

# PA01 – Units, Dimensions & Basic Physics

→ Physics – PA01 · AFCAT General Awareness

AFCAT Level

Every Physics question in AFCAT traces back to units and measurement. Questions here are short, factual, and completely scoring – one right answer gets you a full mark in under 20 seconds. Know the 7 SI base units, 5 key derived units, and the scalar–vector distinction.

✦ **AFCAT Focus:** Direct questions – "SI unit of Force / Pressure / Power?", "Which is a vector quantity?", "Least count of Vernier caliper?" These three question types cover almost all AFCAT PA01 questions. Class 10 level only.

## PART 1 – SI UNITS

### 1. The Seven Fundamental SI Units

Every physical quantity is measured using combinations of just **7 base quantities**. All other (derived) units are built from these seven.

FIG. 1 – SEVEN FUNDAMENTAL SI BASE UNITS (MEMORISE ALL 7)

## SEVEN FUNDAMENTAL SI UNITS

#	Physical Quantity	SI Unit Name	Symbol
1	Length	Metre	m
2	Mass	Kilogram	kg
3	Time	Second	s
4	Electric Current	Ampere	A
5	Temperature	Kelvin	K
6	Amount of Substance	Mole	mol
7	Luminous Intensity	Candela	cd

💡 **Memory aid – 7 base units:** *metre, kilogram, second, Ampere, Kelvin, mole, candela* – think of them as the 7 pillars every measurement stands on.

## 2. Key Derived Units – Most Asked in AFCAT

FIG. 2 – KEY DERIVED UNITS BUILT FROM BASE UNITS

### KEY DERIVED UNITS — AFCAT asks these directly

Quantity	SI Unit Name	Symbol	Made from
Force	<b>Newton</b>	<b>N</b>	$\text{kg} \cdot \text{m} \cdot \text{s}^{-2}$
Energy / Work	<b>Joule</b>	<b>J</b>	$\text{kg} \cdot \text{m}^2 \cdot \text{s}^{-2}$
Power	<b>Watt</b>	<b>W</b>	$\text{J/s} = \text{kg} \cdot \text{m}^2 \cdot \text{s}^{-3}$
Pressure	<b>Pascal</b>	<b>Pa</b>	$\text{N/m}^2 = \text{kg} \cdot \text{m}^{-1} \cdot \text{s}^{-2}$
Frequency	<b>Hertz</b>	<b>Hz</b>	$\text{cycles} / \text{s} = \text{s}^{-1}$
Electric Charge	<b>Coulomb</b>	<b>C</b>	$\text{A} \cdot \text{s}$

## PART 2 — SCALARS AND VECTORS

### 3. Scalars vs Vectors

AFCAT frequently asks: "Which of the following is a vector quantity?" — pure recall in under 5 seconds.

FIG. 3 — SCALAR (MAGNITUDE ONLY) VS VECTOR (MAGNITUDE + DIRECTION) WITH EXAMPLES

#### SCALAR

Magnitude only — no direction

- Distance
- Speed
- Mass
- Time
- Temperature
- Energy / Work
- Power
- Volume, Density

#### VECTOR

Magnitude + Direction

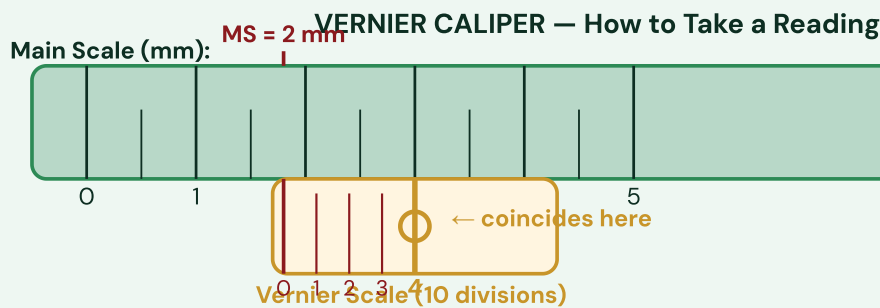
- Displacement
- Velocity
- Acceleration
- Force
- Momentum
- Weight (=  $mg$ , downward)
- Torque / Thrust
- Electric Field

⚠ **AFCAT Trap:** Speed is scalar; **Velocity** is vector. Distance is scalar; **Displacement** is vector. **Weight** is a vector (it is a force – always acts downward); Mass is a scalar (no direction). This distinction is asked directly.

