ULTIMATE KCET

CRASH COURSE 2026

Physics | Lecture : 01

UNITS AND MEASUREMENT & MOTION IN A STRAIGHT LINE

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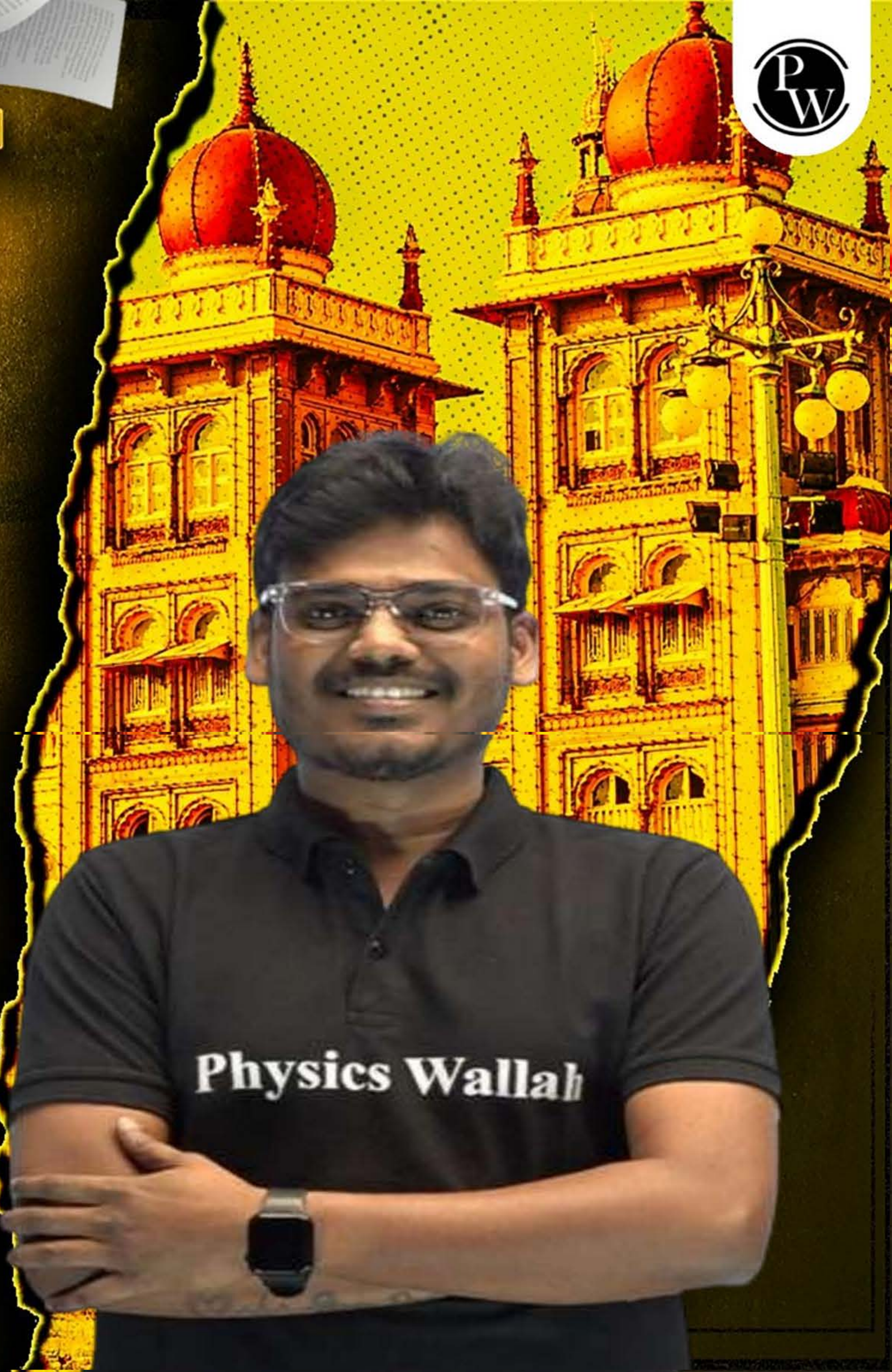


Recap *of previous lecture*

1. ENERGY BAND THEORY
2. SEMICONDUCTORS AND ITS TYPES
3. PN-JUNCTION DIODE AND ITS WORKING
4. RECTIFIERS AND ITS TYPES

Topics *to be covered*

1. HALF WAVE RECTIFIER
2. QUESTIONS
3. UNITS AND MEASUREMENT
4. MOTION IN A STRAIGHT LINE

Question

Application of a forward bias to a *p*-*n* junction

(A) Widens the depletion zone

(B) Increases the potential difference across the depletion zone

(C) Increases the number of donors on the n side

(D) $\boxed{\text{Decreases the electric field in the depletion zone}}$

Question

$\boxed{\text{Reverse}}$ bias applied to a junction diode

(A) Lowers the potential barrier

(B) $\boxed{\text{Raises the potential barrier}}$ ✓

(C) Increase the majority carrier current

(D) Increase the minority carrier current

Question

Barrier potential of a *p*-*n* junction diode $\boxed{\text{does not depend}}$ on

(A) $\boxed{\text{Diode design}}$

(B) Temperature

(C) Forward bias

(D) Doping density

Question

Depletion layer has (for an unbiased PN junction)

A. Electrons

B. Holes

C. Static Ions

D. Neutral Atoms

Question

In $\boxed{\text{forward biasing}}$ of the *p*-*n* junction:

(A) The positive terminal of the battery is connected to *p*-side and the depletion region becomes thick. x

(B) The positive terminal of the battery is connected to *n*-side and the depletion region becomes thin.

(C) The positive terminal of the battery is connected to *n*-side and the depletion region becomes thick.

(D) The positive terminal of the battery is connected to *p*-side and the depletion region becomes thin.

Junction Diode as a Rectifier

The process of converting alternating current into direct current is called rectification and the device used for this process is called rectifier.

