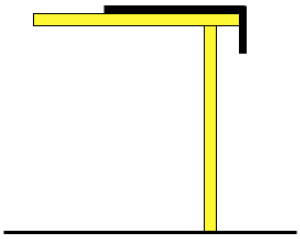
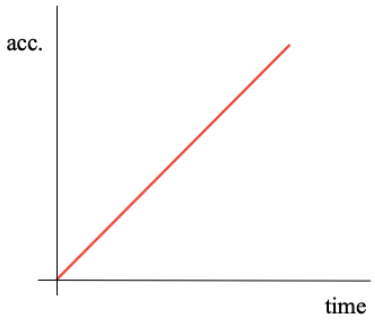
Inspired by “Frensley Physics” Facebook page;



Rope problem: A rope of length L and mass m is placed on a frictionless table so that a quarter of it hangs over the edge. At t = 0, the rope is released and begins to slide off the table. You are asked to graph the acceleration of the hanging end of rope, assuming the rope-end’s initial position is at L/4. Your graph is shown below.



a.) A student, someone who wants to curry favor with you, looks at the graph and notices one thing that is right about it. Explain with justification what that one thing is.

b.) While we are at it, what information were you given that is completely useless, given your task? Explain.

c.) A second less obsequious student looks at the graph and finds two things wrong with it. Identify (with justification) what those two are.

d.) The situation changes some. Now the rope starts with just a tiny bit of its length hanging over the tabletop. It is released from rest and allowed to fall. Once the last bit of it has left the table, it's velocity is observed to be "v." Two students attempt to analyze the situation. Their work is shown below. Both are wrong. For both, explain where they went astray.

Approach 1:

--principle: gravitational potential energy transformed into kinetic energy:
--bottom-end changes height by $\Delta y = L$;

$$\frac{1}{2}Mv^2 = MgL$$

$$\Rightarrow v = (2gL)^{1/2}$$

Approach 2:

--Rope's weight = Mg;
--Force acts as rope travels distance L:
--Work = Fd, so work = MgL;
--Work = gain in KE, so $\frac{1}{2}Mv^2 = MgL$

$$\Rightarrow v = (2gL)^{1/2}$$

Approach 1:

Approach 2: