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 $(V_{SUV\text{-}1},V_{SUV\text{-}2})=(60,10)$ 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 $(V_{SUV\text{-}1},V_{SUV\text{-}2})=(60,-10)$.

Assignment 0 Optional geometry exercises with some later applications

Learn how to ruler & compass construct arctan*(y/x)* and arcsec*(r/x)* and complimentary arcot*(x/y)* and arcsec*(r/y)* and geometric mean $\sqrt{a \cdot b}$ in Fig. 1.8 (3rd frame). Use this to construct √*5* and the *Golden Means* $G^{\pm} = (1 \pm \sqrt{5})/2$.

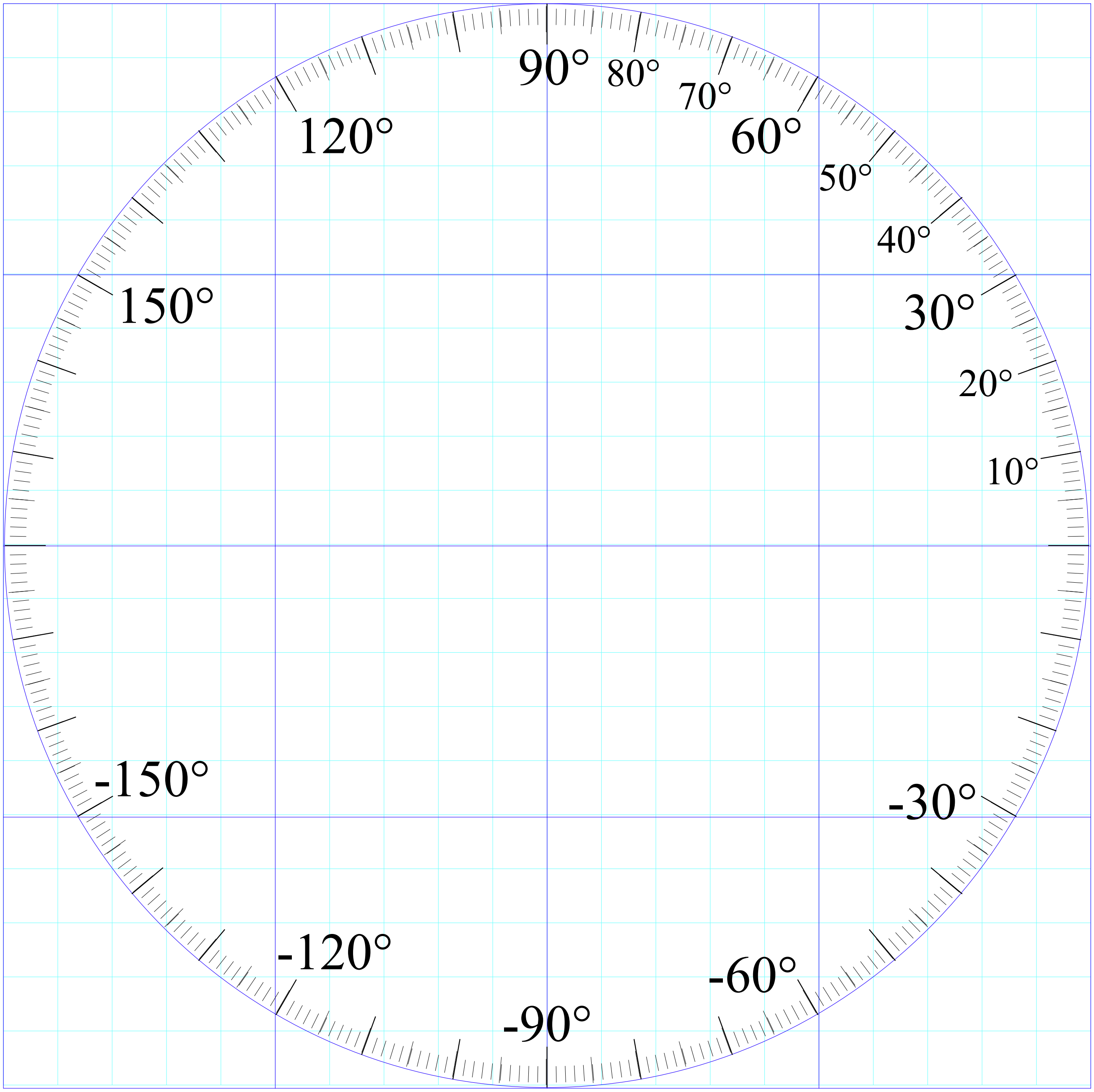
($G^{\pm}$ satisfy $G^{+} + G^{-} = 1$ and $G^{+} \cdot G^{-} = -1$. $G^{\pm}$ are important because they are the "most irrational" numbers.)

