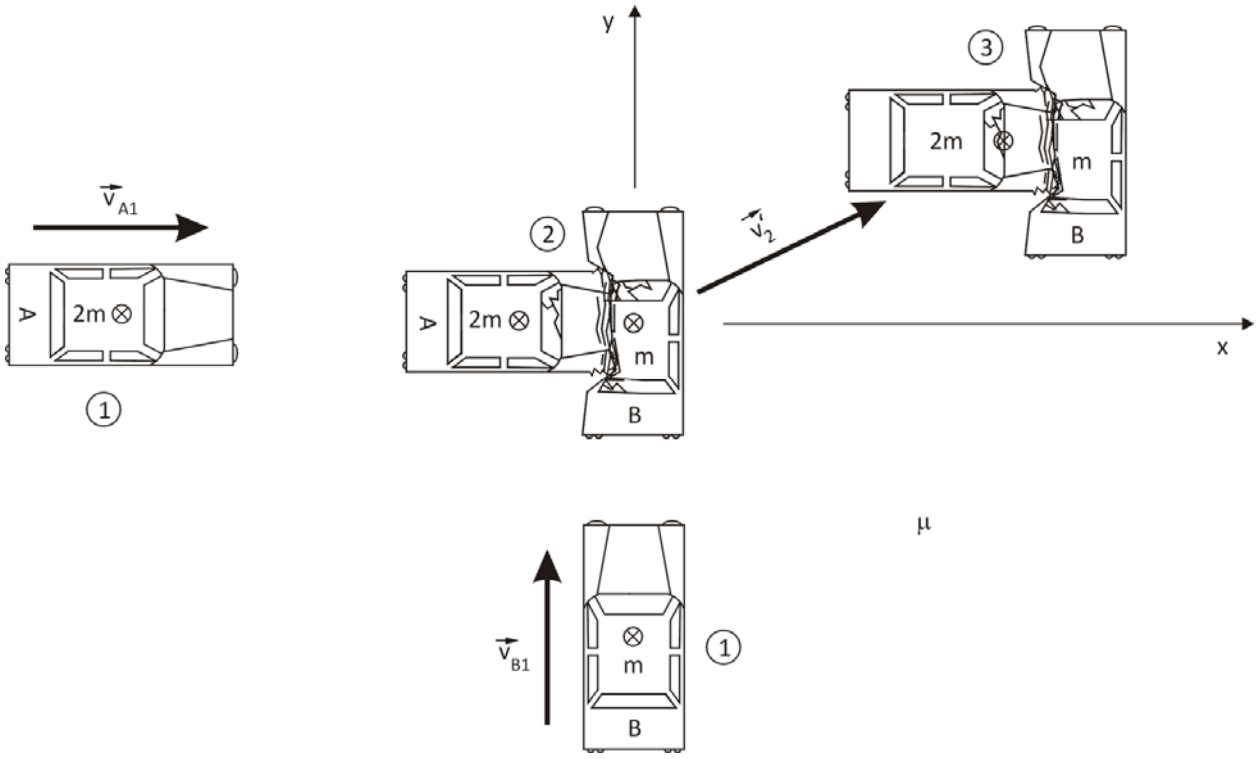
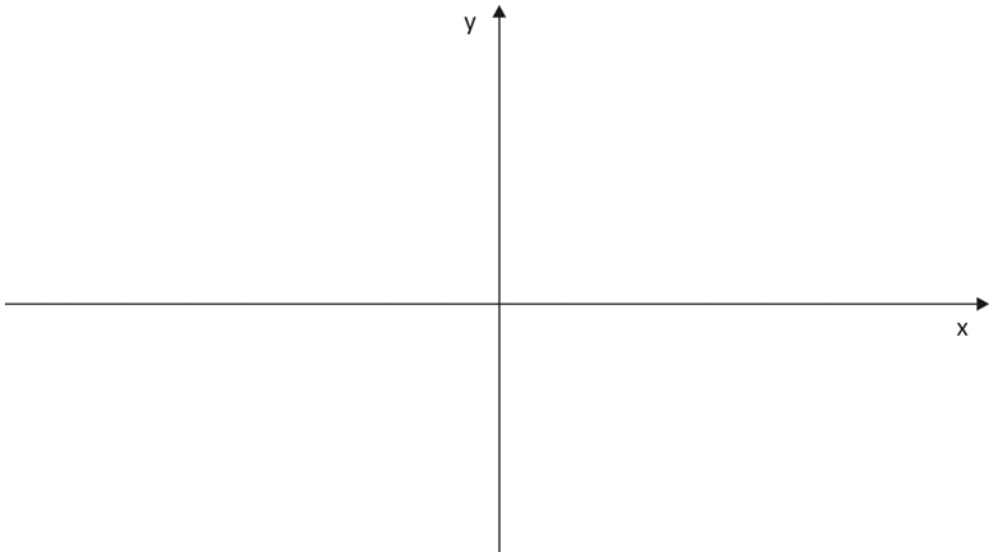
2. (65% of quiz points) The diagram below shows a T-bone car crash with two vehicles traveling the same speed, *v*. Vehicle A, however, weighs twice as much as vehicle B. Car A T-bones car B. There is no pre-crash braking because both drivers were texting. After the crash, both cars stay locked together and slide off to the right and upward with locked wheels until they eventually stop. Both drivers die because they were texting…each other too!



a) Draw a vector diagram of the pre-crash momenta of each vehicle and the total pre-crash momentum on the axes below. Try to be somewhat accurate scalewise.



b. Draw the final momentum vector of the locked-together cars on the diagram.

c. What is the departure angle of the skidding vehicles relative to the +*x*-axis?

