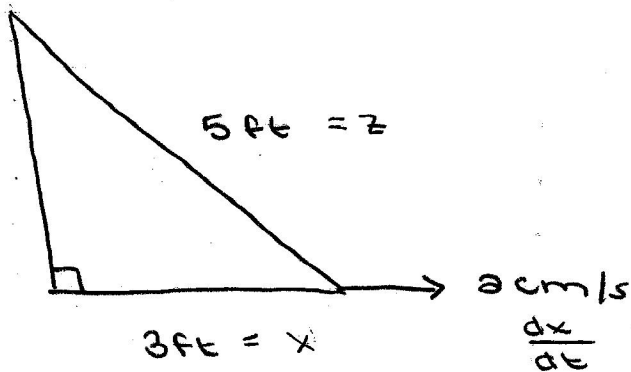## #2 Abby Murrane

Brendyn is 5 ft tall. When she is wearing socks and holds her hands against a wall she slides out at 2cm/s. How fast will Brendyn be falling down the wall when she is 3 ft away from the wall?
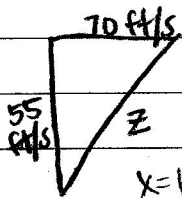

$$x^2 + y^2 = 5^2$$

$$2x\frac{dx}{dt} + 2y\frac{dy}{dt} = 0$$

$$2(3)(2) + 4(2)\frac{dy}{dt} = 0$$

$$\frac{dy}{dt} = -1.5 \ cm/s$$

#2 Lauren Janning

An iron man cyclist is riding east at 70 ft/s. At 2:00 pm, he crossed paths with another cyclist going north at 55 ft/s. How fast is their distance changing 20 seconds later?

$$\frac{dz}{dt} \text{ when } t=20 \qquad x^2+y^2=z^2$$

$$2x\frac{dx}{dt} + 2y\frac{dy}{dt} = 2z\frac{dz}{dt}$$
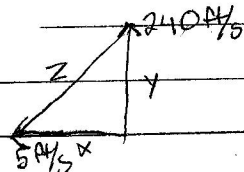
$$x=1400 \quad y=1100 \quad z=1780.45 \qquad 1400(70)+1100(55)=1780.45\frac{dz}{dt}$$

$$\frac{dz}{dt} = 158500/1780.45$$

$$\frac{dz}{dt} = 89.02 \ ft/s$$

#2 Breanna Kroeger

An 80 passenger plane is flying north at 240 ft/s. A bus holding 10 people is travelling west on Lauren Ave. at 5 ft/s. The plane and the bus cross paths at 1:00 pm. How fast is the ground distance between the two changing 15 seconds later?

$$t=15 \qquad \frac{dy}{dt}=240 \ ft/s \qquad \frac{dx}{dt}=5 \ ft/s$$

$$x^2+y^2=z^2 \qquad 2x\frac{dx}{dt} + 2y\frac{dy}{dt} = 2z\frac{dz}{dt}$$

$$x=75 \quad y=3600$$

$$z=60.6 \qquad 5(5)+240(240)=60.6\frac{dz}{dt}$$

$$25+57600 = 60.6\frac{dz}{dt}$$

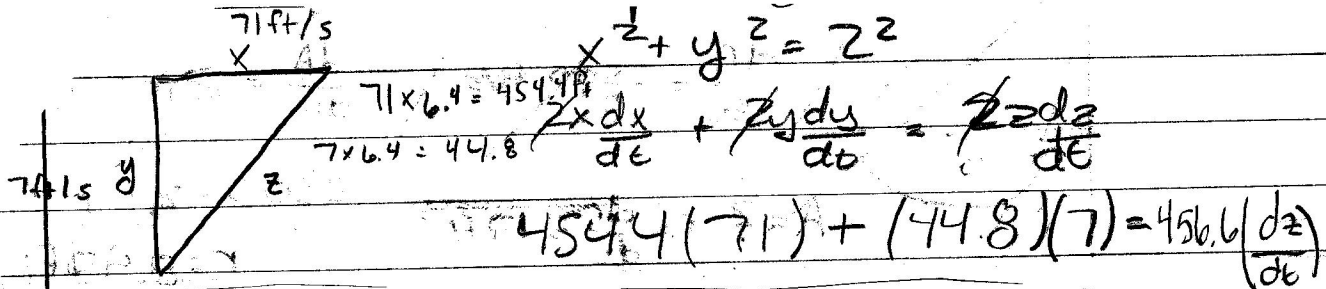$$950.9 \ ft/s = \frac{dz}{dt} \qquad \frac{57625}{60.6} = \frac{dz}{dt}$$

