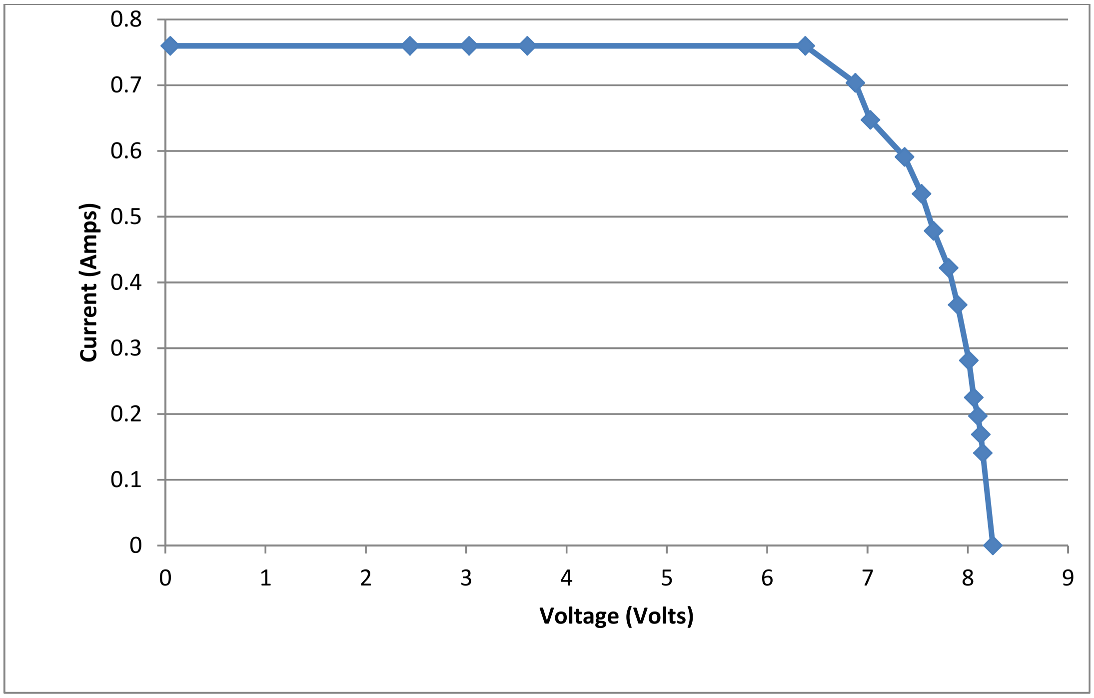
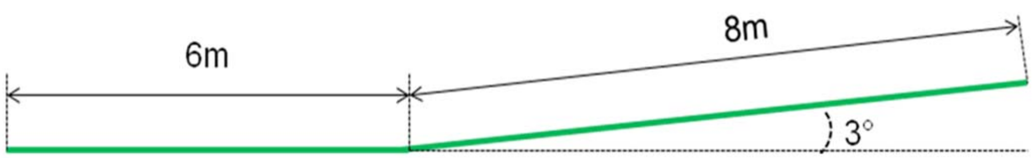
Vb Gear ratio calculations

Current and Voltage in sun with intensity of 800 W/m^2 ([1])





Flat part

$U.I.\ \eta = F_{wheel}.V_{A/B}$ U=6,38;I=0,76(solar panel graph at max power); η=70% (efficiency for maxon motor)

$T_{wheel} = T_{constant}.I.i.\ \eta$ $T_{constant}$=8,55.10^{-3}mNm/A; i= unknown, transmission ratio

$T_{wheel}=R_{wheel}.F_{wheel}$ estimate R_{wheel}~0,04m

$F_{rolling} = C_{rr}.N$ N=normal force =9,81N/m.0,75kg (estimated); C_{rr}=estimated rolling resistance coefficient= 0,015; $F_{rolling}$= 0,1103N

$(F_{wheel}-F_{rolling}).t_{A/B}=m.V_{A/B}$ $V_{A/B}$=speed at point B (point before slope)

