18. *(a)* Derive an expression for balancing condition of Wheatstone's bridge with neat circuit diagram. 6

(b) The values of resistance of *P*, *Q*, *R* are 50 ohms, 10 ohms, 15 ohms respectively in the balanced condition of the bridge. Find the unknown resistance *S*. 4

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* 6053 *

C16–M–103/C16–CHOT–103/C16–RAC–103

6053

BOARD DIPLOMA EXAMINATION, (C–16)

OCT/NOV—2017

DME—FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.
(2) Each question carries **three** marks.
(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. State the limitations of dimensional analysis.

2. Define scalars and vectors. Write one example for each.

3. Define acceleration due to gravity. Write its SI unit and dimensional formula.

4. Calculate the length of seconds pendulum at a place where $g = 9 \cdot 8 \text{ m/s}^2$.

5. Write three differences between universal gas constant (R) and specific gas constant (r).

6. Write any three applications of echoes.

7. Define surface tension and give one example.

8. Define stress. Write its SI unit and dimensional formula.

9. Calculate the potential difference to be applied across a conductor of resistance 20 Ω so that a current of 2 A may flow through it.

10. Write three applications of photoelectric effect.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.
(2) Each question carries **ten** marks.
(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* State parallelogram law of vectors and derive expressions for magnitude and direction of the resultant vector. 7

(b) Find the magnitude of the vector $2\vec{i} + 3\vec{j} - 4\vec{k}$. 3

12. *(a)* Derive expressions for maximum height and time of flight of a body projected vertically upwards. 6

(b) A stone is thrown vertically upwards from the ground with a velocity of $9 \cdot 8 \text{ ms}^{-1}$. Find the maximum height reached and time of ascent. 4

13. *(a)* Derive expressions for acceleration and time taken to come to rest for a body moving over a rough horizontal surface. 6

(b) Explain two methods of reducing friction. 4

14. *(a)* State and prove the work-energy theorem. 6

(b) A car of mass 1000 kg moving with a velocity of 10 ms^{-1} is accelerated to 70 ms^{-1}. Find the work done. 4

15. *(a)* State any four conditions of SHM. 4

(b) Derive expressions for velocity and acceleration of a particle performing SHM. 6

16. *(a)* Derive the ideal gas equation $PV = RT$. 7

(b) One litre of gas is heated from 27 °C to 127 °C at constant pressure. Find its final volume. 3

17. *(a)* Define noise pollution and write five effects of noise pollution. 1+5=6

(b) A boy hears an echo of his own voice from a distant hill after 2 seconds. Find the distance of the hill if the velocity of sound is 345 ms^{-1}. 4

18. *(a)* Derive expression for couple acting on a bar magnet in uniform magnetic field. 7

(b) A bar magnet of pole strength 40 A-m has a length 20 cm. Find the magnetic moment. 3

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* 6036 *

C16–EE–103/C16–CHPP–103

6036

BOARD DIPLOMA EXAMINATION, (C–16)

OCT/NOV—2017

DEEE—FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. Define fundamental quantities and derived quantities. Give two examples each.

2. Define scalar and vector quantities. Give two examples each.

3. Define projectile. At which point on its path a projectile has the lowest speed?

4. The displacement of a particle performing SHM is $y = 4\sin(4\pi t + \frac{\pi}{6})$ where y is metre. Find—

(a) amplitude

(b) initial phase

(c) time period

5. State the gas laws.

6. Write Sabine's formula and name the symbols in it.

7. Define surface tension. Give one example.

8. A load having mass 10 kg is suspended by a metal wire of certain length having a cross-sectional area 4 mm^2. Find the stress.

9. State Ohm's law. Write the SI units of specific resistance.

10. Write any three applications of photoelectric effect.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* State parallelogram law of vector addition. 1

(b) Derive the expression for the magnitude of the resultant vector. 5

(c) Two vectors have magnitudes 3 unit and 4 unit respectively. What should be the angle between them if the magnitude of the resultant is 7 unit? 4

12. *(a)* Define acceleration due to gravity. 1

(b) Show that the path of a horizontally projected body is a parabola. 5

(c) A ball is thrown from a field with a speed of 20 m/s at an angle of 45° with the horizontal. At what distance will it hit the field again? Take $g = 10 \text{ m/s}^2$. 4

13. *(a)* Define friction. 1

(b) Derive the expression for acceleration of a body moving down a rough inclined plane making an angle θ with the horizontal. Let μ be the coefficient of friction. 5

