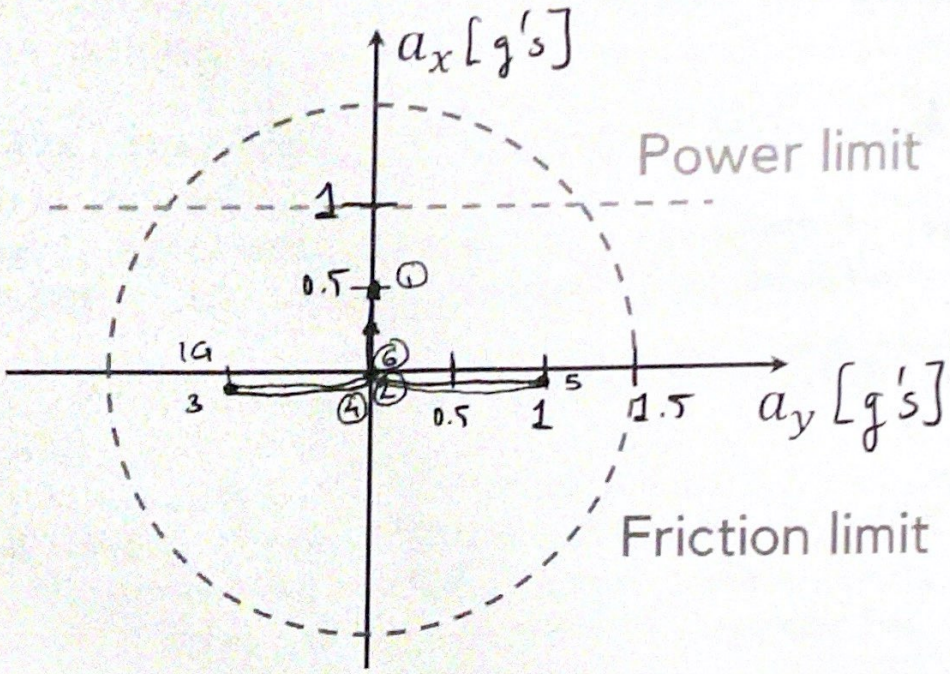
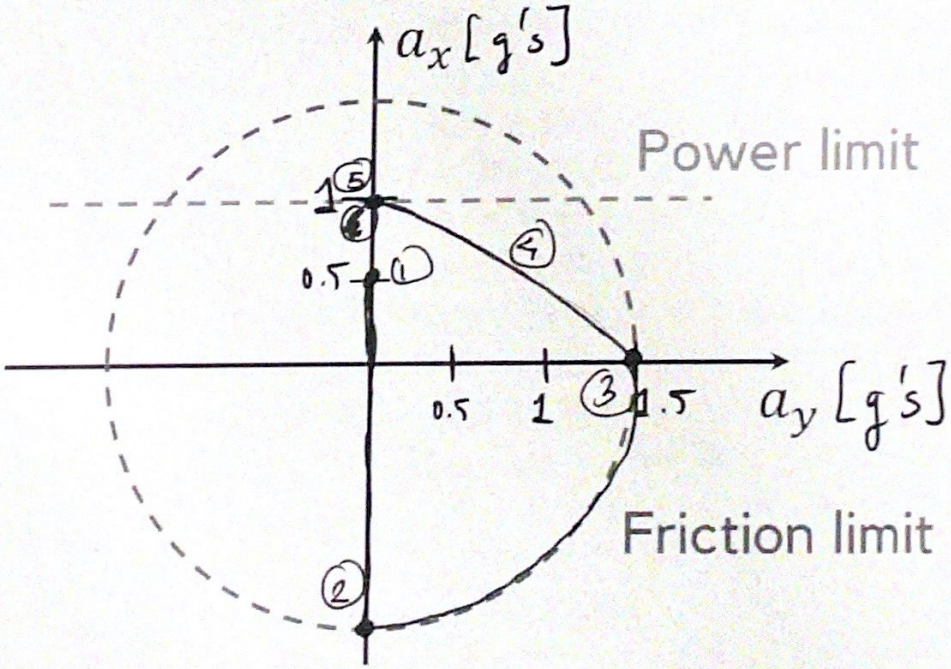
For Problem One:



For Problem Two:



Problem 3

$\alpha = 0.2g's \quad \beta = 2g's \quad l = 200m$

$\theta = 120deg, \quad R = 15m$

lets consider the start the end of one corner

The corner speed is constant hence there is only lateral acceleration

$$a_y = \frac{V_c^2}{R} \quad V_c = \sqrt{a_y R} = \sqrt{2g \times R} = \sqrt{2(9.81)15}$$

$$V_c = 17.155 \text{ m/s}$$

we use bang-bang to figure out the velocity and time for the straight since the entry & exit velocity has to be same $\Delta K.E = 0$

$a_1 = 0.2g = 1.962$

$a_2 = 2g = 19.62$

$W_1 + W_2 = 0 = \Delta K.E$

$ma_1 x_1 + ma_2 x_2 = 0$

$$a_1 x_1 - a_2 x_2 = 0$$

$$1.962 x_1 - 19.62 x_2 = 0$$

$$x_1 + x_2 = 200$$

$$x_1 = 200 - x_2$$

$$1.962(200 - x_2) - 19.62 x_2 = 0$$

$$39.24 - 1.962 x_2 - 19.62 x_2 = 0$$

$$-21.582 x_2 = -39.24$$

$$x_2 = 1.818$$

$$x_1 = 200 - x_2$$

$$x_1 = 198.181$$

$$V_f = \sqrt{V_i^2 + 2a\Delta x} = 32.738$$

$$t_1 = \frac{V_f - V_i}{a} = \frac{32.738 - 17.155}{0.2 \times 9.81}$$

$t_1 = 7.944\,s$

$t_2 = \frac{17.155 - 32.738}{-19.62} = 0.7944$

$t = t_1 + t_2 = 8.738$

To calculate minimum time we add the time required for the three straights & the 3 corners.

~~$t_{total} = 8.738$~~

$t_{corner} = \frac{d}{v_c} = \frac{R\theta}{v_c} = \frac{2.094 \times 120}{17.155}$

$t_{corner} = 1.831$

$t_{total} = (t \times 3) + (t_{corner} \times 3)$

$= 31.707\,(s)$

b) $v_{av} = \frac{\text{total distance}}{\text{total time}} = \frac{694.248}{31.707}$

$v_{av} = 21.895\ m/s$

c) cornering speed → 17.155 m/s

d) Max speed acheived → 32.738 m/s

e) location of braking point → 198.181 m