PHYSICS – MCQ BOOKLET

INDEX OF TOPICS

Measurement/Unit	.1
Measuring Instruments and Scales	.34
Mechanics	.49
Motion under Gravity	.184
Physical Properties of Materials	.195
Optics	.239
Heat and Thermodynamics	.326
Wave Motion	.395
Sound	.420
Electric Current	.445
Conductivity	.520
Nuclear Physics	.535
Computer and Information Technology	.571
Space	.593
Defence Technology	.607
Scientists & Inventions	.608
Miscellaneous	.628

1. Measurement/Unit

Derived Units and their Expression

1. Frequency is measured in

A. hertz
B. meter/second
C. radian
D. watt

Ans: A

BPSC Prelims Exam-64th

- Frequency measures the rate of repetition of an event. - The standard SI unit for frequency is the Hertz (Hz). - 1 Hz = 1 cycle/second = 1 s^{-1}. - Other options represent units for speed, angle, and power respectively.

2. The unit of electric power is

A. ampere
B. volt
C. coulomb
D. watt

Ans: D

BPSC Prelims Exam-64th

BPSC Prelims Exam-65th

Electric power is defined as the rate at which electrical energy is transferred or used. Its standard unit in the International System of Units (SI) is the watt (W).

3. What is the unit of pressure?

A. Newton/sq. meter
B. Newton-meter
C. Newton
D. Newton/meter

Ans: A

BPSC Prelims Exam-64th

Pressure is defined as force per unit area. The standard unit of force is the Newton (N), and the standard unit of area is the square meter (m^2). Therefore, the unit of pressure is Newton/sq. meter (N/m^2).

4. The unit of pressure is

A. kg/cm^2
B. kg/cm
C. kg/mm
D. kg/cm^3

Ans: A

BPSC Prelims Exam-65th

Pressure is force per unit area. Kg/cm² (interpreting kg as kg-force) is a unit of pressure.

5. The SI unit of mechanical power is :

A. Joule
B. Watt
C. Newton-second
D. Joule-second

Ans: B

UPSC CDS-1-2016

Power is defined as the rate at which work is done or energy is transferred. In the International System of Units (SI), the unit of work or energy is the Joule (J), and the unit of time is the second (s). Therefore, the unit of power is Joule per second (J/s), which is defined as the Watt (W).

6. The unit of the force constant k of a spring is

A. N-m
B. N/m
C. N-m^2
D. N/m^2

Ans: B

UPSC CDS-1-2020

- Hooke's Law: $F = kx$. - F is force (unit: N). - x is displacement (unit: m). - k is the force constant.

7. The resistivity ρ of a material may be expressed in units of

A. ohm
B. ohm/cm
C. ohm-cm
D. ohm-cm^2

Ans: C

UPSC CDS-1-2020

The unit of resistance (R) is Ohm (Ω). The unit of area (A) is typically square meters (m^2) or square centimeters (cm^2). The unit of length (L) is typically meters (m) or centimeters (cm). Substituting these units into the formula for ρ: $\text{Units of } \rho = \Omega \times \frac{\text{cm}^2}{\text{cm}} = \Omega \cdot \text{cm}$. Alternatively, using meters: $ \text{Units of } \rho = \Omega \times \frac{\text{m}^2}{\text{m}} = \Omega \cdot \text{m}$. Therefore, the resistivity is commonly expressed in ohm-centimeters ($\Omega \cdot \text{cm}$) or ohm-meters ($\Omega \cdot \text{m}$).

8. 'Joule' is related to energy in the same way as 'Pascal' is related to

A. Mass
B. Pressure
C. Density
D. Purity

Ans: B

CGPSC Prelims Exam-2015

- This question tests the knowledge of standard units for physical quantities. - Energy is the capacity to do work, measured in Joules. - Pressure is force per unit area, measured in Pascals.

9. Which one of the following is NOT a unit of magnetic field strength?

A. Tesla
B. Gauss
C. Ampere - metre
D. Ampere/metre

Ans: C

UPSC Geoscientist-2020

Magnetic field strength can refer to magnetic flux density (B), measured in Tesla (T) or Gauss (G), or magnetic field intensity (H), measured in Amperes per metre (A/m). Ampere - metre (A·m) is the unit for magnetic dipole moment.

