Assignment 1 Read Unit 1 Chapters 1 thru 4. Ex. 1.3.1-2 and 1.4.2 are due Tuesday Sept. 1

Exercise 1.3.1a Plot a \((V_{SUV-1}, V_{SUV-2})=(60,10)\) collision diagram but with an identical mass \(M=4\) SUV replacing the VW. Draw energy ellipses as precisely as possible. Compare to tensor algebraic solutions where you calculate the elastic kinetic energy \(KE\), the totally inelastic kinetic energy \(IE\), and ellipse radii \((a_{KE}, b_{KE}, a_{IE}, b_{IE})\).
(Try to do geometric construction before peeking at answers in Fig. 3.1. Then use tensor bookkeeping to check.)

Exercise 1.3.1b Now do the same problem with a head-on initial velocity vector \((V_{SUV-1}, V_{SUV-2})=(60,-10)\).

Assignment 0 Optional geometry exercises with some later applications

Learn how to ruler & compass construct \(\arctan(y/x)\) and \(\text{arcsec}(r/x)\) and complimentary \(\arccot(x/y)\) and \(\text{arcsec}(r/y)\) and geometric mean \(\sqrt{a \cdot b}\) in Fig. 1.8 (3\(^{rd}\) frame). Use this to construct \(\sqrt{5}\) and the Golden Means \(G^\pm = (1 \pm \sqrt{5})/2\).
(G\(^+\) satisfy \(G^+ + G^- = 1\) and \(G^+ \cdot G^- = -1\). \(G^\pm\) are important because they are the “most irrational” numbers.)

Exercise 1.1.4
Construct both Golden angles associated with the Golden Ratios \(G^+\) and \(G^-\) and measure their slopes in degrees on protractor graph paper below. Show a simpler (Pythagorean) construction of \(\sqrt{5}\)?

Exercise 1.1.5
Construct whirling rectangle diagram like Fig. Fig. 1.5 but for Golden slope angle to give whirling square sketched in Fig. 1.10. Use a protractor graph (Below or in class library) to measure (°)angles of slopes obtained this way.
Assignments for Physics 5103 - Reading in Classical Mechanics with a BANG!
Exercise 1.3.2. Ch. 1-5 contain geometric description of 1D-2-body collisions. Most examples originate from initial velocity vectors \( \mathbf{V}_{1,1}^\text{IN} = (1, -1) \) for which \( m_1 \) and \( m_2 \) have equal speeds (in this case \( \pm \)unit speeds).

This exercise is intended to help match algebra and geometry by asking for the simplest formulas (in terms of \( m_1 \) and \( m_2 \)) for the various velocities in a figure above that are final elastic results of the following IN-velocity vectors. (Give answers in terms of \( m_1 \) and \( m_2 \) by evaluating speeds \( v, V, \) etc., whichever apply.)

a. \( \mathbf{V}_{1,1}^\text{IN} = (1, -1) \)  
b. \( \mathbf{V}_{v,0}^\text{IN} = (v, 0) \)  
c. \( \mathbf{V}_{0,V}^\text{IN} = (0, V) \)  
d. \( \mathbf{V}_{COM}^\text{FIN} = (V_x^{COM}, V_y^{COM}) \)

Derive the IN and FIN vector components of all in terms of masses \( m_1 \) and \( m_2 \) only assuming the same total KE as \( \mathbf{V}_{1,1}^\text{IN} = (1, -1) \) has. (Check results on figure where ratio \( 2 = m_1/m_2 \) holds. Do formulas depend on mass ratio only?)

Indicate where the time reversed vector \( \mathbf{T} \cdot \mathbf{V}^\text{IN} \) of each \( \mathbf{V}^\text{IN} \) lies.

Give a formula for the orange (dashed) and green (solid) tangent line slopes in terms of \( m_1 \) and \( m_2 \).

…and compare to slope of the black line connecting major and minor radii in terms of \( m_1 \) and \( m_2 \).

Exercise 1.4.2: Continue the \( (v_1, v_2) \) and \( (x_1, x_2) \) collision plots begun in class and shown in Fig. 4.7 and Fig. 4.11. Continue until you reach the “gameover” point of last possible \( M_1-M_2 \) collision assuming the floor is open after Bang-1 so both masses can fall thru indefinitely. Indicate where on your graph would be this last last collision.