(c) In a children-park an inclined plane is constructed with an angle of incline 45°. Find the acceleration of a boy sliding on it if the coefficient of friction between the cloth of the boy and the incline is 0·6 and $g = 10 \text{ m/s}^2$. 4

14. *(a)* Define work, power and energy. 3

(b) State the law of conservation of energy. 1

(c) Prove the law of conservation of energy in the case of freely falling body. 6

15. *(a)* Derive the expression for displacement and velocity of a particle executing SHM. 3+3

(b) Calculate the length of the seconds pendulum at a place where the value of g is 9·8 ms^{-2}. 4

16. *(a)* Define isothermal process and adiabatic process. 2

(b) Derive the gas equation $PV = RT$. 5

(c) The volume of certain mass of air at 17 °C is 500 cm^3. Find its volume at 162 °C if the pressure is kept constant. 3

17. *(a)* Define noise pollution and write any four effects of it. 1+4

(b) State any five methods of controlling of noise pollution. 5

18. *(a)* Define conductance and write its SI unit. 2

(b) Derive the expression for couple acting on a bar magnet placed in a uniform magnetic field. 5

(c) Two magnetic poles each of strength 40 Am are separated in air by a distance of 0·2 m. Find the fore between them ($\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$). 3

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* 6029 *

C16–EC–103/C16–CHPC-103/C16–PET–103

6029

BOARD DIPLOMA EXAMINATION, (C–16)

OCT/NOV—2017

DECE—FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. State the limitations of dimensional analysis.

2. Define scalar and vector quantities and give one example for each.

3. Derive the expression for range of projectile.

4. The equation of a particle executing SHM is given by $y = 10\sin\left(4\pi t + \frac{\pi}{3}\right)$, where the quantities are in SI units. Find *(a)* amplitude, *(b)* angular velocity and *(c)* phase at time $t = 0$.

5. State Boyle's law and express its relation in terms of density.

6. State any three conditions for good auditorium.

7. State Hooke's law, define stress, strain.

8. Define surface tension and give one example.

9. State Coulomb's inverse square law in the case of magnetism and write the equation for the law.

10. Write any three applications of optical fiber.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* Define parallelogram law of vectors. Obtain an expression for the magnitude and direction of the resultant vector. 2+5

(b) The magnitude of resultant of two equal forces is 1000 N. Find the magnitude of each force if they are perpendicular. 3

12. *(a)* Define projectile and give one example. 2

(b) Derive equations for the maximum height and range of an object projected at a certain angle with the horizontal. 5

(c) A ball is projected into air by making an angle 45° to the horizontal with a velocity of 9·8 m/s. Find the range. Take the g value as 9·8 m/s^2. 3

13. *(a)* State the laws of friction. 3

(b) Derive the expression for an acceleration of a body sliding down on a smooth inclined plant. 4

(c) Show that the coefficient of friction $\mu = \text{Tan}\,\theta$, where θ is the angle of friction. 3

14. *(a)* Define the terms work, power and energy and state their units and dimensional formulae. 6

(b) If a force of $(2\hat{i} + 3\hat{j} + 4\hat{k})\,N$ is applied on a body, the velocity attained is $(\hat{i} + \hat{j} + \hat{k})$ m/s. Find the power. 4

15. Derive expressions for *(a)* displacement, *(b)* velocity and *(c)* acceleration for a body in SHM. 4+3+3

16. *(a)* Derive $C_p - C_v = R$. 6

(b) Calculate the value of universal gas constant for one gram-mole gas at STP. 4

17. *(a)* What are beats? Mention three applications of beats. 5

(b) What is noise pollution? Write any three effects caused by noise pollution. 5

18. *(a)* State and explain Kirchhoff's laws with neat sketch. 4

(b) Explain Wheatstone's bridge and derive the condition for obtaining balance in the Wheatstone's bridge. 6

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* 6018 *

C16–C/CM–103

6018

BOARD DIPLOMA EXAMINATION, (C–16)

OCT/NOV—2017

DCE—FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. Write the dimensional formulae of the following :

(a) Universal gas constant

(b) Force

(c) Stress

2. State triangular law of vectors and explain.

3. A body is falling freely from a height of 78·4 m. Find the velocity of the body on reaching the ground. The value of g is $9{\cdot}8\ \mathrm{m/s^2}$.