10. Which one of the following is NOT the correct unit of 'power'?

A. Joule / second
B. (Newton-metre) / second
C. Watt
D. Newton / metre

Ans: D

UPSC Geoscientist-2021

Power is defined as the rate of doing work or transferring energy. Its standard unit in the SI system is the Watt (W).

11. Which one of the following is NOT a unit of 'Pressure'?

A. Bar
B. Atmosphere
C. N/m^2
D. N/m

Ans: D

UPSC Geoscientist-2021 UPSC CAPF-2022

Pressure is force distributed over an area. Its units reflect this (Force/Area). Common units include Pascal (Pa), N/m^2, Bar, Atmosphere, psi (pounds per square inch), mmHg (millimeters of mercury), etc.

12. The ratio between the circumference of a circle and the perimeter of a square is 11:3. What is the ratio between area of the circle and area of the square ?

A. 121/9
B. 242/9
C. 77/9
D. None of the above

Ans: D

GPSC Prelims CSP-1-2024

Set up equations based on the given ratio of circumference to perimeter and the formulas. Express the ratio of radii to sides. Calculate the ratio of areas using this ratio. Note that the value of π used in the problem might not be the standard \$22/7\$ or \$3.14\$, but one that makes the options work out.

13. If the curved surface area of a sphere is same as the curved surface area of a hemisphere, what is the ratio of the radius of the hemisphere and that of the sphere?

A. 1 : 2
B. $\sqrt{2}$: 1
C. 1 : $\sqrt{2}$
D. None of the above

Ans: B

GPSC Prelims CSP-1-2024

Use the formulas for the curved surface areas of a sphere and a hemisphere and set them equal to each other. Solve the resulting equation for the ratio of the radii.

14. A cone has a height of 12 cm and a base radius of 3.5 cm, what is the volume of the cone?

A. 77 cm^3
B. 308 cm^3
C. 154 cm^3
D. None of the above

Ans: C

GPSC Prelims CSP-1-2024

The formula for the volume of a cone is $V = (1/3)\pi r^2 h$. Given radius (r) = 3.5 cm and height (h) = 12 cm, we calculate $V = (1/3)\ (22/7)\ (3.5)^2\ 12 = (1/3)\ (22/7)\ 12.25\ 12 = (1/3)\ (22/7)\ (49/4)\ 12 = 154$ cm^3.

15. A 5 cm cube is cut into as many 1 cm cubes as possible. What is the ratio of the surface area of the larger cube to that of the sum of surface areas of the smaller cubes ?

A. 1 : 6
B. 1 : 5
C. 1 : 1.25
D. 1 : 25

Ans: B

GPSC Prelims CSP-1-2017

The volume of the large cube is $5^3 = 125$ cm³. The volume of each small cube is $1^3 = 1$ cm³. The number of small cubes is the total volume divided by the volume of each small cube: 125 cm³ / 1 cm³ = 125 cubes. The surface area of the large cube is 6 × side² = 6 × 5² = 6 × 25 = 150 cm². The surface area of one small cube is 6 × side² = 6 × 1² = 6 cm². The sum of the surface areas of all the smaller cubes is the number of small cubes multiplied by the surface area of one small cube: 125 × 6 = 750 cm².

16. In Δ ABC, AD = DB; If DE || BC and area of Δ ABC = 40 then area of Δ ADE is

A. 10
B. 20
C. 30
D. 24

Ans: A

GPSC Prelims CSP-1-2017

By the Midpoint Theorem (or its converse), if a line segment joins the midpoint of one side of a triangle and is parallel to the second side, then it bisects the third side. Since D is the midpoint of AB and DE || BC, E must be the midpoint of AC. Also, Δ ADE is similar to Δ ABC. This is because ∠DAE = ∠BAC (common angle) and ∠ADE = ∠ABC (corresponding angles, since DE || BC).

