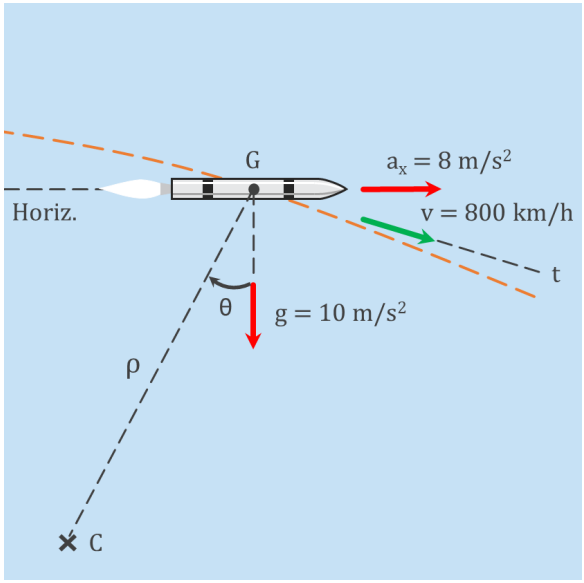
Rocket Accelerates



A rocket maintains at horizontal attitude of its axis during the powered phase of its flight. The acceleration due to horizontal thrust is $8\ \mathrm{m/s^2}$**, and the downward acceleration due to gravity is** $\mathrm{g} = 10\ \mathrm{m/s^2}$**. At the instant represented, the velocity of the mass centre** G **of the rocket along the** $\theta = 15$ **direction of its trajectory is** $800\ \mathrm{km/h}$**. Determine for this position the rate at which the velocity is increasing. Round to the nearest integer.**

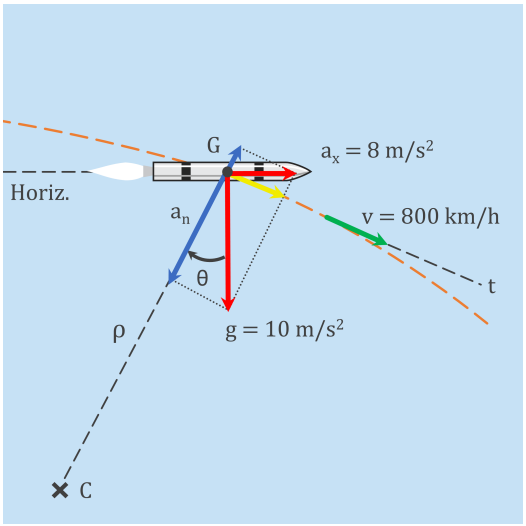


Figure 1: Rocket Accelerates

The rate at which the velocity increases is the tangential acceleration. The tangential acceleration a_t is parallel to v. Figure 1 shows the acceleration vectors a_x and g deconstructed in the normal direction (blue) and the tangential direction (yellow). It can be easily seen that g and a_x deconstructed in the tangential-direction are equal to $g \cdot \sin(\theta)$ and $a_x \cdot \cos(\theta)$ respectively. Resulting in the final answer:

$$a_t = g \cdot \sin(\theta) + a_x \cdot \cos(\theta) \qquad (1)$$

Given:
Angle: $\theta = 15°$
Gravitational acceleration: $g = 10m/s^2$
Horizontal acceleration: $a_x = 8m/s^2$
Velocity: $v = 800km/h = 222.22m/s$

Inserting θ, g and a_x into Equation 1 results in:

$$a_t = g \cdot \sin(\theta) + a_x \cdot \cos(\theta) \quad \Rightarrow \quad a_t = 10 \cdot \sin(15) + 8 \cdot \cos(15) = 10m/s^2 \qquad (2)$$