Chapter 1

Measurement

Exercise:

1) Choose the correct answer.

Choose the correct one.

a) mm< cm < m < km

b) mm > cm > m > km

c) km < m < cm < mm

d) mm > m> cm> km

Ans: a) mm< cm < m < km

Explanation:

Because, 1mm = 10^{-3}m

1cm = 10^{-2}m

1km = 10^{3}m

2) Rulers, measuring tapes and meter scales are used to measure

a) mass

b) weight

c) time

d) length

Ans: d) length

Explanation:

Because, rulers, measuring tapes and meter scales are used to measure lengths.

3) 1 metric ton is equal to

a) 100 quintals

b) 10 quintals

c) 1/10 quintals

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d) 1/100 quintals

Ans: b) 10 quintals

Explanation:

Because, 1 metric ton = 1000 × 1 kg = 10 quintal

4) Which among the following is not a device to measure mass?

a) Spring balance

b) Beam balance

c) Physical balance

d) Digital balance

Ans: a) Spring balance

Explanation:

Because, it is used to measure the weight of an object. And other three devices are used to measure the mass of the object.

II) Fill in the blanks.

1) Meter is the unit of _____

Ans: Meter is the unit of length.

2) 1 kg of rice is weighed by _____

Ans: 1 kg of rice is weighed by Common (beam) balance.

Because, it measures accurately up to 5kg.

3) Thickness of a cricket ball is measured by _____

Ans: Thickness of a cricket ball is measured by Vernier Caliper or Simple Scale.

4) Radius of a thin wire is measured by _____

Ans: Radius of a thin wire is measured by Screw Gauge.

Because, it measures the dimensions up to 0.01mm.

5) A physical balance measures small differences in mass up to _____

Ans: A physical balance measures small differences in mass up to milligram.

Because, it measures mass of an object correct to milligram.

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III) State whether true or false. If false, correct the statement.

1) The SI unit of electric current is kilogram.

Ans: False

Explanation:

Because, The SI unit of electric current is ampere or A.

2) Kilometer is one of the SI units of measurement.

Ans: False

Explanation:

Because, Meter is one of the SI units of measurement.

3) In everyday life, we use the term weight instead of mass.

Ans: True

Explanation:

In everyday life, we use the term weight instead of mass, because the acceleration due to gravity acting on any object is same anywhere on the earth's surface.

4) A physical balance is more sensitive than a beam balance.

Ans: True

Explanation:

Because, it measures the mass of an object correct to a milligram.

5) One Celsius degree is an interval of 1K and zero degree Celsius is

273.15 K.

Ans: True

6) With the help of vernier caliper we can have an accuracy of 0.1 mm and with screw gauge we can have an accuracy of 0.01 mm.

Ans: True

IV) Match the following.

Ans:

1) Length : meter

Mass: kilogram

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Time: second

Temperature: kelvin

2) Screw gauge: coins

Vernier caliper: Cricket ball

Beam balance: vegetables

Digital balance: Gold ornaments

V) Assertion and reason type questions.

Mark the correct answer as:

a. Both A and R are true but R is not the correct reason.

b. Both A and R are true and R is the correct reason.

c. A is true but R is false.

d. A is false but R is true.

1) **Assertion** (A): The scientifically correct expression is "The mass of the bag is 10 kg"

Reason (R): In everyday life, we use the term weight instead of mass.

Ans: a. Both A and R are true but R is not the correct reason.

Because, the mass of the bag is 10kg means it contains that amount in it.

2) Assertion (A): 0 °C = 273.16 K. For our convenience we take it as 273 K after rounding off the decimal.

Reason (R): To convert a temperature on the Celsius scale we have to add 273 to the given temperature.

Ans: b. Both A and R are true and R is the correct reason.

Because, 0^0C= 273K and 1^0C = 1+ 273 = 274K

3) Assertion (A): Distance between two celestial bodies is measured in terms of light year.
Reason (R): The distance travelled by the light in one year is one light year.

Ans: d. A is false but R is true.

Because, distance between two celestial bodies is not measured in terms of light year.

VI. Answer very briefly.

1) Define measurement.

Net Explanations

Ans:

From many years ago, there were no specific units for measuring quantities. And that time people have made the measurements according to their need and region. But to make the measurements of any quantity over all the world to be same, we have given the SI units.

Hence, measurement is the calculation or counting or determination of size, length or magnitude of a quantity. So for exchanging or interacting purpose we made the specific measurements and according to that we measures them, because of that we can easily handle them.

Like length is measured in meter, mass in kg, temperature in K etc. which made easy to measure them. And this are standard units. Hence, it plays an important role in our daily life.

2) Define standard unit.

Ans:

The standard unit is the unit of measurement of any physical quantity which is universally accepted and does not change with place to place, person to person or with time.