17. Match List-I with List-II:

List-I	List-II
A. S.I. unit of power of a lens	**1. V**
B. S.I. unit of electric potential difference	**2. Coulomb**
C. Potential difference between two points	**3. Diopter**
D. S.I. unit of electric charge	**4. W/Q**

A. A–4, B–3, C–2, D–1
B. A–3, B–4, C–1, D–2
C. A–2, B–3, C–4, D–1
D. A–2, B–3, C–4, D–1

Ans: B

HPPSC HPAS Prelims-2020

- S.I. unit of power of a lens: Diopter (D), defined as the reciprocal of the focal length in meters (1/f). Thus, A maps to 3 (Diopter). - S.I. unit of electric potential difference: Volt (V). Thus, B maps to 1 (V). - Potential difference between two points: Defined as the work done per unit charge to move a charge from one point to the other. Work (W) divided by charge (Q) is W/Q. Thus, C maps to 4 (W/Q). - S.I. unit of electric charge: Coulomb (C). Thus, D maps to 2 (Coulomb).

18. Match List I with List II :

List-I (Quantity)	List-II (Unit of Measurement)
(a) Weight	**(i) Cubic meter**
(b) Volume	**(ii) Newton**
(c) Temperature	**(iii) Pascal**
(d) Pressure	**(iv) Kelvin**

Choose the correct answer from the options given below :

A. (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)
B. (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)
C. (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)
D. (a)-(i), (b)-(iii), (c)-(iv), (d)-(ii)

Ans: B

HPPSC HPAS Prelims-2023

Units of measurement for various physical quantities: - Weight is the force exerted on a mass due to gravity. The SI unit of force is Newton (N) (ii). Although weight is often measured using scales calibrated in kilograms, this measures mass based on standard gravity. - Volume is the amount of space occupied by a substance or object. The SI unit of volume is the cubic meter (m³) (i). - Temperature is a measure of the degree of hotness or coldness of an object. The SI unit of thermodynamic temperature is the Kelvin (K) (iv). Celsius and Fahrenheit are also commonly used scales. - Pressure is the force applied perpendicular to the surface of an object per unit area over which that force is distributed. The SI unit of pressure is the Pascal (Pa) (iii).

19. The S.I. unit of acceleration is

A. ms^{-1}

B. ms^{-2}
C. cms^{-2}
D. kms^{-2}

Ans: B

UPSC NDA-1-2016

Acceleration is the rate of change of velocity with respect to time. The S.I. unit for velocity is meters per second (m/s or ms^{-1}) and the S.I. unit for time is seconds (s).

20. Which one of the following physical quantity has the same unit as that of pressure ?

A. Angular momentum
B. Stress
C. Strain
D. Work

Ans: B

UPSC NDA-1-2017

Pressure is defined as force per unit area (P = F/A). Its unit is Newton per square meter (N/m^2), also known as Pascal (Pa). Stress is also defined as force per unit area, representing the internal force per unit area within a material resisting deformation (Stress = F/A). Therefore, stress also has the unit of N/m^2 or Pascal (Pa).

21. 1 dyne (a unit of force in CGS system) equals to

A. 10^3 g cm/s^2
B. 10^{-3} g cm/s^2
C. 10^5 kg m/s^2
D. 10^{-5} kg m/s^2

Ans: D

UPSC NDA-1-2019

- The CGS unit of force is the dyne, defined as 1 g · cm/s^2. - The SI unit of force is the Newton (N), defined as 1 kg · m/s^2. - To convert dyne to Newton, we convert the units: - 1 gram (g) = 10^{-3} kilogram (kg) - 1 centimeter (cm) = 10^{-2} meter (m) - So, 1 dyne = 1 g · cm/s^2 = (10^{-3} kg) · (10^{-2} m) / s^2 = $10^{-3} \times 10^{-2}$ kg · m/s^2 = 10^{-5} kg · m/s^2.

22. Which one of the following cannot be the unit of frequency of a sound wave ?

A. dB
B. s^{-1}
C. Hz
D. min^{-1}

Ans: A

UPSC NDA-1-2021

Frequency measures how often something happens per unit time (cycles/time). Decibel measures relative intensity or amplitude on a logarithmic scale.

