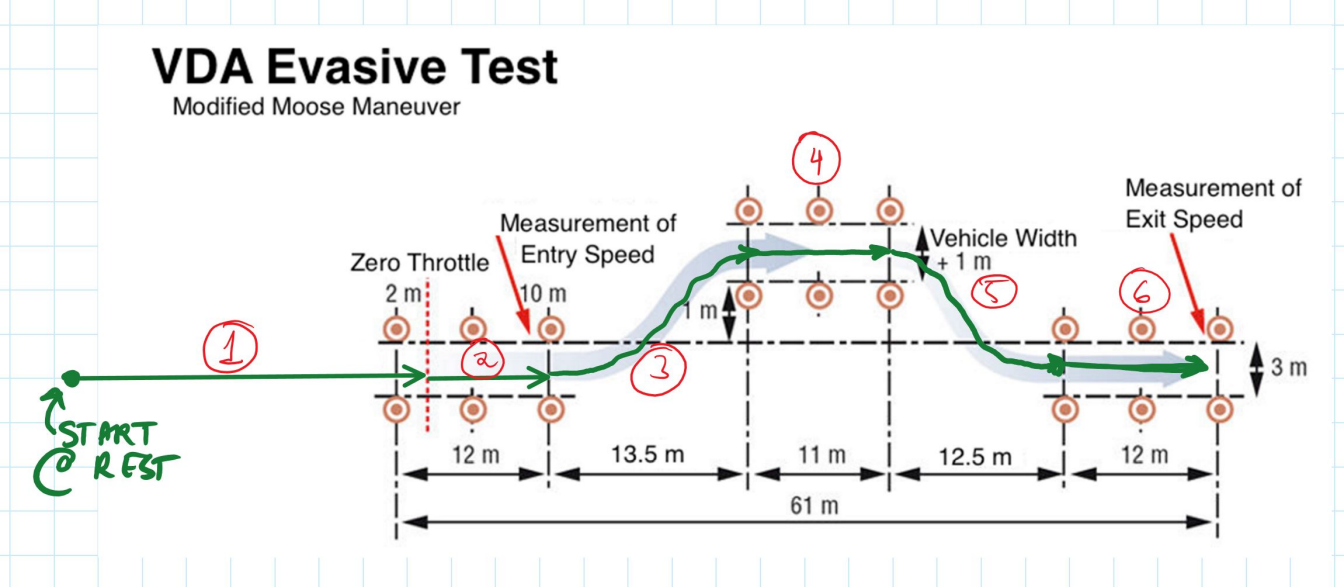
Problem One: *Moose Test.*

Directions: Using the maneuver depicted here, along with the provided description, **fill in the provided GG diagram on the third page**. Label the segments of the GG diagram with the provided numbers.



① Vehicle accelerates from rest, maximum value of 0.5 g's.

② Let off throttle, and vehicle coasts. Assume negligible speed change.

③ No throttle or braking. Vehicle makes rapid lane change to left. Assume some longitudinal deceleration occurs (due to induced drag from tires). Maximum longitudinal deceleration of 0.1 g, maximum lateral acceleration magnitude of 1 g.

