YAKEEN NEET 2.0

2026

Units and Measurements

PHYSICS | **Lecture – 03**

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Todays Goal

- Ques practice & PYQ

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

$MLT^{-2} \longrightarrow$ force

$ML^2T^{-2} \longrightarrow$ Energy, work

$$G = \frac{F \cdot r^2}{m_1 m_2} = \frac{\cancel{M}LT^{-2}L^2}{\cancel{M}M}$$

$$M^{-1}L^3T^{-2}$$

$$\text{Pressure} = \frac{F}{\text{Area}} \longrightarrow \frac{MLT^{-2}}{L^2} = ML^{-1}T^{-2}$$

g (acc) due to gravit = LT^{-2}

$$\text{surface tension} = \frac{F}{l} \Rightarrow \frac{M\cancel{L}T^{-2}}{\cancel{L}} = ML^0T^{-2}$$

$$\text{coff of viscocity} = \eta = \frac{F}{6\pi r v} \longrightarrow \frac{MLT^{-2}}{L\,LT^{-1}} = ML^{-1}T^{-1}$$

$$F = 6\pi r \eta v$$

length, velocit

Impulse = Force × time = MLT^{-1}

* Intensity = $\frac{\text{Energy}}{\text{Area time}} = \frac{ML^2T^{-2}}{L^2T} = ML^0T^{-3}$

* $Q = mL$

heat energy

mass

Latent heat

$L = \frac{Q}{m} \Rightarrow \frac{ML^2T^{-2}}{M} = L^2T^{-2}$

* $Q = ms\Delta T$

Change in temp.

heat

mass

Specific heat

Capacity const

$S = \frac{Q}{m\Delta T} \Rightarrow \frac{ML^2T^{-2}}{M \cdot K} = M^0L^2T^{-2}K^{-1}$

Q $E = h\nu$

Energy

frequency

plank const

h (plank const) =

** Q Energy Density = $\frac{\text{Energy}}{\text{Volume}}$

Q $E = h\nu$

Energy, plank const, frequency

h (plank const) $= \frac{E}{\nu} \Rightarrow \frac{ML^2T^{-2}}{T^{-1}}$

$= ML^2T^{-1}$

Bolzman const (K)

$U = \frac{3}{2}KT$

Energy, temp

$K = \frac{2}{3}\frac{U}{T} \Rightarrow \boxed{ML^2T^{-2}K^{-1}}$

** Q Energy Density $= \frac{\text{Energy}}{\text{Volume}}$

$= \frac{ML^2T^{-2}}{L^3} = ML^{-1}T^{-2}$

Q spring const (k') $= \frac{F}{x} = \frac{MLT^{-2}}{L}$

$= ML^0T^{-2}$

$F = kx$

Force, Distance

wave velocity $\rightarrow LT^{-1}$

Escape Velocity $\rightarrow LT^{-1}$

Inst. Velocity $\rightarrow LT^{-1}$

Speed $\rightarrow LT^{-1}$

Terminal Velocity $\rightarrow LT^{-1}$

Orbital Velocity $\rightarrow LT^{-1}$

Drift velocity $\rightarrow LT^{-1}$

Dhokebaj

Angular Velocity $\rightarrow T^{-1}$

(k) Refractive Index = $\dfrac{\text{speed of light in vaccum}}{\text{speed of light in medium}} = \dfrac{LT^{-1}}{LT^{-1}} = M^0L^0T^0$

(l) $\dfrac{\Delta Q}{\Delta t} = KA\dfrac{\Delta T}{L}$

$K = \dfrac{\Delta Q}{\Delta t}\dfrac{L}{A\,\Delta T} \Rightarrow \dfrac{ML^2T^{-2}\cdot L}{T\cdot L^2\cdot K} = MLT^{-3}K^{-1}$

$\Delta Q \longrightarrow$ heat

$\Delta t \longrightarrow$ time

$K \longrightarrow$ thermal conductivity

$A \longrightarrow$ Area

$\Delta T \longrightarrow$ change in temp.

$L \longrightarrow$ Length

1

$$* \quad PV = nRT$$

pressure, vol, temp

R → gas const

n → no. of moles (mol)

$$R = \frac{PV}{nT} \Rightarrow \frac{\frac{MLT^{-2}}{L^2} \cdot L^3}{mol \cdot K} = ML^2T^{-2}mol^{-1}K^{-1}$$

Q $\frac{\Delta Q}{\Delta t} = A\sigma T^4$

A → Area, T → temp

$$\sigma = \frac{\Delta Q}{\Delta t \cdot A T^4} \Rightarrow \frac{ML^2T^{-2}}{T L^2 K^4}$$

$$= ML^0T^{-3}K^{-4}$$

$kg + kg = kg$

$10kg + 4kg = 14kg$

$10kg - 4kg = 6kg$

कद्दू − कद्दू = कद्दू

कद्दू + कद्दू = कद्दू

$2kg + 4m =$

$2kg + 4^{\circ}C =$

$U_1 + U_2 = U_3 \Rightarrow U_1\ U_2\ U_3$ will have Same D.F.

$U_2 - U_1 = U_3 \Longrightarrow U_1\ U_2\ U_3$ will have Same D.F.

Q Find the D.F. of Unknown phy. quant A, B, C . . .

SKC

सबसे पहले ये देखो किसमें क्या +, − हो रहा है

① $v = \frac{A}{B+t}$ find D.F. of A & B

($v \rightarrow$ velocity, $t \rightarrow$ time)

$\boxed{B = \text{time} \equiv T}$

$v = \frac{A}{B+t}$

$LT^{-1} = \frac{A}{T}$

$\boxed{A = LT^{-1} \times T = L}$

② $v = \frac{Ax}{B+x^2}$ $x \longrightarrow$ Distance, $v \longrightarrow$ velocity

Sol^n $\boxed{B \Rightarrow L^2}$

$LT^{-1} = \frac{AL}{L^2}$

$\boxed{A = \frac{LT^{-1}L^2}{L} = L^2T^{-1}}$

$$
\left\{
\begin{array}{l}
x \longrightarrow \text{distance} \\
t \longrightarrow \text{time} \\
v \longrightarrow \text{velocity} \,|\, \text{speed} \\
F \longrightarrow \text{Force}
\end{array}
\right\}
$$

③ $v = \dfrac{Ax}{B+x^3}$

$\boxed{B \equiv L^3}$

$LT^{-1} = \dfrac{AL}{L^3}$

$\boxed{A = L^3T^{-1}}$

④ $v = \dfrac{Ax}{B-x^3}$

$\boxed{B \equiv L^3}$

$LT^{-1} = \dfrac{AL}{L^3}$

$\boxed{A = L^3T^{-1}}$

⑤ $v = \dfrac{At}{B+x^2}$

$\boxed{B \Rightarrow L^2}$

$LT^{-1} = \dfrac{AT}{L^2}$

$\boxed{A = L^3T^{-2}}$

⑥ $F = \dfrac{A}{B+t^2}$

$B \Rightarrow T^2$

$MLT^{-2} = \dfrac{A}{T^2}$

$\boxed{A \Rightarrow ML}$

⑦ $F = \dfrac{A}{B+x^2}$

$B \equiv L^2$

$MLT^{-2} = \dfrac{A}{L^2}$

$\boxed{A \equiv ML^3T^{-2}}$

Q $F = \frac{At^2}{B+x^2}$

If D.F. of $\frac{A}{B}$ is given by $M^x L^y T^z$

find $|x| + |y| + |z|$

Sol^n $\boxed{B \equiv L^2}$

$MLT^{-2} = \frac{AT^2}{L^2}$

$\boxed{A = ML^3T^{-4}}$

$\frac{A}{B} = \frac{ML^3T^{-4}}{L^2} = MLT^{-4}$

$x = 1$
$y = 1$
$z = -4$

Ans 6

Q $U = \frac{At^2}{B+x^2}$ → Potential energy

$ML^2T^{-2} = \frac{AT^2}{L^2}$

$\boxed{A \Rightarrow ML^4T^{-4}}$

$\boxed{B = L^2}$

$B \equiv L^2$

$\frac{A}{B} = \frac{ML^4T^{-4}}{L^2} \equiv ML^2T^{-4}$

Q $F = \dfrac{Av^2}{B + x^2}$

If D.F. of A.B is $M^x L^y T^z$

find $|x| + |y| + |z|$

$MLT^{-2} = \dfrac{A\,L^2T^{-2}}{L^2}$

$\boxed{A \equiv ML}$

4

$A \cdot B \Rightarrow MLL^2$

$= ML^3T^0$

Q $U = \dfrac{At^2}{B + \sqrt{x}}$ → Potential Energy.

