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**Pakistan School , Kingdom of Bahrain**

**E- Support and Learning Material / Session 2020-2021**

**Subject: Physics Grade : 9**

**Book: Physics 9 PTB FIRST TERM**

**Unit 3: Physical Quantities and measurement Pg. No: 10+11+12**

**Questions:**

**Q. What is meant by scientific notation? Give examples.**

**Ans: Scientific notation:  In scientific notation a number is expressed as some power of 10 multiplied by a number between one and 10.**

**For example:**

* 1. **A number 54987 can be expressed as 5.4987 x 104 in standard form.**
  2. **The standard form of 0.00035 s is 4.5 x 10-4 s**

**Note:  In standard form or scientific notation, a number has only one non- zero digit before the decimal.**

**Rules:**

1. **In any value if the decimal is shifted from right to left then power of 10 will be positive.**
2. **In any value if the decimal is shifted from left to right then power of 10 will be negative.**

**Q. Write the numbers in scientific notation.**

**a. 3000000000m/s b. 0.0000584s**

**Ans: a. 3000000000m/s**

**In scientific notation it is equal to = 3x109 m/s**

**b. 0.0000584s**

**In scientific notation it is equal to = 5.84 x 10-5**

**Q. Estimate your age in seconds.**

**Ans: Suppose age of person = 14 years**

**Therefore**

**Total days in one year = 365 Total hours in one day = 24hours**

**Total minutes in one hour = 60 min**

**Total seconds in minutes = 60 sec**

**Age of person in seconds =14 x 365 x 24 x 60 x 60 sec**

**Q. Rewrite the following in standard form**

### a) 1168x10-27 =1.168x10-27+3 =1.168x10-24

**b)** 32 x 105 = 32 x 105 + 1 = 3.2 x 10

**Q. Write the following quantities in standard form.**

**a) 6400 km b) 380 000 km**

**Ans: a) 6400 km = 6.4 x 103 km**

**b) 380 000 km =3.8 x 105 km**

**Q. What are measuring instruments? Give some examples.**

**Ans:  Measuring instruments are used to measure various physical quantities such as length, mass, time, volume etc.**

**EXPLANATION:**

**Measuring instruments used in the past were not so reliable and accurate as we use today.**

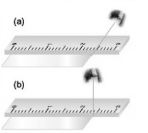
**E.g. sundial, water clock and other time measuring devices used around 1300 AD were quite crude. On the other hand, digital clocks and watches used now a-days are highly reliable and accurate.**

**Q. What is meant by least count?**

**Ans: The minimum measurement that can be taken by any measuring device is known as least count of that device.**

**For example: Least count of vernier callipers is 0.01cm. It means that we cannot measure the object smaller than 0.01cm by using vernier callipers.**

**Q What is a metre rule? What is the least count of a metre rule used in the laboratories?**

**Ans: A metre rule is a length measuring instrument. It is commonly used in the daily life to measure length of an object or distance between two points.**

**Least count: The least count of metre rule is 0.1 cm. Or 1 mm.**

**Construction: It is one metre long and has hundred cm.**

**Scale on metre rule:**

**Each big division (cm) is divided into 10 small divisions called millimeters (mm).**

**Least count of metre rule:  1 millimeter is the smallest reading that can be taken by using metre rule and is called its least count.**

**Precautions:**

* 1. **While measuring length or distance, eye must be kept vertically above the reading point.**
  2. **The reading becomes doubtful if the eye is positioned either left or right to the reading scale.**

**Q. What is a measuring tape? What is the least count of measuring tape?**

**Ans: Measuring tape: It is used to measure length in metre and centimeters. Measuring tape is used by blacksmith and carpenters.**

**Construction: Measuring tape consists of a thin and long strip of cotton, metal or plastic.**

**Scale on measuring tape: Generally it is 10 m, 20 m, 50 m, or 100 m long. Measuring tapes are marked in centimeters as well as in inches.**

**Least count of measuring tape: The least count of measuring tape is 0.1 cm or 1mm.**

**Q. What do you understand by the zero error of a measuring instrument?**

**Ans: In measuring instruments there may be systematic error, due to which measurement may be less or greater than actual measurement.  Zero error influences all the measurements equally. Zero error is caused by incorrect position of zero point.**

**Q. Why is the use of zero error necessary in measuring instrument?**

**Ans:  Zero error of instruments effects all the measurements, so it must be necessary to calculate the zero error of an instrument before taking measurements. If we don't calculate the zero error then consistent difference in the reading will be calculated.**

**Q. What is a vernier callipers? Write its construction, least count and vernier constant.**

**Ans: Vernier calipers: An instrument used to measure small length such as internal or external diameter or length of a cylinder etc, is called vernier calipers.**

