

Name: _____ Date: _____

Answer Key: When Decimals Drift: A 9th Grade Measurement Integrity Quiz

Navigate 10 demanding scenarios involving dimensional analysis and uncertainty to ensure structural integrity in engineering and laboratory research.

1. An aerospace engineer calculates the tolerance of a turbine blade. If the measurement is 15.050 mm, how many significant figures are present, and what does the final zero imply regarding the instrument used?

Answer: B) 5 significant figures; the instrument has precision to the thousandths place.

Trailing zeros to the right of the decimal point are significant and indicate the precision of the measuring device; in this case, the thousandths place.

2. Using dimensional analysis, a chemist must convert a reaction rate of 5.0 micrograms per millisecond ($\mu\text{g}/\text{ms}$) into kilograms per second (kg/s). The final value is:

Answer: B) $5.0 \times 10^{-6} \text{ kg/s}$

$(5.0 \mu\text{g} / 1 \text{ ms}) * (1 \text{ g} / 10^6 \mu\text{g}) * (1 \text{ kg} / 10^3 \text{ g}) * (10^3 \text{ ms} / 1 \text{ s})$ results in 0.005 kg/s or $5.0 \times 10^{-6} \text{ kg/s}$.

3. In a high-precision lab, a series of measurements that are highly clustered together but far from the theoretical 'true' value are considered to have high accuracy but low precision.

Answer: B) False

This describes high precision (consistency) but low accuracy (proximity to the true value).

4. In the derivation of derived units, which of the following correctly expresses the SI derived unit for Force (Newton) in terms of SI base units?

Answer: C) $\text{kg} \cdot \text{m} / \text{s}^2$

Force = mass (kg) times acceleration (m/s^2), resulting in the derived unit $\text{kg}\cdot\text{m}/\text{s}^2$.

5. A thermal scientist measures a change in temperature as 25.0 degrees Celsius. To utilize this in an ideal gas law equation requiring SI base units, the value must be converted to:

Answer: A) 298.15 Kelvin

Name: _____ Date: _____

The SI base unit for temperature is Kelvin. To convert Celsius to Kelvin, you add 273.15 to the Celsius value.

6. While calibrating a pipette, a technician finds it consistently delivers 0.02 mL more liquid than intended. This is an example of what type of error, and how should it be addressed?

Answer: B) Systematic error; it should be corrected by recalibrating the equipment offset.

A consistent, predictable deviation in one direction is a systematic error, usually caused by faulty equipment calibration.

7. The 'mole' is an SI base unit used to measure the luminous intensity of a chemical substance.

Answer: B) False

The mole measures the amount of substance (count of particles); candela measures luminous intensity.

8. A cube has a side length of 2.0 cm. When calculating the volume in cubic meters (m^3) for an introductory physics report, which conversion factor sequence is required?

Answer: D) Multiply by $(1\text{ m} / 100\text{ cm})^3$

To convert units of volume, the linear conversion factor must be cubed to account for all three dimensions.

9. When multiplying 3.22 m by 2.1 m, the product displayed on a calculator is 6.762. Following the rules of scientific measurement and significant figures, the final answer should be recorded as:

Answer: B) 6.8 m^2

In multiplication, the result must have the same number of significant figures as the measurement with the fewest (2.1 has two sig figs).

10. In the SI system, the kilogram is unique because it is the only base unit defined by a physical artifact rather than a fundamental physical constant.

Answer: B) False

As of 2019, the kilogram was redefined based on the Planck constant, removing the reliance on a physical prototype (Le Grand K).