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CLASS 11 PHYSICS NCERT SOLUTIONS

NCERT Solutions for Class 11 Physics Chapter 1: Units and Measurements (2026-27)

Class 11 Physics Chapter 2, Units and Measurements, is where the CBSE board syllabus formalises the language every later chapter depends on: SI units, significant figures, error analysis, and dimensional analysis. Board papers routinely draw at least one question from this chapter, most often on dimensional consiste...

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Class 11 Physics Chapter 2, Units and Measurements, is where the CBSE board syllabus formalises the language every later chapter depends on: SI units, significant figures, error analysis, and dimensional analysis. Board papers routinely draw at least one question from this chapter, most often on dimensional consistency or error propagation, so getting comfortable with the method (not just the final numbers) pays off across the whole year. Below are original, step-by-step solutions to all 33 in-chapter exercise questions (2.1-2.33) of the 2026-27 rationalised NCERT edition. These Class 11 Physics Chapter 1 solutions are also useful as quick revision notes before exams.

NCERT Solutions for Class 11 Physics Chapter 2: Units and Measurements

Q2.1: Fill in the blanks (unit conversions)

(a) Volume of a cube of side 1 cm = 1 cm^3 = **10^{-6} m^3**.
(b) Curved + two end surface area of a cylinder (r = 2.0 cm, h = 10.0 cm) = 2πr(r+h) = 2π(2)(12) = 150.8 cm^2 = **1.508×10^4 mm^2**.
(c) 18 km/h = 18 × (5/18) m/s = 5 m/s, so a vehicle at this speed covers **5 m in 1 s**.
(d) Relative density 11.3 means density relative to water (1000 kg/m^3), so density of lead = **11.3 g cm^{-3} = 11.3×10^3 kg m^{-3}**.

Q2.2: Fill in the blanks (converting between unit systems)

(a) 1 kg m^2 s^{-2} = 10^3 g × 10^4 cm^2 × s^{-2} = **10^7 g cm^2 s^{-2}**.
(b) 1 light-year = 9.46×10^{15} m, so 1 m = **1.06×10^{-16} ly**.
(c) 3.0 m s^{-2} = 3.0×10^{-3} km × $(3600\ s/h)^2$ = **3.888×10^4 km h^{-2}**.
(d) G = 6.67×10^{-11} N m^2 kg^{-2} = 6.67×10^{-11} m^3 kg^{-1} s^{-2}; converting $m^3 \rightarrow cm^3$ (×10^6) and $kg^{-1} \rightarrow g^{-1}$ (×10^{-3}) gives **6.67×10^{-8} cm^3 g^{-1} s^{-2}**.

Q2.3: 5 J in a new unit system

If the new units of mass, length and time are α kg, β m, γ s, then since [Energy] = M L^2 T^{-2}: $n_2 = n_1(M_1/M_2)(L_1/L_2)^2(T_1/T_2)^{-2} = 5 \times \alpha^{-1}\beta^{-2}\gamma^2$. So **5 J = $5\alpha^{-1}\beta^{-2}\gamma^2$ new units**.

Q2.4: 1 calorie in the same new unit system

1 calorie = 4.2 J, and energy has the same dimension as above, so by the identical substitution, **1 cal = $4.2\alpha^{-1}\beta^{-2}\gamma^2$ new units**.

Q2.5: Distance in a unit where c = 1

Light takes 8 min 20 s = 500 s to travel from the Sun to the Earth. If distance is measured in “light-seconds” (c = 1 in these units), distance = speed × time = 1 × 500 = **500 new units** (i.e. 500 light-seconds, matching the known Earth-Sun distance of ~1.496×10^{11} m).

Q2.6: Most precise length-measuring device

Least count (LC) of (a) a vernier where 20 divisions = 19 main-scale mm divisions: LC = 1 mm/20 = 0.05 mm. (b) a screw gauge of pitch 1 mm with 100 circular divisions: LC = 1/100 = 0.01 mm. (c) an optical instrument resolving to about one wavelength of light: $\approx 5 \times 10^{-4}$ mm. **The optical instrument (c) is the most precise** — its resolution is roughly 20× finer than the screw gauge.

Q2.7: Estimating hair thickness

Microscope magnification = 100×, image diameter = 3.5 mm. Actual thickness = image size / magnification = 3.5/100 = **0.035 mm = 3.5×10^{-5} m**.

Q2.8: Diameter from a screw gauge reading

Pitch = 1 mm, 100 circular divisions ⇒ LC = 0.01 mm. Main scale reads 1 mm; circular scale's 47th division lines up with the reference line. Diameter = 1 mm + (47 × 0.01 mm) = **1.47 mm**.

Q2.9: Linear magnification of a projector

A 1.75 cm × 1.75 cm negative is projected to a 7.5 m × 7.5 m image. Linear magnification = 7.5 m / 1.75 cm = 750 cm / 1.75 cm ≈ **428.6**.