If D.F. of A.B is $M^x L^y T^z$

find $|x| + |y| + |z|$

Sol^n $B = L^{\frac{1}{2}}$

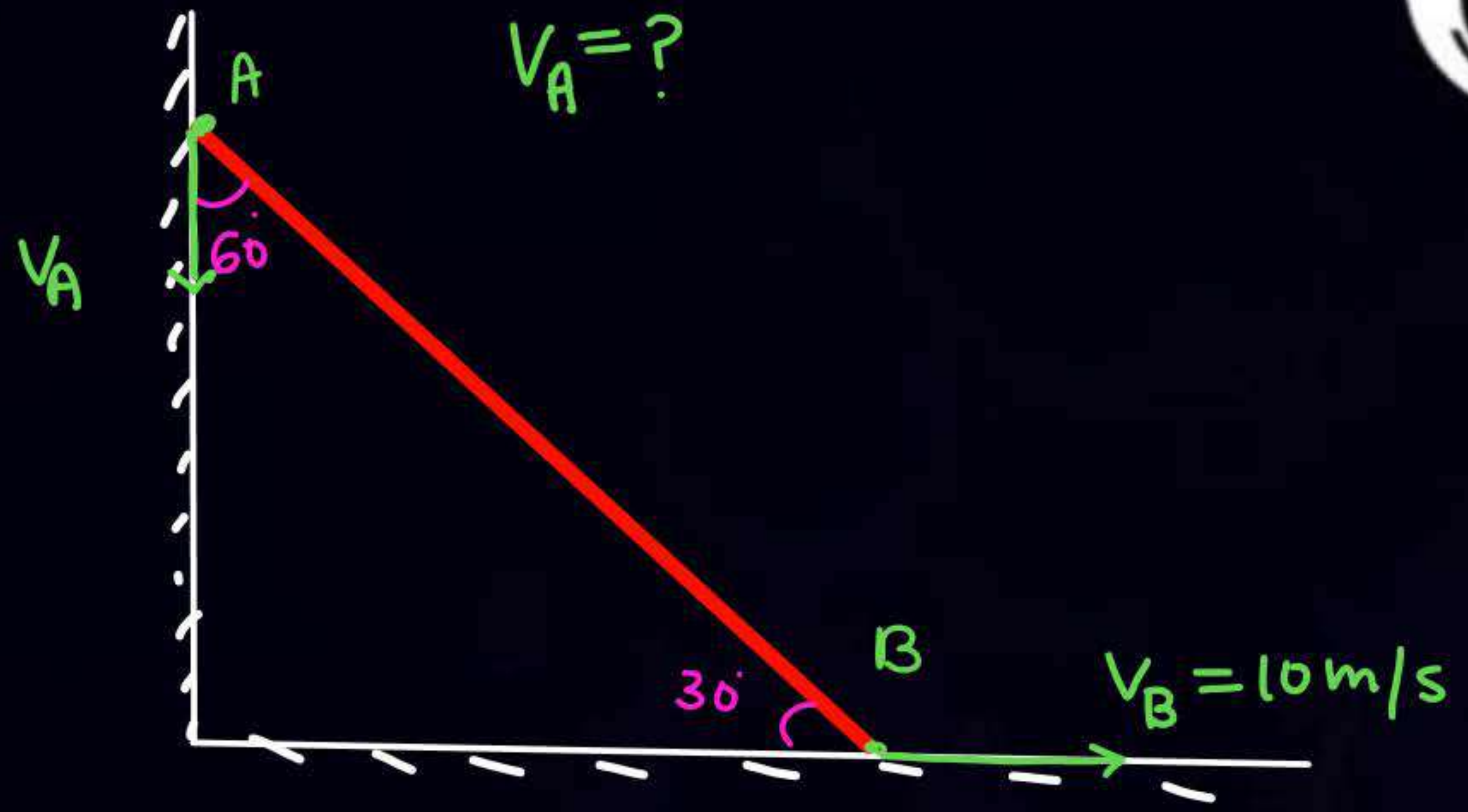
$ML^2T^{-2} = \dfrac{AT^2}{L^{\frac{1}{2}}}$

$\boxed{A \Rightarrow ML^{5/2}T^{-4}}$

$A \cdot B \Rightarrow ML^{5/2} \cdot T^{-4} \cdot L^{\frac{1}{2}}$

$ML^3T^{-4} \Rightarrow$ Ans. 8

H/W



T Q

Potential Energy.

$$U = \frac{At^2}{B+\sqrt{x}}$$

If D.F. of A.B is $m^x L^y T^z$

find $|x|+|y|+|z|$

$$B = L^{\frac{1}{2}}$$

$$m L^3 T^{-4}$$

1

Question

The pair of physical quantities not having same dimensions is: (29 Jan. 2025 - Shift 1)

1. Torque and energy
2. Surface tension and impulse
3. Angular momentum and Planck's constant
4. Pressure and Young's modulus

Ans : (2)

Question

Match List - I with List - II.
Choose the correct answer from the options given below:

(29 Jan. 2025 – Shift 2)

	List - I		List – II
(A)	Young's Modulus	(I)	$[ML^{-1}T^{-1}]$
(B)	Torque	(II)	$[ML^{-1}T^{-2}]$
(C)	Coefficient of Viscosity	(III)	$[M^{-1}L^{3}T^{-2}]$
(D)	Gravitational Constant	(IV)	$[ML^{2}T^{-2}]$

1. (A)-(I), (B)-~~(III)~~, (C)-(II), (D)-(IV)
2. (A)-(IV), (B)-~~(II)~~, (C)-(III), (D)-(I)
3. (A)-(II), (B)-(IV), (C)-(I), (D)-(III)
4. (A)-(II), (B)-~~(I)~~, (C)-(IV), (D)-(III)

Ans : (3)

Question

velocity $AT^2 = LT^{-1}$

The expression given below shows the variation of velocity (v) with time (t), $v = At^2 + \frac{Bt}{C+t}$. The dimension of ABC is: (29 Jan. 2025 – Shift 1)

1. $[M^0 L^2 T^{-3}]$
2. $[M^0 L^1 T^{-3}]$
3. $[M^0 L^1 T^{-2}]$
4. $[M^0 L^2 T^{-2}]$

$C = T$ $A \equiv LT^{-3}$

$\frac{Bt}{C+t} \rightarrow$ velocity

B

$\frac{B\cancel{T}}{\cancel{T}} = LT^{-1}$

Ans : (1)

Question

$= \tau \times t$ ML^2T^{-1}

Match List - I with List - II.
Choose the correct answer from the options given below:

(28 Jan. 2025 – Shift 2)

List - I		List – II	
(A).	Angular Impulse	(I)	$[M^0L^2T^{-2}]$
(B)	Latent Heat $=$ (I)	(II)	$[ML^2T^{-3}A^{-1}]$
(C)	Electrical resistivity	(III)	$[ML^2T^{-1}]$
(D)	Electromotive force	(IV)	$[ML^3T^{-3}A^{-2}]$

$Q = mL$

$L = \frac{\cancel{m}L^2T^{-2}}{\cancel{m}}$

$\frac{P.E.}{\text{Charge}}$

1. (A)-(II), (B)-(I), (C)-(IV), (D)-(III)
2. (A)-(I), (B)-(~~III~~), (C)-(IV), (D)-(II)
3. (A)-(III), (B)-(I), (C)-(II), (D)-(IV)
4. (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

Ans : (4)

Question

The position of a particle moving on x-axis is given by $x(t) = A \sin t + B \cos^2 t + Ct^2 + D$, where t is time. The dimension of $\frac{ABC}{D}$ is: (22 Jan. 2025 - Shift 2)

1. L
2. $L^3 T^{-2}$
3. $L^2 T^{-2}$
4. L^2

Ans : (3)

Question

The dimensional formula of latent heat is: (09 April 2024 – Shift 1)

1. $[M L^2 T^{-2}]$
2. $[M^0 L^2 T^{-2}]$
3. $[M L T^{-2}]$
4. $[M^0 L T^{-2}]$

Ans. (2)

Question

Given below are two statements:

Statement (I): Dimensions of specific heat is $[L^2T^{-2}K^{-1}]$.

Statement (II): Dimensions of gas constant is $[ML^2T^{-1}K^{-1}]$.

In the light of the above statements, choose the most appropriate answer from the options given below:

(06 April 2024 – Shift 2)

1. Both statement (I) and statement (II) are correct
2. Statement (I) is correct but statement (II) is incorrect
3. Both statement (I) and statement (II) are incorrect
4. Statement (I) is incorrect but statement (II) is correct

Ans. (2)

Question

What is the dimensional formula of ab^{-1} in the equation $\left(P + \frac{a}{V^2}\right)(V - b) = RT$, where letters have their usual meaning.

(05 April 2024 - Shift 2)

1. $[M^{-1}L^{5}T^{3}]$
2. $[M^{6}L^{7}T^{4}]$
3. $[M L^{2} T^{-2}]$
4. $[M^{0}L^{3}T^{-2}]$

Ans. (3)

Question

The dimensional formula of angular impulse is: (01 February 2024 - Shift 1)

$\tau \times t \equiv ML^2T^{-2}T$

1. $[ML^{-2}T^{-1}]$
2. $[ML^2T^{-2}]$
3. $[MLT^{-1}]$
4. $[ML^2T^{-1}]$

Ans. (4)

Question

Consider two physical quantities A and B related to each other as $E = \frac{B - x^2}{At}$ where E, x and t have dimensions of energy, length and time respectively. The dimension of AB is

(31 January 2024 - Shift 2)

1. $L^{-2} M^{1} T^{0}$
2. $L^{2} M^{-1} T^{1}$
3. $L^{-2} M^{-1} T^{1}$
4. $L^{0} M^{-1} T^{1}$

$$E = \frac{B - x^2}{At}$$

$$B \equiv L^2$$

$$ML^2T^{-2} = \frac{L^2}{At}$$

$$A =$$

Ans. (2)

Question

A force is represented by $F = ax^2 + bt^{1/2}$

Where x = distance and t = time. The dimensions of b^2/a are:

(31 January 2024 - Shift 1)

1. $[ML^3 T^{-3}]$
2. $[MLT^{-2}]$
3. $[ML^{-1} T^{-1}]$
4. $[ML^2 T^{-3}]$

Ans. (1)

Question

$\frac{M\cancel{L}T^{-2}}{\cancel{L}}$

Match the list-I with List-II.