#2 Jessica Cheney

George is late picking up his wife from the airport. He starts driving north from work towards the airport at 45 mph, but at the same time his wife got a ride and is traveling west to their home at 25 mph. At what rate is the distance between the two changing when George is 2 miles from the airport and his wife is 4 miles away from the airport?

$$x^2 + y^2 = z^2$$

$$\frac{dz}{dt} = ? \quad \text{when } y = 2 + x = 4$$

$$x\frac{dx}{dt} + y\frac{dy}{dt} = z\frac{dz}{dt}$$
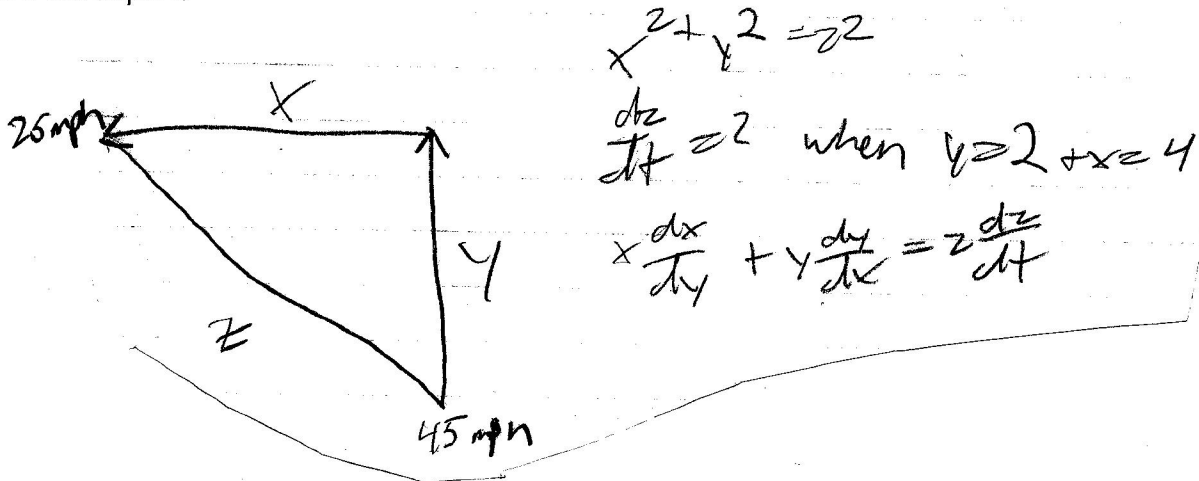
$$\frac{(4)(25) + (2)(45)}{\sqrt{20}} = 42.485 \text{ mph}$$
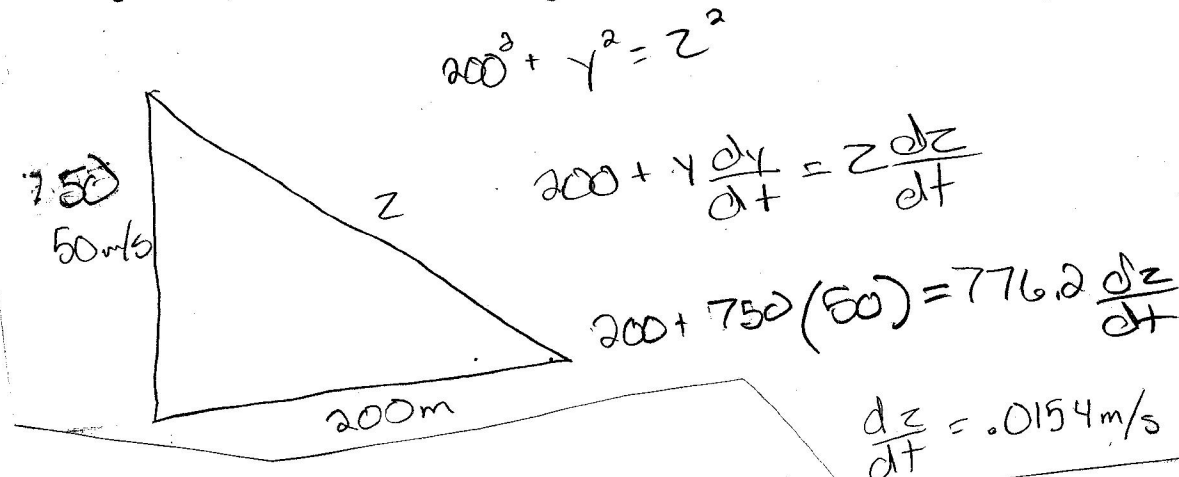
#2 Zena Olberding

