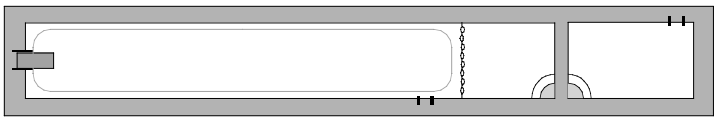
PhyzSpringboard: Accuracy and Precision



ACCURACY AND PRECISION ARE DIFFERENT

1. A gold coin is measured on a very accurate and precise scale to have a mass of 127.96458 grams.
   - A second scale gives a reading of 128 grams. The second scale is **accurate** but not **precise**.
   - A third scale gives a reading of 135.21568 grams. The third scale is **precise** but not **accurate.**
   - A fourth scale gives a reading of 115 grams. The fourth scale is neither **accurate** nor **precise.**

   a. Based on the examples above, what is the scientific meaning of the term **accuracy**?

   b. Based on the examples above, what is the scientific meaning of the term **precision?**

   c. If you could have either accuracy or precision in making measurements—but not both—which would you choose and why?

PRECISION PUZZLEMENT

2. a. Consider these two measurements: 3,100 m and 0.0031 m. Which value—if either— is more precise and why?

   b. Which of these two values—if either—is more precise: ___ 3.1×10^{3} m or ___ 3.1×10^{-3} m ?

   c. Which of these two values—if either—is more precise: ___ 0.031 m or ___ 3.1 cm ?

   d. Rank the following measurements from most precise (1) to least precise (6).

   _____i. 9.23 cm _____ii. 0.36 A _____iii. 3,572 g

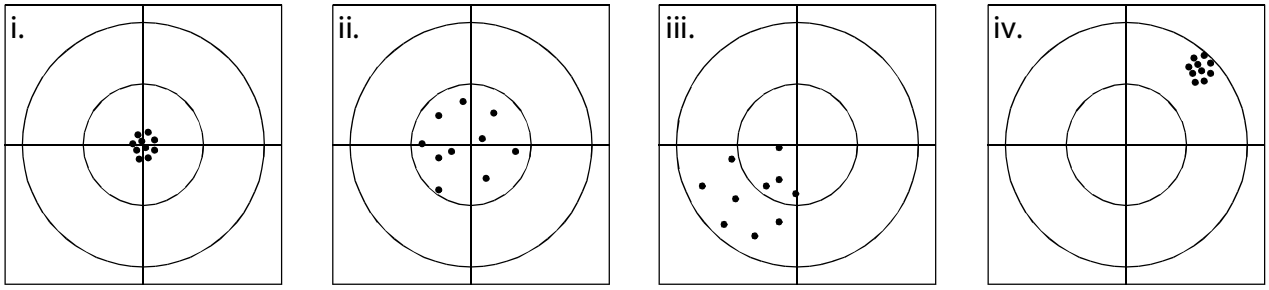
   _____iv. 0.00001 s _____v. 569,432,000 eV _____vi. 87,629,000,000 V

   e. What is the **misconception** held by someone who thinks 0.001 m is a more precise value than 12 m ?

RANDOM VS. SYSTEMATIC ERROR

2. Consider the target-shooting results shown below. The objective is to hit the center of the target each time. Ten shots were fired through each target. Error prevents the shooter from hitting the target at its center each time. Two types of error affect the results: **random** and **systematic**.

a. Match the correct title to each diagram: Mostly Random Error, Mostly Systematic Error, Random and Systematic Error, Minimal Error.



b. Distinguish between **random** and **systematic** error.

c. Under what conditions can an error-free measurement be made?

3. Consider the odometers of four cars. Car Alpha is a vehicle engineered by the Bureau of Weights and Standards to be precise and accurate; it is free of systematic and random error. Cars Gamma, Lambda, and Theta were recently purchased from Crazy Eddie's Used Car Emporium. Their odometer readings are compared to the readings of Car Alpha as all cars run a 6.0 mile course. The data is listed below.

Car Alpha	1.0	2.0	3.0	4.0	5.0	6.0
Car Gamma	0.9	1.8	2.7	3.6	4.5	5.4
Car Lambda	1.2	2.0	2.7	3.9	5.3	6.1
Car Theta	1.1	2.4	3.6	4.7	6.2	7.5

Diagnose the type of error or errors—random or systematic—that each car (other than Car Alpha) suffers from.