Exercise

Tick (✓) the correct answer:

1.1. The instrument that is most suitable for measuring the thickness of a few sheets of cardboard is:
(a) metre rule
(b) measuring tape
(c) Vernier Callipers
✓ **(d) micrometer screw gauge**

1.2. One femtometre is equal to:
(a) 10^{-9} m
✓ **(b) 10^{-15} m**
(c) 10^{0} m
(d) 10^{15} m

1.3. A light year is a unit of:
(a) light
(b) time
✓ **(c) distance**
(d) speed

1.4. Which one is a non-physical quantity?
(a) distance
(b) density
✓ **(c) colour**
(d) temperature

1.5. When using a measuring cylinder, one precaution to take is to:
(a) check for the zero error
(b) look at the meniscus from below the level of the water surface
(c) take several readings by looking from more than one direction
✓ **(d) position the eye in line with the bottom of the meniscus**

1.6. Volume of water consumed by you per day is estimated in:
(a) millilitre
✓ **(b) litre**
(c) kilogram
(d) cubic metre

1.7. A displacement can is used to measure:
(a) mass of a liquid
(b) mass of a solid
(c) volume of a liquid
✓ **(d) volume of a solid**

1.8. Two rods with lengths 12.321 cm and 10.3 cm are placed side by side, the difference in their lengths is:
✓ **(a) 2.02 cm**
(b) 2.0 cm
(c) 2 cm
(d) 2.021 cm

1.9. Four students measure the diameter of a cylinder with Vernier Callipers. Which of the following readings is correct?
(a) 3.4 cm
(b) 3.475 cm
✓ **(c) 3.47 cm**
(d) 3.5 cm

1.10. Which of the following measures are likely to represent the thickness of a sheet of this book?
(a) 6×10^{-25} m
(b) 1×10^{4} m
✓ **(d) 4×10^{-2} m**
(c) 1.2×10^{-15} m

1.11. In a Vernier Callipers, ten smallest divisions of the Vernier scale are equal to nine smallest divisions of the main scale. If the smallest division of the main scale is half millimetre, the Vernier constant is equal to:
(a) 0.5 mm
✓ **(b) 0.1 mm**

(c) 0.05 mm
(d) 0.001 mm

B. Write short answers

1.1 Can a non-physical quantity be measured? If yes, then how?
Non-physical quantities like *color* or *taste* cannot be measured directly using standard instruments. However, they can be quantified indirectly through physical parameters (e.g., wavelength for color).

1.2 What is measurement? Name its two parts.
Measurement is the comparison of a physical quantity with a standard unit.
Two parts:

1. Numerical value
2. Unit

1.3 Why do we need a standard unit for measurements?
To ensure **uniformity**, **accuracy**, and **consistency** in measurements across the world.

1.4 Write the name of 3 base quantities and 3 derived quantities.
Base quantities: Length, Mass, Time
Derived quantities: Speed, Force, Volume

1.5 Which SI unit will you use to express the height of your desk?
Metre (m) or commonly **centimetre (cm)** for practical use.

1.6 Write the name and symbols of all SI base units.

1. Length – metre (m)
2. Mass – kilogram (kg)
3. Time – second (s)
4. Temperature – kelvin (K)
5. Electric current – ampere (A)
6. Luminous intensity – candela (cd)

7. Amount of substance – mole (mol)

1.7 Why prefix is used? Name three sub-multiple and three multiple prefixes with their symbols.
Prefixes simplify very large or very small values by scaling the unit.
Sub-multiples:

- milli (m) = 10^{-3}
- micro (μ) = 10^{-6}
- nano (n) = 10^{-9}

Multiples:

- kilo (k) = 10^{3}
- mega (M) = 10^{6}
- giga (G) = 10^{9}

1.8 What is meant by:
(a) 5 pm = 5 picometres = 5×10^{-12} m
(b) 15 ns = 15 nanoseconds = 15×10^{-9} s
(c) 6 μm = 6 micrometres = 6×10^{-6} m
(d) 5 fs = 5 femtoseconds = 5×10^{-15} s

1.9 (a) Purpose of Vernier Callipers:
To measure small lengths accurately, such as the diameter of a cylinder or thickness of a sheet.

(b) Two main parts:

1. Main scale
2. Vernier scale

(c) Least count (LC):
LC = Value of 1 main scale division – Value of 1 Vernier scale division

(d) Zero error:
Error observed when the jaws of the instrument are closed but the scale doesn't read zero.

1.10 State least count and Vernier scale reading as shown in the figure and hence, find the length.
Def in notes. Reading is 2.6 cm

1.11 Which reading out of A, B and C shows the correct length and why?
Provided option "B" is correct. As it is aligned in front of eye.

Constructed Response Questions.

Here are well-structured, clear, and concept-based answers to the **Constructed Response Questions**, suitable for student understanding:

1.1. In what unit will you express each of the following?

(a) **Thickness of a five-rupee coin:**
→ **Millimetre (mm)**

(b) **Length of a book:**
→ **Centimetre (cm)**

(c) **Length of a football field:**
→ **Metre (m)**

(d) **Distance between two cities:**
→ **Kilometre (km)**

(e) **Mass of a five-rupee coin:**
→ **Gram (g)**

(f) **Mass of your school bag:**
→ **Kilogram (kg)**

(g) **Duration of your class period:**
→ **Minutes (min)**

(h) **Volume of petrol filled in the tank of a car:**
→ **Litres (L)**

(i) **Time to boil one litre milk:**
→ **Minutes (min)**

1.2. Why might a standard system of measurement be helpful to a tailor?

A standard system helps the tailor take **accurate, consistent, and repeatable** body measurements, ensuring properly fitting clothes regardless of who is doing the measuring.