A child is running south at 7 ft/s. A crazy clown is running east at 71 ft/s. The clown was screaming past the kid at 6:39 am. How fast is the ground distance between the two people 6.4 seconds later.

$$x^2 + y^2 = z^2$$

$$71 \times 6.4 = 454.4 \text{ ft}$$
$$7 \times 6.4 = 44.8$$

$$2x\frac{dx}{dt} + 2y\frac{dy}{dt} = 2z\frac{dz}{dt}$$

$$454.4(71) + (44.8)(7) = 456.6\left(\frac{dz}{dt}\right)$$

$$\frac{dz}{dt} = 71.34 \text{ ft/s}$$

#2 Daric Teske

A 1:10 PM Central Time, a plane is exactly 200 m straight east of Mr. Duhrkopf's house. If the plane is flying at 50 m/s straight north, what is the rate of change in distance between the house and plane 15 seconds later?

$$200^2 + y^2 = z^2$$

$$200 + y\frac{dy}{dt} = z\frac{dz}{dt}$$

$$750$$
$$50 \text{ m/s}$$

$$200 + 750(50) = 776.2\frac{dz}{dt}$$

$$\frac{dz}{dt} = .0154 \text{ m/s}$$

200m

#2 Emily Peters

Kennedy and Jensyn are both on their way to work. Kennedy is walking east at 80 ft/s. Jensyn is walking north at 180 ft/s. They both arrive at the main corner just in time for work at 1:00 AM. How fast is the ground distance between the two changing 10 seconds later?

$$\frac{dz}{dt} = ? \quad t = 10$$

$$x^2 + y^2 + z^2 \qquad 2x\frac{dx}{dt} + 2y\frac{dy}{dt} = \frac{2z\,dz}{dt}$$

$$800(80) + 1800(180) = 1969\frac{dz}{dt}$$

$$\frac{dz}{dt} = 197\,ft/s.$$

#2 Jessica Pottebaum

A 12ft ladder slips down a wall so that the base of the ladder moves away from the wall at a rate of 5 feet per second. How fast will the top of the ladder be moving down when the base is 6 feet from the wall?

$$\frac{dy}{dt}\,? \qquad 12 \qquad x^2 + y^2 = z^2$$

$$2x\frac{dx}{dt} + 2y\frac{dy}{dt} = 0$$

$$6 \qquad 5ft/s$$

$$(6)(5) + 10.4\left(\frac{dy}{dt}\right) = 0$$

$$30 + 10.4\left(\frac{dy}{dt}\right) = 0$$

$$10.4\frac{dy}{dt} = -30$$

$$\frac{dy}{dt} = -2.88\,ft/s$$

#2 Caleb Horsley

A car is driving from east from Denison to Carroll at a rate of 60 ft/s. At 1:20 pm, a south bound plane flies over the car going 500 ft/s. How fast is the distance between the two changing 15 seconds later?

