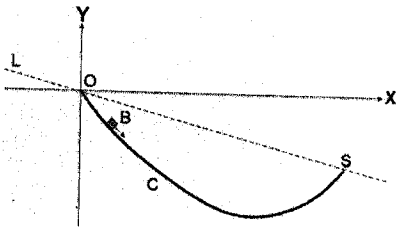
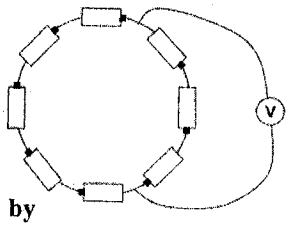
所別：光電科學研究所碩士班　　科目：普通物理

1. (15%) A body *B* is sliding (but not rolling) along the curve *C* as shown. It starts at point *O*, performing an slides with friction coefficient *k*, and stops at point *S*. Show that the slope of the line *L* connecting the points *O* and *S* is equal to *-k*. (Neglecting the centripetal force due to the effects of the curve's curvature.)



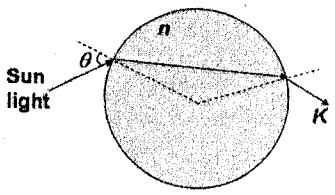
2. (15%) Determine the thickness of a coin having a radius of *R* so that it has a probability of 1/3 to fall on its front "  " side, 1/3 on its back "  " side, and 1/3 on its edge.

3. (5%) Eight identical 1.5V batteries are serially connected into an electrical circuit as shown. What voltage will be read on the voltmeter?



4. (10%) The restoring force of an anharmonic oscillator is given by $F(x) = -ax - bx^2$, derive the potential energy of this oscillator. Explain this potential function possess no symmetry.

5. (18%) Explain and draw the formation of the primary rainbow (虹) and the secondary rainbow (霓) by considering a ray of sun light entering a spherical water drop of refractive index *n* as shown. Can one see a zeroth-order rainbow by looking at rays like *K*? why?



6. (15%) In 1849, Fizeau first measured the speed of ligh ($c=3\times10^8$ m/s) on the ground by mainly using a gear wheel (齒輪). If you were him, how will you complete this experiment with a gear wheel? You can use any other tool which you can find in the 19th century.

7. (12%) The farthest distance your naked eyes can clearly see an object is 100 cm. What kind of glasses (lens type and focal length) you could wear?

8. (10%) Estimate the shortest wavelength radiated from an *x*-ray tube (as shown) whose accelerating voltage is as high as 100kV. (Plank constant $h = 6.626\times10^{-34}$ J-s, electron charge $e = 1.6\times10^{-19}$ C)