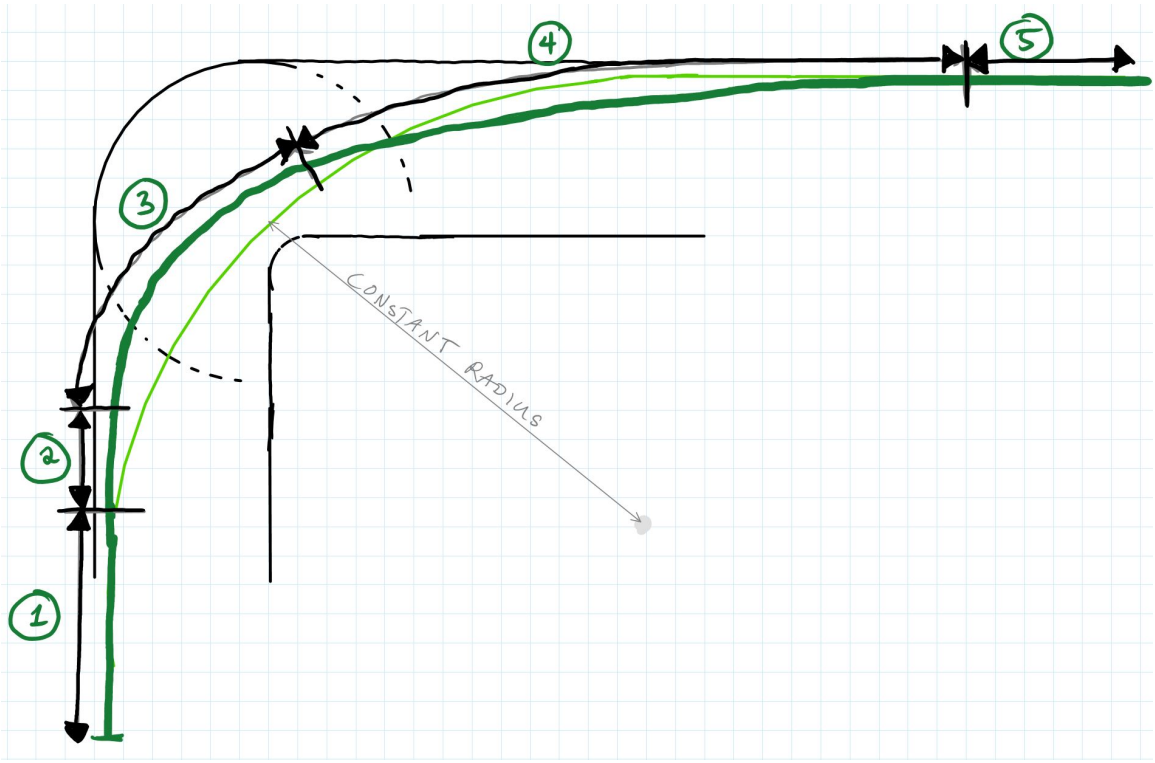
④ Vehicle coasts. Assume negligible speed change.

⑤ No throttle or braking. Vehicle makes rapid lane change to right. Assume some longitudinal deceleration occurs (due to induced drag from tires). Maximum longitudinal deceleration of 0.1 g, maximum lateral acceleration magnitude of 1 g.

⑥ Vehicle coasts. Assume negligible speed change.

Problem Two: *Right Turn.* Fill in GG diagram on last page.

Directions: Using the maneuver depicted here in **dark green**, along with the provided description, **fill in the GG diagram on the third page**. Label the segments of the GG diagram with the provided numbers.



*Note: the **light green** line is a constant radius racing line, for comparison*

① Vehicle accelerates from rest, max value of 0.5 g.

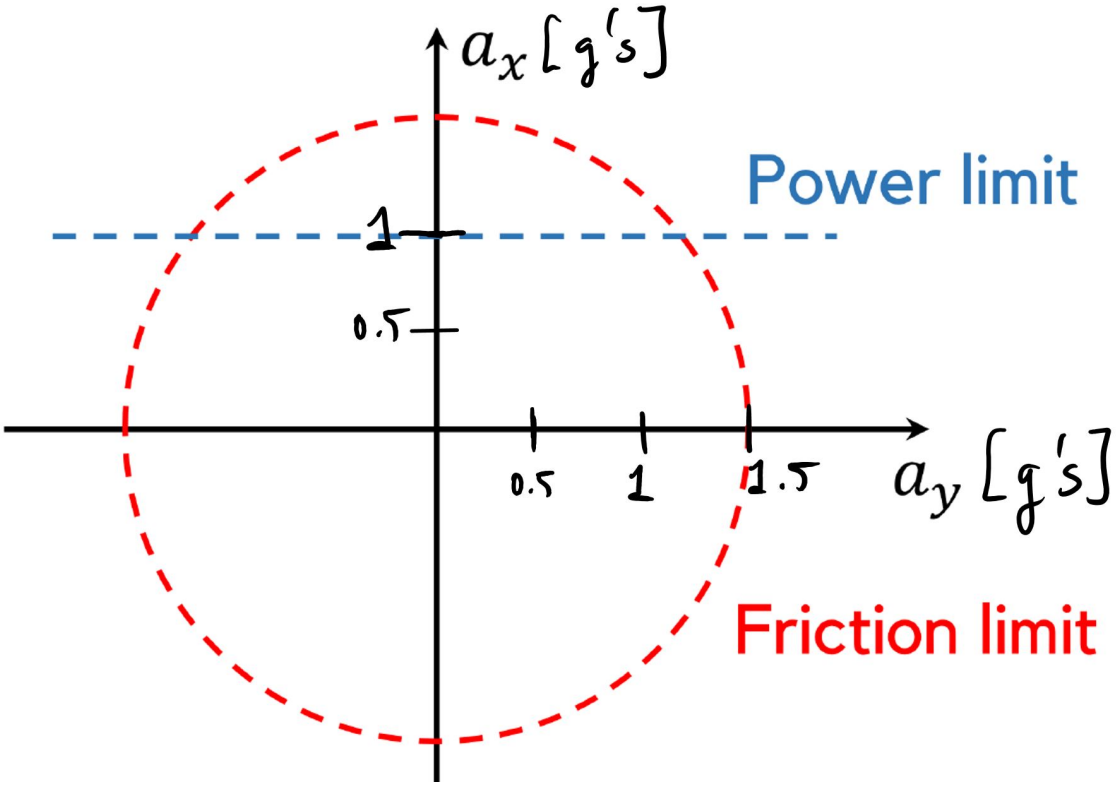
② Vehicle brakes, max deceleration -1.5 g.