$$60ft/s$$

$$500\,ft/s$$

$$x\frac{dx}{dt} + y\frac{dy}{dt} = z\frac{dz}{dt}$$

$$900(60) + 7500(500) = 7553.8\frac{dz}{dt}$$

$$\boxed{503.59\,ft/s}$$

#2 Addison Ross

Alex Stenbo is running south at 5 ft per second. The quarterback is running west at 12 ft per second trying to avoid him. They both start the play in the same spot. Three seconds after the ball is snapped, how fast is the ground distance between the two changing?

$$12\,f/s\ x$$

$$25 + 14$$

$$x^2 + y^2 = z^2$$

$$5\,ft/s\ y$$

$$z \qquad x\frac{dx}{dt} + y\frac{dy}{dt} = 2z\frac{dz}{dt}$$

$$5(15) + 12(36) = 13\frac{\left(\frac{dz}{dt}\right)}{dt}$$

$$\boxed{13\,ft/s}$$

#2 Trent Lux
A U.S. Ohio Class submarine is traveling north 150 miles of the coast of China at 3 km/h. A Chinese Type 093 attack submarine is traveling east at 7 km/h and crosses paths with the U.S. submarine at 2:00 A.M. How fast is the distance changing between the two submarines at 4:00 A.M.?

$$y = 6 \qquad z = \qquad z = 15.23 \qquad \frac{dz}{dt} = ? \qquad x^2 + y^2 = z^2$$

$$x = 14$$

$$\frac{dy}{dt} = 3 \, km/h$$

$$\frac{dx}{dt} = 7 \, km/h$$

$$x \cdot \frac{dx}{dt} + y \cdot \frac{dy}{dt} = z \cdot \frac{dz}{dt}$$

$$(14)(7) + (6)(3) = 15.23 \frac{dz}{dt}$$

$$7.61 \, km/h = \frac{dz}{dt}$$

#2 Sterling Schaefer
A 30 foot pole is sliding down a wall at 4 feet per second. how fast will the base be moving away from the wall when the ladder is 15 feet high?

$$x \qquad 30$$
$$Y$$

$$y = 26 \qquad \frac{dy}{dt} = ? \qquad x = 15$$

$$x \frac{dx}{dt} + y \frac{dy}{dt} = z \frac{dz}{dt}$$

$$15 \cdot 4 + 26 \cdot \frac{dx}{dt} = 0 \qquad \qquad \frac{dy}{dt} = 2.3 \, ft/s$$

$$26 \frac{dy}{dt} = -60$$

#2 Brent Wernimont
A 17 feet tall ladder is sliding down a wall at a rate of 3 feet per second. How fast will the base be moving when the ladder is 10 feet up the wall?

$$x^2 + y^2 = z^2$$
$$x^2 + 100 = \qquad x = 13.75$$

$$\frac{dy}{dt} = 3 \, ft$$
$$17 \, ft$$
$$y = 10 \quad Y$$

$$2(13.75)\frac{dx}{dt}(10)(3) = 2(17) \, 0$$

$$x \frac{dx}{dt} = ? \qquad = 0$$

$$\boxed{-2.18 \, ft \text{ per second}}$$

#2 Alex Stenbo
A plane passes by overhead moving south at 400 mph at the same time another plane heading east is going 300 mph. How fast is the distance between the planes increasing after 6 hours.

