Unit 1 · Physical Quantities

WORKSHEET

Full marks 35

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 35

1 Key words [4]

Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

accuracy	candela	derived	fundamental	homogeneity	kelvin	mole
physical quantity	precision	uncertainty				

Anything in nature that can be measured is a _____. Mass, length and time are _____ quantities; velocity and force, which are made from them, are _____ quantities. The SI unit of amount of substance is the _____, and the SI unit of luminous intensity is the _____. How close a measurement comes to the true value is its _____; how close repeated readings come to one another is its _____. The rule that every term of a correct equation has the same dimensions is the principle of _____.

2 True or false [3]

Write ✓ for a true statement and ✗ for a false one. Correct the false ones.

i. The number 0.00340 has three significant figures. ☐

ii. A light year is a unit of time. ☐

iii. Impulse and momentum have different dimensions. ☐

iv. Strain has no dimensions. ☐

v. Taking the average of many readings removes the error of a scale that always reads 2 kg too much. ☐

vi. Dimensional analysis can't give the 2π in the period of a simple pendulum. ☐

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. The dimensional formula of pressure is: [1]

a. $[M\,L\,T^{-2}]$ **b.** $[M\,L^{-1}\,T^{-2}]$

c. $[M\,L^{2}\,T^{-2}]$ **d.** $[M\,L^{-2}\,T^{-2}]$

ii. Which pair of quantities has the same dimensions? [1]

a. force and momentum **b.** work and torque

c. power and energy **d.** velocity and acceleration

iii. 6.4350 rounded off to three significant figures, by the rules of this unit, is: [1]

a. 6.43 **b.** 6.44

c. 6.435 **d.** 6.4

iv. A table top is measured as 2.5 m by 1.25 m. Its area, written to the right number of significant figures, is: **[1]**

a. 3.125 m^2 **b.** 3.13 m^2

c. 3.1 m^2 **d.** 3 m^2

v. The radius of a circle is measured with an uncertainty of 1%. The uncertainty in its area is: **[1]**

a. 0.5% **b.** 1%

c. 2% **d.** 4%

4 Short answers **[9]**

Write short answers to the following questions.

a. Prapti's kitchen balance reads to 0.1 g. She weighs a coin and writes its mass as 5.2 g; her brother Sujan, using the same balance, writes 5.20 g. Who has written it correctly? Give a reason. **[2]**

b. Write any two limitations of dimensional analysis. **[2]**

c. Since 2019 every SI base unit is defined by fixing the value of a constant of nature. Why is this better than keeping one metal object as the standard, as was done for the kilogram until then? **[2]**

d. The gravitational constant is $G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}. Using its dimensional formula, [M^{-1} L^3 T^{-2}], express it in CGS units (dyn cm^2 g^{-2}). **[3]**

5 Long answer [4]

Write a long answer to the following question.

The speed v of waves on deep water is thought to depend on their wavelength λ, the density ρ of the water and the acceleration due to gravity g. Use the method of dimensions to find how v depends on them. What does your answer say about waves on a liquid denser than water?

6 Numerical problems [7]

Solve the following problems. Show your working.

a. A wooden block has a mass of (25.0 ± 0.1) g. Its sides are (2.00 ± 0.01) cm, (2.50 ± 0.01) cm and (2.00 ± 0.01) cm. Find its density with its uncertainty, and the percentage uncertainty. [4]

Answer:

b. Sushant times 20 full swings of a pendulum with a stopwatch: 36.4 s. His reaction makes each reading uncertain by about 0.2 s. Find the period with its uncertainty. What would the percentage uncertainty have been if he had timed a single swing? [3]

Answer:

7 Think [3]

The Mars Climate Orbiter was lost because one team's software gave the thrusters' push in pound-force seconds while the other read the numbers as newton seconds. Would checking the dimensions of the equations in the software have caught this mistake? Explain.

8 Activity: The thickness of a coin (not marked)

You need: twenty coins of the same kind and a ruler marked in millimeters. Measure the height of a stack of 1, 5, 10 and 20 coins, then work out the thickness of one coin each time. A ruler can be read to about 0.5 mm.

Coins in the stack	Height of the stack (mm)	Thickness of one coin (mm)	Uncertainty in one coin (mm)
1			± 0.5
5			
10			
20			

Which stack gives the most precise thickness of one coin? Why?