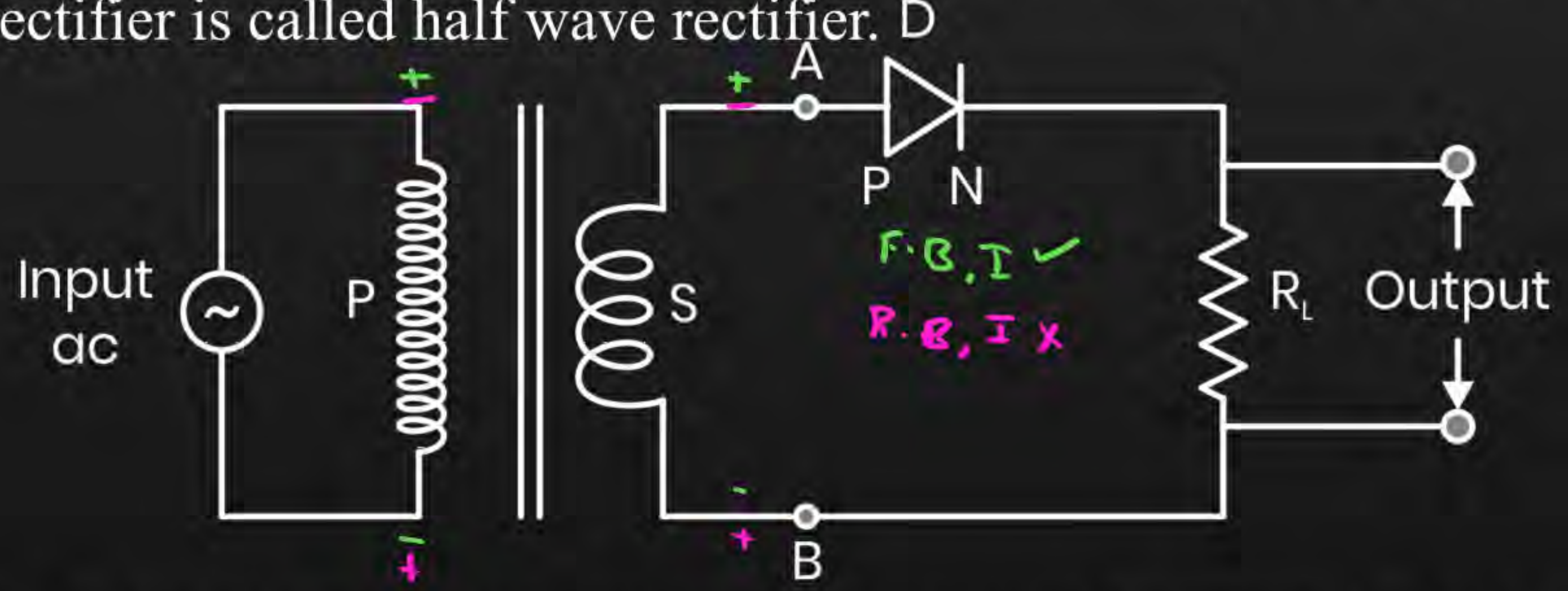
The p-n junctions can be used as

(i) a half-wave rectifier, and

(ii) a full-wave rectifier.

Junction Diode as a Half-wave Rectifier

Ans: When a current flows through the rectifier circuit only during one half of input ac, the rectifier is called half wave rectifier.



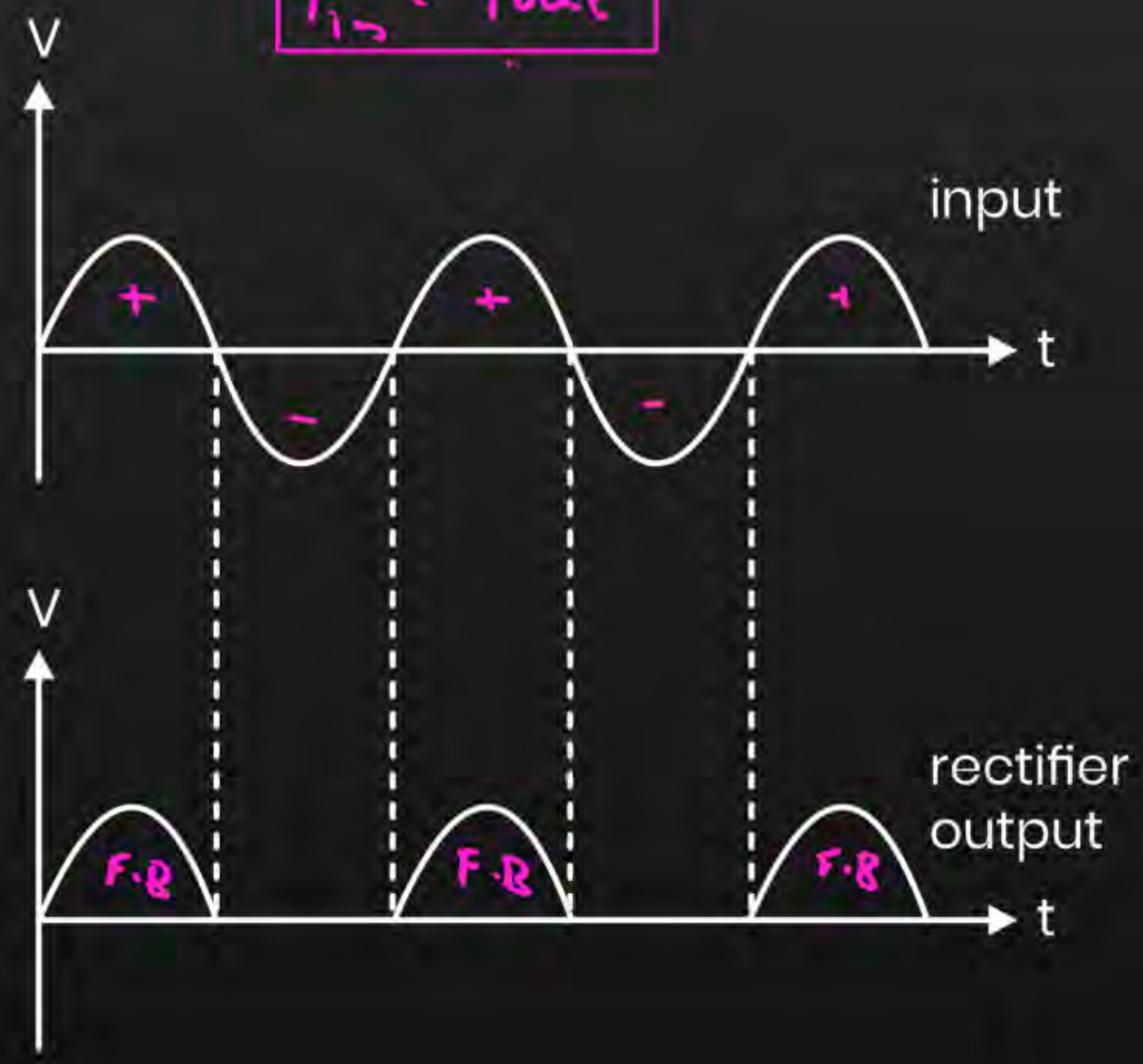
The ac voltage to be rectified is applied across the primary of the transformer P. A diode D is connected in series with a load resistor R_L and this series combination is connected to the secondary S of the transformer.

Junction Diode as a Half-wave Rectifier

During the positive half cycles of the transformer output, the end A is positive and the other end B is negative. The diode is forward biased and conducts a current.

During the negative half cycles of the transformer output, the end A is negative and the other end B is positive. The diode is reverse biased and does not conducts a current. Thus a current flows through output circuit only during positive half cycles of input ac. The input and output waveforms of a half wave rectifier is as shown.

