4a – 12 pts) Against your better judgement, you agree to a motorcycle race with Dave. You race through the foggy San Cruzan evening when all of sudden you see that the flat road ends in a cliff. You decide to swerve in a circular arc to avoid driving off the cliff. If you are driving at a velocity of 20 m/s, you and your bike have a mass of 150 kg, and the coefficient of static friction is 0.6, what is the radius of your turn?

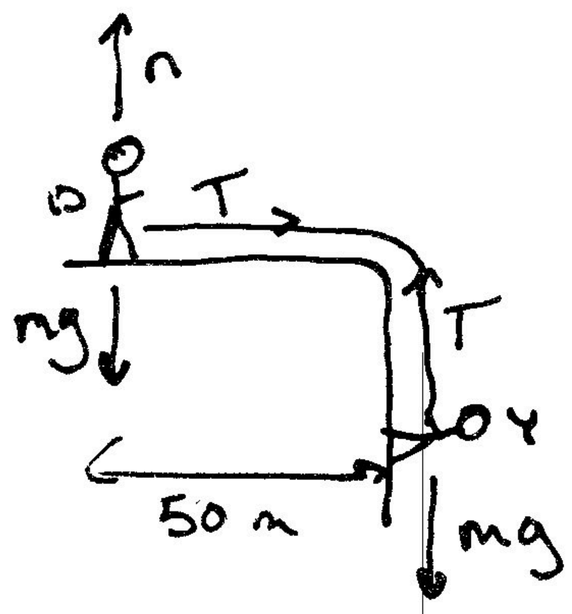
$$x: \quad ma = \frac{mv^2}{r} = f_s = \mu_s n \qquad y: \quad ma = 0 = n - mg$$
$$n = mg$$

Substituting: $\frac{mv^2}{r} = \mu_s mg$

$$v^2 = \mu_s g r$$

$$r = \frac{v^2}{\mu_s g} = \frac{(20\ m/s)^2}{0.6 \cdot 9.8\ m/s^2} = 68\ m$$

4b – 13 pts) Unfortunately, you are not going to stop in time so you decide to jump off your bike, but you slip over the cliff and land on a narrow edge. Dave (mass=70 kg) tells you not to worry and throws you (mass=60 kg) a rope. He starts to pull you up so you are suspended in air, but unfortunately runs into an area of slime covered rock where friction is effectively zero. How much time do you have before Dave goes over the cliff edge that is 50 meters from his current position (assuming zero friction and that there is nothing impeding your fall)?



Dave $x: \quad m_D a_x = T$

$y: \quad n = m_D g$

Your $y: \quad -m_y a_y = T - m_y g$

But $a_x = a_y = a$ so

$$-m_y a = m_D a - m_y g$$

$$a(m_y + m_D) = m_y g$$

$$a = \frac{m_y g}{m_y + m_D} = \frac{60}{130} g = 4.5\ m/s^2$$

$$\Delta x = \tfrac{1}{2} a t^2$$

$$t = \sqrt{\frac{2\Delta x}{a}} = \sqrt{\frac{2 \cdot 50\ m}{4.5\ m/s^2}}$$

$$= 4.7\ s$$