It cannot be destructible**.**

They are easily available and easy to handle in daily life for every person. They are defined for particular standard amount of the quantity. If that amount changes then the unit also changes in magnitude only.

For example, for mass the standard unit is kg, and starts from 1kgand hence, in terms of kg we can measure the other quantities of the same type.

So it is easy to predict from the standard unit.

3) What is the full form of SI system?

Ans:

Because of the different system of units it was inconvenient to exchange the scientific knowledge over all the world. Hence, in 1960, in Paris, at the 11^{th} international conference of weighs and measures a common system of unit called as “System International d’ Units” was accepted.

It consist of seven fundamental units and 2 supplementary units. Now a days, SI system replaced all other system of units over all the world.

The seven fundamental quantities are length, mass, time, temperature, electric current, luminous intensity, and amount of substance and their SI units are meter, kilogram, second, kelvin, ampere, candela and mole respectively

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The two supplementary units are, plane angle in radian and solid angle in steradian.

4) Define least count of any device.

Ans:

For our daily purpose of measuring lengths we use cm or meter as a units on meter scale.

The smallest length which is measured by any scale like meter scale or cm scale is called as its least count.

For example the least count of Vernier caliper is 0.1mm or 0.01cm. It means that, the smallest division on that scale is 0.1mm.

The least count of Vernier Caliper is defined as the ratio of value of one main scale division to the total no. of vernier scale divisions.

L.C. of Vernier Caliper = (value of one main scale division)/ (total no. of divisions on vernier scale)

The main scale division is in cm and which is again divided into mm. and hence smallest division is 1mm. and total divisions on vernier scale will be 10.]

Hence, L.C. = 1mm/10 = 0.1mm = 0.01cm

5) What do you know about pitch of screw gauge?

Ans:

Screw Gauge is the device used to measure the dimensions of the object up to0.01mm

We can measure the diameter or radius of thin wire and thickness of coin also by using screw gauge.

The screw gauge works on the principal that, when we rotate a screw in a nut then the distance covered by the tip of the screw is directly proportional to the no. of rotations.

The pitch of the screw is the distance covered by the tip of the screw for one complete rotation of the head and it is equal to 1mm.

Pitch of the screw = (distance moved by the pitch)/ (no. of rotations done by the head scale)

6) Can you find the diameter of a thin wire of length 2 m using the ruler from your instrument box?

Ans:

We cannot measure the diameter of a thin wire of length 2m using rural from instrument box, because the least count of the ruler from instrument box is about 1mm and which is greater than the diameter of thin wire.

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To measure the diameter of thin wire we have to use Screw Gauge.

Screw Gauge is the device used to measure the dimensions of the object up to0.01mm

We can measure the diameter or radius of thin wire and thickness of coin also by using screw gauge.

VII. Answer briefly.

1) Write the rules that are followed in writing the symbols of units in SI system.

Ans:

The rules used for writing the symbols of units in SI system are as follows:

The units which are given the names of scientists are not written with initial letter as a capital. For example: current in ampere and not as Ampere, force in newton and not as Newton, energy in joule and not as Joule etc.

The units which has given the name of scientists with their symbols are written in capital letter. For example: A for ampere, N for newton, J for joule etc.

The units which are not derived from proper noun are written with initial letter as a small letter. For example: m for meter, kg for kilogram etc.

There should be no full stop or any other punctuation mark between the units or at the end of it. For example: 40 m and not as 40 m.

Also, 5kg and not as 5kg.

The symbols of the units should not written in plural form. For example: 10 kg and not as 10 kgs

There is no degree sign when temperature is expressed in kelvin. For example: 273K and not as 273^0K and if temperature is expressed in Celsius then we have to write degree sign. For example: 25^0C and not as 25C

The no. and unit should be separated by space. For example: 5 m/s and not as 5m/s

The symbols which are accepted should be written alone. For example: ampere and not as amp and second and not as sec

The numerical values should be written in scientific form only. For example: density of mercury as 1.36 * 104 kgm^{-3} and not as 13600 kgm^{-3}

2) Write the need of a standard unit.

Ans:

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To make our measurements correct and proper for every person all over the world we have to use standard units only. The units should not be changed from one place to other or person to person, so we have accepted standard units.

For the sec of convenience, we have constructed the common system of standard units which is same all over the world.

The standard unit is the unit of measurement of any physical quantity which is universally accepted and does not change with place to place, person to person or with time.

It cannot be destructible**.**

They are easily available and easy to handle in daily life for every person. They are defined for particular standard amount of the quantity. If that amount changes then the unit also changes in magnitude only.

For example, for mass the standard unit is kg, and starts from 1kgand hence, in terms of kg we can measure the other quantities of the same type. So it is easy to predict from the standard unit.

3) Differentiate mass and weight.

Ans:

Mass is the fundamental quantity whereas the weight is the derived quantity.