$\boxed{f_{in} = f_{out}}$

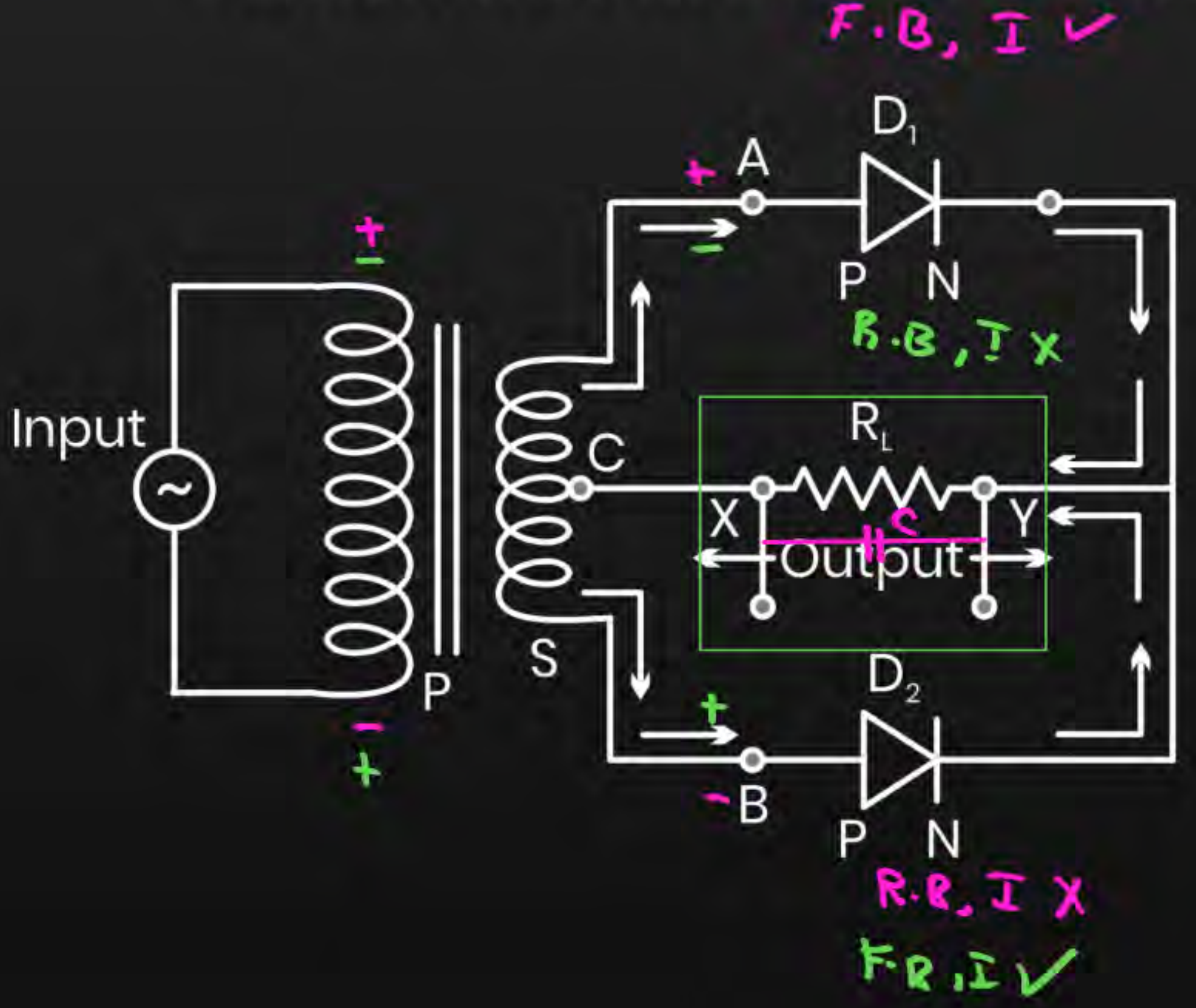


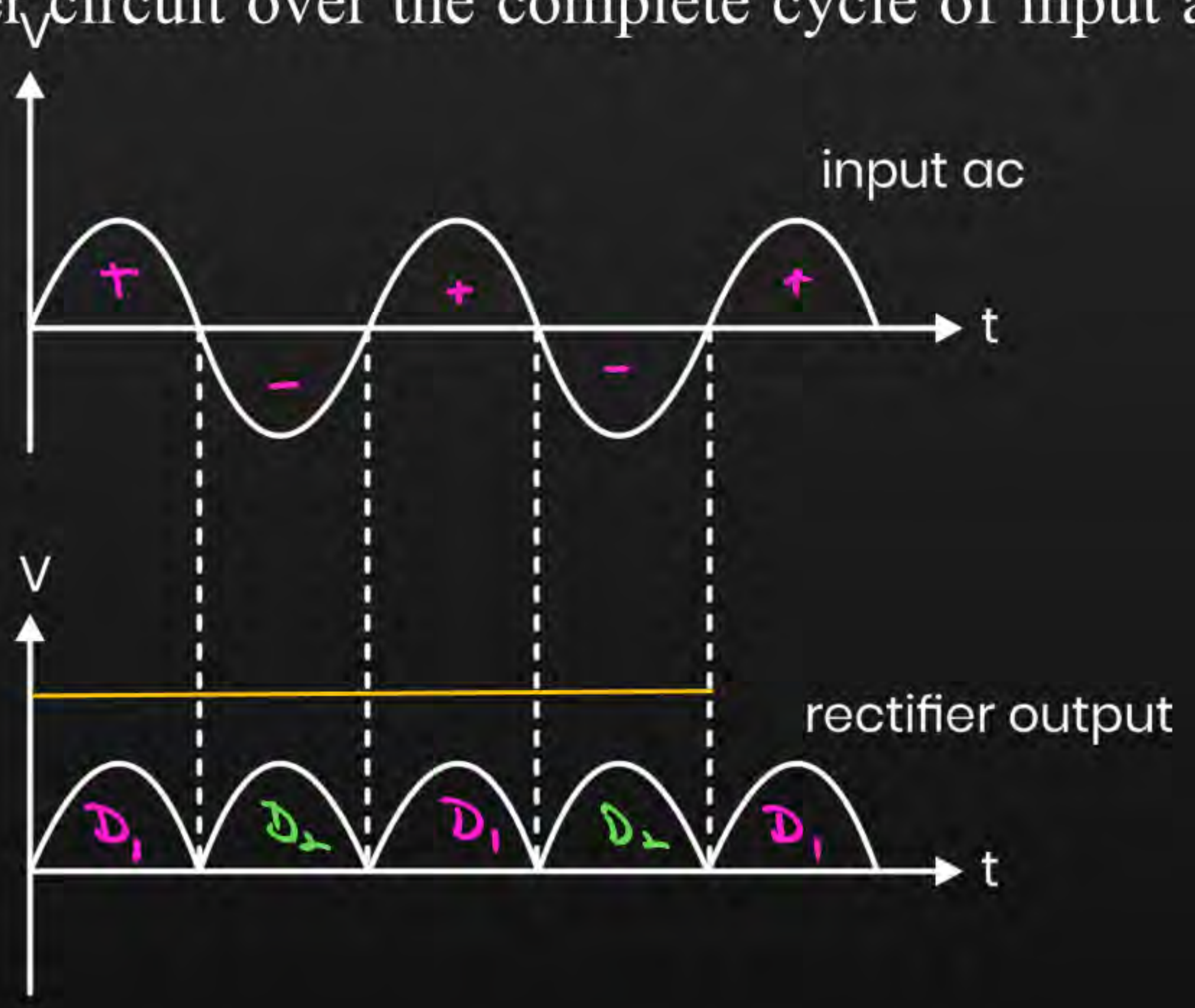
Junction Diode as a $\boxed{\text{full Wave}}$ Rectifier

HWR, $f_{in} = f_{out}$

FWR, $f_{out} = 2f_{in}$

Ans: When a current flows through a rectifier circuit over the complete cycle of input ac, rectifier is called full wave rectifier.