23. Which one of the following is the SI unit of the thermal conductivity of a material?

A. Wm'K~!
B. Wm/K
C. WmYK™?
D. Js'm'K

Ans: A

UPSC NDA-2-2015

The SI unit of thermal conductivity (k) is Watt per meter-Kelvin (W/(m·K)) or $W \cdot m^{-1} \cdot K^{-1}$. This unit comes from Fourier's law of heat conduction, which states that the rate of heat flow (Q) is proportional to the area (A), the temperature gradient (dT/dx), and the thermal conductivity (k): Q = -k A (dT/dx). Rearranging for k, k = Q / (A (dT/dx)). The units are W / (m^2 (K/m)) = W / (m K) = W m^{-1} K^{-1}. Assuming the symbols in option A represent W m^{-1} K^{-1}, it is the correct unit.

24. In SI unit of force 'Newton' (N) is given by (where m stands for metre and s stands for second):

A. 1 N = 1 kg/ms^2
B. 1 N = 1 kgm/s^2
C. 1 N = 1 kg s^2/m
D. 1 N = 1 kg m s^2

Ans: B

UPSC NDA-2-2015

The SI unit of force, the Newton (N), is defined based on Newton's second law of motion, which states that force (F) equals mass (m) multiplied by acceleration (a): F = ma. The SI unit of mass is the kilogram (kg), and the SI unit of acceleration is meters per second squared (m/s²). Therefore, 1 Newton is defined as the force required to accelerate a mass of 1 kilogram at a rate of 1 meter per second squared. This gives the relationship 1 N = 1 kg (m/s²), or 1 N = 1 kgm/s².

25. One kilowatt hour is equal to

A. 36×10^3 joule
B. 36×10^5 joule
C. 10^3 joule
D. 10^5 joule

Ans: B

UPSC NDA-2-2016

1 kilowatt (kW) = 1000 watts (W) = 1000 joules per second (J/s). 1 hour (h) = 60 minutes × 60 seconds = 3600 seconds (s).

26. Which one of the following statements is not correct ?

A. The SI unit of charge is ampere-second
B. Debye is the unit of dipole moment
C. Resistivity of a wire of length l and area of cross-section a depends upon both l and a
D. The kinetic energy of an electron of mass m kg and charge e coulomb, when accelerated through a potential difference of V volt, is eV joule

Ans: C

UPSC NDA-2-2016

- Resistivity is a material property. - Resistance depends on material, length, and area. - Charge unit is Coulomb (C) or Ampere-second (A·s). - Debye is a unit for electric dipole moment. - Kinetic energy gained by a charge 'e' accelerated by potential 'V' is eV.

27. The symbol of SI unit of inductance is H. It stands for

A. Holm
B. Halogen
C. Henry
D. Hertz

Ans: C

UPSC NDA-2-2017

- H is the symbol for the SI unit of inductance. - The unit is named after Joseph Henry.

28. Which one of the following is NOT the unit of energy ?

A. Joule
B. Watt-hr
C. Newton-metre
D. kg-metre/sec²

Ans: D

UPSC NDA-2-2020

Energy can be expressed in various units depending on the context (e.g., Joules, kilowatt-hours, calories, foot-pounds). Force and Energy are distinct physical quantities with different units.

29. The S.I unit of gravitational constant G is

A. N kg^{-2}
B. Nm kg^{-1}
C. Nm^2 kg^{-1}
D. Nm^2 kg^{-2}

Ans: D

TNPSC CS Prelims-2015

Rearranging the formula to solve for G, we get $G = \frac{F r^2}{m_1 m_2}$. Substituting the SI units for force (N), distance (m), and mass (kg), the unit of G is $\frac{N \cdot m^2}{kg \cdot kg} = N m^2 kg^{-2}$.

30. Dioptre is the SI unit of :

A. size of the lens.
B. curvature of the lens.
C. power of the lens.
D. magnification produced by a lens.

Ans: C

UPSC CISF-AC-EXE-2022

- Dioptre is the unit used to measure the optical power of lenses. - Optical power is the reciprocal of the focal length measured in metres.