Choose the correct answer from the options given below: **(30 January 2024 – Shift 1)**

(1) A – II, B – I, C – IV, D – ~~III~~

(2) A – I, B – II, C – III, D – ~~IV~~

(3) A – III, B – IV, C – II, D – I

(4) A – IV, B – III, C – II, D – I

List-I		List-II	
A.	Coefficient of viscosity	I.	$[ML^2T^{-2}]$
B.	Surface Tension IV	II.	$[ML^2T^{-1}]$
C.	Angular momentum	III.	$[ML^{-1}T^{-1}]$
1 D.	Rotational kinetic energy	IV.	$[ML^0T^{-2}]$

Ans. (3)

Question

The equation of state of a real gas is given by $\left(P + \frac{a}{V^2}\right)(V - b) = RT$, where P, V and T are pressure. volume and temperature respectively and R is the universal gas constant. The dimensions of $\frac{a}{b^2}$ is similar to that of:

(27 January 2024 - Shift 2)

(1) PV

(2) P

(3) RT

(4) R

Ans. (2)

Question

Match the list-I with List-II. **(12 April 2023 - Shift 1)**

List-I		List-II	
A.	Spring constant	I.	$[T^{-1}]$
B.	Angular speed	II.	$[MT^{-2}]$
C.	Angular momentum	III.	$[ML^2]$
D.	Moment of Inertia	IV.	$[ML^{-2}T^{-1}]$

Choose the correct answer from the options given below:

1. A–I, B–III, C–II, D–IV
2. A–IV, B–I, C–III, D–II
3. A–II, B–I, C–IV, D–III
4. A–II, B–III, C–I, D–IV

Ans : (3)

Question

Match the list-I with List-II. (08 April 2023 - Shift 2)

List-I		List-II	
A.	Torque ii	I.	$ML^{-2}T^{-2}$
B.	Stress = IV	II.	$ML^{2}T^{-2}$
C.	Pressure gradient	III.	$ML^{-1}T^{-1}$
D.	Coefficient of viscosity	IV.	$ML^{-1}T^{-2}$

$$\frac{MLT^{-2}}{L^2}$$

$$ML^{-1}T^{-2}$$

Choose the correct answer from the options given below:

1. A–II, B–I, C–IV, D–III
2. A–IV, B–II, C–III, D–I
3. A–II, B–IV, C–I, D–III
4. A–III, B–IV, C–I, D–II

Ans : (3)

Question

Match the list-I with List-II. (31 January 2023 - Shift 2)

	List-I		List-II
A.	Angular momentum	I.	$[ML^2T^{-2}]$
B.	Torque	II.	$[ML^{-2}T^{-2}]$
C.	Stress	III.	$[ML^2T^{-1}]$
D.	Pressure gradient	IV.	$[ML^{-1}T^{-2}]$

Choose the correct answer from the options given below:

1. A–I, B–IV, C–III, D–II
2. A–III, B–I, C–IV, D–II
3. A–II, B–III, C–IV, D–I
4. A–IV, B–II, C–I, D–III

Ans : (2)

Question

ML^2T^{-2} $kg\,m^2\,s^{-2}$

Match the list-I with List-II. (30 January 2023 - Shift 2)

	List-I		List-II
A.	Torque IV	I.	$kg\,m^{-1}\,s^{-2}$
B.	$\boxed{\text{Energy density}}$	II.	$kg\,ms^{-1}$
C.	Pressure gradient	III.	$kg\,m^{-2}\,s^{-2}$
D.	Impulse	IV.	$kg\,m^2\,s^{-2}$

$$\frac{ML^2T^{-2}}{L^3}$$

$ML^{-1}T^{-2}$

$kg\,m^{-1}\,s^{-2}$

Choose the correct answer from the options given below:

1. A–IV, B–~~III~~, C–I, D–II
2. ~~A~~–I, B–IV, C–III, D–II
3. A–IV, B–I, C–II, D–III
4. A–IV, B–I, C–III, D–II

Ans : (4)

Question

$F = qE$

Match the list-I with List-II. (29 January 2023 - Shift 1)

List-I (Physical Quantity)		List-II (Dimensional Formula)	
A.	Pressure gradient	I.	$[M^0L^2T^{-2}]$
B.	Energy density	II.	$[M^1L^{-1}T^{-2}]$
C.	Electric Field	III.	$[M^1L^{-2}T^{-2}]$
D.	Latent heat	IV.	$[M^1L^1T^{-3}A^{-1}]$

Choose the correct answer from the options given below:

1. A–III, B–II, C–I, D–IV
2. A–II, B–III, C–IV, D–I
3. A–III, B–II, C–IV, D–I
4. A–II, B–III, C–I, D–IV

Ans : (3)

Question

Match the list-I with List-II. (25 January 2023 – Shift 2)

List-I		List-II	
A.	Young's Modulus (Y)	I.	$[ML^{-1}T^{-1}]$
B.	Co-efficient of Viscosity (η)	II.	$[ML^{2}T^{-1}]$
C.	Planck's Constant (h)	III.	$[ML^{-1}T^{-2}]$
D.	Work Function (ϕ)	IV.	$[ML^{2}T^{-2}]$

Stress = Y (~~Strain~~)

$\frac{MLT^{-2}}{L^2}$

Choose the correct answer from the options given below:

1. A–II, B–III, C–IV, D–I
2. A–III, B–I, C–II, D–IV
3. A–I, B–III, C–IV, D–II
4. A–I, B–II, C–III, D–IV

Ans : (2)

Question

Match the list-I with List-II. (25 January 2023 - Shift 1)

	List-I		List-II
A.	Surface tension	I.	Kg $m^{-1}s^{-1}$
B.	Pressure	II.	Kg ms^{-1}
C.	Viscosity	III.	Kg $m^{-1}s^{-2}$
D.	Impulse	IV.	Kg s^{-2}

Choose the correct answer from the options given below:

1. A–IV, B–III, C–II, D–I
2. A–IV, B–III, C–I, D–II
3. A–III, B–IV, C–I, D–II
4. A–II, B–I, C–III, D–IV

Ans : (2)

Question

Match the list–I with List–II. (24 January 2023 - Shift 1)

List–I		List–II	
A.	Planck's constant (h)	I.	$[M^1L^2T^{-2}]$
B.	Stopping potential (Vs)	II.	$[M^1L^2T^{-1}]$
C.	Work function (ϕ)	III.	$[M^1L^2T^{-1}]$
D.	Momentum (p)	IV.	$[M^1L^2T^{-3}A^{-1}]$

1. A–III, B–I, C–II, D–IV
2. A–III, B–IV, C–I, D–II
3. A–II, B–IV, C–III, D–I
4. A–I, B–III, C–IV, D–II

Ans : (2)

Question

The SI unit of a physical quantity is pascal-second. The dimensional formula of this quantity will be:

(JEE Main-2022)

$$\frac{MLT^{-2}}{L^2} \cdot T$$

$$ML^{-1}T^{-1}$$

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

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

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

(4) $[M^{-1}L^{3}T^{0}]$

Ans : (1)

Question

Match the list-I with List-II.

	List-I		List-II
A.	Torque	I.	$N\,ms^{-1}$
B.	Stress	II.	$J\,kg^{-1}$
C.	Latent Heat	III.	Nm
D.	Power	IV.	Nm^{-2}

Choose the correct answer from the options given below: (JEE Main-2022)

1. A-III, B-II, C-I, D-IV
2. A-III, B-IV, C-II, D-I
3. A-IV, B-I, C-III, D-II
4. A-II, B-III, C-I, D-IV

Ans : (2)

Question

Match List-I with List-II. **(JEE Main-2021)**

	List-I		List-II
(a)	Torque · iii	(i)	MLT^{-1}
(b)	Impulse $= F \times t$	(ii)	MT^{-2}
(c)	Tension	(iii)	ML^2T^{-2}
(d)	Surface Tension	(iv)	MLT^{-2}

Choose the most appropriate answer from the option given below:

1. (a)–(iii), (b)–(i), (c)–(iv), (d)–(ii)
2. (a)–(ii), (b)–(i), (c)–(iv), (d)–(iii)
3. (a)–(i), (b)–(iii), (c)–(iv), (d)–(ii)
4. (a)–(iii), (b)–(iv), (c)–(i), (d)–(ii)

Ans : (1)

Question

Match List-I with List-II:

List-I	List-II
(a) h (Planck's constant)	(i) $[M L T^{-1}]$
(b) E (kinetic energy)	(ii) $[M L^2 T^{-1}]$
(c) V (electric potential)	(iii) $[M L^2 T^{-2}]$
(d) P (linear momentum)	(iv) $[M L^2 I^{-1} T^{-3}]$