$$x^2 + y^2 = z^2$$
$$DX/DT = 300$$
$$DY/DT = 400$$
$$DZ/DT = ?$$

$$\sqrt{3240000 + 5760000} = 3000 \, mph$$

$$1080000 + 1920000 = 3000 \, mph$$

$$\boxed{DZ/DT = 1000 \, mph}$$

#2 Colton Thompson

An F-15E Strike Eagle is flying a sortie over ▮▮▮▮ a speed of 1,200 miles an hour due east. At the same time, a Tupolev Tu-22 bomber from the ▮▮▮▮ ir Force is flying at 900 miles an hour due north. If they cross paths at exactly 0300, how fast is the distance between the planes increasing at 0600.
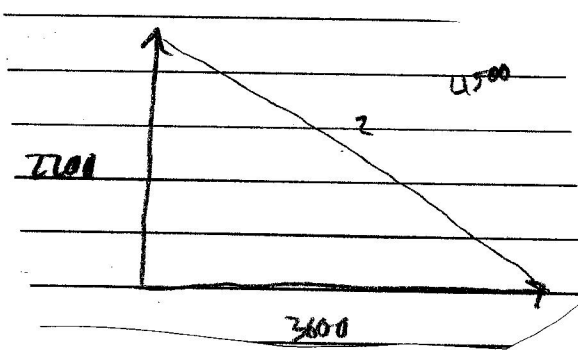
$$\frac{dx}{dt} = 1200 \qquad \frac{dy}{dt} = 900$$

$$\frac{dz}{dt} = ? \quad \text{when}$$

$$\frac{2x\,dx}{dt} + \frac{2y\,dx}{dy} = \frac{2z\,dz}{dt}$$

$$x(1200) + y(900) = z\frac{dz}{dt}$$

$$3600(1200) + 2700(900) = 4500\frac{dz}{dt}$$

$$\boxed{1500 \text{ mi/hr} = \frac{dz}{dt}}$$

(figure: right triangle with vertical side 2700, hypotenuse z, horizontal side 3600)

#2 Allison Baumhover

A car is driving south at 110 miles per hour. A police is driving east at 60 miles per hour. Both left the prison at noon. How fast is the ground distance between the two changing two hours later?

(figure: right triangle, top side x 60 mph, left side y, hypotenuse z, 110 miles/hr, z = 250.6)
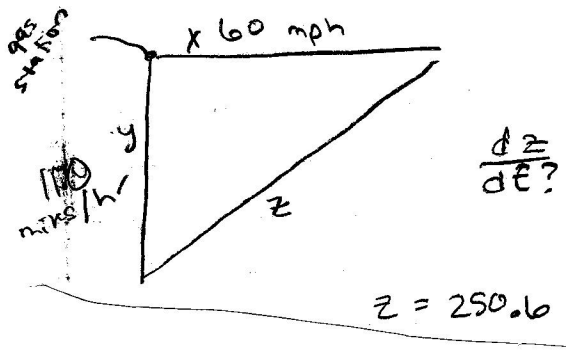
$$x = 120 \qquad \frac{dx}{dt} = 60 \text{ mph}$$

$$y = 220$$

$$\frac{dy}{dt} = 110 \text{ mph}$$

$$x^2 + y^2 = z^2$$

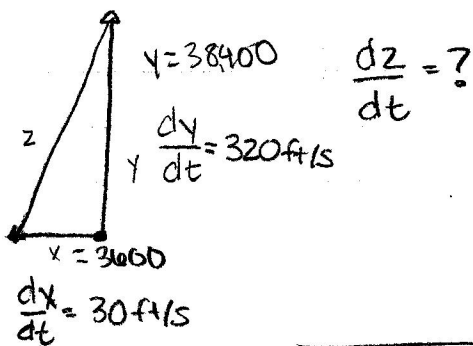$$2x\frac{dx}{dt} + 2y\frac{dy}{dt} = 2z\frac{dz}{dt}$$

$$\frac{(120)(60) + (220)(110)}{250.6} = \frac{250.6 \cdot \frac{dz}{dt}}{250.6}$$

$$= \boxed{125.3 \text{ miles/hr}}$$

#2 Stephanie Schneider

A jet is flying north at 320 ft/s. A bird is flying west at 30 ft/s. The jet flies directly over the bird around 11:00 a.m. How fast is the ground distance between the two changing 2 minutes later.

