Gabriel Staples
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Maj. Rolling
T4A

Corrections on GR #2

+6

Problem 1: and V

I messed up on $C_{t_{alt}}$, so I will just correct these pieces and finish solving to the end.

$$V = \sqrt{\frac{2nw}{\rho S C_L}} = \sqrt{\frac{2(1)(724{,}223)}{3\times10^{-6}(6280)(.462)}} = 12{,}900 \frac{ft}{s}$$

$$q = \frac{1}{2}\rho V^2 = \frac{1}{2}(3\times10^{-6})(12{,}900\ ft/s)^2 = 249.615$$

$$D = C_D q S$$

$$C_D = .05 + .078(.462)^2 = .0666$$

$$D = .0666\,(249.6)(6280) = \boxed{104{,}394.7\ lbs}\ drag$$ ✓

Max powered Range:

$$E = \frac{1}{C_t}\frac{C_L}{C_D}\ln\left(\frac{W_1}{W_2}\right)$$

$$C_{t_{alt}} = C_{t_{SL}}\left(\frac{q_{ALT}}{q_{SL}}\right) = \frac{.0005}{sec}\left(\frac{1075\ ft/s}{1116.4\ ft/s}\right) = 0.000481\ \frac{}{sec}$$

$$E = \frac{1}{.000481/s}\ \frac{.462}{.0666}\ln\left(\frac{724{,}223}{624{,}223}\right) = 2143.0\ sec$$

$$d = vt \qquad d = \frac{12{,}900\ ft}{s}(2143.0\ sec)\cdot\frac{1\ nmile}{6076\ ft} = \boxed{4{,}549.8\ n\ miles\ Range}$$ ✓

$$M = \frac{12{,}900\ \frac{ft}{s}}{1075\ \frac{ft}{s}} = \boxed{12}$$ ✓

Problem 2)

A)

Given: glider $S = 303\ ft^2$ $\rho = .002377\ \frac{slugs}{ft^3}$

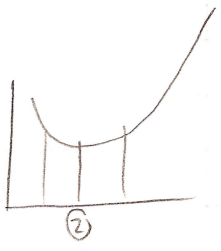
$W = 225\ lbs + 145\ lbs$ Wilbur $= 370\ lbs$

$C_D = \underbrace{0.07}_{C_{D_0}} + \underbrace{0.08}_{k} C_L^2$

Find: V for max range

Assume: std. atmos.; flying at sea level

Sketch:



Estimate: < 100 mph

Solution: $C_{D_0} = kC_L^2$

$C_L = \sqrt{\frac{C_{D_0}}{k}}$

$C_L = \sqrt{\frac{.07}{.08}} = 0.9354$

$V = \sqrt{\frac{2nW}{\rho S C_L}} = \sqrt{\frac{2(370\ lbs)}{.002377(303)(.9354)}} = \boxed{33.14\ \frac{ft}{s}}$ @ max. range

check: $\frac{33.14\ ft}{s} \cdot \frac{mile}{5280\ ft} \cdot \frac{3600\ s}{hr} = 22.6\ mph$ ✓

B) Given: $h = 100\ ft$

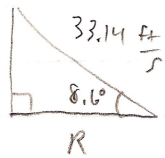
Find: range

$D = C_D q S = .14(1.305)(303) = 55.36\ lbs$ drag

$q = \frac{1}{2}\rho V^2 = \frac{1}{2}(.002377)(33.14)^2 = 1.305$

$C_D = .07 + .08(.9354)^2 = .1400$

$\gamma = \sin^{-1}\left(\frac{D}{W}\right) = \sin^{-1}\left(\frac{55.36\ lbs}{370\ lbs}\right) = 8.6°$



$\sin 8.6° = \frac{h}{33.14}$

$h = 4.96\ ft/s$ down

$\frac{100\ ft}{4.96\ ft/sec} = 20.16$ seconds

$\cos 8.6 = \frac{R}{33.14}$

$R = 32.77 \text{ ft/s} \cdot 20.16 \text{ s} = \boxed{660.6 \text{ ft}}$ ✓

c) $3 C_{D_0} = k C_L^2$

$C_L = \sqrt{\frac{3 C_{D_0}}{k}} = \sqrt{\frac{3(.07)}{(.08)}} = 1.62$

$V = \sqrt{\frac{2(370)}{(.002377)(303)(1.62)}} = \boxed{25.18 \text{ ft/s}}$ ✓

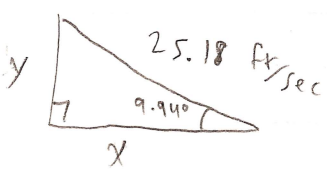
D) $q = \frac{1}{2}\rho V^2 = \frac{1}{2}(.002377)(25.18)^2 = .7535$

$C_D = .07 + .08(1.62)^2 = .28$

$D = .28(.7535)(303) = \boxed{63.9 \text{ lbs drag}}$

$\gamma = \sin^{-1}\left(\frac{D}{W}\right) = \sin^{-1}\left(\frac{63.9}{370}\right) = \boxed{9.940^\circ}$ ✓

Bonus) orville:



$\sin(9.94)(25.18) = 4.346 \text{ ft/s down}$

$\frac{100 \text{ ft}}{4.346 \text{ ft/s}} = 23.01 \text{ sec} - 20.16 \text{ sec} = \boxed{2.85 \text{ sec longer}}$ ✓