Choose the correct answer from the options given below: (JEE Main-2021)

1. (a)→(iii), (b)→(iv), (c)→(ii), (d)→(i)
2. (a)→(ii), (b)→(iii), (c)→(iv), (d)→(i)
3. (a)→(i), (b)→(ii), (c)→(iv), (d)→(iii)
4. (a)→(iii), (b)→(ii), (c)→(iv), (d)→(i)

Ans : (2)

Question

Expression for time in terms of G(universal gravitational constant), h(Planck's constant) and c(speed of light) is proportional to: **[Main 9, Jan. 2019 (II)]**

1. $\sqrt{\frac{hc^5}{G}}$
2. $\sqrt{\frac{c^3}{Gh}}$
3. $\sqrt{\frac{Gh}{c^5}}$
4. $\sqrt{\frac{Gh}{c^3}}$

Ans: (3)

Question

A quantity f is given by $f = \sqrt{\frac{hc^5}{G}}$ where c is speed of light, G universal gravitational constant and h is the Planck's constant. Dimension of f is that of: **[Main 9, Jan 2019 (I)]**

1. Area
2. Energy
3. Momentum
4. Volume

Ans: (2)

Dimensions of Quantites Related to Mechanics

S.N.	Quantity	Formula	Unit	Dimension
1.	Velocity or speed (v)	$v = \frac{d}{t} = \frac{\text{Displacement or Distance}}{\text{Time}}$	m/s	$[M^0L^1T^{-1}]$
2.	Acceleration (a)	$a = \frac{\Delta v}{\Delta t} = \frac{\text{Change in velocity}}{\text{Change in time}}$	m/s^2	$[M^0LT^{-2}]$
3.	Momentum (P)	$P = mv = \text{Mass} \times \text{Velocity}$	kg − m/s	$[M^1L^1T^{-1}]$
4.	Impulse (I)	$I = F \times \Delta t = \text{Force} \times \text{Time}$	Newton-second or kg − m/s	$[M^1L^1T^{-1}]$
5.	Force (F)	$F = ma = \text{Mass} \times \text{Acceleration}$	Newton	$[M^1L^1T^{-2}]$
6.	Pressure (P)	$P = \frac{F}{A} = \frac{\text{Force}}{\text{Area}}$	Pascal	$[M^1L^{-1}T^{-2}]$

7.	Kinetic energy (E_K)	$K = \frac{1}{2}mv^2 = \frac{1}{2}$ Mass × Velocity^2	Joule	$[M^1L^2T^{-2}]$
8.	Power (P)	$P = \frac{W}{t} = \frac{\text{Work}}{\text{Time}}$	Watt or Joule/sec	$[M^1L^2T^{-3}]$
9.	Density (d)	$\rho = \frac{m}{V} = \frac{\text{Mass}}{\text{Volume}}$	kg/m^3	$[M^1L^{-3}T^0]$
10.	Angular displacement (θ)	$\theta = \frac{S}{r} = \frac{\text{Arc}}{\text{Length}}$	Radian (rad.)	$[M^0L^0T^0]$
11.	Angular velocity (ω)	$\omega = \frac{\Delta\theta}{\Delta t} = \frac{\text{Angular displacem}}{\text{Time}}$	Radian/sec	$[M^0L^0T^{-1}]$
12.	Angular acceleration (α)	$\alpha = \frac{\Delta\omega}{\Delta t} = \frac{\text{Angular velocity}}{\text{Time}}$	Radian/sec^2	$[M^0L^0T^{-2}]$
13.	Moment of inertia (I)	$I = mx^2 =$ Mass × Distance^2	kg − m^2	$[M^1L^2T^0]$

14.	Torque (τ)	$\tau = F \times r_{\perp} =$ Force $\times$ Perpendicular distance	Newton-meter	$[M^1L^2T^{-2}]$
15.	Angular momentum (L)	$L = mvr =$ Mass $\times$ Velocity $\times$ Radius	Joule-sec	$[M^1L^2T^{-1}]$
16.	Force constant or spring constant (k)	$F = -kx =$ Force constant $\times$ Displacement	Newton/m	$[M^1L^0T^{-2}]$
17.	Gravitational constant (G)	$F = \frac{Gm_1m_2}{r^2} = \frac{\text{Gravitational constant} \times \text{Mass}^2}{\text{Distance}^2}$	$N - m^2/k^2$	$[M^{-1}L^3T^{-2}]$

18.	Gas constant (R)	$PV = nRT$ Pressure × Velocity = Gas constant × Temperature	Joule/mol-K	$[M^1L^2T^{-2}\theta^{-1}]$
19.	Planck's constant (h)	$E = hv$ Energy = Planck's constant × Frequency	Joule-s	$[M^1L^2T^{-1}]$
20.	Surface tension (T)	$T = \frac{F}{l} \Rightarrow$ Surface Tension = $\frac{\text{Force}}{\text{Length}}$	N/m or joule/m^2	$[M^1L^0T^{-2}]$
21.	Coefficient of viscosity (η)	$\eta = \frac{F}{6\pi rv} = \frac{\text{Force}}{\text{Radius} \times \text{Velocity}}$	kg/m − s	$[M^1L^{-1}T^{-1}]$
22.	Time period (T)	$T = \frac{1}{n} = \frac{1}{\text{Frequency}}$	Second	$[M^0L^0T^1]$
23.	Frequency (n)	$n = \frac{1}{T} = \frac{1}{\text{Time}}$	Hz	$[M^0L^0T^{-1}]$

Dimensions of Quantities Related to Electricity & Heat

S.N.	Quantity	Formula	Unit	Dimension
1.	Heat (Q)	Energy	Joule	$[ML^2\, T^{-2}]$
2.	Specific Heat (c)	$c = \frac{Q}{m \times \Delta\theta} = \frac{\text{Heat}}{\text{Mass} \times \text{Temperature}}$	Joule/kg-K	$[M^0\, L^2\, T^{-2}\, K^{-1}]$
3.	Thermal capacity (K)	$K = \frac{Q}{\Delta t} = \frac{\text{Heat}}{\text{Time}}$	Joule/K	$[M^1L^2T^{-2}K^{-1}]$
4.	Latent heat (L)	$L = \frac{Q}{m} = \frac{\text{Heat}}{\text{Mass}}$	Joule/kg	$[M^0L^2T^{-2}]$
5.	Boltzmann constant (k)	$k = \frac{E}{T} = \frac{\text{Energy}}{\text{Temperature}}$	Joule/K	$[M^1L^2T^{-2}K^{-1}]$

6.	Coefficient of thermal conductivity (k)	$k = \frac{Qd}{A \times \Delta\theta \times t} = \frac{\text{Heat} \times \text{Distance}}{\text{Area} \times \text{Temp. difference} \times \text{Time}}$	Joule/m-s-K	$[M^1 L^1 T^{-3} K^{-1}]$
7.	Stefan's constant (σ)	$\sigma = \frac{\Delta E}{A \times \Delta t \times \theta^4} = \frac{\text{Energy}}{\text{Area} \times \text{Time} \times \text{Temperature}^4}$	Watt $/m^2 - K^4$	$[M^1 L^0 T^{-3} K^{-4}]$
8.	Wien's constant (b)	$b = \lambda_{max} \times T =$ Wavelength $\times$ Temperature	Meter-K	$[M^0 L^1 T^0 K^1]$
9.	Coefficient of linear expansion (α)	$\alpha = \frac{\Delta L}{L} \frac{1}{T} = \frac{\text{Change in length}}{\text{Length} \times \text{Temperature}}$	Kelvin $^{-1}$	$[M^0 L^0 T^0 K^{-1}]$
10.	Mechanical eq. of Heat (J)	$J = \frac{W}{Q} = \frac{\text{Work}}{\text{Heat}}$	Joule/Calorie	$[M^0 L^0 T^0]$
11.	Vander wall's constant (a)	$a = \frac{RTV^2}{V-b} - PV^2$	Newton-m^4	$[M^1 L^5 T^{-2}]$

12.	Vander wall's constant (b)	Same as Volume (V)	m^3	$[M^0L^3T^0]$
13.	Temperature (T)	$T = \frac{Q}{M\Delta C}$	Kelvin (K)	$[M^0L^0T^0K^1]$

Electricity and Magnetism

S.N.	Quantity	Formula	Unit	Dimension
1.	Electric charge (q)	$q = \mathrm{i} \times t =$ Electric current × Time	Coulomb	$[M^0L^0T^1A^1]$
2.	Electric current (I)	$i = \frac{q}{t} = \frac{\text{Charge}}{\text{Time}}$	Ampere	$[M^0L^0T^0A^1]$
3.	Capacitance (C)	$C = \frac{q}{V} = \frac{\text{Charge}}{\text{Voltage difference}}$	Coulomb/volt or Farad	$[M^{-1}L^{-2}T^4A^2]$
4.	Electric potential (V)	$V = \frac{q}{C} = \frac{\text{Charge}}{\text{Capacitance}}$	Joule/coulomb	$[M^1L^2T^{-3}A^{-1}]$
5.	Permittivity of free space (ε_0)	$\varepsilon_0 = \frac{Fr^2}{m^2}$ $= \frac{\text{Charge}^2}{\text{Electric force} \times \text{Distance}^2}$	Coulomb^2/ Newton-meter^2	$[M^{-1}L^{-3}T^4A^2]$

6.	Dielectric constant (K)	$K = \frac{\varepsilon}{\varepsilon_0} = \frac{\text{Permittivity in medium}}{\text{Permittivity in free space}}$	Unitless	$[M^0L^0T^0]$
7.	Resistance (R)	$R = \frac{V}{I} = \frac{\text{Voltage difference}}{\text{Electric current}}$	Volt/Ampere or Ohm	$[M^1L^2T^{-3}A^{-2}]$
8.	Resistivity or Specific resistance (ρ)	$\rho = \frac{RA}{\ell} = \frac{\text{Resistance} \times \text{Area}}{\text{Length}}$	Ohm-meter	$[M^1L^3T^{-3}A^{-2}]$
9.	Coefficient of self-induction (L)	$L = \frac{\mu_0 N^2 A}{\ell}$	Volt-Second/ Ampere or Henery or Ohm-second	$[M^1L^2T^{-2}A^{-2}]$
10.	Magnetic flux (ϕ)	$\phi = B \times A =$ Magnetic field × Area	Volt-second or Weber	$[M^1L^2T^{-2}A^{-1}]$
11.	Magnetic induction (B)	$B = \frac{F}{q \times v} = \frac{\text{Magnetic force}}{\text{Charge} \times \text{Velocity}}$	Newton /Ampere-Meter or Tesla	$[M^1L^0T^{-2}A^{-1}]$

12.	Magnetic intensity (H)	$H = \frac{B}{\mu} = \frac{\text{Magnetic field}}{\text{Permeability}}$	Ampere/meter	$[M^0L^{-1}T^0A^1]$
13.	Magnetic dipole moment (M)	$M = I \times A = \text{Current} \times \text{Area}$	Ampere-meter^2	$[M^0L^2T^0A^1]$
14.	Permeability of free space (μ_0)	$\mu_0 = \frac{B \cdot \ell}{I}$ $= \frac{\text{Magnetic field} \times \text{Length}}{\text{Current}}$	Newton/Ampere^2	$[M^1L^1T^{-2}A^{-2}]$
15.	Surface charge density (σ)	$\sigma = \frac{q}{A} = \frac{\text{Charge}}{\text{Area}}$	Coulomb-meter^2	$[M^0L^{-2}T^1A^1]$
16.	Electric dipole moment (p)	$p = q \times d = \text{Charge} \times \text{Distance}$	Coulomb-meter	$[M^0L^1T^1A^1]$
17.	Conductance (G)	$G = \frac{1}{R} = \frac{1}{\text{Resistance}}$	Ohm $^{-1}$	$[M^{-1}L^{-2}T^3A^2]$

18.	Conductivity (σ)	$\sigma = \frac{1}{\rho} = \frac{1}{\text{Resistivity}}$	Ohm^{-1} meter^{-1}	$[M^{-1}L^{-3}T^{3}A^{2}]$
19.	Current density (J)	$J = \frac{I}{A} = \frac{\text{Current}}{\text{Area}}$	Ampere/m^2	$[M^{0}L^{-2}T^{0}A^{1}]$
20.	Intensity of electric field (E)	$E = \frac{F}{q} = \frac{\text{Electric force}}{\text{Electric charge}}$	Volt/meter, Newton/coulomb	$[M^{1}L^{1}T^{-3}A^{-1}]$
21.	Rydberg constant (R)	$R_H = \frac{me^4}{8h^3c\varepsilon_0^2}$	m^{-1}	$[\mathrm{M}^{0}\mathrm{L}^{-1}\mathrm{T}^{0}]$

Quantities Having Same Dimensions

S.N.	Dimension	Quantity
1.	$[M^0L^0T^{-1}]$	Frequency, Angular frequency, Angular velocity and Velocity gradient
2.	$[M^1L^2T^{-2}]$	Work, Internal energy, Potential energy, Kinetic energy, Torque
3.	$[M^1L^{-1}T^{-2}]$	Pressure, Stress, Young's modulus, Bulk modulus, Modulus of rigidity, Energy density
4.	$[M^1L^1T^{-1}]$	Momentum, Impulse
5.	$[M^1L^1T^{-2}]$	Thrust, Force, Weight
6.	$[M^1L^2T^{-1}]$	Angular momentum and Planck's constant
7.	$[M^1L^0T^{-2}]$	Surface tension, Surface energy (energy per unit area), Force constant and Spring constant

8.	$[M^0L^2T^{-2}]$	Latent heat and Gravitational potential
9.	$[M^1L^2T^{-2}\theta^{-1}]$	Thermal capacity, Gas constant and Entropy
10.	$[M^0L^0T^1]$	$L/R, \sqrt{LC}, RC$ where $L =$ Inductance, $R =$ Resistance, $C =$ Capacitance and time
11.	$[M^0L^1T^0]$	Distance, Displacement, Radius, Wavelength radius of gyration.
12.	$[M^0L^1T^{-1}]$	Speed, Velocity, Velocity of light.
13.	$[M^0L^1T^{-2}]$	Acceleration, Acceleration due to gravity, Centripetal acceleration.
14.	$[M^0L^0T^1]$	Decay constant, Rate of disintegration.
15.	$[M^0L^2T^{-2}\theta^{-1}]$	Specific heat, Specific gas constant.
16.	$[M^0L^1T^0]$	Wave Number, Power of a lens, Rydberg's constant.
17.	$[M^1L^2T^{-3}A^{-1}]$	Electric Potential, emf (electromotive force).

18.	No Dimension $[M^0L^0T^0]$	Strain, Poisson's ratio, Refractive index, Dielectric constant, Coefficient of friction, Relative permeability, Magnetic susceptibility, Electric susceptibility, Angle, Solid angle, Trigonometric ratio's, Logarithm function all Exponential constant are all dimensionless.
19.	$[M^{-1}L^{-3}T^4A^2]$	Permittivity of free space, Permeability of free space.

Kal upload

2026

KPP [HCV questions]

Vector

1. Add vectors $\vec{A}$, $\vec{B}$ and $\vec{C}$ each having magnitude of 100 unit and inclined to the X-axis at angles 45°, 135° and 315° respectively.

2. Let $\vec{a} = 4\vec{i} + 3\vec{j}$ and $\vec{b} = 3\vec{i} + 4\vec{j}$. (a) Find the magnitudes of (1) $\vec{a}$, (2) $\vec{b}$, (3) $\vec{a}+\vec{b}$ and (4) $a - \vec{b}$.

3. Refer to figure. Find (a) the magnitude, (b) x and y components and (c) the angle with the X-axis of the resultant of $\overrightarrow{OA}$, $\overrightarrow{BC}$ and $\overrightarrow{DE}$.

4. Two vectors have magnitudes 3 unit and 4 unit respectively. What should be the angle between them if the magnitude of the resultant is (a) 1 unit, (b) 5 unit and (c) 7 unit.

5. Suppose $\vec{a}$ is a vector of magnitude 4.5 unit due north. What is the vector (a) $3\vec{a}$, (b) $-4\vec{a}$?

6. Two vectors have magnitudes 2 m and 3 m. The angle between them is 60°. Find (a) the scalar product of the two vectors, (b) the magnitude of their vector product.

7. Let $\vec{a} = 2\vec{i} + 3\vec{j} + 4\vec{k}$ and $\vec{b} = 3\vec{i} + 4\vec{j} + 5\vec{k}$. Find the angle between them.

8. Prove that $\vec{A} \cdot (\vec{A} \times \vec{B}) = 0$.

9. If $\vec{A} = 2\vec{i} + 3\vec{j} + 4\vec{k}$ and $\vec{B} = 4\vec{i} + 3\vec{j} + 2\vec{k}$, find $\vec{A} \times \vec{B}$.

10. The electric current in a charging R-C circuit is given by $i = i_0 e^{-t/RC}$ where i_0, R and C are constant parameters of the circuit and t is time. Find the rate of change of current at (a) $t = 0$, (b) $t = RC$, (c) $t = 10\ RC$.

11. The electric current in a discharging R-C circuit is given by $i = i_0 e^{-t/RC}$ where i_0, R and C are constant parameters and t is time. Let $i_0 = 2.00$ A, $R = 6.00 \times 10^5\ \Omega$ and $C = 0.500\ \mu$F.
(a) Find the current at $t = 0.3$ s.
(b) Find the rate of change of current at $t = 0.3$ s.
(c) Find approximately the current at $t = 0.31$ s.

12. Find the area bounded under the curve $y = 3x^2 + 6x + 7$ and the X-axis with the ordinates at $x = 5$ and $x = 10$.

13. Find the area enclosed by the curve $y = \sin x$ and the X-axis between $x = 0$ and $x = \pi$.

14. Find the area bounded by the curve $y = e^{-x}$, the X-axis and the Y-axis.

15. The changes in a function y and the independent variable x are related as $\frac{dy}{dx} = x^2$. Find y as a function of x.