4. State the conditions of simple harmonic motion.

5. Write any three differences between isothermal process and adiabatic process.

6. Write any three applications of Doppler effect.

7. Write the Poiseulle's equation for the coefficient of viscosity and name the symbols involved.

8. Define the terms 'stress' and 'strain'.

9. State Kirchhoff's laws.

10. Write three properties of superconductors.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* Define dot product. 2

(b) Mention any four properties of dot product. 4

(c) Find the area of parallelogram formed by two vectors $P = \hat{i} + 2\hat{j} + 3\hat{k}$ and $Q = \hat{i} + \hat{j} + \hat{k}$ as two adjacent sides. 4

12. *(a)* Define projectile and give one example. 2

(b) Show that the path of a projectile is a parabola in the case of oblique projection. 5

(c) The range of projectile is equal to maximum height reached, find the angle of projection. 3

13. *(a)* Explain any three methods of reducing friction. 3

(b) Derive the expression for the acceleration of a body slides down on a rough (with friction) inclined plane. 4

(c) Find the force of friction on a body of mass 100 kg when it is just start sliding on horizontal surface if $\mu = 0 \cdot 5$. The value of g is $9 \cdot 8\ \mathrm{m/s^2}$. 3

14. *(a)* State the law of conservation of energy and prove it in the case of freely falling body. 6

(b) An engine is used to lift water from a well 60 m deep to fill a tank of dimensions $5\,\mathrm{m} \times 5\,\mathrm{m} \times 10\,\mathrm{m}$ in 40 minutes. Find the power of the engine if 30% energy is wasted. Take g as $9 \cdot 8\ \mathrm{m/s^2}$. 4

15. *(a)* Derive the equation for time period of a simple pendulum. 6

(b) The displacement of a particle executing SHM is given by

$$x = 4\cos\left(0 \cdot 2\,\pi\,t + \frac{\pi}{4}\right)$$ All values are in S.I units.

Find *(i)* amplitude *(ii)* angular velocity, *(iii)* maximum velocity and *(iv)* epoch. 4

16. *(a)* What are the gas laws. Explain. 6

(b) 15000 J of heat is given to a gas when its volume increased by $0{\cdot}025\ \mathrm{m^3}$ at a constant pressure 5×10^5 Pa. Calculate increase in the internal energy of the gas. 4

17. *(a)* Write any three differences between musical sound and noise. 3

(b) Write any three effects of noise pollution and write any four measures to be taken to minimise the noise pollution. 7

18. *(a)* Derive an expression for magnetic induction field strength at a point on the axial line of a bar magnet. 6

(b) In the meter bridge experiment, if the resistance in the left and right gaps is in the ratio 3 : 4, find where the balancing point is obtained. 4

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6053

C16–M/CHOT/RAC–103

6053

BOARD DIPLOMA EXAMINATION, (C–16)

MARCH/APRIL—2018

DME—FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. Write any three advantages of SI units.

2. A force of 200 N is inclined at an angle of 30° to the horizontal. Find the components in the horizontal and vertical directions.

3. Derive the expression for time of ascent in vertical projection.

4. Define SHM and give two examples.

5. State the gas laws.

6. Write any three applications of Doppler effect.

7. Define stress, strain and state Hooke's law.

8. Write Poiseuille's equation for coefficient of viscosity and name the symbols.

9. State and explain Coulomb's inverse square law of magnetism.

10. State any three laws of photoelectric effect.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* Define dot product and write three properties of dot product. 1+5

(b) Find the area of the parallelogram formed by the vectors $\vec{A} = 2\vec{i} + \vec{j} - 2\vec{k}$ and $\vec{B} = 2\vec{i} - 3\vec{j} + 2\vec{k}$ as adjacent sides. 4

12. *(a)* Show that the path of projectile is a parabola in horizontal projection. 6

(b) an aeroplane flying horizontally with a speed of 270 kmph releases a body at a height of 490 m from ground. Find when and where the body strikes the ground. 4

13. *(a)* Derive the expression for acceleration of a body sliding down on a rough inclined plane. 6

(b) A body is sliding down on a rough inclined plane which makes an angle of 30° with the horizontal. Calculate the acceleration, if $\mu = 0 \cdot 1$. 4

14. *(a)* Define potential energy and kinetic energy and give two examples for each. 4

(b) Derive an expression for kinetic energy. 6

15. *(a)* Derive the expression for time period of oscillations of a simple pendulum. 7