### PART 3 – MEASURING INSTRUMENTS

## 4. Vernier Caliper & Screw Gauge

FIG. 4 – VERNIER CALIPER READING: MAIN SCALE + VERNIER SCALE = TOTAL MEASUREMENT



#### Reading Calculation

$$\text{Least Count} = 1 \text{ MSD} - 1 \text{ VSD} = 1 \text{ mm} - 0.9 \text{ mm} = \mathbf{0.1 \text{ mm}}$$

$$\text{Main Scale Reading} = 2.0 \text{ mm}$$

$$\text{Vernier Reading} = 4 \times 0.1 = 0.4 \text{ mm}$$

$$\text{Total Reading} = 2.0 + 0.4 = \mathbf{2.4 \text{ mm}}$$

#### Instrument Formulae:

- Vernier Caliper LC = 1 MSD - 1 VSD = **0.1 mm** (standard)
- Screw Gauge LC = Pitch / Circular divisions = 0.5/50 = **0.01 mm**
- Screw gauge is **more precise** than Vernier caliper (reads to 0.01 mm vs 0.1 mm)



## AFCAT PYQs – Units & Basic Physics

Q1. The SI unit of Force is: **AFCAT PYQ**

- (a) Joule (b) Pascal (c) Newton (d) Watt

✓ Answer: (c) Newton

Force = mass  $\times$  acceleration =  $[\text{kg} \times \text{m}/\text{s}^2]$  = **Newton (N)**. Joule = energy; Pascal = pressure; Watt = power. This is the single most frequently asked unit question in AFCAT science. Named after Isaac Newton.

**Q2. Which of the following is a vector quantity?** AFCAT PYQ

- (a) Speed (b) Distance (c) Mass (d) Displacement

✓ Answer: (d) Displacement

**Displacement** has both magnitude and direction (e.g., "5 km north"). Speed, distance, and mass have magnitude only — they are scalars. The key test: if the question "in which direction?" is meaningful for that quantity, it is a vector.

**Q3. The SI unit of Pressure is:** AFCAT PYQ

- (a) Newton (b) Pascal (c) Joule (d) Bar

✓ Answer: (b) Pascal

Pressure = Force/Area =  $\text{N}/\text{m}^2$  = **Pascal (Pa)**. While bar and atm are used in daily life, the SI unit is Pascal. 1 atmosphere  $\approx$  101,325 Pa. Named after Blaise Pascal.

**Q4. Which of the following is NOT a fundamental SI unit?**

⚡ Tricky

- (a) Kelvin (b) Mole (c) Newton (d) Candela

✓ Answer: (c) Newton

**Newton is derived** ( $= \text{kg} \cdot \text{m} \cdot \text{s}^{-2}$ ), not fundamental. The 7 base SI units are: metre, kilogram, second, Ampere, Kelvin, mole, candela. Students often include Newton — it is built from mass, length, and time.

**Q5. The least count of a screw gauge with pitch 0.5 mm and 50 circular divisions is:** AFCAT PYQ

- (a) 0.5 mm (b) 0.1 mm (c) 0.01 mm (d) 0.001 mm

✓ Answer: (c) 0.01 mm

LC = Pitch / divisions =  $0.5/50$  = **0.01 mm**. The screw gauge is more precise than the Vernier caliper (0.01 mm vs 0.1 mm). This formula is directly tested in AFCAT.

# Quick Memory Chart — PA01

## 7 Base SI Units

- ◆ Length → **metre (m)**
- ◆ Mass → **kilogram (kg)**
- ◆ Time → **second (s)**
- ◆ Current → **Ampere (A)**
- ◆ Temp → **Kelvin (K)**
- ◆ Substance → **mole (mol)**
- ◆ Luminosity → **candela (cd)**

## Derived Units

- ◆ Force → **Newton (N)**
- ◆ Energy/Work → **Joule (J)**
- ◆ Power → **Watt (W)**
- ◆ Pressure → **Pascal (Pa)**
- ◆ Frequency → **Hertz (Hz)**
- ◆ Newton = DERIVED (not base)

## Scalar vs Vector

- ◆ Scalars: speed, distance, mass, energy
- ◆ Vectors: velocity, displacement, force
- ◆ **Weight = vector** (force, downward)
- ◆ Mass = scalar (no direction)
- ◆ Screw gauge LC = 0.01 mm

## Practice Exercise

**E1. The SI unit of Power is:**

- (a) Joule   (b) Newton   (c) Watt   (d) Ampere

**E2. Which one is a scalar quantity?**

- (a) Velocity   (b) Acceleration   (c) Force   (d) Speed

**E3. Screw gauge has pitch 0.5 mm and 50 circular divisions. Least count:**

- (a) 0.5 mm   (b) 0.1 mm   (c) 0.01 mm   (d) 0.001 mm

**E4. Which quantity has the same SI unit as energy?**

- (a) Power   (b) Torque   (c) Pressure   (d) Force

**Answers:**

E1 → (c) Watt | E2 → (d) Speed [only magnitude, no direction] | E3 → (c) 0.01 mm [LC = 0.5/50] | E4 → (b) Torque [N·m = Joule; same dimension  $ML^2T^{-2}$ , different physical meaning]



**Mock Tests**



**Subject Quiz**



**Telegram**

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