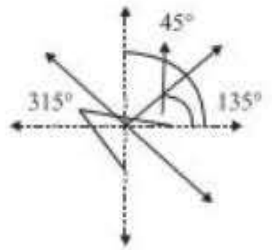
Answer Key

1. 100 unit at 45° with X-axis
2. (1) 5, (2) 5, (3) $7\sqrt{2}$, (4) $\sqrt{2}$
3. (a) 1.6 m, (b) 0.98 m and 1.3 m respectively
   (c) $\tan^{-1}(1.32)$
4. (a) 180°, (b) 90°, (c) 0
5. (a) 13.5 unit due north, (b) 18 unit due south
6. (a) 3 m^2, (b) $3\sqrt{3}$ m^2
7. $\cos^{-1}(38/\sqrt{1450})$
8. $\vec{A}\cdot(\vec{A}\times\vec{B})=0$
9. $-6\hat{i}+12\hat{j}-6\hat{k}$
10. (a) $\frac{-i_0}{RC}$, (b) $\frac{-i_0}{RCe}$, (c) $\frac{-i_0}{RCe^{10}}$
11. (a) $\frac{2.00}{e}$ A, (b) $\frac{-20}{3e}$ A/s, (c) $\frac{5.8}{3e}$ A
12. (1135)
13. (2)
14. (1)
15. $y=\frac{x^3}{3}+C$

Solution

1. 100 unit at 45° with X-axis

Sol.



x component of $\vec{A} = 100\cos 45° = \frac{100}{\sqrt{2}}$ unit

x component of $\vec{B} = 100\cos 135° = \frac{100}{\sqrt{2}}$

x component of $\vec{C} = 100\cos 315° = \frac{100}{\sqrt{2}}$

Resultant x component $= \frac{100}{\sqrt{2}} - \frac{100}{\sqrt{2}} + \frac{100}{\sqrt{2}} = \frac{100}{\sqrt{2}}$

y component of $\vec{A} = 100\sin\ 45° = 100/\sqrt{2}$ unit

y component of $\vec{B} = 100\sin\ 135° = 100/\sqrt{2}$

y component of $\vec{C} = 100\sin\ 315° = -100/\sqrt{2}$

Resultant y component $= \frac{100}{\sqrt{2}} + \frac{100}{\sqrt{2}} - \frac{100}{\sqrt{2}} = \frac{100}{\sqrt{2}}$

Resultant = 100

$\text{Tan}\ \alpha = \frac{y\text{ component}}{x\text{ component}} = 1$

$\Rightarrow \alpha = \tan^{-1}(1) = 45°$

The resultant is 100 unit at 45° with x-axis.

2. (1) 5, (2) 5, (3) $7\sqrt{2}$, (4) $\sqrt{2}$

Sol. **(1)** $\vec{a} = 4\hat{i} + 3\hat{j}$

Calculate its magnitude:

$|\vec{a}| = \sqrt{4^2+3^2} = \sqrt{16+9} = \sqrt{25} = 5$

(2). $\vec{b} = 3\hat{i} + 4\hat{j}$

Calculate its magnitude:

$|\vec{b}| = \sqrt{3^2+4^2} = \sqrt{9+16} = \sqrt{25} = 5$

(3). Find $a+\vec{b}$:

$\vec{a}+\vec{b} = (4\hat{i}+3\hat{j})+(3\hat{i}+4\hat{j})$

$= (4+3)\hat{i}+(3+4)\hat{j} = 7\hat{i}+7\hat{j}$

Calculate its magnitude:

$|\vec{a}+\vec{b}| = \sqrt{7^2+7^2}$

$= \sqrt{49+49} = \sqrt{98} = 7\sqrt{2}$

(4). Find $a-\vec{b}$:

$\vec{a}-\vec{b} = (4\hat{i}+3\hat{j})-(3\hat{i}+4\hat{j})$

$= (4-3)\hat{i}+(3-4)\hat{j} = 1\hat{i}-1\hat{j}$

Calculate its magnitude:

$|\vec{a}-\vec{b}| = \sqrt{1^2+(-1)^2} = \sqrt{1+1} = \sqrt{2}$

3. (a) 1.6 m, (b) 0.98 m and 1.3 m respectively (c) $\tan^{-1}(1.32)$

Sol. x component of $\overline{OA} = 2\cos 30° = \sqrt{3}$

x component of $\overline{BC} = 1.5\cos 120° = -0.75$

x component of $\overline{DE} = 1\cos 270° = 0$

y component of $\overline{OA} = 2\sin 30° = 1$

y component of $\overline{BC} = 1.5\sin 120° = 1.3$

y component of $\overline{DE} = 1\sin 270° = -1$

$R_x = x$ component of resultant

$= \sqrt{3} - 0.75 + 0 = 0.98$ m

$R_y =$ resultant y component $= 1 + 1.3 - 1$

$= 1.3$ m

So, $R =$ Resultant $= 1.6$ m

If it makes and angle α with positive x-axis

$\text{Tan}\ \alpha = \frac{y\text{ component}}{x\text{ component}} = 1.32$

$\Rightarrow \alpha = \tan^{-1} 1.32$

4. (a) 180°, (b) 90°, (c) 0

Sol. $|\vec{a}| = 3m|\vec{b}| = 4$

(a) If $R = 1$ unit

$\Rightarrow \sqrt{3^2+4^2+2\cdot 3\cdot 4\cdot \cos\theta} = 1$

$\theta = 180°$

(b) $\sqrt{3^2+4^2+2\cdot 3\cdot 4\cdot \cos\theta} = 5$

$\theta = 90°$

(c) $\sqrt{3^2+4^2+2\cdot 3\cdot 4\cdot \cos\theta} = 7$

$\theta = 0°$

Angle between them is 0°.

5. (a) 13.5 unit due north, (b) 18 unit due south

Sol. $\vec{a}$ is a vector of magnitude 4.5 unit due north

(a) $3|\vec{a}| = 3\times 4.5 = 13.5, 3|\vec{a}|$ is along north

having magnitude 13.5 units.
(b) $-4|\vec{a}| = -4 \times 4.5 = 18$ units
$-4\vec{a}$ is a vector of magnitude 18 units due south.

6. (a) $3\ m^2$, (b) $3\sqrt{3}\ m^2$

Sol. $|\vec{a}| = 2$ m, $|\vec{b}| = 3$ m
angle between them $\theta = 60°$
(a) $\vec{a}\cdot\vec{b} = |\vec{a}|\cdot|\vec{b}|\cos 60° = 2 \times 3 \times \frac{1}{2} = 3\ m^2$
(b) $|\vec{a}\times\vec{b}| = |\vec{a}|\cdot|\vec{b}|\sin 60° = 2 \times 3 \times \sqrt{\frac{3}{2}} =$
$3\sqrt{3}\ m^2$.

7. $\cos^{-1}(38/\sqrt{1450})$

Sol. We have:
$\vec{a} = 2\vec{i} + 3\vec{j} + 4\vec{k}$
$\vec{b} = 3\vec{i} + 4\vec{j} + 5\vec{k}$
Using scalar product, we can find the angle between vectors $\vec{a}$ and $\vec{b}$. i.e.,
$\vec{a}\cdot\vec{b} = |\vec{a}||\vec{b}|\cos\theta$

$$\text{So, } \theta = \cos^{-1}\left(\frac{\vec{a}\cdot\vec{b}}{|\vec{a}||\vec{b}|}\right)$$

$$= \cos^{-1}\left(\frac{2\times3+3\times4+4\times5}{\sqrt{(2^2+3^2+4^2)}\sqrt{(3^2+4^2+5^2)}}\right)$$

$$= \cos^{-1}\left(\frac{38}{\sqrt{29}\sqrt{50}} = \cos^{-1}\frac{38}{\sqrt{1450}}\right)$$

$\therefore$ The required angle is $\cos^{-1}\frac{38}{\sqrt{1450}}$.

8. $\vec{A}\cdot(\vec{A}\times\vec{B}) = 0$

Sol. $\vec{A}(\vec{A}\times\vec{B}) = 0$ (claim)
As $\vec{A}\times\vec{B} = AB\sin\theta\hat{n}$ < br > is a vector which is perpendicular to the place containing $\vec{A}$ and $\vec{B}$ < br > this implies that it is also perpendicular to $\vec{A}$. As dot product of two perpendicular vector is zero. $\vec{A}\cdot(\vec{A}\times\vec{B}) = 0$.