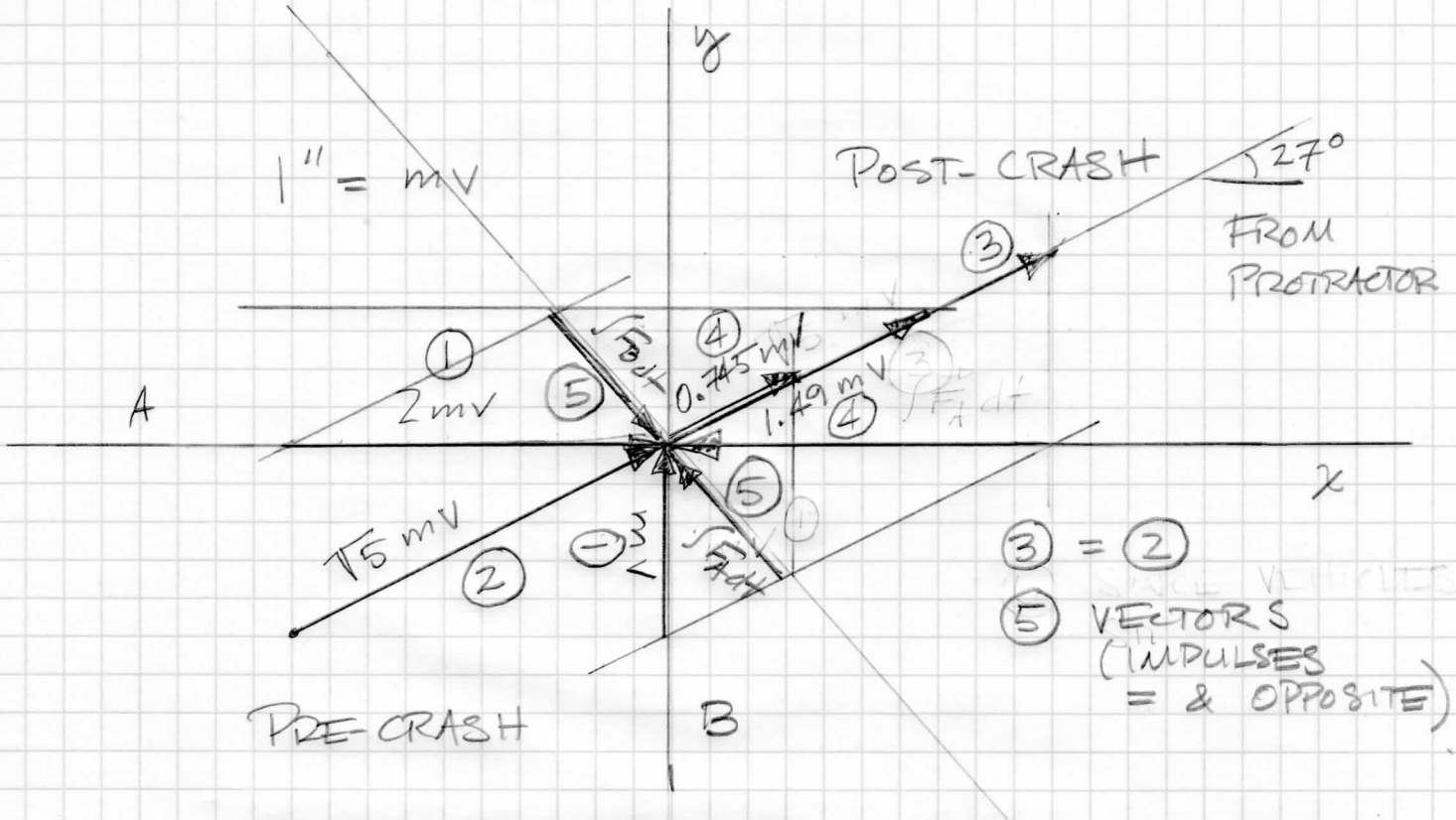
d. What is the coefficient of restitution in the crash? Explain.

e. What is v_2' ?

f. How long are the post-crash skid marks in terms of *v*, *m*, μ, and *g*?

GRAPHICAL SOLUTION FOR 2. ON Q2, W13

$V_A = V_B = V$, $m_A = 2m$, $m_B = m$



(1) DRAW PRE-CRASH MOMENTUM VECTORS

(2) DRAW TOTAL PRE-CRASH MOMENTUM

(3) DRAW TOTAL POST-CRASH MOMENTUM
= TOTAL PRE-CRASH MOMENTUM
IT'S VECTOR SUM OF TWO POST-CRASH MOMENTA (OF EACH VEHICLE)

$3m_4 V'_{2f} = \sqrt{5}\, mv$, $V'_{2f} = \frac{\sqrt{5}}{3} V = 0.745\, V$

(4) $P_{Af} = 2m(0.745)V = 1.49\, mv$

$P_{Bf} = 0.745\, mv$

DRAW THESE 2 POST-CRASH MOMENTA ON DIAGRAM

(5) DRAW IMPULSE VECTORS ← PDOF

$\int F_{cl}\, dt \simeq \frac{7}{8} mV$ @ $L = 131.5°$ FROM +x

(6) SINCE VEHICLES STICK TOGETHER

$$e = 0.$$

(7) $$\Delta V_A = V_{Af} - V_{Ai} = \frac{\int F_A \, dt}{2m} = \frac{(7/8)mV}{2m}$$

$$\Delta V_A = \frac{7}{16} V \quad \angle 131.5°$$

$$\Delta V_B = \frac{\int F_B \, dt}{m} = \frac{7}{8} V \quad \angle -48.5$$

IN THIS CASE PROCEDURE SOMEWHAT CONFUSING AT STEP (4) BECAUSE $e = 0$, I.E. VEHICLES STICK TOGETHER. NEVERTHELESS PROCEDURE IS SAME AS WHEN $e > 0$.