**Construction:**

**Jaws of vernier callipers: Vernier callipers consists of two jaws.**

1. **Fixed jaw: that is attached with main scale. It has marks in centimeters and millimeters.**
2. **Moveable Jaw: The other jaw is a moveable jaw having vernier scale having 10 divisions and each of its division is 0.9mm.**



**Vernier Constant:  The difference between one small division on main scale division and 1 vernier scale division is 0.1 millimeter is called vernier constant.**

**1mm - 0.9mm = 0.1 mmm**

### Least Count of Vernier Callipers:

**“The difference between one small division on main scale division and one vernier scale division is 0.1 mm. It is called least count (LC) of the Vernier Callipers”.**

**Least count of the Vernier Callipers can also be found as given below:**

**Least count of vernier calipers = smallest reading on main scale**

**No. of division on vernier scale**

**= 1 mm**

**10**

**= 0.1 mm = 0.01 cm**

**ZERO ERROR:**

**Zero error will exist if zero line of the vernier scale is not coinciding with the zero of main scale.**

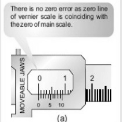
**Types of zero error: There are two types of zero error.**

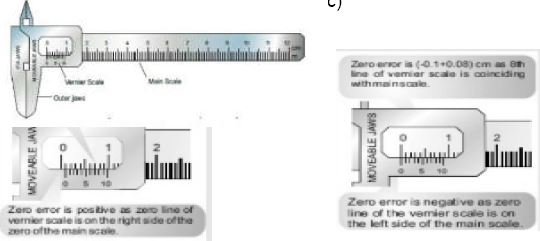
### Positive Zero Error: Zero error will be positive if zero line of vernier scale is on the right side of the zero of the main scale

1. **Negative zero error: If zero line of vernier scale is on the left side of zero of the main scale then zero error will be negative.**

**Note: Zero correction will be positive if zero error is negative.**

**Zero correction will be negative if zero error is positive.**





### Q. How can we take reading on vernier callipers?

### Taking a Reading on Vernier Callipers:

* 1. **Let us find the diameter of a solid cylinder using Vernier Callipers.**
  2. **Place the solid cylinder between jaws of the Vernier Callipers. Close the jaws till they press the opposite sides of the object gently.**
  3. **Note the complete divisions of main scale past the vernier scale zero in a tabular form.**
  4. **Next find the vernier scale division that is coinciding with any division on the main scale multiply it by least count of Vernier Callipers**
  5. **Now add main scale reading and vernier scale reading. This is equal to the diameter of the solid cylinder.**
  6. **Add zero correction (Z.C) to get correct measurement.**
  7. **Repeat the above procedure and record at least three observations with the solid cylinder displaced or rotated each time.**

### Digital Vernier Callipers:

**A digital vernier callipers has greater precision than mechanical vernier callipers. Least count of digital vernier callipers is 0.01 mm.**

**Example 1.1: Find the diameter of a cylinder placed between the outer jaws of vernier callipers as shown in figure:**

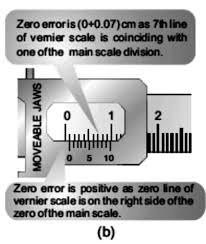
**Zero Error:**

**On** **closing the jaws of vernier callipers, the position of vernier scale as shown in fig is Vernier division coinciding with main scale = 7 div**

**Zero error (Z.E)** **= 7 x 0.01 cm**

**= +0.07 cm**

**Zero correction (Z.C) = – 0.07 cm**

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### Diameter of the Cylinder:

**Main scale reading**

**Vernier division coinciding with main**

**scale Vernier Scale reading**

**Observed diameter of the cylinder**

**correct diameter of the cylinder**

**Thus the correct diameter of the given cylinder as found by vernier calipers is 2.19 cm.**

**= 2.2 cm**

**= 6 div**

**= 6 x 0.01 cm**

**= 0.06 cm**

**= 2.2 cm + 0.06 cm**

**= 2.26 cm**

**= 2.26 – 0.07**

**= 2.19 cm**

### Q. On closing the jaws of a Vernier callipers, zero of the vernier scale is on the right

### To its main scale such that 4 division of its vernier scale coincides with one of the main scale

**Division. Find its zero error and zero correction.**

**Sol: Vernier division coinciding with main scale = 4 div Least count of vernier calipers = 0.01 cm Now**

**Zero error (Z.E) = 4 x 0.01 cm**

**= +0.04 cm**

**Zero correction (Z.C) = – 0.04 cm**

**Q. What is screw gauge? Describe construction, least count, zero error and working of screw gauge?**

**Ans: SCREW GAUGE:**

**“A screw gauge is an instrument that is used to measure small lengths with accuracy greater than a vernier callipers. It is also called micro meter screw gauge”.**

