HW 2.3

Monday, February 10, 2020 9:30 PM

a) To minimize his time, the cyclist should operate at max power which has a torque of 665 in-lbs and a speed of 98.5 rpm

~~666~~ in-lbs : 75.13 n.m

$$\frac{60 \cdot 775W}{2\pi \cdot 75.13 n.m} = \frac{2\pi \cdot \text{speed (rpm)} \cdot 75.13 n.m}{60} \quad /60$$

$$98.5 \text{ rpm}$$

b) Our hero will take 47.27 seconds to reach the top of the hill.

$$\text{Power} = \frac{F \cdot d}{t} \qquad F = \frac{\tau}{R} = \frac{665 in-lbs}{12.5 in} = 53.2 lbs$$

$$775W = \frac{53.2 lbs \cdot 508.0 ft}{t} \rightarrow t = \frac{53.2 lbs \cdot 508 ft}{775 w}$$

$$\text{distance} = \sqrt{500^2 + 90^2} = 508.0 ft$$

$$t = 47.27 \text{ seconds}$$

c) To produce the expected time the speed of the rear wheel needs to be 155.2 rpm and the torque needs to be 453.17 in-lbs.

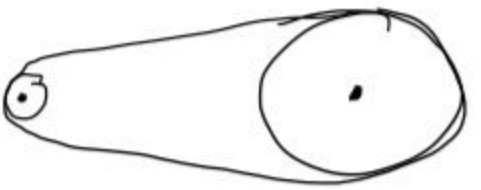
$$\frac{508 ft}{30 s} \cdot 16.93 \frac{ft}{s} = 155.2 \text{ rpm}$$

$$\tau = r \cdot \sin\theta \cdot F = 190 lbs \cdot 12.5 in \cdot \sin(11°) = 453.17 in\ lbs$$

a)

$$\frac{T_1}{34} = \frac{98.5\,rpm}{V_2}$$

17 tooth sprocket



e) With 2 fewer teeth, the biker's speed will go down but his cadence will be higher than it would with the ideal sprocket.

f) It wouldn't. Even though there are deviations from the actual grade, these deviations are <u>above</u> and <u>below</u> the average grade so they cancel and one can trust the use of the average grade.

Question 2:

a)

$(50/15)(70/20)(60/30)(30/60) = 11.\overline{6} \cdot 100\,rpm$

$\downarrow$

1166.7 rpm

b) Shaft D's effect on the overall speed ratio is 2:1 with C and 1:2 with E so it cancels and has no impact on overall speed. Its function is unclear other than to withstand the stress applied to it to transfer torque.

c)

$\tau = F \cdot r \cdot \sin\theta = 100 \cdot 0.26 =$ 20 N·m required