Exercise-1(A)

1. What is meant by measurement?

Solution:

It is the comparison of the specified physical quantity with the known standard quality of the equivalent nature.

2. What do you understand by the term unit?

Solution:

Unit is the quantity of a constant magnitude which is used to measure the magnitudes of other quantities of the same nature.

3. What are the three requirements for selecting a unit of a physical quantity?

Solution:

The three requirements for selecting a unit of a physical quantity are:

- It should be reproducible
- Is required to be of convenient size
- No ambiguity while defining the unit
- The value of unit should not change with space and time.

4. Name the three fundamental quantities.

Solution:

The three fundamental quantities are:

- Length
- Mass
- Time

5. Name the three systems of unit and state the various fundamental units in them.

Solution:

The three systems of unit and the corresponding fundamental units are:

System of Unit	Fundamental units
CGS system	Centimeter (cm) Gram(g) Second(s)
F.P.S system	Foot(ft) Pound(lb) Second(s)
M.K.S system	Metre(m) Kilogramme(kg) Second(s)

6. Define a fundamental unit.

Solution:

It is that unit which is independent of any other unit or which can neither be changed nor can be related to any other basic unit. Example – Units of mass, length, time etc.

7. What are the fundamental units in S.I. system? Name them along with their symbols.

Solution:

The fundamental units in S.I. system along with their symbols are:

Quantity	Symbol
Length	m
Mass	kg
Time	s
Temperature	K
Luminous intensity	cd
Electric current	A
Amount of substance	mol
Angle	rd
Solid angle	st-rd

8. Explain the meaning of derived unit with the help of one example.

Solution:

Derived units are those which depend on the fundamental units or which can be expressed in relation with the fundamental units.

Example – to measure area, we need to measure length and breadth in the unit of length and then express area in a unit which is length x length or $(length)^2$

9. Define standard metre.

Solution:

The standard meter is the length of the path travelled by light in vaccum during a time interval of 1/299 792 458 of a second.

10. Name two units of length which are bigger than a metre. How are they related to the metre?

Solution:

The two units of length that are bigger than a metre are:

- Astronomical unit (A.U)
- Kilometre (km)

Relation between metre (m) and astronomical unit (A.U):

1 A.U = 1.496 X 10^{11} m

Relation between metre (m) and kilometer (km):

1 km = 1000m

11. Write the name of two units of length smaller than a metre. How are they related to the metre?

Solution:

The two units of length smaller than a metre are:

- Angstrom(Å)
- Fermi (f)

Relation between metre (m) and Angstrom (Å) is:

1 Angstrom (Å) = 10^{-10} metre

Relation between metre (m) and Fermi is:

1 fermi (f) = 10^{-15}m

12. How is nanometer related to Angstrom?

Solution:

Relation between nanometer (nm) and Angstrom (Å):

1 nanometer = 10 Å

13. Name the three convenient units used to measure length ranging from very short to very long value. How are they related to the S.I. unit?

Solution:

The 3 convenient units used to measure length ranging from very short to very long value are:

- Centimeter (cm)
- Metre (m)
- Kilometer (km)

Relation between meter (m) and the units are:

1 m = 100cm

1 km = 1000m

14. Name the S.I unit of mass and define it.

Solution:

The S.I. unit of mass is Kilogram (Kg)

One kilogram was defined as the mass of a cylindrical piece if platinum-iridium alloy kept at International Bureau of Weights and Measures at Serves near Paris.

15. Complete the following:

(a) 1 light year = _____m
(b) 1 m = _____Å
(c) 1 m = _____μ
(d) 1 micron = _____Å
(e) 1 fermi = _____m

Solution:

(a) 1 light year = 9.46 x 10^{15} m
(b) 1 m = 10^{10} Å
(c) 1 m = 10^{6} μ
(d) 1 micron = 10^{4} Å
(e) 1 fermi = 10^{-15} m

16. State two units of mass smaller than a kilogram. How are they related to kilogram?

Solution:

The two units of mass smaller than a kilogram (kg) are:

- gram(g)
  1 g = 10^{-3}kg
- milligram(mg)
  1 mg = 10^{-6}kg

17. State two units of mass bigger than a kilogram. Give their relationship with the kilogram.

Solution:

The two units of mass bigger than a kilogram (kg) are:

- Quintal
  1 quintal = 100kg
- Metric tonne
  1 metric tonne = 1000kg

18. Complete the following:

(a) 1g = _____kg
(b) 1mg = _____kg
(c) 1 quintal = _____kg
(d) 1 a.m.u (or u) = _____kg

Solution:

(a) 1g = 10^{-3}kg
(b) 1mg = 10^{-6} kg
(c) 1 quintal = 100 kg
(d) 1 a.m.u (or u) = 1.66 x 10^{-27} kg

19. Name the S.I. unit of time and define it.

Solution:

The S.I. unit of time is second(s).
A second can be defined as 1/86400th part of a mean solar day, i.e.,
1s = 1/86400 x one mean solar day

20. Name two units of time bigger than a second. How are they related to second?

Solution:

The two units of time bigger than a second (s) are:

- Minute (min)
  1 min = 60s
- Hour (h)
  1 h = 3600s

21. What is a leap year?

Solution:

A leap year is the year in which the month of February is of 29 days, i.e.,
1 Leap year = 366 days

22. 'The year 2020 will have February of 29 days'. Is this statement true?

Solution:

Yes, the year 2020 shall be a leap year.

23. What is a lunar month?

Solution:

It is a month measured between successive new moons.

