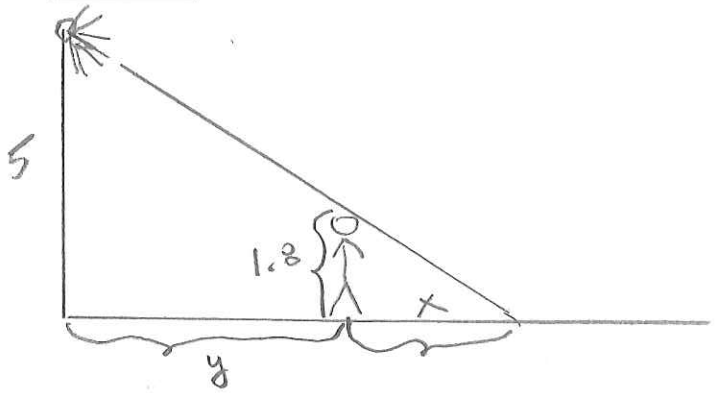
Name KEY/SHUBLEKA **No calculators. Present neatly. Score_____.**

1)

A man of height 1.8 meters walks away from a 5-meter lamppost at a speed of 1.2 m/s. Find the rate at which his shadow is increasing in length when he is 8 meters away from the lamppost.

Your work:



$\frac{dy}{dt} = 1.2 \text{ m/s}$

$\frac{dx}{dt} = ?$

$\frac{x+y}{5} = \frac{x}{1.8}$

$1.8x + 1.8y = 5x$

$1.8\frac{dx}{dt} + 1.8 \cdot \frac{dy}{dt} = 5 \cdot \frac{dx}{dt}$

$3.2\frac{dx}{dt} = 1.8 \cdot \frac{dy}{dt}$

$\rightarrow \quad \frac{dx}{dt} = \frac{1.8}{3.2} \cdot 1.2 = 0.675 \frac{m}{s}$

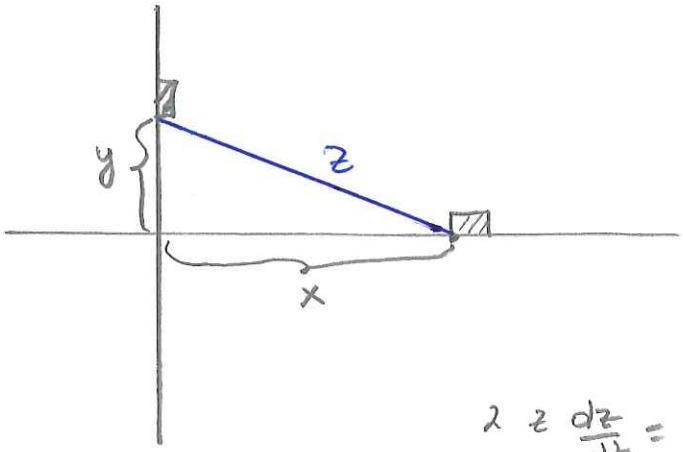
The length of the shadow is increasing at a rate of 0.675 m/s at all times (being 8m away is unimportant.)

Name SHUBLEKA / KEY **No calculators. Present neatly. Score_____.**

1)
A police car traveling south toward Sioux Falls at 160 km/h pursues a truck traveling east away from Sioux Falls, Iowa, at 140 km/h. At time t = 0, the police car is 20 km north and the truck is 30 km east of Sioux Falls. Calculate the rate at which the distance between the vehicles is changing:

a) At time t = 0 **(b)** 5 minutes later

Your work:



$\frac{dy}{dt} = -160$ km/hr

$\frac{dx}{dt} = 140$ km/hr

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

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

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

a) $t=0 \Rightarrow x=30$; $y=20$; $z=\sqrt{20^2+30^2}$

$$\frac{dz}{dt} = \frac{20(-160)+30(140)}{\sqrt{20^2+30^2}} \approx 27.735 \text{ km/hr}$$

At $t=0$, the distance between the cars is increasing at a rate of 27.735 km/hr.

b) $t = 5\text{mins} = \frac{5}{60} = \frac{1}{12}$ hrs ; $x = 30 + 140\cdot\frac{1}{12} = \frac{125}{3}$ km

$y = 20 + (-160)\cdot\frac{1}{12} = \frac{20}{3}$; $z = \sqrt{\left(\frac{125}{3}\right)^2+\left(\frac{20}{3}\right)^2} = \frac{5\sqrt{641}}{3}$

$$\frac{dz}{dt} = \frac{\frac{20}{3}\cdot(-160)+\frac{125}{3}\cdot 140}{\frac{5\sqrt{641}}{3}} = \frac{2860}{\sqrt{641}} \approx 112.963 \frac{\text{km}}{\text{hr}}$$

5 minutes later, the distance between the cars is increasing at a rate of 112.963 km/hr.