QUIZ 06: WORK AND ENERGY

Trial	Release Height h (cm)	Horizontal Distance		
		x_1 (cm)	x_2 (cm)	x_3 (cm)
A	4.2	119.0	116.5	115.5
B	6.7	202.0	200.5	200.0
C	8.9	277.5	277.0	274.0
D	10.7	337.3	329.5	320.8
E	12.6	377.5	374.4	370.5
F	13.6	415.7	409.6	403.0

The data on the right were collected using the same methods as in lab.

1. For **Trial A** shown on the table shown, calculate the **average distance.** $x_A = 117.0$cm
2. Find the **standard deviation** in the distance. $\sigma_A = \pm 1.5–1.8$cm
3. Points **A** and **D** are *exactly* on the best fit line. Using the average distances, calculate the **slope** of the graph (slope = rise/run, or $\mu = \Delta h/\Delta x$). $\mu = 0.0306$
4. Determine the intercept of this graph ($h = \mu x + b$, or $b = h - \mu x$). b= 0.57–0.62
5. If the intercept of this particular graph is **positive**, it is most likely the result of
   A) random error. As your own graph shows, the data are very scattered. There is so much random error that it would be easily possible to draw a best fit line that intersects the origin.
   B) random error. The data all fit closely to the line, but the entire line should be shifted. What makes it random is that you do not know in advance if it needs to be shifted up or down.
   C) systematic error. The release height has been systematically measured too large, possibly as a result of measuring height with respect to the floor instead of with respect to the carpet where the ball actually lands.
   D) systematic error. The horizontal distance has been systematically measured too large. This would happen if the distance was measured by "flossing" the ball on the side away from the ramp.
6. Would is even be possible to get results with a **negative** intercept?
   A) No. The intercept will either be positive or zero.
   B) Sure. We intentionally introduced a systematic error into our measurement of x, by under-measuring the position. If we had instead chosen to over-measure x, the intercept would be shifted to the negative.
7. If you managed to measure all values of the release heights and horizontal distances *very* accurately, with no systematic measurement error, your graph should have an intercept
   A) of zero. Zero release height should naturally mean zero horizontal distance.
   B) that is positive. The assumption that all of the initial potential energy is converted to kinetic energy is flawed, because some of the initial potential energy is lost to friction on the ramp. This makes all of the horizontal distances shorter than they should be, because the ball had less kinetic energy than your equation predicts.
   C) that is negative. All that business in B) about losing energy on the ramp is correct, but the result would be that the ball would travel a *greater* horizontal distance than your equation predicts.
8. If you graphed your data and *did* get an intercept of exactly zero, it would mean
   A) that you performed the experiment flawlessly. There are no random errors, there are no systematic errors.
   B) that there is substantial random error affecting your line. You may need to collect more data (is your correlation coefficient a lot less than 1.00?).
   C) that you have more than one systematic error affecting your results. If the effect of random error has been minimized (correlation coefficient very close to 1.00), then you may be seeing a combination of systematic measuring error (h too small or x too large) with missing physics (energy loss on ramp).
   D) either B or C is possible, but our data show that C is more likely. Since the real data fit very close to the line, this indicates that it is possible (and actually pretty easy) to minimize the effect of random error.
9. The amount of force applied to the ball by the carpet depends on the release height: the higher the ball is at release, the greater the force of friction acting to stop it rolling: FALSE
10. The amount of work done on the ball by the carpet to stop the bowling ball rolling is the same for each release height: FALSE
11. The ball actually lost no energy; the gravitational PE was converted to KE, then the KE was converted into carpet potential. The carpet behaves like a spring, storing energy without any losses: FALSE
12. The slope of your graph was approximately 0.03. A typical coefficient of sliding friction between waxed wood skis and fresh snow is about 0.1. Anything strike you as unusual about this?
    A) No. It would actually be easier to ski across the carpet than on the snow.
    B) Um, yeah. Does this have anything to do, perhaps, with the fact that the ball was rolling and not sliding? Rolling resistance and kinetic friction are not quite the same are they?