③ Trail braking employed (braking while cornering). Reaches lateral acceleration magnitude of 1.5 g's at end of this segment.

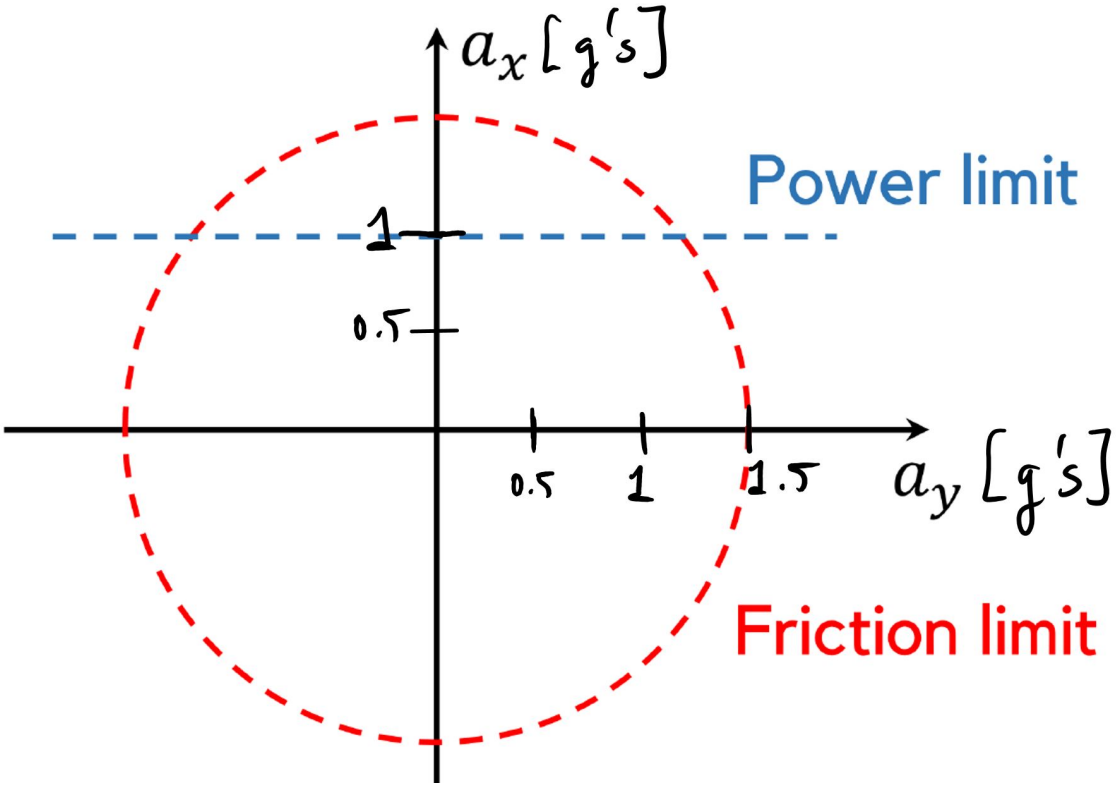
④ Accelerating during cornering. Vehicle straightens out by end of segment, and reaches power limit.

⑤ Pure longitudinal acceleration at power limit.