9. $-6\vec{i} + 12\vec{j} - 6\vec{k}$

Sol. The cross product $\vec{A}\times\vec{B}$ can be found using a determinant.

$$\vec{A}\times\vec{B} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$$

Substitute the components of $\vec{A}$ and $\vec{B}$.

$$\vec{A}\times\vec{B} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 2 & 3 & 4 \\ 4 & 3 & 2 \end{vmatrix}$$

Expand along the first row.

$$\vec{A}\times\vec{B} = \vec{i}\begin{vmatrix} 3 & 4 \\ 3 & 2 \end{vmatrix} - \vec{j}\begin{vmatrix} 2 & 4 \\ 4 & 2 \end{vmatrix} + \vec{k}\begin{vmatrix} 2 & 3 \\ 4 & 3 \end{vmatrix}$$

For the $\vec{i}$ component: $(3)(2) - (4)(3) = 6 - 12$
$= -6$.
For the $\vec{j}$ component: $(2)(2) - (4)(4) = 4 - 16$
$= -12$.
For the $\vec{k}$ component: $(2)(3) - (3)(4) = 6 - 12$
$= -6$.
Substitute the calculated values back into the expanded form.
$\vec{A}\times\vec{B} = -6\vec{i} - (-12)\vec{j} + (-6)\vec{k}$
$\vec{A}\times\vec{B} = -6\vec{i} + 12\vec{j} - 6\vec{k}$

10. (a) $\frac{-i_0}{RC}$, (b) $\frac{-i_0}{RCe}$, (c) $\frac{-i_0}{RCe^{10}}$

Sol. The rate of change of current is
Given that, $i = i_0 e^{-t/RC}$

$$\therefore \text{ Rate of change of current } = \frac{di}{dt} = \frac{d}{dt} i_0 e^{-t/RC}$$

$$= i_0 \frac{d}{dt} e^{-t/RC} = \frac{-i_0}{RC} \times e^{-t/RC}$$

When
(a) $t = 0, \frac{di}{dt} = \frac{-i_0}{RC}$
(b) when $t = RC, \frac{di}{dt} = \frac{-i_0}{RCe}$
(c) when $t = 10RC, \frac{di}{dt} = \frac{-i_0}{RCe^{10}}$

11. (a) $\frac{2.00}{e}$ A, (b) $\frac{-20}{3e}$ A/s, (c) $\frac{5.8}{3e}$ A

Sol. Equation $i = i_0 \cdot e^{-\frac{t}{RC}}$, where
$i_0 = 2$ A, $R = 6 \times 10^5$ ohm
$C = 0.0500 \times 10^{-6}$ F
$= 5 \times 10^{-7}$ F
$i = 2.0e^{-\frac{t}{0.3}}$

(a) $i = 2 \times xe^{(-1)} = \frac{2}{e}$ amp

(b) $\frac{di}{dt} = \frac{(-i_0)}{RC} \cdot e^{\left(-\frac{t}{RC}\right)}$

when $t = 0.3$sec, then $di/dt = 2/$

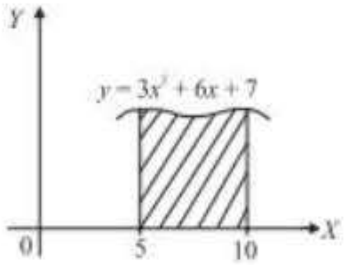
$(0.3)e\text{^})(-0.3)/(0.3)\,) = \frac{-20}{3e}$ amp/sec

(c) At $t = 0.31$ st

$i = 2e((-0.3)/0.3), \frac{5.8}{3e}$ amp (approx)

12. 1135

Sol.



The area bounded by the curve and the X-axis with coordinates $x_1 = 5$ and $x_2 = 10$ is given by:

$$\int_{x_1}^{x_2} y\,dx = \int_5^{10} (3x^2 + 6x + 7)\,dx = \left[\frac{3x^3}{3} + \frac{6x^2}{2} + 7x\right]_5^{10}$$

$= 1000 - 125 + 300 - 75 + 70 - 35$

$= 1370 - 235$

$= 1135$ sq. units

13. 2

Sol. Area $= \int^{x_2} - (x_1)\,y\,dx = \int^{\pi} - 0 \sin x\,dx < br >$

$= [\cos x]^{\pi} - 0 < br > = -\cos\pi - (-\cos 0)$

$< br > = +1 + 1 = 2$

14. 1

Sol. The given function is $y = e^{-x}$.

When $x = 0$, $y = e^{-0} = 1$

When x increases, the value of y decrease. Also, only when $x = \infty$, $y = 0$

So, the required area can be determined by integrating the function from 0 to ∞.

$\therefore$ Area $= \int_0^{\infty} e^{-x}\,dx = -\left[e^{-x}\right]_0^{\infty}$

$= -[0 - 1] = 1$ sq. unit

15. $y = \frac{x^3}{3} + C$

Sol. Change in a functin of y and the independent variable x are related as $\frac{dy}{dx} = x^2 \langle br \rangle \to dy = x^2 dx$

Taking integration of both sides we get

$\int dy = \int x^2 dx < br > \to y = \frac{x^3}{3} + c < br > y$ as a function of x is represented b

$y = \frac{x^3}{3} + c$

KPP - Formula **Unit and Dimensions**

I will upload

Dimensions of Quantites Related to Mechanics:

S.N.	Quantity	Formula	Unit	Dimension
1.	Velocity or speed (v)	$v = \frac{d}{t} = \frac{\text{Displacement or Distance}}{\text{Time}}$	m/s	$[M^0L^1T^{-1}]$
2.	Acceleration (a)	$a = \frac{\Delta v}{\Delta t} = \frac{\text{Change in velocity}}{\text{Change in time}}$	m/s^2	$[M^0LT^{-2}]$
3.	Momentum (P)	$P = mv$ = Mass × Velocity	kg – m/s	$[M^1L^1T^{-1}]$
4.	Impulse (I)	$I = F \times \Delta t$ = Force × Time	Newton-second or kg – m/s	$[M^1L^1T^{-1}]$
5.	Force (F)	$F = ma$ = Mass × Acceleration	Newton	$[M^1L^1T^{-2}]$
6.	Pressure (P)	$P = \frac{F}{A} = \frac{\text{Force}}{\text{Area}}$	Pascal	$[M^1L^{-1}T^{-2}]$
7.	Kinetic energy (E_K)	$K = \frac{1}{2}mv^2 = \frac{1}{2}$Mass × Velocity^2	Joule	$[M^1L^2T^{-2}]$
8.	Power (P)	$P = \frac{W}{t} = \frac{\text{Work}}{\text{Time}}$	Watt or Joule/sec	$[M^1L^2T^{-3}]$
9.	Density (d)	$\rho = \frac{m}{V} = \frac{\text{Mass}}{\text{Volume}}$	kg/m^3	$[M^1L^{-3}T^0]$
10.	Angular displacement (θ)	$\theta = \frac{S}{r} = \frac{\text{Arc}}{\text{Length}}$	Radian (rad.)	$[M^0L^0T^0]$
11.	Angular velocity (ω)	$\omega = \frac{\Delta\theta}{\Delta t} = \frac{\text{Angular displacement}}{\text{Time}}$	Radian/sec	$[M^0L^0T^{-1}]$
12.	Angular acceleration (α)	$\alpha = \frac{\Delta\omega}{\Delta t} = \frac{\text{Angular velocity}}{\text{Time}}$	Radian/sec^2	$[M^0L^0T^{-2}]$
13.	Moment of inertia (I)	$I = mx^2$ = Mass × Distance^2	kg – m^2	$[M^1L^2T^0]$

14.	Torque (τ)	$\tau = F \times r_\perp$ = Force × Perpendicular distance	Newton-meter	$[M^1L^2T^{-2}]$
15.	Angular momentum (L)	$L = mvr$ = Mass × Velocity × Radius	Joule-sec	$[M^1L^2T^{-1}]$
16.	Force constant or spring constant (k)	$F = -kx$ = Force constant × Displacement	Newton/m	$[M^1L^0T^{-2}]$
17.	Gravitational constant (G)	$F = \frac{Gm_1m_2}{r^2}$ $= \frac{\text{Gravitational constant} \times \text{Mass}^2}{\text{Distance}^2}$	$N - m^2/k^2$	$[M^{-1}L^3T^{-2}]$
18.	Gas constant (R)	$PV = nRT$ Pressure × Velocity = Gas constant × Temperature	Joule/mol-K	$[M^1L^2T^{-2}\theta^{-1}]$
19.	Planck's constant (h)	$E = \text{h}v$ Energy = Planck's constant × Frequency	Joule-s	$[M^1L^2T^{-1}]$
20.	Surface tension (T)	$T = \frac{F}{l} \Rightarrow$ Surface Tension $= \frac{\text{Force}}{\text{Length}}$	N/m or joule/m²	$[M^1L^0T^{-2}]$
21.	Coefficient of viscosity (η)	$\eta = \frac{F}{6\pi rv} = \frac{\text{Force}}{\text{Radius} \times \text{Velocity}}$	kg/m − s	$[M^1L^{-1}T^{-1}]$
22.	Time period (T)	$T = \frac{1}{n} = \frac{1}{\text{Frequency}}$	Second	$[M^0L^0T^1]$
23.	Frequency (n)	$n = \frac{1}{T} = \frac{1}{\text{Time}}$	Hz	$[M^0L^0T^{-1}]$

Dimensions of Quantities Related to Electricity and Heat:

S.N.	Quantity	Formula	Unit	Dimension
1.	Heat (Q)	Energy	Joule	$[ML^2T^{-2}]$
2.	Specific Heat (c)	$c = \frac{Q}{m \times \Delta\theta} = \frac{\text{Heat}}{\text{Mass} \times \text{Temperature}}$	Joule/kg-K	$[M^0L^2T^{-2}K^{-1}]$
3.	Thermal capacity (K)	$K = \frac{Q}{\Delta t} = \frac{\text{Heat}}{\text{Time}}$	Joule/K	$[M^1L^2T^{-2}K^{-1}]$
4.	Latent heat (L)	$L = \frac{Q}{m} = \frac{\text{Heat}}{\text{Mass}}$	Joule/kg	$[M^0L^2T^{-2}]$

