AL AMAL LEARNING CENTER

PHYSICS KEY BOOK

Class 9 | Unit 1

PHYSICAL QUANTITIES AND MEASUREMENT

NUMERICALS

What is inside

#	Contents
1	Solved Examples
2	Exercise Numericals (Q4)

About this part

Solved numericals for Class 9 Physics Unit 1: scientific notation, prefixes, unit conversion, vectors, least count, vernier calliper and screw gauge readings, significant figures and rounding off. Each answer shows the steps, because every step carries marks.

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PART NUMERICALS

Solved Examples

Example 1.1: Scientific notation

	Given	Working	Answer
a	Earth–Sun distance 149,530,000,000 m	Decimal moved 11 places left	1.4953×10^{11} **m**
b	Mass of a human hair 0.0008 g	Decimal moved 4 places right	8×10^{-4} **g**
c	Seconds in a day	1 d = 24 h × 60 min × 60 s = 86,400 s	8.64×10^{4} **s**

Example 1.2: Prefixes

	Given	Working	Answer
a	1 ton	1000 kg = 1000 × 1000 g = 1,000,000 g (mega = 10^{6})	1.0×10^{6} **g = 1.0 Mg**
b	Diameter 0.0000000000000017 m	1.7×10^{-15} m (femto = 10^{-15})	**1.7 fm**

Quick practice (Can you tell?)

Given	Working	Answer
Thickness of a sheet 100,000 nm	$10^{5} \times 10^{-9}$ m = 10^{-4} m	**0.1 mm** (= 100 µm)
Pakistan's power capacity 40,000 MW	$4 \times 10^{4} \times 10^{6}$ W = 4×10^{10} W	**40 GW**
A 30 TB hard disk	30×10^{12} B	3×10^{13} **B**

Example: Resultant of two perpendicular vectors

A = 3 N along the x-axis and B = 4 N along the y-axis act at right angles. Find the resultant.

$$R = \sqrt{A^2 + B^2} = \sqrt{3^2 + 4^2} = \sqrt{25} = 5\ \text{N}$$

$$\tan\theta = \frac{B}{A} = \frac{4}{3} \quad \Rightarrow \quad \theta = \tan^{-1}\left(\frac{4}{3}\right) \approx 53^\circ$$

Answer: R = 5 N, at about 53° with A.

Example: Drawing a vector to scale

A helicopter moves 20 km from the origin at 60° south of west. Use the scale 5 km = 1 cm.

Length of the arrow = 20 ÷ 5 = **4 cm**, drawn 60° from the west line towards the south, with an arrowhead at the end.

Example 1.3: Significant figures

Value	Significant figures	Reason	Scientific notation
100.8 s	4	Zeros between non-zero digits count	1.008×10^{2} s
0.00580 km	3	First two zeros are place holders; 5, 8 and the final 0 count	5.80×10^{-3} km
210.0 g	4	Zero after the decimal point and the zero between digits count	2.100×10^{2} g

Example 1.4: Rounding off

Number	Round to	Working	Answer
3.876	2 decimal places	Dropping digit 6 ≥ 5, so 7 becomes 8	**3.88**
657.873	2 decimal places	Dropping digit 3 < 5, so no change	**657.87**
0.0857	2 decimal places	Dropping digit 5 ≥ 5, so 8 becomes 9	**0.09**
24.68	3 significant digits	Dropping 8 ≥ 5, so 6 becomes 7	**24.7**
0.07683	3 significant digits	Dropping 3 < 5, no change	**0.0768**
7,847	3 significant digits	Dropping 7 ≥ 5, so 4 becomes 5; the rest become 0	**7,850**

Exercise Numericals (Q4)

1. Write in scientific notation

	Given	Working	Answer
a	1234 m	Decimal moved 3 places left	1.234×10^{3} **m**
b	0.000023 s	Decimal moved 5 places right	2.3×10^{-5} **s**
c	469.3×10^{5} m	469.3 = 4.693×10^{2}; add exponents: 2 + 5 = 7	4.693×10^{7} **m**
d	0.00985×10^{7} s	0.00985 = 9.85×10^{-3}; −3 + 7 = 4	9.85×10^{4} **s**

2. Express using prefixes

	Given	Working	Answer
a	27.5×10^{-10} m	= 2.75×10^{-9} m; 10^{-9} = nano	**2.75 nm**
b	0.00023×10^{-2} s	= $2.3 \times 10^{-4} \times 10^{-2} = 2.3 \times 10^{-6}$ s; 10^{-6} = micro	**2.3 µs**

3. A boy is 15 years 2 months and 10 days old. Convert his age to (a) seconds (b) milliseconds (c) megaseconds

Take 1 year = 365 days and 1 month = 30 days. Days = 15 × 365 + 2 × 30 + 10 = 5475 + 60 + 10 = **5545 days**. One day = 86,400 s.

Unit	Working	Answer
(a) seconds	5545 × 86,400	4.79088×10^{8} **s** (479,088,000 s)
(b) milliseconds	$4.79088 \times 10^{8} \times 10^{3}$	4.79088×10^{11} **ms**
(c) megaseconds	$4.79088 \times 10^{8} \div 10^{6}$	**479.088 Ms** ($\approx 4.79 \times 10^{2}$ Ms)

4. How many kilometres are there in 25 micrometres?

25 µm = 25×10^{-6} m. Since 1 km = 10^{3} m, divide by 10^{3}:

$$25 \times 10^{-6} \div 10^{3} = 25 \times 10^{-9} = 2.5 \times 10^{-8}\ \text{km}$$

Answer: 2.5×10^{-8} **km**

5. Pitch and least count

(a) Vernier calliper (smallest main-scale division 1 mm, 20 vernier divisions): a vernier calliper has no pitch (pitch applies to a screw gauge).

$$\text{LC} = 1\ \text{mm} \div 20 = 0.05\ \text{mm}$$

(b) Screw gauge (smallest main-scale division 0.5 mm, 50 circular divisions): the pitch is the distance moved in one rotation, **0.5 mm**.

$$\text{LC} = 0.5\ \text{mm} \div 50 = 0.01\ \text{mm}$$

6. Vernier calliper reading (diagram in the book)

Step	Working
Least count	1 mm ÷ 10 divisions = **0.1 mm = 0.01 cm**
(a) Main scale reading (MSR)	The vernier zero lies just after the 2.5 cm mark, so MSR = **2.5 cm** (25 mm)
(b) Coinciding vernier division (VSR)	The vernier zero is about 0.4 mm past the 2.5 cm mark, so the **4th** vernier line coincides: VSR = **4**
(c) Total reading	2.5 cm + (4 × 0.01 cm) = **2.54 cm** (25.4 mm)

7. Screw gauge reading (diagram in the book)

Step	Working
Least count	Taken as **0.01 mm** (pitch 0.5 mm ÷ 50 divisions); no zero error
(a) Main scale reading	The sleeve shows the 6 mm mark and then the half-millimetre mark before the thimble edge, so reading = **6.5 mm**
(b) Coinciding circular division	The 46th line of the circular scale is at the datum line: **46**

Step	Working
(c) Total diameter of the ball	6.5 mm + (46 × 0.01 mm) = 6.5 + 0.46 = **6.96 mm**

Exam tip

In vernier and screw gauge numericals, write the least count first, then MSR (or linear reading), then the scale reading, then the total with its unit. Check for zero error and always write the unit.

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