(b) Find the value of g where the length of seconds pendulum is 0·9 m. 3

16. *(a)* Distinguish between isothermal and adiabatic processes. 4

(b) Derive the equation $C_p - C_v = R$. 6

17. *(a)* Define longitudinal and transverse waves. 4

(b) Define noise pollution and write any four methods of controlling noise pollution. 2+4

18. *(a)* Derive the balancing condition of Wheatstone's bridge with necessary circuit diagram. 7

(b) In a Wheatstone's bridge circuit $Q = 3\,\Omega$, $R = 4\,\Omega$ and $S = 6\,\Omega$. Find the resistance P required to balance the bridge. 3

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* 6036 *

C16–EE/CHPP–103

6036

BOARD DIPLOMA EXAMINATION, (C–16)

MARCH/APRIL—2018

DEEE—FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. State three applications of dimensional analysis.

2. If $\vec{A} = 2\vec{i} + 5\vec{j} + 5\vec{k}$ and $\vec{B} = 2\vec{i} + 4\vec{j} + 6\vec{k}$, find $\vec{A} \cdot \vec{B}$.

3. A stone is allowed to fall from the top of a tower reaches the ground in 8 s. Find the height of the tower.

4. Define amplitude and time period of a particle executing simple harmonic motion.

5. State and explain Boyle's law.

6. Define transverse and longitudinal waves.

7. Define angle of contact and capillarity.

8. Define coefficient of viscosity. Write Poiseuille's equation for coefficient of viscosity and name the symbols.

9. State Kirchoff's 1st and 2nd laws.

10. List three applications of superconductors.

PART—B 10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* State and explain triangle law and polygon law of vectors. 3+3

(b) Find the area of the parallelogram formed by vectors $\vec{A} = 2\vec{i} + 3\vec{j} + \vec{k}$ and $\vec{B} = \vec{i} - 2\vec{j} + 2\vec{k}$ as adjacent sides. 4

12. *(a)* Derive the expressions for *(i)* maximum height and *(ii)* horizontal range for a projectile in oblique projection. 3+3

(b) A football is projected into air with velocity of 10 m/s at an angle 60° to the horizontal. Find the *(i)* maximum height and *(ii)* horizontal range. 4

13. *(a)* Define limiting friction. 2

(b) Derive an expression for acceleration of a body on a rough inclined plane sliding down the plane. 5

(c) Brief any three methods of reducing friction. 3

14. *(a)* State and prove work-energy theorem. 6

(b) A machine gun fires 360 bullets per minute and each bullet travels with a velocity of 600 m/s. If the mass of each bullet is 5 gram, find the power of the gun. 4

15. *(a)* State the conditions of simple harmonic motion. 4

(b) Derive the expression for the velocity and the acceleration of a particle executing simple harmonic motion. 6

16. *(a)* Derive the relation, $C_p - C_v = R$. 6

(b) The ratio of two specific heats of a gas is 1·4. Its molar specific heat at constant volume C_v is 4·96 J/mol/K. Find the value of universal gas constant. 4

17. *(a)* Distinguish between musical sound and noise. 4

(b) Define Doppler effect. List four applications of Doppler effect. 2+4

18. *(a)* Write four properties of magnetic lines of force. 4

(b) Derive magnetic induction field strength at a point on the axial line of a bar magnet. 6

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* 6029 *

C16–EC/CHPC/PET–**103**

6029

BOARD DIPLOMA EXAMINATION, (C–16)

MARCH/APRIL—2018

DECE—FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A

3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. State the applications of dimensional analysis.

2. State triangle law and polygon law of vectors.

3. A body is thrown vertically upwards with a velocity of 19·6 m/s from the ground. How long the body remains in air?

4. Define the terms *(a)* amplitude, *(b)* time period and *(c)* frequency in SHM.

5. Define absolute zero and write the relation between absolute temperature and centigrade temperature.

6. Write any three differences between musical sound and noise.

7. Define capillarity and angle of contact.

8. Write any three examples of viscosity.

9. State the Kirchhoff's law of electricity.

10. Write three applications of superconductivity.

PART—B

10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. *(a)* Define cross product and write four properties of cross product. 2+4

(b) If $\vec{A} = \vec{i} + 2\vec{j} - 2\vec{k}$ and $\vec{B} = 2\vec{i} + n\vec{j} + 2\vec{k}$ are perpendicular vectors, then find the value of *n*. 4

12. *(a)* Show that the path of projectile is a parabola in oblique projection. 6

(b) A body is thrown up vertically with a velocity of 19·6 ms^{-1}. Find the maximum height reached and time of ascent. 4

13. *(a)* Derive an expression for acceleration of a body moving up on a rough inclined plane with necessary diagram. 6

(b) Write any four advantages of friction. 4

14. *(a)* Define work, power and energy. 3

(b) State and prove the law of conservation of energy in the case of a freely falling body. 7

15. *(a)* Derive expressions for time period and frequency of a particle in SHM. 6

(b) In a SHM, the maximum acceleration and maximum velocity are 62·8 ms^{-2} and 10 ms^{-1} respectively. Find the time period. 4

16. *(a)* Show that $C_p - C_v = R$. 6

(b) A gas occupies a volume of 10^{-4} cm^3 at 30 °C and 4×10^5 N-m^2 pressure. Find its volume at NTP. 4

17. *(a)* Define noise pollution and write any five methods of controlling noise pollution. 1+5

(b) Write any four conditions of good auditorium. 4

18. *(a)* State and explain Ohm's law. 3

(b) Derive an expression for the magnetic induction field strength at a point on the axial line of a bar magnet. 7

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* 6018 *

C16–C/CM–103

6018

BOARD DIPLOMA EXAMINATION, (C–16)
MARCH/APRIL—2018
DCE—FIRST YEAR EXAMINATION

ENGINEERING PHYSICS

Time : 3 hours] [*Total Marks* : 80

PART—A

3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

1. List the base and supplementary units of the SI system with their symbols.

2. Two forces of magnitude 30 N and 40 N are acting on a body perpendicular to each other. Find the magnitude of resultant force.

3. Derive the expression for height of the tower when a body is projected vertically upwards from the top of the tower.

4. Determine the length of the Second's pendulum on the earth. Take the value of gas $9{\cdot}8\ m/s^2$.

5. The volume of a gas at 27 °C is 50 cm^3. Find its temperature at which its volume is doubled, if the pressure remains constant.

6. Distinguish between musical sound and noise.

7. Define surface tension and capillarity. Give an example for surface tension.

8. What is the effect of temperature on viscosity of liquids and gases?

9. State and explain Coulomb's inverse-square law of magnetism.

10. State the laws of photoelectric effect.

PART—B

10×5=50

Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

11. *(a)* Define cross product. Write three properties of cross product. 5

(b) Under what conditions the sum and difference of two vectors will be equal in magnitude? 5

12. *(a)* What is projectile? Give two examples. 2

(b) Prove that in the case of body thrown up vertically, the time of ascent is equal to time of descent. 5

(c) A stone is projected vertically upwards from the top of a tower of height 105 m with a velocity of 20 ms^{-1}. Find the time taken by the stone to reach the bottom of the tower. ($g = 10\ ms^{-2}$) 3

13. *(a)* Explain any four methods of minimizing the friction. 4

(b) A body placed at the top of a 10 m long plane surface, inclined at an angle of 30° with the horizontal, slides down. If coefficient of friction $\mu = 0{\cdot}18$, find the—

(i) acceleration of the body;

(ii) velocity of the body at the bottom of the plane;

(iii) time taken by the body it reaches the bottom. 6

14. *(a)* Define kinetic energy. Derive the expression for kinetic energy of a body of mass m and moving with a velocity v. 6

(b) A body of mass 1 kg falls from a height of 40 m. Find the potential and kinetic energies of the body after 2 seconds of its motion. 4

15. *(a)* Define simple harmonic motion. Give two examples. 4

(b) Derive the expressions for velocity and acceleration of a particle executing SHM. 6

16. *(a)* State first and second laws of thermodynamics. 4

(b) Distinguish between isothermal and adiabatic processes. 4

(c) What is ideal gas? Write the ideal gas equation for n moles. 2

17. *(a)* Define Doppler effect. Write any four applications of Doppler effect. 5

(b) Write Sabine's formula and name the parameters contained. 3

(c) Find the minimum distance between reflecting surface and listener to hear an echo, if the velocity of sound in air is 330 ms^{-1} and persistence of hearing is 0·1 second. 2

18. *(a)* Define magnetic moment. Derive an expression for the strength of magnetic induction field at a point on the axial line of a bar magnet. 7

(b) Three currents 1 mA, 3 mA and i_3 mA are flowing towards the junction, and two currents 2 mA and 3 mA are flowing away from the junction. Find the value of i_3. 3

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