Junction Diode as a full Wave Rectifier

$X_C = \frac{1}{2\pi f C}$

$C \propto \frac{1}{f} \rightarrow f = 0 \rightarrow DC$

Ans: The ac voltage to be rectified is applied across the primary of the transformer. The p regions of the two diodes D_1 and D_2 are connected to the ends of the secondary of the transformer. The n regions are joined together and this in turn is connected to the centre tap C through a load resistance R_L. The rectified output can be drawn across the load resistor R_L.

During positive half cycles of transformer output, the end A is positive and the other end B is negative with respective C. The diode D_1 is forward biased and D_2 is reverse biased. Consequently D_1 conducts and D_2 does not conduct. A current flows through a load resistor from Y to X.

Junction Diode as a full Wave Rectifier

During negative half cycle of transformer output, the end A becomes negative and B becomes positive with respective C. D_1 is reverse biased and D_2 is forward biased. Consequently D_2 conducts and D_1 does not conduct any current. A current flows through the load resistor R_L in the same direction Y to X.

Thus a unidirectional current flows through a load resistance over the complete cycle of input ac.

The input and output waveforms of a full wave rectifier is as shown.

This pulsating dc can be made steady using filter circuit.

Junction Diode as a full Wave Rectifier

How to get a steady d.c output from the pulsating d.c output of a full wave rectifier?

Ans: The pulsating dc output of a full wave rectifier can be made steady using filter circuit.

What are filter circuits in rectifiers?

Ans: Rectifier filter is an electronic circuit that removes ripple or unwanted ac signal components from the output of a rectifier. It is nothing but a RC circuit.

Filter circuit : Filter circuit is just a capacitor connected parallel to loa resistor.

Question

A full-wave rectifier with diodes D_1, and D_2 is used to rectify $\boxed{50\ Hz}$ alternating voltage. The diode D_1 conducts .... times in one second.

(A) $\boxed{100}$

(B) 25

(C) 75

(D) 50

Question

A full wave rectifier circuit consists of two p-n junction diodes, a centre-tapped transformer, capacitor and a load resistance. Which of these components remove the ac ripple from the rectified output

(A) Load resistance

(B) A centre-tapped transformer

(C) *p*-*n* junction diodes

(D) Capacitor

Question

In half wave rectification, if the input frequency is 60 Hz, then the output frequency would be

(A) 120 Hz

(B) 30 Hz

(C) 0

(D) $\boxed{\text{60 Hz}}$

Question

If a $\boxed{\text{full wave rectifier}}$ circuit is Operating from 50 Hz mains, the fundamental frequency in the ripple will be

$$\boxed{f_r = 2f_{op}}$$

A. 25 Hz

B. 50 Hz

C. 70.7 Hz

D. $\boxed{100 \text{ Hz}}$

UNITS AND MEASUREMENTS

FUNDAMENTAL UNITS (7)

Units of fundamental physical quantities are called fundamental units In SI, fundamental units are as follows:

Physical Qty.	Unit	Symbol
Mass	kilogram	kg
Length	meter	m
Time	second	s
Current	ampere	A
Temperature	kelvin	K
Amount of Substance	mole	mol
Luminous Intensity	candela	cd

FUNDAMENTAL UNITS

Note : Fundamental units in some of the old systems are as follows

System	Fundamental Physical Quantities		
	Length	Mass	Time
FPS	foot (ft)	pound (lb)	second (s)
CGS	centimetre (cm)	gram (g)	second (s)
MKS	metre (m)	kilogram (kg)	second (s)

DERIVED UNITS (Undefined)

Units of derived physical quantities are called derived units. SI units of some derived physical quantities are as follows :

Physical Qty.	Unit	Symbol
Area	metre square	m^2
Volume	metre cube	m^3
Velocity	metre per second	ms^{-1}
Acceleration	metre per second square	ms^{-2}
Force	newton	N
Work	joule	J

SUPPLEMENTARY UNITS

Units of supplementary physical quantities are called supplementary units. In SI, units of supplementary physical quantities are as follows:

Physical Qty.	**Unit**	**Symbol**
Plane angle	radian	rad
Solid angle	steradian	sr

UNITLESS QUANTITIES

Ratio (numerical value only):

When a physical quantity is a ratio of two similar quantities, it has no unit.

For Example:

1) Relative density = Density of object/Density of water at 4°C
2) Refractive index = Velocity of light in air/Velocity of light in medium
3) Strain = Change in dimension/Original dimension

S.No.	Multiplication factor	Prefix	Symbol
1.	10	deca	da
2.	10^2	hecto	h
3.	10^3	kilo	k
4.	10^6	mega	M
5.	10^9	giga	G
6.	10^{12}	tera	T
7.	10^{15}	peta	P
8.	10^{18}	exa	E
9.	10^{-1}	deci	d
10.	10^{-2}	centi	c
11.	10^{-3}	milli	m
12.	10^{-6}	micro	μ
13.	10^{-9}	nano	n
14.	10^{-12}	pico	p
15.	10^{-15}	femto	f
16.	10^{-18}	atto	a

QUESTION

The physical quantity which is measure in the unit of $\boxed{\text{wb } A^{-1}}$ is

$\frac{\phi}{I} = L$ or M

A. self-inductance

B. mutual inductance

C. magnetic flux

D. $\boxed{\text{Both (A) and (B)}}$

QUESTION

The $\boxed{\text{S.I. unit}}$ of specific heat capacity is

(c)

A) $J\,K^{-1}$

B) $J\,kg^{-1}$

C) $J\,mol^{-1}\,K^{-1}$

D) $\boxed{J\,kg^{-1}K^{-1}}$

$$Q = mc\Delta T$$

$$c = \frac{Q}{m\Delta T} = \frac{J}{kg \times K} = J\,kg^{-1}\,K^{-1}$$

QUESTION

The unit of Stefan's constant is

(A) $Wm^{-1} K^{-1}$

(B) $Wm K^{-4}$

(C) $\boxed{W m^{-2} K^{-4}}$

(D) $N m^{-2}$

$$P = \sigma A T^4$$

$$W = \sigma \times m^2 \times K^4$$

$$\boxed{\sigma = Wm^{-2} K^{-4}}$$

QUESTION

Convert 36 km/hr to m/s

A 20

B $\boxed{10}$

C 40

D 15

$36\,km/hr = \frac{36\,km}{1\,hr}$

$= \frac{\cancel{36}^{1} \times 1000\,m}{\cancel{3600}\,s}$

$\boxed{= 10\,m/s}$

QUESTION

Convert 500 kg/m^3 of density of CGS System

A $\boxed{0.5\ g/\text{cm}^3}$

B $1.5\ g/\text{cm}^3$

C $2\ g/\text{cm}^3$

D $5\ g/\text{cm}^3$

$$D = \frac{m}{v} = \frac{500\,\text{kg}}{m^3}$$

$$= \frac{500 \times 1000\,g}{(100\,cm)^3}$$

$$= \frac{\cancel{500} \times 1\cancel{000}\,g}{1\cancel{00} \times 1\cancel{00} \times 100 \times cm^3}$$

$$= \frac{5}{10} = \boxed{0.5\ g\,cm^{-3}}$$

QUESTION

Convert 1 Newton of force to CGS Systems

(A) 10^3

(B) $\boxed{10^5}$

(C) 10^7

(D) 10^9

$F = ma$

$1N = 1kg \times 1m/s^2$

$= 1000g \times 100\, cm/s^2$

$1N = 10^5\, g\,cm/s^2$

$\boxed{1N = 10^5\, dyne}$

QUESTION

Convert 1 Joule of work to CGS System

(A) 10^6

(B) 10^5

(C) $\boxed{10^7}$

(D) 10^9

$W = F \times S$

$1J = 1N \times 1m$

$= 10^5 \text{ dyne} \times 10^2 \text{ cm}$

$1J = 10^7 \text{ dyne} \times \text{cm}$

$\boxed{1J = 10^7 \text{ erg}}$

SIGNIFICANT FIGURES AND ITS RULES

The number digits in measured value about the correctness of which we sure plus one more digit are called as significant figure.