Q2.10: Significant figures

(a) 0.007 m^2 → 1 s.f.   (b) 2.64×10^{24} kg → 3 s.f.   (c) 0.2370 g cm^{-3} → 4 s.f.   (d) 6.320 J → 4 s.f.   (e) 6.032 N m^{-2} → 4 s.f.   (f) 0.0006032 m^2 → **4 s.f.** (leading zeros never count as significant).

Q2.11: Area and volume to correct significant figures

Length l = 4.234 m, breadth b = 1.005 m, thickness t = 2.01 cm = 0.0201 m (each has 3-4 s.f., the least being 3 for t). Area = l × b = 4.234 × 1.005 = 4.25517 → rounded to the least-precise factor's s.f. gives **4.255 m^2**. Volume = l × b × t = 4.25517 × 0.0201 = 0.0855 → **8.55×10^{-2} m^3** (3 s.f., matching t).

Q2.12: Total mass and mass difference to correct significant figures

Box mass (grocer's balance, 2 decimal places) = 2.30 kg. Two gold pieces = 20.15 g and 20.17 g (physical balance, 2 decimal places in g). (a) Total = 2.30 + 0.02015 + 0.02017 = 2.34032 kg → limited by the least precise instrument → **2.34 kg**. (b) Difference = 20.17 g – 20.15 g = **0.02 g**.

Q2.13: Percentage error in a derived quantity

$P = a^3b^2 / (\sqrt{c} \cdot d)$. Using the rule that percentage errors add according to the power of each factor: %error in P = 3(%error in a) + 2(%error in b) + ½(%error in c) + 1(%error in d) = 3(1) + 2(3) + ½(4) + 2 = 3 + 6 + 2 + 2 = **13%**. Since the error is about 13% of 3.763 (≈0.49), only the first decimal place is meaningful, so P should be rounded to **3.8**.

Q2.14: Dimensionally inconsistent formulas

The argument of a trigonometric function must be dimensionless. In (a) y = a sin(2πt/T) and (d) y = a√2(sin 2πt/T – cos 2πt/T), the arguments (t/T) are dimensionless — correct. In **(b) y = a sin(vt)**, vt has dimension of length, not angle — wrong. In **(c) y = (a/T) sin(t/a)**, t/a has dimension of T/L, not dimensionless — wrong.

Q2.15: Checking the relativistic mass formula

The given form $m = m_0/\sqrt{(1 - v^2)}$ cannot be dimensionally correct because you cannot subtract a quantity with dimension $[L^2T^{-2}]$ (v^2) from the dimensionless number 1. The dimensionally consistent (and physically correct) relation is $\mathbf{m = m_0/\sqrt{(1 - v^2/c^2)}}$, where v^2/c^2 is dimensionless.

Q2.16: Estimating the volume of a sodium atom

23 g of sodium (1 mole, 6.02×10^{23} atoms) has density 971 kg/m^3 = 0.971 g/cm^3, so its volume = 23/0.971 = 23.69 cm^3. Volume per atom = 23.69 / (6.02×10^{23}) ≈ $\mathbf{3.94 \times 10^{-23}\ cm^3}$.

Q2.17: Why is molar volume ~1000× larger in gas than in solid?

In a solid or liquid, atoms sit almost touching; in a gas at STP, the average spacing between molecules is roughly 10× the molecular diameter. Since volume occupied scales as the cube of separation, $(10)^3$ = **1000**, explaining why 1 mole of gas at STP (22.4 L) occupies about 1000× the volume of the same amount of matter in condensed (solid/liquid) form, even though the atoms themselves are the same size.

Q2.18: Why parallax matters for distance measurement

When you look out of a moving train, nearby trees appear to move rapidly backwards relative to distant hills, which appear almost stationary — this is **parallax**: the apparent shift of a nearby object against a distant background when the observer's position changes. Astronomers use the same idea (Earth's orbital diameter as the "baseline") to measure how far away nearby stars are, since a star's apparent position shifts slightly against very distant background stars as the Earth moves from one side of its orbit to the other.

Q2.19: What is a parsec?

A **parsec** is the distance at which an arc of length 1 AU (the Earth-Sun distance) subtends an angle of exactly 1 arcsecond at the observer. 1 pc = 1 AU / (1 arcsec in radians) = 1.496×10^{11} m / (4.848×10^{-6}) ≈ **3.086×10^{16} m ≈ 3.26 light-years**.

Q2.20: Distance and parallax of the nearest star

The nearest star (other than the Sun) is 4.29 light-years away. In parsecs: 4.29 / 3.26 = **1.32 pc**. Since parallax angle (in arcsec) = 1/distance(in pc), the parallax observed over Earth's 2 AU baseline (six months apart) ≈ 1/1.32 ≈ **0.76 arcsecond**.

Q2.21: Why modern science keeps pushing for greater precision

Effects that are invisible at low precision (gravitational wave strain of ~10^{-21}, tiny shifts in atomic clock frequency used to test relativity, minute variations in fundamental "constants") only show up once measurement precision improves by orders of magnitude. Every major advance in fundamental physics — from confirming general relativity to detecting gravitational waves in 2015 — has depended on instruments precise enough to isolate a signal from noise that would have swamped earlier equipment.

