

Units and Measurements — CBSE Pattern Test 1

Class 11 Physics · 90 minutes · 40 marks · Sections A–D with answer key · Narayan Gurukul Academy

Test 1 — CBSE Pattern (90 minutes, 40 marks)

Class 11 Physics · Units and Measurements · Narayan Gurukul Academy (ClassApna)

General Instructions: (1) This paper has four sections — Section A (1×10), Section B (2×4), Section C (3×4) and Section D (5×2) — total 40 marks. Time allowed: 90 minutes.

(2) All questions are compulsory. No overall choice is given; internal choice, where allowed, is clearly marked.

(3) For MCQ questions choose the single correct option; for VSA answers write a single line.

(4) Take $g = 10 \text{ m/s}^2$. All symbols carry their usual meaning. Use of a calculator is not permitted.

Section A — MCQ & VSA ($10 \times 1 = 10$ marks)

1. Which of the following is a fundamental (base) quantity in the SI?

- (A) mass
- (B) force
- (C) area
- (D) velocity

2. The dimensions of force are

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

3. The SI unit of the plane angle is the

- (A) radian
- (B) steradian
- (C) degree
- (D) watt

4. The least count of a vernier callipers is

- (A) $1 \text{ MSD} - 1 \text{ VSD}$
- (B) $1 \text{ MSD} + 1 \text{ VSD}$
- (C) $1 \text{ VSD} - 1 \text{ MSD}$
- (D) $1 \text{ MSD}/2$

5. The number of significant figures in 0.0006032 m^2 is

- (A) 4
- (B) 5
- (C) 7
- (D) 3

6. The dimensional formula of work is

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

7. Errors that repeat consistently because of an instrument defect are

- (A) systematic errors

- (B) random errors
 - (C) least-count errors
 - (D) parallax errors
8. In addition and subtraction, the errors to be added are the
- (A) absolute errors
 - (B) relative errors
 - (C) percentage errors
 - (D) least counts
9. State the principle of homogeneity of dimensions.
10. Define the least count of a measuring instrument.

Section B — Short Answer I ($4 \times 2 = 8$ marks)

11. Check the dimensional consistency of the equation $v = u + at$.
12. Check whether the equation $s = ut + \frac{1}{2}at^2$ is dimensionally correct (u : velocity, a : acceleration, s : distance, t : time).
13. A quantity $X = a^2b^3/c$. If the percentage errors in a , b and c are 1%, 2% and 3%, find the percentage error in X .
14. $A = 5.00 \pm 0.02$ m and $B = 3.00 \pm 0.03$ m. Find $A + B$ with its error.

Section C — Short Answer II ($4 \times 3 = 12$ marks)

15. Using dimensional analysis, derive the relation for the period of a simple pendulum ($T \propto \sqrt{l/g}$).
16. Explain how a screw gauge works and write the formula for its least count.
17. Six readings of a time interval (in s) are 1.23, 1.24, 1.23, 1.25, 1.24 and 1.23. Find the mean, the mean absolute error and the percentage error.
18. The viscous force on a sphere of radius r moving with speed v in a fluid is $F = 6\pi\eta rv$. Find the dimensions of η .

Section D — Long Answers ($2 \times 5 = 10$ marks)

19. Describe the construction and use of a vernier callipers. Explain how the least count is found and how a measurement with zero error is corrected, with one worked reading.
20. Explain the parallax method for measuring the distance of a far-off star. Also derive the use of dimensions to check the correctness of $s = ut + \frac{1}{2}at^2$ and $v^2 = u^2 + 2as$.

Answer Key (Marking Scheme)

- Q1 — (A) mass. Q2 — (A) $[M L T^{-2}]$. Q3 — (A) radian. Q4 — (A) 1 MSD – 1 VSD.
- Q5 — (A) 4. Q6 — (A) $[M L^2 T^{-2}]$. Q7 — (A) systematic errors. Q8 — (A) absolute errors.
- Q9 — Every term in a correct physical equation must have the same dimensions.
- Q10 — The smallest measurement an instrument can read; for vernier callipers, $LC = 1 \text{ MSD} - 1 \text{ VSD}$.
- Q11 — $[L T^{-1}] = [L T^{-1}] + [L T^{-1}]$ — dimensionally correct.
- Q12 — s and ut have $[L]$; $\frac{1}{2}at^2$ has $[L]$ — both sides have the dimension of length, so correct.
- Q13 — $\Delta X/X = 2 \times 1\% + 3 \times 2\% + 3\% = 11\%$.
- Q14 — 8.00 ± 0.05 m.
- Q15 — $T = k l^a g^b \Rightarrow a + b = 0, 2b = 1 \Rightarrow b = \frac{1}{2}, a = -\frac{1}{2}$, so $T = k\sqrt{l/g}$.

Q16 — Pitch is the linear distance moved per rotation of the circular scale; $LC = \text{pitch} / \text{number of divisions on the circular scale}$.

Q17 — mean = 1.237 s; mean absolute error ≈ 0.007 s; percentage error $\approx 0.5\%$.

Q18 — $\eta = [M L^{-1} T^{-1}]$.

Q19 — Vernier callipers: main scale + sliding vernier; $LC = 1 \text{ MSD} - 1 \text{ VSD}$; a reading is corrected for zero error (subtract the zero error, with sign).

Q20 — Parallax: distant star observed from two positions a baseline apart; the parallax angle gives distance $b/2\theta$. Both equations are homogeneous and hence dimensionally correct.