The Rules to be followed.

1. All the non-zero digits are significant

   Example: 1234 - S.F = 4
   125 - S.F = 3
   1.212 - S.F = 4
   3.14 - S.F = 3

2. Trapped zeros i.e zeros lies between non-zero digits are significant

   Example: 1.004 - S.F = 4
   20.3 - S.F = 3
   300.002 - S.F = 6

SIGNIFICANT FIGURES AND ITS RULES

3. Initial zeros or Leading zeros are never significant OR If the number is less than one then left of the first non-zero digit is insignificant

Example: 0.001 – S.F = 1
0.312 – S.F = 3
0.0032 – S.F = 2
0.0204 – S.F = 3

4. Ending zeros or trailing zeros are significant if they appear after decimal

Example: 2.00 – S.F = 3
3.120 – S.F = 4
0.003020 – S.F = 4
200 – S.F = 1
1400 – S.F = 2

SIGNIFICANT FIGURES AND ITS RULES

5. Order of magnitude is never significant

Example : 2.1×10^3 $\rightarrow$ S.F = 2

$2.010 \times 10^3 \rightarrow$ S.F = 4

$200 = 2 \times 10^2 \rightarrow$ S.F = 1

$1400 = 14 \times 10^2 \rightarrow$ S.F = 2

6.Pure numbers or constants have infinite significant figure

Example: $1 = 1.00000000 \ldots \infty$

$\left.\begin{matrix} 2 \\ 5 \\ 8 \end{matrix}\right\} \infty$

ROUNDING OFF THE UNCERTAIN DIGITS

The result of computation with approximate numbers, which contain more than one uncertain digit, should be rounded off.

Rule.1 : If the digit to be rounded off is more than 5, then preceding digit is increased by one, Example :

(a) 3.77 $= 3.8$ +1 ↳ $7 > 5$

(b) 2.16 $= 2.2$ +1 ↳ $6 > 5$

Rule.2 : If the digit to be rounded off is less than 5, then preceding digit is unchanged. Example :

(a) 5.74 $= 5.7$ ↳ $4 < 5$

(b) 2.13 $= 2.1$ ↳ $3 < 5$

ROUNDING OFF THE UNCERTAIN DIGITS

Rule.3 : If the digit to be rounded off is 5, then preceding digit is increased by one if it is odd and is left unchanged if it is even.

Example : (a) 3.15 = 3.2 (b) 3.25 = 3.2

+1 ↳ 5=5 ↳ 5=5

Rule.4 : If the digit to be rounded of is 5 followed by digits other than zero, then the preceding digit is raised by one

Example : (a) 16.351 = 16.4 (b) 5.758 = 5.8

+1 ↳ 5=5 +1 ↳ 5=5

Arithmetic operations with significant figures

Arithmetic operations $+, -, \times, \div$

$+, -$

In addition or subtraction, the final result should retain as many $\boxed{\text{decimal places}}$ as are there in the number with the least decimal places.

$\times, \div$

In multiplication or division, the final result should retain as many $\boxed{\text{significant figures}}$ as are there in the original number with the least significant figures

QUESTION

5 3

Subtract 4.27153 from 6.807 and express the result to an appropriate number of significant figures.

A $\boxed{2.535}$

B 2.536

C 2.530

D 2.534

$$\begin{array}{r} 6.80700 \\ 4.27153 \\ \hline 2.53547 \end{array}$$

$\hookrightarrow 4 < 5$

2.535

QUESTION

s.f = 3   s.f = 2

5.74 g of a substance occupies 1.2 cm3 . Express its density by keeping the significant figures in view.

(A) 4.78 ✗ s.f = 3

(B) $\boxed{4.8}$

(C) 4.7833 ✗

(D) 4.7

$$D = \frac{5.74}{1.2}$$

$$D = 4.7\overset{+1}{}8 3 3 \ldots$$

$8 > 5$

$D = 4.8$

QUESTION

S.F = 4 S.F = 2

A substance of mass 49.53 g occupies 1.5 cm^3 of volume. The density of the substance (in g cm^{-3}) with correct number of significant figures is

(A) 3.3 → S.F = 2

(B) 3.300 4

(C) 3.302 4

(D) 3.30 3

QUESTION

The number of significant figures in the numbers 4.8000×10^4 and 48000.50 are respectively

5 7

A 5 and 6

B $\boxed{\text{5 and 7}}$

C 2 and 7

D 2 and 6

DIMENSIONS

$\Rightarrow$ powers of base quantities

The dimensions of a physical quantity are the powers to which the base quantities are raised to represent that quantity.

The physical quantity that is expressed in terms of the base quantities is enclosed in a square bracket '[ ]'

Example : (a) Length $= [L^1]$

(b) Velocity $= \frac{\text{Disp}}{\text{time}} = \frac{[L^1]}{[T^1]} = [L^1 T^{-1}]$

(c) Density $= \frac{m}{\text{Vol}} = \frac{[M^1]}{[L^3]} = [M^1 L^{-3}]$

DIMENSIONAL FORMULA

The expression which shows how and which of the base quantities represent the dimensions of a physical quantity is called the dimensional formula of the given physical quantity.

Fundamental Physical Qty.	Dimensional formula
Mass	[M] *
Length	[L]
Time	[T]
Current	[I] or [A]
Temperature	[θ] or [K]
Amount of Substance	[mol]
Luminous Intensity	[cd]

DIMENSIONAL FORMULA

HOW WRITE DOEMSIONAL FORMULA

1. Length $= [L]$ or $[L^1]$
2. Area $= [L^2]$
3. Volume $= [L^3]$
4. Velocity $= [L^1T^{-1}]$
5. Acceleration $= \frac{dv}{dt} = \left[\frac{L^1T^{-1}}{T^1}\right] = [L^1T^{-2}]$
6. Force, $F = ma = [M^1][L^1T^{-2}] = [M^1L^1T^{-2}]$

DIMENSIONALESS QUANTITIES

Dimensionless Quantities

1. Pure Numbers like 1,2,3,4,5,……….etc

2. Ratio of same quantities and π

3. Trigonometric Ratios

4. Angles, Log functions and exponent functions

PRINCIPLE OF HOMOGENEITY

It states, " Every equation relating physical quantities must be dimensionally homogeneous" i.e the dimensions of each term of a physical equation must be the same.

Other words " Only those quantities can be added, subtracted or equated which have the same dimensions"

$$\boxed{z = x \pm y}$$

$z = x$ $\quad$ $z = y$

$x = y$

Note : The quantities which are having same units, will have same dimensions

QUESTION

A dimensionless quantity

(A) Never has a unit ✗

(B) Always has a unit ✗

(C) $\boxed{\text{May have a unit}}$ ✓

(D) Does not exist

μ, η, D_{rel}

plane, solid angles have units

$\theta = \frac{l}{R} = \frac{[L]}{[L]} = \underline{1}$

★ Unitless quantities can never have dimensions

$\Rightarrow \eta, \mu, D_{rel}$

★ Dimensionless quantities may have units.