Q2.22: Order-of-magnitude estimation practice

Estimating without precise data is itself a testable skill. Example: mass of air in your classroom ≈ room volume (say 8m × 6m × 3.5m ≈ 168 m^3) × density of air (≈1.2 kg/m^3) ≈ **200 kg**. Similarly, the number of heartbeats in an average human lifetime ≈ 72 beats/min × 60 × 24 × 365 × 70 years ≈ **2.6×10^9**.

Q2.23: Estimated average mass density of the Sun

Mass of Sun M ≈ 2.0×10^{30} kg, radius R ≈ 7.0×10^8 m. Density = M / (&frac43;πR^3) = 2.0×10^{30} / (4.19 × 3.43×10^{26}) ≈ **1.4×10^3 kg/m^3** (only slightly more than water — showing the Sun behaves overall like a fluid despite its core being far denser).

Q2.24: Diameter of Jupiter from its angular size

Jupiter's angular diameter as seen from Earth ≈ 35.72 arcsec at a distance of 824.7×10^6 km. Diameter = angle(radians) × distance = (35.72/206265) × 824.7×10^6 km ≈ **1.43×10^5 km**, matching Jupiter's known diameter closely.

Q2.25: Dimensionally correcting a pendulum-period relation

For a simple pendulum of length l in gravity g, only l [L] and g [LT^{-2}] can combine to give a quantity of dimension [T]. Testing T = k√(l/g): dimension = √(L / LT^{-2}) = √(T^2) = T — consistent. The dimensionally (and physically) correct relation is **T = 2π√(l/g)**; any proposed relation with g in the numerator or a different power is dimensionally wrong.

Q2.26: Accuracy of a caesium atomic clock

Accuracy = 1 part in 10^{11}. Over 100 years (≈3.156×10^9 s), maximum error = $3.156 \times 10^9 \times 10^{-11}$ ≈ **0.03 s** — illustrating why caesium clocks define the SI second.

Q2.27: Comparing atomic and bulk (crystalline) sodium density

From Q2.16, the volume per Na atom (as a free sphere estimate) gives a density of 23 g / (6.02×10^{23} × 3.94×10^{-23} cm^3) ≈ 0.97 g/cm^3, which is **almost identical** to the measured bulk density of solid sodium (0.971 g/cm^3). This shows that in the solid state, atoms are packed with very little empty space between them — unlike in a gas.

Q2.28: Nuclear mass density is (nearly) constant for all nuclei

Nuclear radius follows $R = R_0A^{1/3}$, so nuclear volume ∝ R^3 ∝ A. Since nuclear mass also ∝ A (mass number), density = mass/volume ∝ A/A = **constant**, independent of which element/isotope you pick — a strong piece of evidence that nucleons are packed at essentially the same density inside every nucleus.

Q2.29: Earth-Moon distance via laser ranging

A laser pulse sent to a reflector on the Moon returns after 2.56 s. Distance = c × t / 2 = (3×10^8 × 2.56) / 2 = **3.84×10^8 m** (matches the well-known Earth-Moon distance).

Q2.30: Submarine distance via SONAR

A SONAR pulse returns after 1.02 s; speed of sound in seawater ≈ 1450 m/s. Distance = speed × time / 2 = (1450 × 1.02)/2 ≈ **739.5 m**.

Q2.31: Distance to a quasar from light travel time

Light from a quasar takes about 3.0×10^9 years to reach us. Distance = c × t = (3×10^8 m/s) × (3.0×10^9 × 3.156×10^7 s) ≈ **2.84×10^{25} m** (about 3 billion light-years).

Q2.32: Diameter of the Moon from a solar eclipse

During a total solar eclipse, the Moon's disc almost exactly covers the Sun's, so both subtend nearly the same angle (≈0.5° = 0.00873 rad) at the Earth. Using the Moon's distance (3.84×10^5 km): diameter = distance × angle = 3.84×10^5 × 0.00873 ≈ **3353 km**, close to the Moon's known diameter of 3474 km — the small gap comes from the approximate angle used.

Q2.33: Estimating a time scale from fundamental constants

Combining the fundamental constants G (gravitation), h (Planck's constant) and c (speed of light) dimensionally, the only combination with dimension of time is t_P = √(hG/c&sup5;), the **Planck time** ≈ 5.4×10^{-44} s — the smallest physically meaningful time interval in current physics, illustrating how dimensional analysis alone can hint at deep physical scales without solving any equation of motion.

Why This Chapter Matters for Boards

Units and Measurements rarely appears as a standalone long-answer question, but its tools (dimensional analysis, error propagation, significant figures) are tested indirectly in almost every numerical chapter that follows. A single conceptual slip here (like Q2.15's dimensional check) is a very common board-exam trap question.

Related NCERT Content for Class 11 Physics Chapter 2

- Extra Questions (HOTS) for Units and Measurements
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