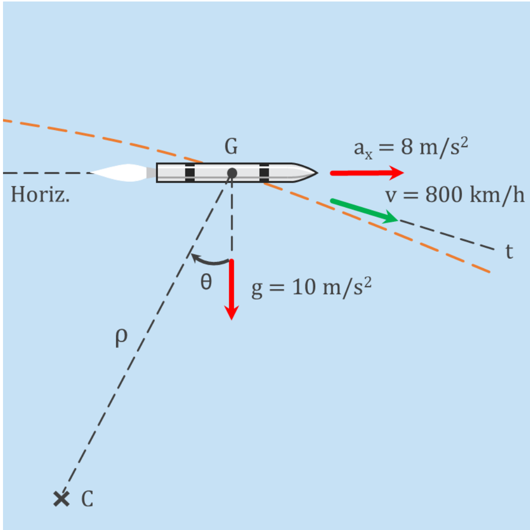
Rocket Acceleration



A rocket maintains at horizontal attitude of its axis during the powered phase of its flight (see the Figure). The acceleration due to horizontal thrust is 8 m/s^2, and the downward acceleration due to gravity is $g = 10$ m/s^2. At the instant represented, the velocity of the centre of mass G of the rocket along the $\theta = 15°$ direction of its trajectory is 800 km/h. Determine the normal acceleration a_n with respect to the centre of curvature C in terms of g,a_x and θ.

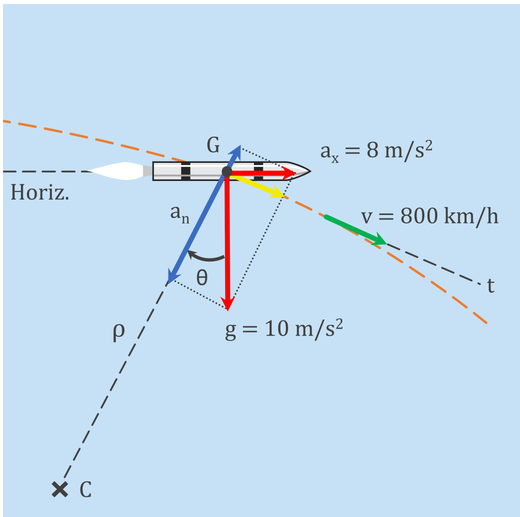


Figure 1: Rocket Accelerates

The normal acceleration a_n points towards the centre of curvature C. 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 normal-direction are equal to $g\cos\theta$ and $a_x \sin\theta$ respectively. However, in this case, $a_x \sin\theta$ points in the opposite way of a_n (points $\nearrow$ instead of $\swarrow$). This means that to determine the final value of a_n, the term $a_x \sin\theta$ should be negative. Adding both terms results in the final answer:

$$a_n = g\cos\theta - a_x \sin\theta \qquad (1)$$