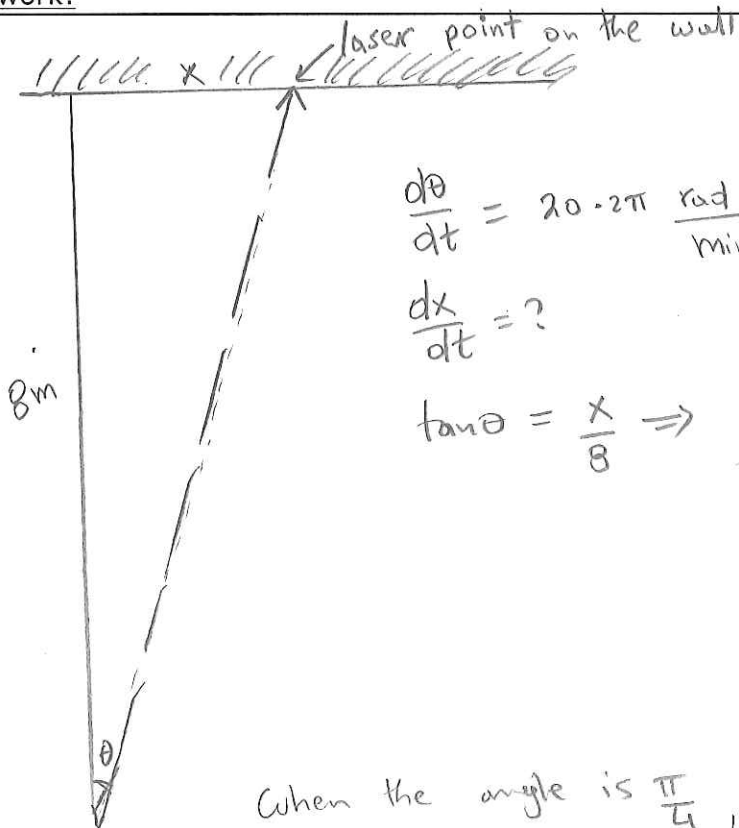


Name KEY/SHUBLEKA **No calculators. Present neatly. Score _____.**

A laser pointer is placed on a platform that rotates at a rate of 20 revolutions per minute. The beam hits a wall 8 m away, producing a dot of light that moves horizontally along the wall. Let θ be the angle between the beam and the line through the searchlight

perpendicular to the wall. How fast is this dot moving when $\theta = \frac{\pi}{4}$?

Your work:



$$\frac{d\theta}{dt} = 20 \cdot 2\pi \frac{\text{rad}}{\text{min}} = \frac{40\pi \text{ rad}}{\text{min}}$$

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

$$\tan\theta = \frac{x}{8} \Rightarrow x = 8 \tan\theta$$

$$\frac{dx}{dt} = 8 \sec^2\theta \frac{d\theta}{dt}$$

$$\frac{dx}{dt} = 8 \sec^2\left(\frac{\pi}{4}\right) \cdot 40\pi$$

$$\frac{dx}{dt} = 8 \cdot 2 \cdot 40\pi = 640\pi \text{ m/min}$$

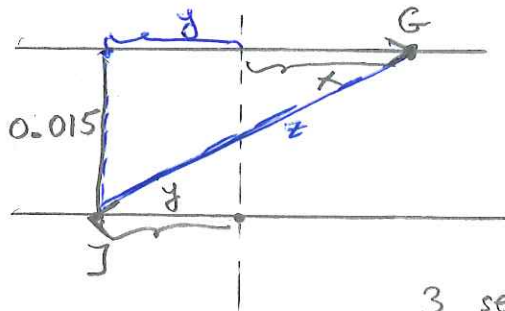
When the angle is $\frac{\pi}{4}$, the dot is moving at a rate of 640π m/min.

$$\left(\approx 2010.620 \text{ m/min.} \right)$$

Name KEY / SHUBLEKA **No calculators. Present neatly. Score** _____.

Two parallel paths 15 m apart run east-west through the woods. Genie jogs east on one path at 10 km/h, while Joshua walks west on the other path at 6 km/h. If they pass each other at time $t = 0$, how far apart are they 3 s later, and how fast is the distance between them changing at that moment?

Your work:



$$\frac{dx}{dt} = 10 \text{ km/h}$$

$$\frac{dy}{dt} = 6 \text{ km/h}$$

$$(x+y)^2 + (0.015)^2 = z^2$$

3 seconds later $\sim t = \frac{3}{60 \cdot 60} = \frac{1}{1200} \text{ hrs}$

$$x\left(\frac{1}{1200}\right) = 10 \cdot \frac{1}{1200} = \frac{1}{120} \text{ km}$$

$$y\left(\frac{1}{1200}\right) = 6 \cdot \frac{1}{1200} = \frac{1}{200} \text{ km}$$

$$z = \sqrt{\left(\frac{1}{120} + \frac{1}{200}\right)^2 + (0.015)^2} \approx$$

$$0.0200693$$

$$2(x+y) \left(\frac{dx}{dt} + \frac{dy}{dt} \right) = 2z \frac{dz}{dt}$$

$$\left. \frac{dz}{dt} \right|_{t=\frac{1}{1200} \text{ hrs}} = \left(\frac{1}{120} + \frac{1}{200} \right) (10 + 6) \cdot \frac{1}{0.0200693} \approx 10.6298 \frac{\text{km}}{\text{h}}$$

OR 0.177164 km/min OR 177.164 m/min.

OR 2.95273 m/sec

Three seconds later, the distance between Genie and Joshua is increasing at a rate of 2.953 m/s.