$\Rightarrow$ plane angle

solid Angle.

QUESTION

The distance covered by a particle in time t is going by $x = a + bt + ct^2 + dt^3$; find the dimensions of a, b, c and d

(A) $\boxed{L, LT^{-1}, LT^{-2}, LT^{-3}}$

(B) L^2, LT, LT^2, LT^{-2}

(C) $L, L^2T^{-1}, LT^{-3}, LT^{-3}$

(D) $L^{-2}, L^3T^{-1}, LT^{-2}; L2T^{-3}$

$x = a$ $\qquad$ $x = bt$ $\qquad$ $x = ct^2$ $\qquad$ $x = dt^3$

$a = x$ $\qquad$ $b = \frac{x}{t}$ $\qquad$ $c = \frac{x}{t^2}$ $\qquad$ $d = \frac{x}{t^3}$

$\boxed{a = [L]}$ $\qquad$ $b = \frac{[L^1]}{[T]}$ $\qquad$ $c = \frac{[L^1]}{[T^2]}$ $\qquad$ $d = \frac{[L^1]}{[T^3]}$

$b = [L^1T^{-1}]$

$c = [L^1T^{-2}]$ $\qquad$ $d = [L^1T^{-3}]$

QUESTION

$v = \frac{A}{B - x^2}$ in this relation if v is velocity and x is length. Find dimensional formula of AB.

$$v = \frac{A}{B - x^2}$$

A L^5T^2

B LT^2

C $\boxed{L^5T^{-1}}$

D L^5T

$B = x^2$

$B = [L^2]$

$A = v(B - x^2)$

$A = [L^1T^{-1}][L^2]$

$A = [L^3T^{-1}]$

$A \cdot B = [L^2][L^3T^{-1}]$

$$\boxed{AB = [L^5T^{-1}]}$$

QUESTION

If a and b are two physical quantities having $\boxed{\text{different dimensions}}$ then which of the following $\boxed{\text{can}}$ denote a new physical quantity?

(A) $a + b$ ✗

(B) $a - b$ ✗

(C) $\boxed{a/b}$

(D) $e^{a/b}$

QUESTION

H.W

The time dependence of a physical quantity p is given by $p = p_0 \exp(-at^2)$, where a is a constant and t is the time. The constant a

(A) Is dimensionless

(B) Has dimensions $[T^{-2}]$

(C) Has dimensions $[T^{2}]$

(D) Has dimensions of p

APPLICATIONS OF DIMENSIONAL ANALYSIS

1. Checking the dimensional Consistency of Equations.

$D_{LHS} = D_{RHS}$

Let us consider an equation $\frac{1}{2}mv^2 = mgh$ where m is the mass of the body, v its velocity, g is the acceleration due to gravity and h is the height. Check whether this equation is dimensionally correct.

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

$= [M^1L^2T^{-2}]$

$D_{LHS} = [M^1L^2T^{-2}]$

$mgh = [M^1][L^1T^{-2}][L^1]$

$D_{RHS} = [M^1L^2T^{-2}]$

$\boxed{D_{LHS} = D_{RHS}}$

APPLICATIONS OF DIMENSIONAL ANALYSIS

2. Deducing Relation among the Physical Quantities.

Consider a simple pendulum, having a bob attached to a string, that oscillates under the action of the force of gravity. Suppose that the period of oscillation of the simple pendulum depends on its length (l), mass of the bob (m) and acceleration due to gravity (g). Derive the expression for its time period using method of dimensions.

$\rightarrow \quad T \propto l \, m \, g$

$\rightarrow \quad T = k \, l^x m^y g^z$

$$T = k\, l^{x} m^{y} g^{z}$$

$$\rightarrow [T^1] = [L^1]^x [m^1]^y [L^1 T^{-2}]^z$$

$$\rightarrow [T^1] = [L^x][m^y][L^z T^{-2z}]$$

Equate the powers:

Time, $1 = -2z$

$$\boxed{z = -\frac{1}{2}}$$

mass $\rightarrow$ $0 = y$

Length $\rightarrow$ $0 = x + z$

$$\boxed{x = -z}$$

$$x = -\left(-\frac{1}{2}\right) = \frac{1}{2}$$

$$T = k\, l^{1/2} m^{0} g^{-\frac{1}{2}}$$

$$T = k \sqrt{l} \times 1 \times \frac{1}{\sqrt{g}}$$

* $$\boxed{T = k\sqrt{\frac{l}{g}}}$$

$$\boxed{T = 2\pi\sqrt{\frac{l}{g}}}$$

DRAWBACKS OF DIMENSIONAL ANALYSIS

$\frac{1}{2}mv^2 = KE$ ✓

$\frac{5}{7}mv^2 = K.E$ ✗

1. Cannot determine the value of constant.
2. Even a dimensionally correct formula may be experimentally invalid.
3. Cannot determine the physical quantity just by dimensions

   $[M^1L^2T^{-2}] = W$

   $[M^1L^2T^{-2}] = E$

4. Cannot determine the nature of the physical quantity i.e scalar or vector
5. Cannot derive formula containing trigonometric functions like $\sin\theta$, $\cos\theta$. log function like $\log x$ and exponent function like e^x

QUESTION

If velocity [V], time [T] and force [F] are chosen as the base quantities, the dimensions of the mass will be

(A) $[FT^{-1}V^{-1}]$

(B) $\boxed{[FTV^{-1}]}$

(C) $[FT^{2}V]$

(D) $[FVT^{-1}]$

$m \propto V\, T\, F$

$m = k V^{x} T^{y} F^{z}$ — (1)

$[M^1] = (L^1T^{-1})^{x}(T^1)^{y}[M^1L^1T^{-2}]^{z}$

$[M^1] = [L^{x}T^{-x}](T^{y})[M^{z}L^{z}T^{-2z}]$

Equate the powers

mass, $\boxed{1 = z}$

length, $0 = x + z$, $x = -z$

$x = -1$

Time, $0 = -x + y - 2z$

$= -(-z) + y - 2z$

$= z + y - 2z$

$0 = y - z \Rightarrow y = z$

$\boxed{y = 1}$

$m = K\boxed{(V^{-1}T^{1}F^{1})}$

QUESTION

If energy (E), velocity (V) and force (F) be taken as fundamental quantity, then what are the dimensions of mass [Home Work]

A. EV^2

B. EV^{-2}

C. FV^{-1}

D. FV^{-2}

QUESTION

If P, Q and R are physical quantities having different dimensions, which of the following combinations can never be a meaningful quantity?