5.	Boltzmann constant (k)	$k = \frac{E}{T} = \frac{\text{Energy}}{\text{Temperature}}$	Joule/K	$[M^1 L^2 T^{-2} K^{-1}]$
6.	Coefficient of thermal conductivity (k)	$k = \frac{Qd}{A \times \Delta\theta \times t} = \frac{\text{Heat} \times \text{Distance}}{\text{Area} \times \text{Temp. difference} \times \text{Time}}$	Joule/m-s-K	$[M^1 L^1 T^{-3} K^{-1}]$
7.	Stefan's constant (σ)	$\sigma = \frac{\Delta E}{A \times \Delta t \times \theta^4} = \frac{\text{Energy}}{\text{Area} \times \text{Time} \times \text{Temperature}^4}$	Watt $/m^2 - K^4$	$[M^1 L^0 T^{-3} K^{-4}]$
8.	Wien's constant (b)	$b = \lambda_{max} \times T$ = Wavelength × Temperature	Meter-K	$[M^0 L^1 T^0 K^1]$
9.	Coefficient of linear expansion (α)	$\alpha = \frac{\Delta L}{L}\frac{1}{T} = \frac{\text{Change in length}}{\text{Length} \times \text{Temperature}}$	Kelvin $^{-1}$	$[M^0 L^0 T^0 K^{-1}]$
10.	Mechanical eq. of Heat (J)	$J = \frac{W}{Q} = \frac{\text{Work}}{\text{Heat}}$	Joule/Calorie	$[M^0 L^0 T^0]$
11.	Vander wall's constant (a)	$a = \frac{RTV^2}{V - b} - PV^2$	Newton-m^4	$[M^1 L^5 T^{-2}]$
12.	Vander wall's constant (b)	Same as Volume (V)	m^3	$[M^0 L^3 T^0]$
13.	Temperature (T)	$T = \frac{Q}{M \Delta C}$	Kelvin (K)	$[M^0 L^0 T^0 K^1]$

Electricity and Magnetism:

S.N.	Quantity	Formula	Unit	Dimension
1.	Electric charge (q)	$q = I \times t$ = Electric current × Time	Coulomb	$[M^0 L^0 T^1 A^1]$
2.	Electric current (I)	$i = \frac{q}{t} = \frac{\text{Charge}}{\text{Time}}$	Ampere	$[M^0 L^0 T^0 A^1]$
3.	Capacitance (C)	$C = \frac{q}{V} = \frac{\text{Charge}}{\text{Voltage difference}}$	Coulomb/volt or Farad	$[M^{-1} L^{-2} T^4 A^2]$
4.	Electric potential (V)	$V = \frac{q}{C} = \frac{\text{Charge}}{\text{Capacitance}}$	Joule/coulomb	$[M^1 L^2 T^{-3} A^{-1}]$

5.	Permittivity of free space (ε_0)	$\varepsilon_0 = \frac{Fr^2}{m^2} = \frac{\text{Charge}^2}{\text{Electric force} \times \text{Distance}^2}$	Coulomb²/Newton-meter²	$[M^{-1}L^{-3}T^4A^2]$
6.	Dielectric constant (K)	$K = \frac{\varepsilon}{\varepsilon_0} = \frac{\text{Permittivity in medium}}{\text{Permittivity in free space}}$	Unitless	$[M^0L^0T^0]$
7.	Resistance (R)	$R = \frac{V}{I} = \frac{\text{Voltage difference}}{\text{Electrict current}}$	Volt/Ampere or Ohm	$[M^1L^2T^{-3}A^{-2}]$
8.	Resistivity or Specific resistance (ρ)	$\rho = \frac{RA}{\ell} = \frac{\text{Resistance} \times \text{Area}}{\text{Length}}$	Ohm-meter	$[M^1L^3T^{-3}A^{-2}]$
9.	Coefficient of self-induction (L)	$L = \frac{\mu_0 N^2 A}{\ell}$	Volt-Second/Ampere or Henery or Ohm-second	$[M^1L^2T^{-2}A^{-2}]$
10.	Magnetic flux (ϕ)	$\phi = B \times A =$ Magnetic field × Area	Volt-second or Weber	$[M^1L^2T^{-2}A^{-1}]$
11.	Magnetic induction (B)	$B = \frac{F}{q \times v} = \frac{\text{Magnetic force}}{\text{Charge} \times \text{Velocity}}$	Newton/Ampere-Meter or Tesla	$[M^1L^0T^{-2}A^{-1}]$
12.	Magnetic intensity (H)	$H = \frac{B}{\mu} = \frac{\text{Magnetic field}}{\text{Permeability}}$	Ampere/meter	$[M^0L^{-1}T^0A^1]$
13.	Magnetic dipole moment (M)	$M = I \times A =$ Current × Area	Ampere-meter²	$[M^0L^2T^0A^1]$
14.	Permeability of free space (μ_0)	$\mu_0 = \frac{B \cdot \ell}{I} = \frac{\text{Magnetic field} \times \text{Length}}{\text{Current}}$	Newton/Ampere²	$[M^1L^1T^{-2}A^{-2}]$
15.	Surface charge density (σ)	$\sigma = \frac{q}{A} = \frac{\text{Charge}}{\text{Area}}$	Coulomb-meter²	$[M^0L^{-2}T^1A^1]$
16.	Electric dipole moment (p)	$p = q \times d =$ Charge × Distance	Coulomb-meter	$[M^0L^1T^1A^1]$

17.	Conductance (G)	$G = \frac{1}{R} = \frac{1}{\text{Resistance}}$	Ohm $^{-1}$	$[M^{-1}L^{-2}T^{3}A^{2}]$
18.	Conductivity (σ)	$\sigma = \frac{1}{\rho} = \frac{1}{\text{Resistivity}}$	Ohm^{-1} meter^{-1}	$[M^{-1}L^{-3}T^{3}A^{2}]$
19.	Current density (J)	$J = \frac{I}{A} = \frac{\text{Current}}{\text{Area}}$	Ampere/m^2	$[M^{0}L^{-2}T^{0}A^{1}]$
20.	Intensity of electric field (E)	$E = \frac{F}{q} = \frac{\text{Electric force}}{\text{Electric charge}}$	Volt/meter, Newton/coulomb	$[M^{1}L^{1}T^{-3}A^{-1}]$
21.	Rydberg constant (R)	$R_H = \frac{me^4}{8h^3c\varepsilon_0^2}$	m^{-1}	$[M^{0}L^{-1}T^{0}]$

Quantities Having Same Dimensions:

S.N.	Dimension	Quantity
1.	$[M^0L^0T^{-1}]$	Frequency, Angular frequency, Angular velocity and Velocity gradient
2.	$[M^1L^2T^{-2}]$	Work, Internal energy, Potential energy, Kinetic energy, Torque
3.	$[M^1L^{-1}T^{-2}]$	Pressure, Stress, Young's modulus, Bulk modulus, Modulus of rigidity, Energy density
4.	$[M^1L^1T^{-1}]$	Momentum, Impulse
5.	$[M^1L^1T^{-2}]$	Thrust, Force, Weight
6.	$[M^1L^2T^{-1}]$	Angular momentum and Planck's constant
7.	$[M^1L^0T^{-2}]$	Surface tension, Surface energy (energy per unit area), Force constant and Spring constant
8.	$[M^0L^2T^{-2}]$	Latent heat and Gravitational potential
9.	$[M^1L^2T^{-2}\theta^{-1}]$	Thermal capacity, Gas constant and Entropy
10.	$[M^0L^0T^1]$	$L/R, \sqrt{LC}, RC$ where L = Inductance, R = Resistance, C = Capacitance and time
11.	$[M^0L^1T^0]$	Distance, Displacement, Radius, Wavelength radius of gyration.

12.	$[M^0L^1T^{-1}]$	Speed, Velocity, Velocity of light.
13.	$[M^0L^1T^{-2}]$	Acceleration, Acceleration due to gravity, Centripetal acceleration.
14.	$[M^0L^0T^1]$	Decay constant, Rate of disintegration.
15.	$[M^0L^2T^{-2}\theta^{-1}]$	Specific heat, Specific gas constant.
16.	$[M^0L^1T^0]$	Wave Number, Power of a lens, Rydberg's constant.
17.	$[M^1L^2T^{-3}A^{-1}]$	Electric Potential, emf (electromotive force).
18.	No Dimension $[M^0L^0T^0]$	Strain, Poisson's ratio, Refractive index, Dielectric constant, Coefficient of friction, Relative permeability, Magnetic susceptibility, Electric susceptibility, Angle, Solid angle, Trigonometric ratio's, Logarithm function & Exponential constant are all dimensionless.
19.	$[M^{-1}L^{-3}T^4A^2]$	Permittivity of free space, Permeability of free space.

Home Work

- Ques are attached solve them → in this ppt
- DPP
- Module → Prarambh → 1, 3, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 21, 25, 27, 28, 29, 37

Prabal Ex. 2 (Level up) ⇒ 11, 15,

THANK YOU