31. Match List–I with List–II and select the correct answer using the code given below the lists :

List–I	List–II
(a) Wavelength	1. Hertz
(b) Energy	2. Angstrom
(c) Intensity of sound	3. Joule
(d) Frequency	4. Decibel

A. 2 3 4 1
B. 1 2 3 4
C. 2 3 1 4
D. 2 1 3 4

Ans: A

UPPCS Prelims-2008

Wavelength is commonly measured in Angstroms (especially for light/EM spectrum), Energy in Joules (SI unit), Intensity of sound in Decibels (a logarithmic scale related to sound pressure level), and Frequency in Hertz (cycles per second).

32. Match List-I with List-II and select the correct answer from the code given below the lists :

List I (Physical quantities)	List II (Units)
A. Acceleration	1. Joule
B. Force	2. Newton second
C. Work done	3. Newton
D. Impulse	4. Meter / second2

Code:

A. 1 2 3 4
B. 2 1 4 3
C. 4 3 1 2
D. 3 4 2 1

Ans: C

UPPCS Prelims-2005

Matching the physical quantities with their standard SI units: - Acceleration (A) is the rate of change of velocity, measured in meters per second squared (m/s^2). This corresponds to List II item 4. - Force (B) is an interaction that causes acceleration, measured in Newtons (N). This corresponds to List II item 3. - Work done (C) is energy transferred by force acting over a distance, measured in Joules (J). This corresponds to List II item 1. - Impulse (D) is the change in momentum, equal to force multiplied by the time interval over which the force acts, measured in Newton seconds ($N \cdot s$). This corresponds to List II item 2. Thus, the correct matching is A-4, B-3, C-1, D-2. Checking the code options, 4 3 1 2 corresponds to option C.

33. Match List I (Quantity) with List II (Units) and select the correct answer using the codes given below the Lists:

List I (Quantity)	List II (Units)
I. High speed	A) Mach
II. Wavelength	B) Angstrom
III. Pressure	C) Pascal
IV. Energy	D) Joule

Codes:

A. I-B, II-A, III-C, IV-D
B. I-A, II-B, III-D, IV-C

C. I-A, II-B, III-C, IV-D
D. I-B, II-A, III-D, IV-C

Ans: C

UPPCS Prelims-1999

This question requires matching physical quantities with their standard units. - High speed is often measured in relation to the speed of sound, using the Mach number (dimensionless, but often referred to as Mach). - Wavelength, being a measure of length, can be expressed in various units of distance, but Angstrom is a common unit for wavelengths of light and atomic scales (1 Angstrom = 10^{-10} meters). - Pressure is force per unit area, and the SI unit is the Pascal (Pa). - Energy is the capacity to do work, and the SI unit is the Joule (J).

34. One hectare cm (1 ha.cm.) water is equal to

A. 10000 m^3
B. 1000 m^3
C. 100 m^3
D. 10 m^3

Ans: A

Agri. Officer -2020

The unit 'hectare cm' (ha.cm) is a unit of volume used in irrigation, representing the volume of water covering one hectare to a depth of one centimeter. Its conversion to cubic meters is 1 ha.cm = 100 m^3.

35. The unit of linear momentum is

A. kg m s^{-2}
B. kg^2 m s^{-1}
C. N s^{-1}
D. N s

Ans: D

ae -2020 ae -2025

Momentum is a fundamental concept in physics, representing the "quantity of motion" an object possesses. It is a vector quantity.

36. The unit of spring constant is

A. Ns^{-2}
B. Ns
C. Nm^{-1}
D. Nm^{-2}

Ans: C

ae -2024

The spring constant (k) is a measure of the stiffness of a spring. It relates the force (F) applied to the spring to the resulting displacement (x) from its equilibrium position, according to Hooke's Law: $F = -kx$. Therefore, $k = F/x$. The unit of force is Newton (N), and the unit of displacement is meter (m). Hence, the unit of spring constant is N/m or Nm^{-1}.

37. Unit of magnetic flux :

A. Tesla
B. Weber
C. Ampere
D. Henry

Ans: B

lower devision clerk -2025

The unit of magnetic flux is Weber. Other options represent: - Tesla (T): Unit of magnetic flux density (magnetic field strength). - Ampere (A): Unit of electric current. - Henry (H): Unit of inductance.