For Problem One:



For Problem Two:



Problem Three: *Lap Time Estimation*
Consider a car with the G-G Diagram limits given in Figure 1, which races on the track depicted in Figure 2:

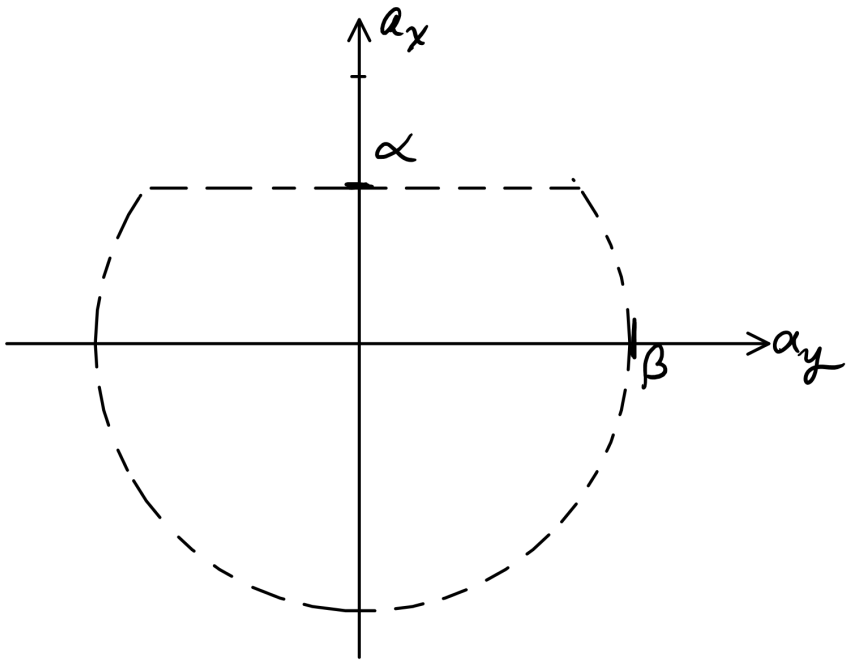


Figure 1: G-G Diagram for Problem One

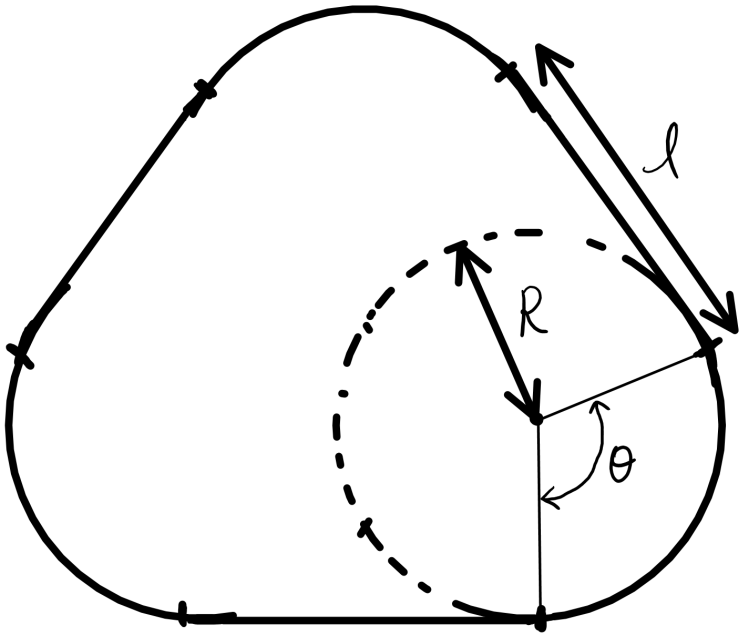


Figure 2: Race Track. The three identical straights are length ℓ, leading into circular corners of radius R, navigating an arc of angle θ

Assume:

1. $\alpha = 0.2$ g's, $\beta = 2$ g's, $\ell = 200$ meters, $\theta = 120\,\text{deg}$, $R = 15$ meters
2. The power-limited acceleration remains constant at the level depicted in Figure 1
3. The car is in a "flying lap" and doesn't start from zero velocity. Rather, the car is traveling at the optimal velocity for the fastest time at each instant.
4. Constant speed is held during the corners, and the tangential velocity transition from the straightaway to the corner is instantaneous

Determine the following:

a) Minimum time for one lap

b) Average speed for one lap

c) Cornering speed

d) Maximum speed achieved on straights

c) Location of braking point on straight (taken as distance from the end of the previous corner)