$T_{wheel}=8,55*10^{-3}*0,76A*0,7*i=0,00269325*i$ Nm

$T_{wheel}/R_{wheel}=0,06733125*i$ N=F_{wheel}

$U.I.\ \eta = F_{wheel}.V_{A/B}$ $V_{A/B}=29,8479/i$ m/s

$S=6=(1/2.t_{A/B}.V_{A/B})$ $t_{A/B}=12/V_{A/B}$

$(F_{wheel}-F_{rolling}).t_{A/B} = m.V_{A/B}$

$(0,06733125.i -0,0221N).12/V_{A/B}=0,75kg.\ V_{A/B}$

$V_{A/B}^2=12.(\ 0,06733125.i -0,0221N)/0,75kg$ $V_{A/B}=29,8479/i$ m/s

---

[1] Value of 800 W/m^2 on Toledo Course DocumentsAchtergrondinfo / Background information/Solar panel Zonlicht
Graphs on powerpoint umicore solar team on toledo

Solving $0=1{,}0773i^3-0{,}3536i^2-890{,}891$ gives $i=8{,}2$

$V_{A/B}=3{,}63$ m/s; $t_{A/B}=3, 305$s

On the slope:

total resistance force: $F_r=F_{rolling}+m.g.\sin(3°)= 0{,}1103+ 0{,}75.9{,}81.\sin(3°)=0{,}495N$

$F_{wheel}=F_r=0{,}495N$

$T_{wheel}=0{,}495N.0{,}04m=0{,}0198Nm$

$T_{wheel} = T_{constant}.I.i.\ \eta$ $\quad$ $I=T_{wheel}/(T_{constant}.i.\ \eta)=0{,}4034A$

U on graph for this current = 7,15V

$U.I.\ \eta = F_{wheel}.V_{slope}$ → $7{,}15V.0{,}4034A.0{,}7/0{,}495N=V_{eq}=4.07m/s$

$S /V_{eq}=t_{slope}$ $\quad$ 8m/4.07m/s=1,96s

$t_{tot}=t_{flat} + t_{slope}= 3, 305s+1.96s=5.27s$

<u>for i = 9</u>

On flat part

T_{wheel} =0,0409374Nm

F_{wheel} =1.023435N

$a=(F_{wheel}–F_{rolling})/m=1.02\ m/s^2$

$V_{A/B}= U.I.\eta/F_{wheel}=3.3164m/s$

$t_{A/B}= \frac{V_{A/b}}{a}=3.102s$

$S=\frac{1}{2}\cdot a\cdot t^2 =4{,}907m$

$F_{Wheel} = F_{rolling}$ for the rest of the flat path

$F_{wheel} = 0.1103$ N $\rightarrow T_{wheel}= 4.412\cdot 10^{-3}N\cdot m$

I=0.0819A

$I_{graph=0.30A}$

U = 7.6 V

$V_{A/B}= \frac{7.60\times 0.0819\times 0.7}{0.1103} = 3.95\ m/s$

On slope

$F_{wheel}=F_r=F_{rolling}+m.g.\sin(3°)=0{,}495N$

$T_{wheel}=0{,}495N.0{,}04m=0{,}0198Nm$

$I=T_{wheel}/(T_{constant}.i.\ \eta)=0{,}3675A$

U on graph for this current = 7,1V

$U.I.\ \eta = F_{wheel}.V_{eq}$ → $7{,}1V.0{,}3675A.0{,}7/0{,}495N=V_{eq}=3{,}6898m/s$

$S/V_{eq}= t_{eq}= 2{,}168s$

t_{tot} = 3,102s + (6m-4, 907m)/3,6898 m/s + 2,168s=5,566s

<u>for i = 8</u>

On flat part

T_{wheel} =0,036388Nm
F_{wheel} =0,90972N

a=(F_{wheel}–$F_{rolling}$)/m=1,065893m/s^2
$V_{A/B}$= U.I.η/F_{wheel}=3,730994 m/s
$t_{A/B}$= $\frac{V_{A/B}}{a}$=3,5s
S=$\frac{1}{2} \cdot a \cdot t^2$ =6,5244m>6M

So the car will keeps accelerating after it steps on the slope.

$\frac{1}{2} \cdot$ a $\cdot t_{flat}^2$ = 6 m →t_{flat} = 3.355s

$V_{A/B}$ = a·t_{flat} = 3. 576 m/s

t_{slope}>$\frac{8}{V_{A/B}}$ = 2.23688s

t_{tot}>3. 5 + 2.2368 =5,7369 s > 5.566 (i = 9)

So i=9 is better .