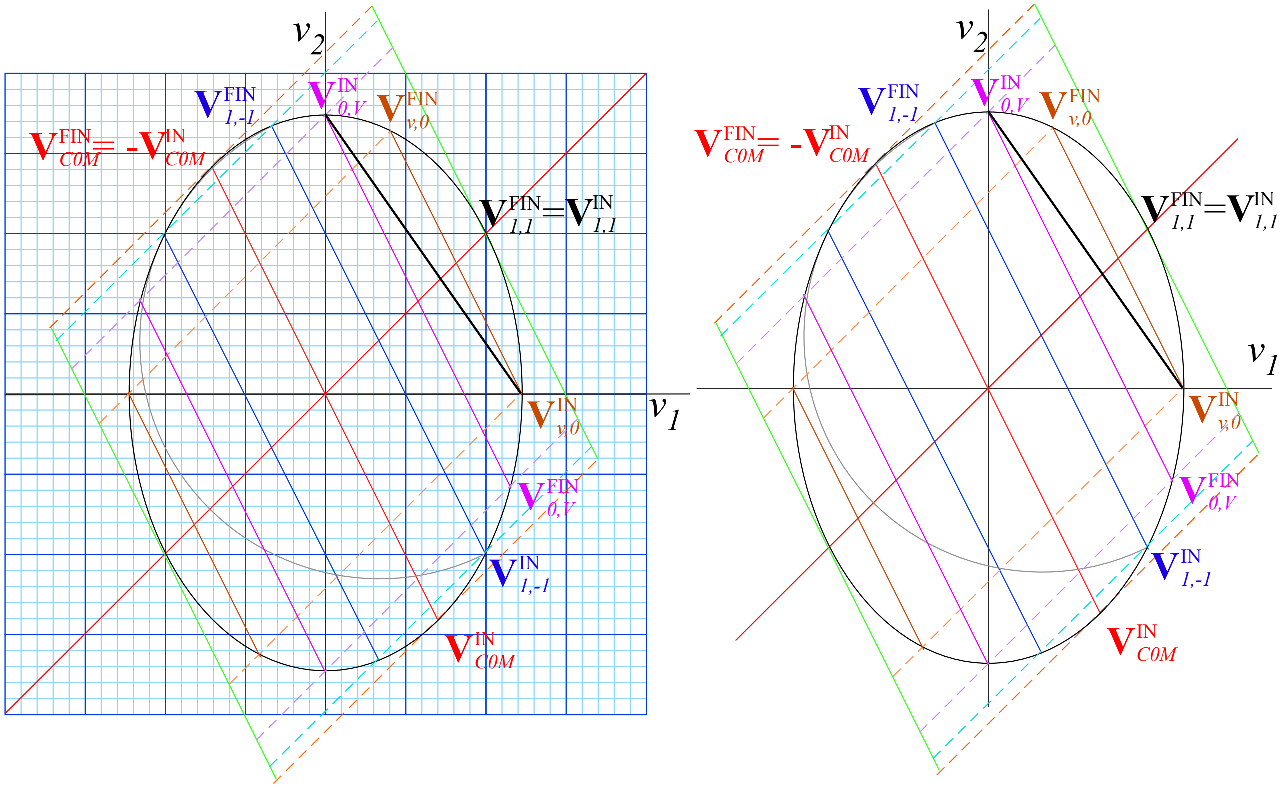
Exercise 1.1.4

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 √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.


90°
80°
70°
60°
50°
40°
30°
20°
10°
120°
150°
-150°
-120°
-90°
-60°
-30°



Exercise 1.3.2. Ch. 1-5 contain geometric description of 1D-2-body collisions. Most examples originate from initial velocity vectors $\mathbf{V}^{IN}_{1,-1} = (1,-1)$ for which m_1 and m_2 have equal speeds (in this case ±*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. $\mathbf{V}^{IN}_{1,-1} = (1,-1)$ b. $\mathbf{V}^{IN}_{v,0} = (v,0)$ c. $\mathbf{V}^{IN}_{0,V} = (0,V)$ d. $\mathbf{V}^{IN}_{COM} = (v^{COM}_x, v^{COM}_y)$

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 $\mathbf{V}^{IN}_{1,-1} = (1,-1)$ 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 $\mathbf{T}\cdot\mathbf{V}^{IN}$ of each $\mathbf{V}^{IN}$ 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 <u>last</u> <u>possible</u> 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.