(figure: right triangle, vertical side Y = 38400, hypotenuse z, horizontal side x = 3600)

$$2 \min = 120 \sec$$

$$y = 38400 \qquad \frac{dz}{dt} = ?$$

$$\frac{dy}{dt} = 320 \text{ ft/s}$$

$$x^2 + y^2 = z^2$$

$$\frac{x\,dx}{dt} + Y\frac{dy}{dt} = z\frac{dz}{dt}$$

$$x = 3600$$

$$\frac{dx}{dt} = 30 \text{ ft/s}$$

$$(30)(3600) + (320)(38400) = (38568.4)\frac{dz}{dt}$$

$$\boxed{\frac{dz}{dt} = 321.4 \text{ ft/s}}$$

#2 Ryan Elmquist

A dog is walking north at a rate of 50 feet per second, while a cat is walking west AT A rate of 90 feet per second. How fast is the distance between the two animals increasing after 75 seconds?

$$\frac{dy}{dt} = 50 \, ft/s$$

$$\frac{dz}{dt} = ? \text{ when } t = 75$$

$$\frac{dx}{dt} = 90 \, ft/s$$

$$x^2 + y^2 = z^2$$

$$(6750)^2 + (3750)^2 = z^2$$

$$45,562,500 + 14,062,500 = 7,721$$

$$z = 7,721.72 \, ft$$

$$2x\frac{dx}{dt} + 2y\frac{dy}{dt} = 2z\frac{dz}{dt}$$

$$6750(90) + 3750(50) = 7,721.72 \left(\frac{dz}{dt}\right)$$

$$795,000 = 7,721.72 \frac{dz}{dt}$$

$$\boxed{102.956 = \frac{dz}{dt}}$$

#2 Shannon O'Leary

A helicopter is flying north at 80 mi/hr. It's looking for a car containing two murder suspects. The car is going east at 50 mi/hr. It drove right underneath of the helicopter and is now 2 miles past the location where the helicopter and car intersected. How fast is the ground distance between the two changing when the car is 10 miles away from the helicopter?

$$\frac{dy}{dt} = 80 \, mph \qquad z = 10$$

$$x = 2mi$$

$$\frac{dx}{dt} = 50 \, mph$$
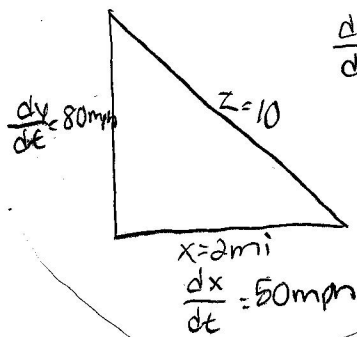
$$\frac{dz}{dt} = ? \text{ when } x = 2mi$$

$$x^2 + y^2 = z^2$$

$$2x\frac{dx}{dt} + 2y\frac{dy}{dt} = 2z\frac{dz}{dt}$$

$$2 \cdot 50 + 9.8 \cdot 80 = 10\frac{dz}{dt}$$

$$4 + y^2 = 100 \qquad y = 9.8$$

$$\boxed{\frac{dz}{dt} = 88.4 \, mi/hr}$$

#2 Kennedy Reid

Justin Bieber is 6 ft tall. He is leaning against a wall and while seeing Kennedy, slips so that his feet move away from the wall at a rate of 2 ft/sec. How fast will the top of Justins head move down the wall when his feet are 3 ft from the wall?

$$x^2 + y^2 = 36$$

$$y^2 = 36 - 9$$

$$\frac{2x \, dx}{dt} + \frac{2y \, dy}{dt} = 0$$

$$\frac{dx}{dt} = 2 \qquad \frac{dy}{dt} = ?$$

$$x = 3$$

$$y = \sqrt{27} = 5.2$$

6ft

2ft/sec

$$2(3)(2) + 2(5.2)\frac{dy}{dt} = 0$$

$$\frac{dy}{dt} = -\frac{2(6)}{2(5.2)}$$

$$\boxed{-1.7 \, ft/sec}$$