Dimensional Analysis (Dimensions, Homogeneity, Applications)

38. Which one of the following physical quantities has the same dimensions as that of Planck's constant h?

A. Linear momentum
B. Angular momentum
C. Force
D. Potential energy

Ans: B

UPSC CDS-2-2016

- Planck's constant (h) relates the energy (E) of a photon to its frequency (ν) by the equation E = hν. The dimensions of E are $[ML^2T^{-2}]$ and the dimensions of ν are $[T^{-1}]$. Therefore, the dimensions of h are $[E/\nu] = [ML^2T^{-2}] / [T^{-1}] = [ML^2T^{-1}]$. - Let's check the dimensions of the given options: - Linear momentum (p = mv): $[M] [LT^{-1}] = [MLT^{-1}]$. - Angular momentum (L = Iω or L = rp): [Moment of inertia Angular velocity] or [Radius Linear momentum]. Dimensions are $[ML^2] [T^{-1}]$ or $[L] [MLT^{-1}] = [ML^2T^{-1}]$. - Force (F = ma): $[M] [LT^{-2}] = [MLT^{-2}]$. - Potential energy (e.g., mgh): $[M] [LT^{-2}] [L] = [ML^2T^{-2}]$. - Comparing the dimensions, angular momentum $[ML^2T^{-1}]$ has the same dimensions as Planck's constant $[ML^2T^{-1}]$.

39. The dimension of dielectric constant i

A. $M^0L^0T^0$
B. ML^0T^0
C. MLT^0
D. M^0L^0T

Ans: A

CGPSC Prelims Exam-2024

Dielectric constant (relative permittivity, εr) is defined as the ratio of the permittivity of a material (ε) to the permittivity of free space (ε_0). Since both ε and ε_0 have the same physical dimensions, their ratio is a dimensionless quantity.

40. Which one of the following quantities is dimensionless?

A. Specific weight
B. Specific heat
C. Specific density
D. Specific gravity

Ans: D

UPSC Geoscientist-2023

Specific gravity is defined as the ratio of the density of a substance to the density of a standard substance, making it a dimensionless quantity.

41. Which one of the following expressions has dimensions of energy (here V is the voltage across a resistor of resistance R and I is the current through the resistor, and t is the time)?

A. V^2 / I t
B. V^2 / R t
C. I^2 / R t
D. I^2 / V t

Ans: C

UPSC Geoscientist-2023

- Energy = Power × Time. - Power in a resistor = $V^2/R = I^2R = VI$. - Dimensions of Energy = [Force × Distance] = $[MLT^{-2} \times L] = [ML^2T^{-2}]$.

42. The unit of the ratio between thrust and impulse is same as that of

A. frequency
B. speed
C. wavelength
D. acceleration

Ans: A

UPSC NDA-2-2021

Thrust is a force. The SI unit of force is Newton (N), which is equivalent to $\text{kg} \cdot \text{m/s}^2$. Impulse is the change in momentum, or force multiplied by time. The SI unit of impulse is N·s, which is equivalent to $(\text{kg} \cdot \text{m/s}^2) \cdot \text{s} = \text{kg} \cdot \text{m/s}$. The ratio $\frac{\text{Thrust}}{\text{Impulse}}$ has units $\frac{\text{N}}{\text{N} \cdot \text{s}} = \frac{1}{\text{s}}$. The unit $1/\text{s}$ is the unit of frequency. Frequency is the number of cycles or events per unit time, measured in Hertz (Hz), where 1 Hz = $1/\text{s}$. Let's check the units of the options: A) Frequency: $1/\text{s}$ or Hz. B) Speed: m/s. C) Wavelength: m. D) Acceleration: m/s^2. The unit of the ratio is the same as the unit of frequency.