**Construction: A simple screw gauge consists of you shaped metal frame with a metal stud at its one end.**

**Scales: It has 2 scales**

**i. Main scale: A hollow cylinder has a millimeter scale over it along a line called index line.**

**ii. Circular scale:  Cylinder not it is fixed at one end having division on it, called circular scale.**

**Thimble has a threaded spindle inside it.**

**Pitch of the Screw Gauge: As the thimble completes one rotation, the spindle moves 1 mm along the index line. It is because the distance between consecutive threads on the spindle is 1 mm. This distance is called the pitch of screw on the spindle.**

### Least Count of Screw Gauge:

**The thimble has 100 divisions around its one end. It is the circular scale of the screw gauge. As thimble completes one rotation, 100 divisions pass the index line and the thimble moves 1 mm along the main scale. Thus each division of circular scale crossing the index line moves the thimble through 1/100 mm or 0.01 mm on the main scale**

**Least count of screw guage = Pitch of screw guage**

**No of division on circular scale**

**L.C = 1mm**

**100**

**= 0.01mm or 0.001cm**

### Zero Error of Screw Gauge:

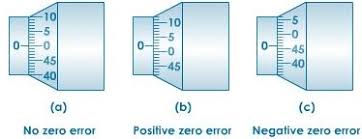
**To find the zero error, close the gap between the spindle and the stud of the screw gauge by rotating the ratchet in the clockwise direction. If zero of circular scale coincides with the index line, then the zero error will be zero.**

### Positive Zero Error:

**Zero error will be positive if zero of circular scale is behind the index line. In this case, multiply the number of divisions of the circular scale that has no crossed the index line with the least count of screw gauge to find zero error.**

### Negative Zero Error:

**Zero error will be negative if zero of circular scale has crossed the index line. In this case, multiply the number of divisions of the circular scale that has crossed the index line with the least count of screw gauge to find the negative zero error.**



**Working:**

### Taking a Reading Using a Screw Gauge:

**The diameter of given wire can be found as follows:**

1. **Close the gap between spindle and stud of the screw guage by turning the ratchet in clockwise direction.**
2. **Note main scale as well as circular scale readings to find the error and hence zero correction of the screw gauge.**
3. **Open the gap between stud and spindle of the screw gauge by turning the ratchet in anti- clockwise direction. Place the given wire in the gap. Turn the ratchet so that the object is pressed gently between studs and the spindle.**
4. **Note main scale as well as circular scale readings to find the diameter of the given wire.**
5. **Apply zero correction to get the correct diameter of the wire.**
6. **Repeat steps 3, 4 and 5 at different places of the wire to obtain its average diameter.**

### Q. A screw gauge has 50 divisions on its circular scale. The pitch of the screw gauge is 0.5 mm. What is its least count?

**Sol: No of divisions on circular scale = 50 div Pitch of Screw Gauge = 0.5 mm**

**Least count of a screw gauge can be found as given below:**

**Least count = Pitch / No. of divisions on circular scale**

**L.C = 0.5/50**

**L.C = 0.01 mm**

**L.C = 0.001cm**

**Thus least count of the screw gauge is 0.01 mm or 0.001 cm.**

### Example 1.2: Find the diameter of a wire using screw gauge as shown in figure:

**Sol: Zero Correction:**

**On closing the gap of the screw gauge, the position of circular scale as shown in fig is**

**Main scale reading = 1mm**

**Circular division coinciding with index line = 85**

**Circular Scale reading = 85 x 0.01 = 0.85mm**

**Observed diameter of the wire = 1+0.85 =1.85mm**

**Correct diameter of the cylinder = 1.85 - 0.24**

**=1.61 mm**

**Thus correct diameter is 1.61mm**

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**ASSESSMENT**

**Answer the following questions:**

**1. The Sun is one hundred and fifty million kilometers away from the Earth. Write this**

**a) As an ordinary whole number**

**b) In scientific notation**

**2. Write the numbers given below in scientific notation?**

**a. 6400000m b. 0.0000000016g**

**3. Express 1 cm in milliliters?**

**4. Rewrite the following in standard form.**

**a. 725 x 10-5 Kg b. 0.02 x 10-8**

**5. Write the following quantities in standard form.**

**a. 300000000 m/s b. second in a day**

**6. On closing the jaws of a Vernier callipers, zero of the vernier scale is on the right Of its main scale such that 6 division of its vernier scale coincides with one of the main scale division. Find its zero error and zero correction.**

**7. Cut a strip of paper sheet. Fold it along its length. Now mark centimeters and half centimeters along its length using a ruler. Answer the following questions:**

1. **What is the range of your paper scale?**
2. **What is its least count?**
3. **Measure the length of pencil using your paper scale and with meter ruler. Which one is more accurate and why?**
4. **A screw gauge has 100 divisions on its circular scale. The pitch of the screw gauge is 0.1 mm. What is its least count?**
5. **What is the least count of screw gauge?**
6. **What is the pitch of your laboratory screw gauge?**
7. **What is the range of school laboratory screw gauge?**