Name: _____ **Date:** _____

Answer Key: Cosmic Scales and Nano-Nudges: 7th Grade Measurement Mastery

Can you bridge the gap between microscopic precision and galactic distances? Apply dimensional analysis and SI derivation to solve complex engineering puzzles.

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1. An aerospace engineer is calculating the 'Specific Impulse' of a new rocket engine, which is measured in seconds. If the engine fires for 0.05 kiloseconds, how many minutes has it been active?

Answer: A) 0.833 minutes

0.05 kiloseconds is 50 seconds (0.05 * 1000). To find minutes, divide by 60: 50/60 = 0.833 minutes.

2. A scientist uses a laser to measure a tectonic shift of 14 micrometers. To report this in the SI base unit for length using scientific notation, the value would be _____.

Answer: A) 1.4 x 10^-5 meters

One micrometer is 10^-6 meters. Therefore, 14 micrometers is 14 x 10^-6, which in standard scientific notation is 1.4 x 10^-5 meters.

3. In the SI system, the 'Newton' is considered a base unit because it measures the fundamental property of force.

Answer: B) False

False. The Newton is a derived unit ($kg \cdot m/s^2$). There are only seven base units; force is derived from mass, length, and time.

4. You are calibrating a digital pipette that consistently measures a 5.00 mL sample as 4.21 mL, 4.22 mL, and 4.21 mL. How would you characterize these measurements?

Answer: D) Low accuracy and high precision

The values are very close to each other (high precision) but far from the intended 5.00 mL target (low accuracy).

5. A theoretical physicist is working with a temperature of 20 millikelvins. What is this temperature expressed in the base unit Kelvin (K)?

Answer: B) 0.02 K

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The prefix 'milli' denotes one-thousandth (10^-3). 20 / 1000 = 0.02 K.

6. Which of the following measurements is the most precise based on the significant figures provided?

Answer: B) 45.008 kg

Precision in measurement is indicated by the number of decimal places or significant figures. 45.008 kg measures to the nearest thousandth of a unit.

7. When converting 50 gigahertz (GHz) to megahertz (MHz), the numerical value of the measurement will increase.

Answer: A) True

True. Because a megahertz is a smaller unit than a gigahertz (10^6 vs 10^9), you need more of them to represent the same total frequency.

8. An oceanographer measures the 'Luminous Intensity' of bioluminescent algae. To adhere to SI standards, which unit and tool must they use?

Answer: B) Candela; Photometer

The candela (cd) is the SI base unit for luminous intensity, typically measured using a photometer.

9. If a chemist needs to prepare a solution using 0.25 moles of a substance, and 1 mole equals 1,000 millimoles, how many millimoles are required?

Answer: C) 250 mmol

To convert moles to millimoles, multiply by 1,000. 0.25 * 1000 = 250 mmol.

10. A data center measures energy consumption in 'Kilowatt-hours'. Why is this unit considered 'derived' rather than 'base'?

Answer: B) Because it is calculated using a combination of power (derived) and time (base)

Derived units are created by multiplying or dividing base units or other derived units. Kilowatt-hours combine Watts (J/s) and time.