(A) $\boxed{\dfrac{P-Q}{R}}$

(B) $PQ-R$

(C) $\dfrac{PQ}{R}$

(D) $\dfrac{PR-Q^2}{R}$

QUESTION

H.W

The dimensions of the ratio of magnetic flux (ϕ) and permeability (μ) are

A $[M^0 L^1 T^0 A^1]$

B $[M^9 L^{-3} T^0 A^1]$

C $[M^0 L^1 T^1 A^{-1}]$

D $[M^0 L^2 T^0 A^1]$

QUESTION

If C the capacitance and V be the electric potential, then the dimensional formula of CV^2 is

cv^2

$U = \left(\frac{1}{2}\right) cv^2 = [m^1 L^2 T^{-2}]$

(A) $\boxed{[M L^2 T^{-2} A^0]}$

(B) $[ML T^{-2} A^{-1}]$

(C) $[M^0 LT^{-2} A0]$

(D) $[M L^{-3} TA]$

QUESTION

Dimensional formula for the universal gravitational constant G is

(A) $[M^{-1} L^{2} T^{-2}]$

(B) $[M^{0} L^{0} T^{0}]$

(C) $\boxed{[M^{-1} L^{3} T^{-2}]}$

(D) $[M^{-1} L^{3} T^{-1}]$

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

$$G = \frac{F r^2}{m_1 m_2} = \frac{[\cancel{M^1} L^1 T^{-2}][L^2]}{[\cancel{M}][M^1]}$$

$$\boxed{G = [M^{-1} L^{3} T^{-2}]}$$

QUESTION

The dimensional formula for impulse is

(A) $\boxed{[MLT^{-1}]}$

(B) $[ML^{-1}T]$

(C) $[M^{-1}LT^{-1}]$

(D) $[ML^{-1}T^{-1}]$

$J = F \times \Delta t$

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

$\boxed{J = [M^1L^1T^{-1}]}$

QUESTION

The physical Quantity having the dimensions $\boxed{[M^{-1}L^{-3}T^{3}A^{2}]}$

(A) resistance $R = \frac{V}{I}$

(B) resistivity $R = \rho\frac{l}{A}$ $\rho = \frac{RA}{l}$

(C) electrical conductivity $\sigma = \frac{1}{\rho}$

(D) electromotive force √

Motion in Straight Line

STATE OF THE BODY

STATE OF THE BODY

STATE OF REST

STATE OF MOTION

SCALARS AND VECTORS

$p = mv$

$m = 1kg$

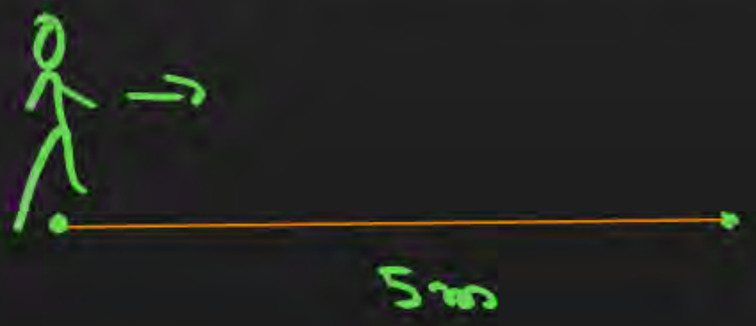
SCALAR	VECTOR
The quantities are expressed with magnitude only	The quantities are expressed with both magnitude and direction
Does not depends on the direction	Depends on the direction
Ex : Distance, Speed, Mass, Length, Time and etc	Ex : Displacement, Velocity, Acceleration, Force and etc
Follows simple algebra for addition	Follows vector algebra for addition

DISTANCE AND DISPLACEMENT

DISTANCE	DISPLACEMENT
It is the total length of the path covered by the object.	It is the shortest distance between the final and initial positions
It is a scalar quantity	It is a vector quantity
It depends on the path followed by the object	It does not depend on the path followed by the object
It is always positive	It can be positive or negative depending on the direction
It can be more than or equal to the magnitude of displacement	Its magnitude can be less than or equal to the distance, but can never be greater than the distance
It may not be zero even if displacement is zero, but it can not be zero if displacement is zero	It is zero if the distance is zero, but it can be zero even if distance is not zero

DISTANCE AND DISPLACEMENT

Case (i) : The distance and displacement can be equal



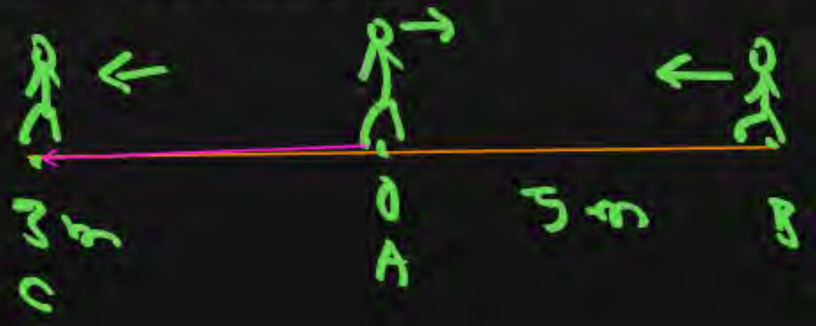
Dist = 5m.

Disp = +5m.

Dist $\geq$ Disp

Disp $\leq$ Dist

Case(ii): The distance can be greater than the magnitude of displacement or displacement can never be greater than the distance



Dist = AB + BA + AC = 5 + 5 + 3 = 13m

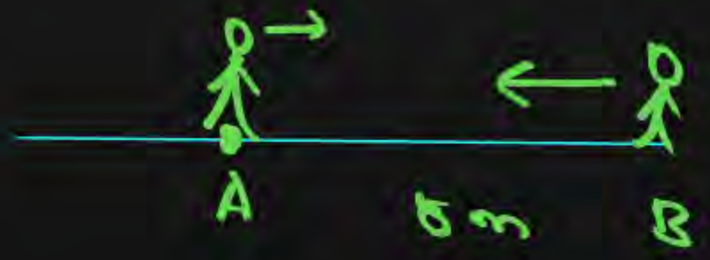
Disp = AC = 3m.

Disp = −3m.

DISTANCE AND DISPLACEMENT

Case (iii) : The distance is always positive and displacement can be positive or negative

Case(iv) The displacement can be zero even if the distance is not zero



Dist = AB + BA = 5 + 5 = 10 m.

Disp = 0

SPEED AND ITS TYPES

The distance travelled by a particle in a given time is called Speed. $v = \frac{l}{t}$

Dimensional Formula - $[L^1 T^{-1}]$

Quantity - Scalar.

SPEED

- UNIFORM SPEED
- NON- UNIFORM SPEED
- INSTANTENEOUS SPEED $v = \left.\frac{dx}{dt}\right|_{t=t_1}$
- AVERAGE SPEED $V_{avg} = \frac{\text{Tot. Dist}}{\text{Tot. Time}}$

VELOCITY AND ITS TYPES

Change → Direction, magnitude, Both.

The displacement of a particle in a given time is called Velocity. $\vec{v} = \frac{\vec{s}}{t}$

Dimensional Formula - $[L^1 T^{-1}]$

Quantity - Vector.