43. Which of the following sets have different dimensions?

A. Pressure, Young's modulus, Stress
B. Emf, potential difference, Electric potential

C. Heat, Work done, Energy

D. Dipole moment, Electric flux, Electric field

Ans: D

TNPSC CS Prelims-2015

Let's analyze the dimensions of each quantity: A) Pressure, Young's modulus, Stress: All have dimensions of Force/Area, which is $[ML^{-1}T^{-2}]$. B) Emf, potential difference, Electric potential: All are potential energy per unit charge, with dimensions $[ML^2T^{-3}I^{-1}]$. C) Heat, Work done, Energy: All are forms of energy, with dimensions $[ML^2T^{-2}]$. D) Dipole moment: Charge x distance, dimensions [IT] [L] = [LIT]. Electric flux: Electric field x Area, dimensions [Force/Charge] x Area = $([MLT^{-2}]/[IT])$ x $[L^2] = [ML^3T^{-3}I^{-1}]$. Electric field: Force/Charge, dimensions $[MLT^{-2}]/[IT] = [MLT^{-3}I^{-1}]$. The dimensions in set D ([LIT], $[ML^3T^{-3}I^{-1}]$, $[MLT^{-3}I^{-1}]$) are all different.

44. Which one of the following pairs of quantities has no length in their dimension?

A. Surface tension and angular momentum

B. Surface tension and strain

C. Angular momentum and mass density

D. Pressure gradient and angle

Ans: B

UPSC CISF-AC-EXE-2019

We need to find the pair of quantities whose dimensions do not include length ([L]). Let's analyze the dimensions of each quantity: - Surface tension Defined as force per unit length. Dimension is [Force]/[Length] = $[MLT^{-2}]/[L] = [MT^{-2}]$. It has no length dimension. - Angular momentum Defined as the product of moment of inertia and angular velocity (Iω) or cross product of position and linear momentum (r x p). Dimension is $[ML^2]$ $[T^{-1}] = [ML^2T^{-1}]$. It has a length dimension. - Strain Defined as the ratio of change in dimension to the original dimension (e.g., change in length / original length). Dimension is [L]/[L] = [Dimensionless]. It has no length dimension. - Mass density Defined as mass per unit volume. Dimension is $[M]/[L^3] = [ML^{-3}]$. It has a length dimension. - Pressure gradient Defined as change in pressure per unit distance. Dimension is [Pressure]/[Length]. Pressure is [Force]/[Area] = $[MLT^{-2}]/[L^2] = [ML^{-2}T^{-2}]$. So, pressure gradient is $[ML^{-2}T^{-2}]/[L] = [ML^{-3}T^{-2}]$. It has a length dimension. - Angle Defined as the ratio of arc length to radius. Dimension is [L]/[L] = [Dimensionless]. It has no length dimension.Now let's check the pairs: A) Surface tension ($[MT^{-2}]$) and angular momentum ($[ML^2T^{-1}]$). Angular momentum has length. B) Surface tension ($[MT^{-2}]$) and strain ([Dimensionless]). Neither has length. C) Angular momentum ($[ML^2T^{-1}]$) and mass density ($[ML^{-3}]$). Both have length. D) Pressure gradient ($[ML^{-3}T^{-2}]$) and angle ([Dimensionless]). Pressure gradient has length.The pair with no length dimension is Surface tension and Strain.

45. In terms of basic units of mass (M), length (L) and time (T), dimension of energy is

A. ML^2T^{-1}

B. MLT

C. MLT^{-1}

D. ML^2T^{-2}

Ans: D

WBCS_Main-Paper-4-2021

Dimension of Work = Dimension of Energy. Work = Force × distance. Force = mass × acceleration. Dimension of mass = [M], length = [L], time = [T]. Dimension of acceleration = $[LT^{-2}]$. Dimension of force = $[MLT^{-2}]$. Dimension of energy = $[ML^2T^{-2}]$.

46. In which of the following pairs, the two physical quantities have different dimensions?

A. Planck's constant and angular momentum

B. Impulse and linear momentum

C. Moment of inertia and moment of a force

D. Energy and torque

Ans: C

WBCS_Main-Paper-4-2019

- Let's determine the dimensions of each quantity: - Planck's constant (h): From E=hf, [h] = [Energy]/[Frequency] = $[ML^2T^{-2}]/[T^{-1}] = [ML^2T^{-1}]$. - Angular momentum (L): L = Iω or L = r×p, [L] = [Moment of Inertia]×[Angular Velocity] = $[ML^2]\times[T^{-1}] = [ML^2T^{-1}]$. (Alternatively, $[r]\times[p] = [L]\times[MLT^{-1}] = [ML^2T^{-1}]$). Dimensions are the same. - Impulse (J):