1. $\langle v \rangle = \Delta x / \Delta t = \boxed{0}$

2. Bird from $\boxed{\text{top}}$ accelerates down, so it wins.

3. $v^2 = v_0^2 + 2a\Delta x$

$10^2 = 0 + 2 \cdot 5 \cdot \Delta x$

$100 = 10\Delta x$

$\boxed{\Delta x = 10\text{m}}$

4. $v^2 = v_x^2 + v_y^2$

$= 4^2 + 3^2$

$= 16 + 9$

$= 25$

$\Rightarrow \boxed{v = 5\ \text{m/s}}$

5. $v_{rel} = 1.5\ \text{m/s}$

$= \Delta x / \Delta t$

$\Rightarrow \Delta t = v_{rel} / \Delta x$

$= 10\text{s}$

In 10 s, Rover runs $\Delta x_R = v_R \cdot 10$

$= 5 \cdot 10$

$= \boxed{50\text{m}}$

6. $t = \Delta x / v_x$

$\Delta y = \frac{1}{2} g t^2$

$= \frac{1}{2} g \left(\frac{\Delta x}{v_x}\right)^2$

to cut Δy by 2

cut Δx^2 by 2

or Δx by $\sqrt{2}$

$\Rightarrow$ $\boxed{L/\sqrt{2}}$

7. $F = ma$

$= 50\,kg \cdot 4\,m/s^2$

$= \boxed{200\,N}$

8. $F_{ext} \cos\theta$ balances F_f

$F_{ext} \sin\theta + N$ balance mg

$\Rightarrow$ $\boxed{\begin{array}{c} F_{ext} > F_f \\ N < mg \end{array}}$

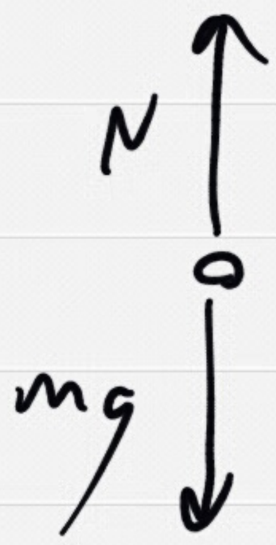
9. $F_{AV} = 300\,N$

$F_{VA} = -300\,N$

$$a_A = F_{AV}/m_A = \boxed{2\ m/s^2}$$

$$a_V = F_{VA}/m_V = \boxed{-3\ m/s^2}$$

10.



$N - mg = mv^2/r = F_c$

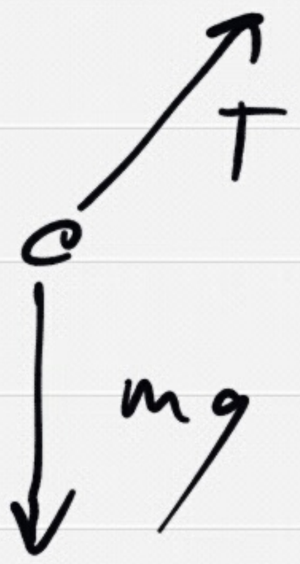
$$\boxed{N > mg}$$

11. $F_f = F_c = mv^2/r$

$= 100 \cdot 2^2/1$

$= \boxed{400\ N}$

12.



13. $W = \Delta KE$

$= \frac{1}{2}mv^2 - \frac{1}{2}mv_0^2$

$= \frac{1}{2} \cdot 1 \cdot 2^2$

$= \boxed{2\ J}$

14. Saul does $+W$ on cart so cart does $-W$ on Saul by Newton's 3rd

15. $V_{y0} = V_0 \sin 30^\circ$

$= 8 \cdot \frac{1}{2}$

$= 4\ m/s$

$\frac{1}{2}mv_{y0}^2 = mgh$

$v_{y0}^2/2 = gh$

$h = v_{y0}^2/2g = \frac{4^2}{2 \cdot 10}$

$= 16/20 = \boxed{0.8}$