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Answers Key:

Case Study Questions

1. (i) In the measured value of physical quantity, the digit about the correctness of which we are sure plus the last digit which is doubtful, are called significant figures.
(ii) The smallest value that can be measured by a measuring instrument is called the least count of the instrument.
(iii) Precision describes the limitation of the measuring instrument. It is determined by the least count of the measuring instrument. Smaller the least count, greater is the precision. Both accuracy and' precision reflect how close a measurement is to an actual value. Accuracy reflects how close a measurement is to a known or accepted value, while precision reflects how reproducible measurements are, even if they are far from the accepted value.
(iv) Larger the number of significant figures in a measurement, greater is the precision of the measurement and vice versa.
(v) Maximum absolute error in sum of the two quantities is equal to sum of the absolute errors in the individual quantities.
(vi) Systematic errors can be minimised by improving experimental techniques, selecting better instruments and removing personal errors.
2. (i) A screw gauge and a spherometer are used to measure distances upto 10^{-5} m.
(ii) Basis - is the distance between two different point of observation while the parallactic angle is the angle between two line of sight against fixed background.
(iii) Since diameter of earth's orbit around the sun is the basis, therefore measure of basis is 2 AU.
(iv) It is because as the distance of star increases, the Parallax angle decreases that can not be measured accurately. Parallax method is limited to measurement of distance upto 100 light years.
(v) Angular diameter of moon is the angle subtended at a point on earth by two diametrically opposite ends of the moon. Its value is 0.5°.

5 Marks

3. Given, Radius of olive oil, r = 0.25 mm = 0.025 cm
Radius of circular film, R = 10 cm and Molecular size, t = ?
We know that,
$t = \frac{Volume\ of\ oil\ drop}{Area\ of\ film} = \frac{\frac{4}{3}\pi r^3}{\pi R^2}$
$t = \frac{\frac{4}{3}\times\pi\times 0.025^3}{\pi(10)^2}$
$= \frac{4}{3}\times(25)^3\times 10^{-11}$
$= 2.08\times 10^{-7} cm$
Thus, the molecular size of olive oil is $2.08\times 10^{-7} cm$
4. Given, Mass of the Sun $=2.0\times 10^{30} kg$
Radius of the Sun $=7.0\times 10^{8} m$
Density of the Sun = $\frac{Mass\ of\ the\ Sun\ (M)}{Volume\ of\ the\ Sun\ (S)}$
$\left[\because \text{Density} = \frac{Mass}{Volume}\right]$
$\rho = \frac{M}{\frac{4}{3}\pi R^3} = \frac{3}{4}\frac{M}{\pi R^3}$
$= \frac{3\times 2.0\times 10^{30}}{4\times 3.14\times(7.0\times 10^8)^3}$
$= \frac{3\times 10^{30}}{6.28\times 343\times 10^{24}}$
$= 1.392\times 10^3$
$\rho \approx 1.4\times 10^3 kg/m^3$
This density is the order of density of solids and liquids and not of gases.
The temperature of inner core of the sun is 10^7 K while the temperature of the outer layers is nearly 6000 K. At so high temperature, no matter can be exist in its solid or liquid state.
Every matter is highly ionised and present as a mixture of nucleus, free electr4onbs and ions which is called plasma. The density of plasma is so high due to inward gravitational attraction on outer layers due o inner layers of the sun.

3 Marks

5. Mean absolute error$= \frac{\sum|\triangle T_i|}{n}$
$\triangle\overline{T} = \frac{0.01+0.06+0.20+0.09+0.18}{5}$
$= \frac{0.54}{5} = 0.108s = 0.11s$
6. The number of significant figures in the given quantities are given below.
(i) In 0.007, the number of significant figures is 1 because in a number less than 1, the zero's on the right of the decimal point but to the left of the first non-zero digit are not significant.
(ii) In 2.64 × 10^{24} kg, the number of significant figures is 3 because all non-zero digits are significant, power of 10 are not taken in significant figure.
(iii) In 0.2370, the number of significant figures is 4, as all non-zero digits left to decimal and trailing zero are significant.
(iv) In 6.320, the number of significant figures is 4, as all non-zero digits left to decimal and trailing zero are significant.
(v) In 6.032, the number of significant figures is 4, as all non-zero digits left to decimal and trailing zero are significant.
(vi) In 0.0006032, the number of significant figures is 4, because in a number less than 1, the zero's on the right of the decimal point but to the left of the first non-zero digit are not significant.
7. Equivalent resistance,
$R = R_1 + R_2$
$= (100\pm 3) + (200\pm 4)$
$= (100 + 200)\pm(3 + 4)$
$= (300\pm 7)\Omega$.

2 Marks

8. Five
9. True, because human heart beats at a regular rate.
10. Weight of diamond = 5.42 g = 0.00542 Kg
    Total weight = 1.2 + 0.00542
    = 1.20542 kg = 1.2 kg
11. Given, Area of object = 1.75 x 10^{-4} m^2
    Area of image = 1.55 m^2
    Areal magnification = $\frac{Area\ of\ image}{Area\ of\ object}$
    $\frac{1.55}{1.74X10^{-4}} \approx 8857$
    Linear magnification = $\sqrt{\text{A real maginification}}$
    $= \sqrt{8857}$
    = 94.1
12. The relation is written by the boy
    $m = \frac{m_0}{(1-\nu^2)^{1/2}}$
    According to the principle of homogeneity of dimensions, the dimensions on either side of a relation must be same i.e., the powers of M, L, T on either side of a relation must be same.
    Dimension of m is equal to the dimension of m_0, therefore, the denominator $(1-\nu^2)^{1/2}$ should be dimensionless. In denominator 1 is dimensionless but factor $\nu^2$is not dimensionless.
    To make it dimensionless, we have to divide it by the same physical quantity with same power, therefore, it should be ν^2/c^2, to become dimensionless.
    Hence, the correct relation should be $m = \frac{m_0}{(1-\frac{\nu^2}{c^2})^{1/2}}$

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