Name _____

Period _____

Experimental "Error" Analysis Exercises

You can tell what kind of uncertainty you have based on repeated measurements. If every time you measure it always comes out too big or always too small, it's called "systematic error". If measurements fluctuate inconsistently (sometimes too big, sometimes too small, even though it's measured the same way) it's called "random error".

Read each example of measurement below. In each case, answer these:
(1) Why are the measurements coming out different from the "true" value?
(2) Were the measurements consistently too big, too small, or inconsistent?
(3) What kind of uncertainty is this, systematic or random?
(4) If you were to repeat the measurement, what could you do that would eliminate the uncertainties you noticed?

1. Mustang Ride

Driving your 1970 Ford Mustang, you ask your friend in the passenger seat to check your gas gauge. It's the old-fashioned dial type. He sees the dial line up with the ¼-full line. You see it as almost empty.

(1)_____
_____
(2)_____
(3)_____
(4)_____
_____
_____

2. How Tall You Are

You want to measure your height, but you only have a tape measure that has a bit broken off from the front of it. You make the measurement anyway. Standing against the wall, you measure a height of 5' 3".

(1)_____
_____
(2)_____

(3)_____
(4)_____
_____
_____

3. Speedy Sprinter

You're helping your friend time his 100 meter dash. You watch him with your stopwatch from the stands as he prepares his run on the track. He yells for you to start just as he takes off running. You start the timer when you hear him. Since you can see him cross the finish line, you just stop the timer when he gets there. For some reason, his times don't match what the coach is telling him.

(1)_____
_____
(2)_____
(3)_____
(4)_____
_____
_____

4. Spinning UFO

Watching a rotating carnival ride that looks like a UFO, you get curious about RPM's (revolutions per minute). To figure out how many RPM's you're going through on the ride, you decide to time ten rotations then just divide the rotations by the time, so you take out your stopwatch and start the timer when you count "one" then stop the timer when you count "ten". Do you get a larger or smaller number for the RPM measurement?

(1)_____
_____
(2)_____
(3)_____
(4)_____
_____
_____

5. Do The Measurement Dance

Timing ten revolutions of the UFO ride, after about four of the revolutions you've got a song going in your head roughly matching the rhythm. Having become hypnotized by the groove you're feeling, you put your arms up around the fifth or sixth revolution and can't resist closing

your eyes as you dance through the eighth, ninth, and tenth counts. Your eyes are still closed as you stop the timer when your rhythm count hits “ten”.

(1)_____
_____
(2)_____
(3)_____
(4)_____
_____
_____

6. You Are Getting Very Sleepy

As Professor Freud attempts to hypnotize you by rigidly attaching the chain of his watch to the ceiling and letting it swing back and forth in front of your eyes, you decide to measure the time of each oscillation instead. Holding your own stopwatch behind your back, therefore, you start the timer exactly when you see the watch at its rightmost position, just as it reverses direction. You confirm this by noting that the watch lines up with a mark on the wall in your vision at that precise point. You stop the timer when the swinging watch returns to that position, passing the same mark. Every time you do this, you get a slightly different number, even though you have been as careful as possible.

(1)_____
_____
(2)_____
(3)_____
(4)_____
_____
_____