1.3. Micrometer screw gauge least count and rod thickness

- **Given:**
  - Pitch = 1 mm (distance moved per one rotation of thimble)
  - Number of divisions = 100
    → **Least Count (LC) = Pitch / No. of divisions = 1 mm / 100 = 0.01 mm**
  - Thickness of the Rod = Main Scale Reading + Circular Scale Reading
  - 9 + 70 x 0.01 mm = 9 + 0.07 mm = 9.07 mm

1.4. How to measure the diameter of a pencil using a metre scale with high precision:

Least Count = 0.01mm

Main scale Reading = 9mm + 0.5mm = 9.5 mm

Circular Scale in front of index line = 70

Circular Scale Reading = 70 x 0.01 mm = 0.07 mm

Thus Thickness of Pencil = 9.5 mm + 0.07 mm = 9.57 mm

1.5. The end of a metre scale is worn out. Where will you place a pencil to find the length?

Place the pencil **starting from the 1 cm mark** (not from the worn-out end).
Then **subtract 1 cm** from the final reading to get the correct length.

1.6. Why is it better to place the object close to the metre scale?

To **avoid parallax error**, which occurs when the object and scale are not on the same level, causing incorrect readings.

1.7. Why is a standard unit needed to measure a quantity correctly?

Standard units ensure **accuracy**, **uniformity**, and **comparison** across different regions and people. Without them, measurements would be confusing and unreliable.

1.8. Suggest some natural phenomena that could serve as a reasonably accurate time standard.

- **Rotation of the Earth** (one day)
- **Revolution of the Moon** (one month)
- **Oscillation of pendulums or quartz crystals**
- **Heartbeat (for very short intervals, historically used)**

1.9. Why is it difficult to locate the meniscus in a wider vessel?

In a wide vessel, the **curved surface (meniscus)** is **less visible and spread out**, making it hard to align your eye with the lowest point for accurate reading.

1.10. Which instrument can be used to measure:

(i) **Internal diameter of a test tube:**
→ **Vernier Callipers**

(ii) **Depth of a beaker:**
→ **Depth rod of Vernier Callipers**

Numericals:

1.1. Calculate the number of seconds in:

(a) A day:
1 day = 24 × 60 × 60 = **86,400 s = 86.4 ks**

(b) A week:
1 week = 7 × 86,400 = **604,800 s = 604.8 ks**

(c) A month (30 days):
30 × 86,400 = **2,592,000 s = 2.592 Ms**

1.2. Convert answers of 1.1 into scientific notation:

(a) 86,400 s = **8.64×10^4 s**
(b) 604,800 s = **6.048×10^5 s**
(c) 2,592,000 s = **2.592×10^6 s**

1.3. Solve the following (in scientific notation):

(a) 4×10^{-4} kg + 3×10^{-5} kg

To add both values power of them should be same.

So, 3×10^{-5} kg = 0.3×10^{-4} kg

Finally 4×10^{-4} kg + 0.3×10^{-4} kg = $(4+0.3)\times10^{-4}$ kg

=(4.3) $\times10^{-4}$ kg

(b) 5.4×10^{-6} m − 3.2×10^{-5} m

To Substract both values power of them should be same.

So, 5.4×10^{-6} m = 0.54×10^{-5} m

Finally 0.54×10^{-5} m − 3.2×10^{-5} m = $(0.54 - 3.2)\times10^{-5}$ m

= - 2.6 $\times10^{-5}$ m

1.4. Multiplication/Division (in scientific notation):

(a) $(5\times10^{4}$ m)×$(3\times10^{-2}$ m)

Add powers

= (5x3) x (10^{4} x 10^{-2}) m^2 = 15 x (10^{4-2}) m^2 =15 x (10^{2}) m^2 =1.5 x 10^{3} m^2

(b) 6×10^{8} kg3 / 3×10^{4} m^3

= $6/3\times10^{8-4}$ = 2x 10^{4} kgm^{-3}

1.5. Calculate and express in scientific notation:

$(3\times10^{2}$ kg)×(4.0×k m) / 5×10^{2} s^2
= 4km = 4x10^{3}m
= $(3\times10^{2}$ kg)×$(4.0\times10^{3}$ m) = (3x4) (10^{2+3}) = 12 x 10^{5}
Now, 12 x 10^{5} / 5×10^{2} = 12/5 x 10^{5-2} = 2.4 x 10^{3} kg ms^{-2}

1.6. Significant figures:

(a) 0.0045 m → **2 significant digits**
(b) 2.047 m → **4 significant digits**
(c) 3.40 m → **3 significant digits**
(d) 3.420 × 10 m → **4 significant digits**

1.7. Write in scientific notation:

(a) 0.0035 m = **3.5×10^{-3} m**
(b) 206.4×10^2 m = **2.064×10^4 m**

1.8. Write using correct prefixes:

(a) 5.0×10^2 cm = **0.5 km**
(b) 580×10^2 g = **58 kg**
(c) 45×10^{-3} s = **4.5×10^{-2} s = 4.5 cs (centi seconds)** or just keep it in **milliseconds = 45 ms**

1.9. Distance of 1 light year

Given:
Speed of light = 3.0×10^8 m/s
Time = 1 year = $365 \times 24 \times 60 \times 60 = 31{,}536{,}000$ s = 3.1536×10^7 s

Distance = $v \times t = (3.0 \times 10^8) \times (3.1536 \times 10^7) = 9.4608 \times 10^{15}$
✔ Final Answer: **9.46×10^{15} m**

1.10. Convert density of mercury:

Given:
Density = 13.6 g/cm³
1 g/cm³ = 1000 kg/m³

$= 13.6 \times 1000 = 13{,}600$ kg/m³
$= 1.36 \times 10^4$ kg/m³

✔ Final Answer: **1.36×10^4 kg/m³**