24. Complete the following:

(a) 1 nano second = _____s

(b) 1 µs = _____s

(c) 1 mean solar day = _____s

(d) 1 year = _____s

Solution:

(a) 1 nano second = 10^{-9} s

(b) 1 µs = 10^{-6} s

(c) 1 mean solar day = 86400s

(d) 1 year = 3.15 x 10^{7}s

25. Name the physical quantities which are measured in the following units:

(a) u

(b) ly

(c) ns

(d) nm

Solution:

Unit	Physical quantity measured
u	Mass
ly	Length
ns	Time
nm	Length

26. Write the derived units of the following:

(a) Speed

(b) Force

(c) Work

(d) Pressure

Solution:

The derived units of the following are as follows:

(a) Speed = ms^{-1}

(b) Force = kg m s^{-2}

(c) Work = kg m^2 s^{-2}

(d) Pressure = kg m^{-1} s^{-2}

27. How are the following derived units related to the fundamental units?

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

Solution:

(a) Newton – kg m s^{-2}
(b) Watt - kg m^2 s^{-3}
(c) Joule - kg m^2 s^{-2}
(d) Pascal - kg m^{-1} s^{-2}

28. Name the physical quantities related to the following units:

(a) km^2
(b) newton
(c) joule
(d) pascal
(e) watt

Solution:

The physical quantities related to the following units are:

(a) km^2 - area
(b) newton – force
(c) joule – energy
(d) pascal – pressure
(e) watt – power

Multiple Choice Type

1. **The fundamental unit is:**
   (a) newton
   (b) pascal
   (c) hertz
   (d) second
   Solution:
   (d) second
   Second is a fundamental unit. Some other fundamental units are meter (m), kilogram(kg).

2. **Which of the following unit is not a fundamental unit:**
   (a) metre
   (b) litre
   (c) second
   (d) kilogram
   Solution:
   (b) litre
   Litre is a unit of volume, which is a derived physical quantity.

3. **The unit of time is:**
   (a) light year
   (b) parsec
   (c) leap year
   (d) angstrom
   Solution:
   (c) leap year
   A leap year is the year in which the month of February is of 29 days.

4. **1 Å is equal to:**
   (a) 0.1 nm
   (b) 10^{-10}cm
   (c) 10^{-8}m
   (d) 10^{4}μ
   Solution:
   (a) 0.1 nm
   1 m= 10^{10} Å

5. **ly is the unit of:**
   (a) time
   (b) length
   (c) mass
   (d) none of these
   Solution:
   (b) length
   ly is the short for light year, which is a unit of distance or length.

Numericals

1. **The wavelength of light of a particular colour is 5800 Å. Express it in (a) nanometer and (b) metre**
   Solution:
   The wavelength of light of a particular colour is 5800 Å.
   (a) 1nm = 10 Å
   5800 Å = 5800/10 = 580 nm
   (b) 1 m= 10^{10} Å
   5800 Å = 5800 / 10^{10} = 5.8 x 10^{-7}m

2. **The size of a bacteria is 1 μ. Find the number of bacteria in 1m length.**
   Solution:
   Size of bacteria is 1 μ
   1 μ = 10^{-6}m
   Number of bacteria in 1m = $1/10^{-6}$
   Number of bacteria in 1m length = 10^{6} bacteria

3. **The distance of a galaxy from the earth is 5.6×10^{25}m. Assuming the speed of light to be 3×10^8 ms^{-1} find the time taken by light to travel this distance.**
   [Hint: Time taken = $\frac{\text{distance travelled}}{\text{speed}}$]

   Solution:
   Given:
   distance = 5.6×10^{25}m
   speed = 3×10^8 ms^{-1}
   Time = ?
   Time taken = $\frac{\text{distance travelled}}{\text{speed}}$

   $= \frac{5.6 \times 10^{25}}{3 \times 10^8}$

   $= 1.867 \times 10^{17}$s

4. **The wavelength of light is 589nm. What is its wavelength in Å?**
   Solution:
   Given:
   The wavelength of light is 589nm.
   1 nm = 10 Å
   ∴ 589nm = 5890 Å

5. **The mass of an oxygen atom is 16.00 u. Find its mass in kg.**
   Solution:
   Given:
   Mass of oxygen atom = 16u
   1 u = 1.66×10^{-27} kg
   Mass of 16 u = $16 \times 1.66 \times 10^{-27}$
   $= 2.656 \times 10^{-26}$ kg

6. **It takes time 8 min for light to reach from the sun to the earth surface. If speed of light is taken to be 3×10^8 ms^{-1}, find the distance from the sun to the earth in km.**
   Solution:
   Given:
   Time = 8 min
   Speed = 3×10^8 ms^{-1}
   Distance = ?

   Time is not given in the standard form, i.e., in seconds. So first convert to seconds;
   1 min = 60s
   8 min = 8 x 60s = 480s

   Distance = s x t
   $= 3 \times 10^8 \times 480 = 1.44 \times 10^8$ km

7. 'The distance of a star from the earth is 8.33 light minutes'. What do you mean by this statement? Express the distance in metre.

Solution:

Given:

The distance of a star from the earth is 8.33 light minutes means that it takes 8.33 minutes for light to reach the earth from the ultimate source of light – the Sun. The distance is large, hence light year is used.

Speed of light = 3×10^8 ms^{-1}

Time = 8.33 min = 499.8s

Distance = speed x time

$= 3 \times 10^8 \times 499.8$

$= 1.5 \times 10^{11}$ m