- worksheet: positron.hep.upenn.edu/p8/files/ws12.pdf
- 4 short problems, 1 hands-on activity (watch for open table)
- ch10/part3 video due Monday. (Or skim ch10 book.) Video is online — I will write/post questions tonight.
- Email **in advance** & file a CAR if you need to miss class.
- I'll bring today's hands-on stuff back next Wednesday, for the benefit of people who can't be here today.

$$x_f = x_i + v_{xi} t \qquad y_f = y_i + v_{yi} t - \frac{1}{2} g t^2$$

$$W = \vec{F} \cdot \Delta \vec{r} \qquad U_{\text{spring}} = \frac{1}{2} k \left(L - L_0\right)^2$$

$$F^K = \mu_K F^{\text{normal}}$$

F^{normal} is perpendicular to the surface and is as large as it needs to be to prevent the object from falling through the surface

$$r = \sqrt{x^2 + y^2} \qquad \theta = \arctan[y/x]$$

Physics 8, Fall 2021, Worksheet #12.

Upload PDF (smartphone scan or tablet edit) to Canvas at or shortly after end of class on Mon, Oct 13, 2021.

Problems marked with (*) must include your own drawing or graph representing the problem and at least one complete sentence describing your reasoning.

Discuss each problem with your teammates (usually groups of 3), then write up your own solution. Be sure to compare final results with your teammates, as a way to catch mistakes. It can also be very interesting when you and a teammate use different methods to arrive at a result! Do not hesitate to ask for help from other students, from Melina, or from Bill.

1*. Your goal is to position two chemistry-lab ringstand rings such that your projectile ball passes through both rings (ideally on the first try), based on measurements and calculations you make before launching the ball. Ball launchers will be on tables 1,7 and 2,10, aimed so that balls land on tables 3 and 6, with ringstands in between. Use the spring-loaded ball launcher **on the medium range setting**. For consistent results, pull the yellow string on the release lever **perpendicular** to the axis of the ball launcher. This will release the ball at an initial speed $\boxed{v_i = 5\,\mathrm{m/s}}$, from the point **where the white ball is painted on the side of the launcher**, which you should take to be the origin of your coordinate system. Be careful to use this same $y = 0$ height reference when positioning your hoops. We have fixed the **launch angle at** 37°**,** to make a 3–4–5 triangle: $\cos(37^\circ) = \frac{4}{5}$ and $\sin(37^\circ) = \frac{3}{5}$. That should give you $v_{xi} = 4\,\mathrm{m/s}$ and $v_{yi} = 3\,\mathrm{m/s}$. Write up your calculations (next page is blank); sketch your setup, including relevant dimensions; and demonstrate your results for Bill or Melina. If you like, you can get one extra point if you email a short video clip to Bill and Melina (below $10 \sim 20$ MB please).

2*. A 1.30 kg block on a horizontal tabletop is pushed against the free end of a spring (whose other end is attached to a wall) until the spring is compressed 0.220 m from its relaxed length. The spring constant is $k = 150\ \mathrm{N/m}$, and the coefficient of kinetic friction between block and tabletop is 0.27. When the block is released from being held against the compressed spring, how far does the block travel before coming to rest?

3*. Sam the bartender knows exactly how fast to push a mug of beer so that it comes to a stop in front of Norm at the other end of the bar. On the last round, however, Norm asks for only half a mug. To make the half-filled mug get to Norm, does Sam push it faster than the full mug, more slowly, or at the same speed? Assume that Sam knows the coefficient of kinetic friction between the glass mug and the granite countertop of the bar. Use your knowledge of friction to argue convincingly, using whatever equations or clear statements about physics may be relevant, how the half-full mug's initial speed should compare with the full mug's initial speed.

4. Three forces are exerted on a 2.00 kg block initially at rest on a slippery surface: a 100 N force directed along the x-axis, a 50.0 N force making an angle of 30.0° (counterclockwise) from the x-axis, and a 144 N force making an angle of 190° (counterclockwise) from the x-axis. (These forces are all in the horizontal plane, so gravity is irrelevant.) (a) Draw a diagram of the three forces, indicating their directions. (b) What is the vector sum of the forces acting on the block? (c) What is the work done on the block (by the vector sum of these forces) in 10.0 s? (Part c is tricky, because time is given, not displacement.)

5. The instructions on a scavenger-hunt map indicate that you should first walk 36 meters east, then walk 42 meters south, then walk 25 meters northwest. Let the x axis point east, and let the y axis point north. (a) Write your displacement vector (from start to finish) in Cartesian coordinates (either in (x, y), notation or in $x\hat{\imath} + y\hat{\jmath}$ notation, or in "x east and y north" notation, all of which are equivalent). (b) What is the magnitude of your displacement? (c) What is the compass direction of your displacement vector (write something like "D degrees south of east"). (d) What is your distance traveled? (e) You complete the journey in 100 seconds. What is your average speed? (f) What are the magnitude and compass direction of your average velocity?