Mass has magnitude only i.e. it is a scalar quantity whereas weight has both magnitude and direction i.e. it is a vector quantity.

Mass remains constant anywhere but weight changes from place to place because of change in gravity.

Mass is measured with the help of physical balance and weight is measured with the help of spring balance.

The unit of mass is kg whereas the unit of weight is newton.

Mass is the quantity of matter contained in it whereas weight is the normal force exerted by the surface on the object against the gravity.

4) How will you measure the least count of vernier caliper?

Ans:

For our daily purpose of measuring lengths we use cm or meter as a units on meter scale.

The smallest length which is measured by any scale like meter scale or cm scale is called as its least count.

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For example the least count of Vernier caliper is 0.1mm or 0.01cm. It means that, the smallest division on that scale is 0.1mm.

The least count of Vernier Caliper is defined as the ratio of value of one main scale division to the total no. of vernier scale divisions.

L.C. of Vernier Caliper = (value of one main scale division)/ (total no. of divisions on vernier scale)

The main scale division is in cm and which is again divided into mm. and hence smallest division is 1mm. and total divisions on vernier scale will be 10.

Hence, L.C. = 1mm/10 = 0.1mm = 0.01cm

In this way we will measure the least count of vernier caliper.

VIII. Answer in detail.

1) Explain a method to find the thickness of a hollow tea cup.

Ans:

To measure the thickness of a hollow tea cup we have to measure its inner radius and the outer radius by using Vernier caliper. The difference between the outer radius and inner radius is the thickness of the hollow tea cup.

The inner radius is the distance between center of tea cup and its inner wall.

The outer radius is the distance between center of tea cup and its outer wall.

And also by following method we can find the thickness of hollow tea cup by using screw gauge.

To measure the thickness of hollow tea cup we have to take following steps;

Find the pitch, least count and zero error of the given screw gauge.

Now put the tea cup in between the two studs by rotating the head until the cup is held firmly by using ratchet but not tightly.

Note the PSR and HSC and the thickness is given by PSR + CHSR.

By repeating the same process we find the thickness of tea cup for different positions and finally by finding the average of thickness we will get the accurate thickness of hollow cup.

2) How will you find the thickness of a one rupee coin?

Ans:

To measure the thickness of a one rupee coin we have to take following steps;

Find the pitch, least count and zero error of the given screw gauge.

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Now put the coin in between the two studs by rotating the head until the coin is held firmly by using ratchet but not tightly.

Note the PSR and HSC and the thickness is given by PSR + CHSR.

By repeating the same process we find the thickness of one rupee coin for different positions and finally by finding the average of thickness we will get the accurate thickness of the hollow one rupee coin.

IX. Numerical Problems.

1) Inian and Ezhilan argue about the light year. Inian tells that it is 9.46 × 1015 m and Ezhilan argues that it is 9.46 × 10 12 km.

Who is right? Justify your answer.

Ans:

Here, Inian and Ezhilan both are right, because they have expressed the light year in two different units only which are correct. The justification is as given bellow.

The light year is the unit used to measure the distance between the earth and stars.

1 light year = 365* 86400* 3* 10^{8} m

= 9.46 * 10^{15} m

But, 1 m = 10^{-3} km

Hence, 1 light year = 9.46 * 10^{15} m = 9.46 * 10^{15} * 10^{-3} km

= 9.46 * 10^{12} km

2) The main scale reading while measuring the thickness of a rubber ball using Vernier caliper is 7 cm and the Vernier scale coincidence is 6. Find the radius of the ball.

Ans:

Given that, MSR = 7 cm and Vernier scale coincidence = 6

The least count of vernier caliper is 0.01 cm

And hence, the radius of the ball is given by,

R = MSR + vernier coincidence* LC

= 7 cm + 6 * 0.01 cm

= 7 cm + 0.06 cm

= 7.06 cm

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Hence, the radius of rubber ball measured with vernier caliper is 7.06 cm

3) Find the thickness of a five rupee coin with the screw gauge, if the pitch scale reading is 1 mm and its head scale coincidence is 68.

Ans:

Given that, pitch scale reading = 1 mm

Head scale coincidence = 68

The least count of screw gauge is 0.01 mm

Hence, thickness of five rupee coin is given by

Thickness = pitch scale reading + head scale reading * LC

= 1 mm + 68 * 0.01 mm

= 1 mm + 0.68 mm

= 1.68 mm

Hence, the thickness of five rupee coin measured with screw gauge is 1.68 mm

1) Find the mass of an object weighing 98 N.

Ans:

Given that, weight of an object is 98 N

We know that, Weight = mass * acceleration due to gravity

W = m * g

Hence, m = W/ g = 98/ 9.8 = 10 kg

Hence, the mass of the object is 10 kg.

Net Explanations