VELOCITY

- **UNIFORM VELOCITY**
- **NON- UNIFORM VELOCITY**
- **INSTANTENEOUS VELOCITY** — $v = \frac{dx}{dt}\Big|_{t=t_1}$
- **AVERAGE VELOCITY** — $v_{avg} = \frac{\vec{s}_{total}}{t_{total}}$

SPEED AND VELOCITY

SPEED	VELOCITY
The distance travelled per second by a moving object is called its speed	Displacement per unit time is called velocity
It is a scalar quantity	It is a vector quantity
It depends on the path followed by the object	It does not depend on the path followed by the object
It is always positive	It can be positive or negative depending on the direction
After one round in a circular path, the speed is not zero	After completing each round in a circular path, the velocity is zero
$Speed = \frac{Distance}{Time}$	$Velocity = \frac{Displacement}{Time}$

ACCELERATION AND ITS TYPES

The rate of change of velocity is called Acceleration. $\boxed{a = \frac{dv}{dt}}$

$a = \frac{v-u}{t}$

$v = f(t)$

$a = \frac{dv}{dt}$

$v = f(x)$

$a = v . \frac{dv}{dx}$

Dimensional Formula - $[L^1T^{-2}]$

Quantity - Vector.

ACCELERATION

- **UNIFORM ACCELERATION**
- **NON- UNIFORM ACCELERATION**
- **INSTANTENEOUS ACCELERATION**
- **AVERAGE ACCELERATION**

CALCULATION PART

x — POSITION $\xrightarrow{v = \frac{dx}{dt}}$ VELOCITY — v

$x = \int v \cdot dt$

$a = \frac{dv}{dt}$, $v = f(t)$

$a = v \cdot \frac{dv}{dx}$, $v = f(x)$

VELOCITY $\rightarrow$ ACCELERATION

ACCELERATION $\rightarrow$ VELOCITY

$v = \int a \cdot dt$

$v = \int a \cdot dx$

QUESTION

The numerical ratio of displacement to the distance covered is always:

(A) Less than one

(B) Equal to one

(C) $\boxed{\text{Equal to or less than one}}$

(D) Equal to or greater than one

disp $\leq$ Dist

$\frac{\text{disp}}{\text{dist}} \leq 1$

QUESTION

Which of the following statement is not true?

(A) If displacement covered of a particle is zero, then distance covered may or may not be zero

(B) If the distance covered is zero then the displacement must be zero

(C) The numerical value of ratio of displacement to distance is equal to or less than one

(D) The numerical value of the ratio of velocity to speed is always less than one

QUESTION

If $t = \sqrt{x} + 4$, then $\frac{dx}{dt}_{t=4}$ is

A) 4

B) $\boxed{\text{Zero}}$

C) 8

D) 16

$\sqrt{x} = t - 4$

$x = (t-4)^2$

$\frac{dx}{dt} = 4(t-4)(1)$

At $t = 4$, $\frac{dx}{dt} = 4(4-4) = 0$

QUESTION

The displacement x (in m) of a particle of mass m (in kg) moving in one dimension under the action of a force, is related to time t (in sec) by $t = \sqrt{x} + 3$. The displacement of the particle when its velocity is zero, will be

(A) Zero

(B) 6 m

(C) 2 m

(D) 4 m

$$\sqrt{x} = t - 3$$

$$x = (t-3)^2$$

$$v = \frac{dx}{dt} = 2(t-3)(1)$$

$$2(t-3) = 0$$

$$t - 3 = 0$$

$$\boxed{t = 3\,s}$$

$$x = (t-3)^2$$

$$x = (3-3)^2$$

$$\boxed{x = 0}$$

QUESTION

The position of a body is $x = 4t^2 + 3$. What will be the velocity at $\boxed{t = 10\ s}$?

(A) 20 m/s

(B) 40 m/s

(C) $\boxed{80\ \text{m/s}}$

(D) 100 m/s

$x = 4t^2 + 3$

$v = \frac{dx}{dt} = 4 \times 2t + 0$

$v = 8t$

At $t = 10s$, $v = 8 \times 10$

$\boxed{v = 80\ m/s}$

QUESTION

The displacement y (in meters) of a body varies with time (in seconds) according to the equation $y = -\frac{2}{3}t^2 + 16t + 2$. $\boxed{\text{How long does the body come to rest?}}$ $\rightarrow v=0$

$$y = -\frac{2}{3}t^2 + 16t + 2$$

A 8 seconds

$$v = \frac{dy}{dt} = -\frac{2}{3} \times 2t + 16(1) + 0 = 0$$

B 10 seconds

$$-\frac{4t}{3} + 16 = 0$$

C $\boxed{\text{12 seconds}}$

$$\frac{4t}{3} = 16^4$$

D 14 seconds

$$\boxed{t = 4 \times 3 = 12 s}$$

QUESTION

The position coordinate of a moving particle is given by $x = 6 + 18t + 9t^2$. What is its velocity at $t = 2\ s$?

$v = \frac{dx}{dt} = 0 + 18(1) + 9 \times 2t$

$v = 18 + 18t$

At $t = 2s$, $v = 18 + 18(2)$

$v = 18 + 36$

$\boxed{v = 54\ m/s}$

(A) 24 m/s

(B) $\boxed{54\ \text{m/s}}$

(C) 50 m/s

(D) 175 m/s

QUESTION

A particle is moving on the x axis such that the velocity is function of the x coordinate according to the relation $v = 2x + 1$. Find out the acceleration of the particle as a function of x.

(A) $2x - 1$

(B) $4x - 1$

(C) $\boxed{4x + 2}$

(D) None of these

$a = v \cdot \frac{dv}{dx}$

$a = (2x+1) \times (2(1) + 0)$

$a = (2x+1)2$

$\boxed{a = 4x + 2}$

QUESTION

The relation between time t and displacement x is expressed by $\boxed{x = 2 - 5t + 6t^2.}$ What will be the $\boxed{\text{initial velocity}}$ of the particle?

$t = 0s$

$v = \frac{dx}{dt} = 0 - 5(1) + 6 \times 2t$

$v = -5 + 12t$

At $t = 0s$, $\boxed{v = -5 \text{ m/s}}$

(A) $\boxed{-5 \text{ m/sec}}$

(B) -3 m/sec

(C) 6 m/sec

(D) 3 m/sec

QUESTION

If the velocity of a particle is $v = At + Bt^2$, where A and B are constants, then the distance travelled by it between 1 s and 2 s is

(A) $3A + 7B$ ✗

(B) $\boxed{\frac{3}{2}A + \frac{7}{3}B}$

(C) $\frac{A}{2} + \frac{B}{3}$ ✗

(D) $\frac{3}{2}A + \frac{4}{3}B$

$$x = \int_{t_1}^{t_2} v.dt = \int_1^2 (At + Bt^2)\,dt$$

$$x = \int_1^2 At.dt + \int_1^2 Bt^2.dt$$

$$x = A\left[\frac{t^2}{2}\right]_1^2 + B\left[\frac{t^3}{3}\right]_1^2$$

$$x = \frac{A}{2}\left[t^2\right]_1^2 + \frac{B}{3}\left(t^3\right)_1^2 = \frac{A}{2}[4-1] + \frac{B}{3}(8-1)$$

$$\boxed{x = \frac{3A}{2} + \frac{7B}{3}}$$

QUESTION

Displacement is given by $x = 1 + 2t + 3t^2$. Find the value of instantaneous acceleration.

$v = \frac{dx}{dt} = 0 + 2(1) + 3 \times 2t$

$v = 2 + 6t$

$a = \frac{dv}{dt} = 0 + 6(1)$

$\boxed{a = 6 m/s^2}$

(A) $3ms^{-2}$

(B) $\boxed{6ms^{-2}}$

(C) $9ms^{-2}$

(D) $12ms^{-2}$

Thank

You