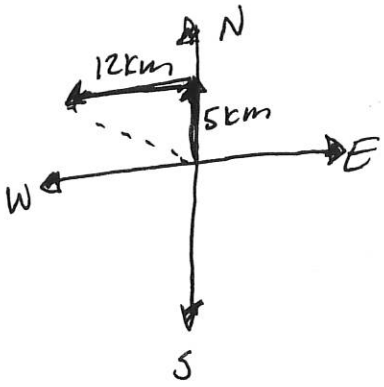
Problem Set #5 Solutions

1. a. Total distance = 5km + 12km = **17km**

b. Total displacement = distance from start = $\sqrt{5km + 12km}$ = 13 km



c. Speed = distance / time

$$t_1 = \frac{5\text{ km} \mid 1\text{ hr}}{6\text{ km}} = \frac{5}{6}\text{ hr} = 0.83\text{ hr}$$

$$t_2 = \frac{12\text{km} \mid 1\text{hr}}{5\text{ km}} = \frac{12}{5}\text{ hr} = 2.4\text{ hr}$$

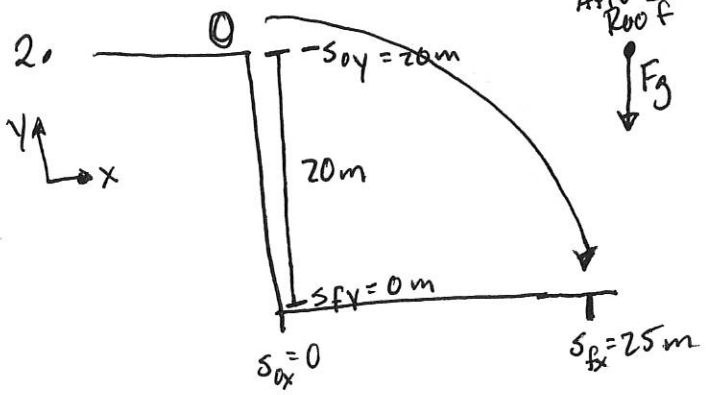
$$t_{total} = 3.23\text{ hr}$$

$$\text{speed} = \frac{17\text{km}}{3.23\text{hr}} = 5.26\text{ km/hr}$$

d. Velocity = $\frac{\text{displacement}}{\text{time}} = \frac{13\text{km}}{3.23\text{hr}} = 4.02\text{ km/hr}$ North West

e. average acceleration is sort of meaningless here (this is not a good question! Sorry!)

2.



FBD After Leaves Roof

After Ball Leaves

Y	X
$a = -9.8\text{ m/s}^2$	$a_x = 0\text{ m/s}^2$
$s_{oy} = 20\text{m}$	$s_{ox} = 0\text{m}$
$s_{fy} = 0\text{m}$	$s_{fx} = 25\text{m}$
$v_{oy} = 0\text{ m/s}$	$v_{ox} = ?$ } the same
$v_{fy} = ?$	$v_{fx} = ?$ } the same

$t_o = 0s$

$t_f = ?$

a. $s(t)_y = s_{oy} + v_{oy}t + \frac{1}{2}a_y t^2$

$s(t_f)_y = s_{fy} = 20 + 0 \cdot t_f + \frac{1}{2}(-9.8)t_f^2$

$0 = 20 + (-4.9)t_f^2$

$-20 \quad -20$

$\frac{-20}{-4.9} = \frac{-4.9t_f^2}{-4.9}$

$\sqrt{t_f^2} = \sqrt{4.08}$

$t_f = 2.02\,s$

2. b. $s(t)_x = s_{0x} + v_{0x}t + \frac{1}{2}a_x t^2$

evaluate at $t_f = 2.02$

$s(t_f)_x = s_{fx} = 25 = 0 + v_{0x}(2.02) + \frac{1}{2}\cdot 0 (2.02)^2$

$25 = v_{0x}(2.02)$

$12.37 \text{ m/s} = v_{0x}$

c. $a = \frac{\Delta v}{\Delta t}$ $\quad \Delta v = 12.37 - 0 = 12.37 \text{ m/s}$

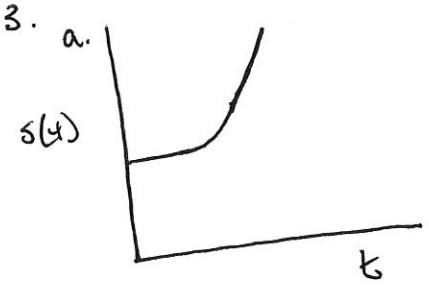
$\Delta t = 0.1 - 0 = 0.1 \text{ s}$

$\frac{12.37}{0.1} = 123.7 \text{ m/s}^2$

d. $s(t)_x = \begin{cases} 61.85t^2 & 0 \le t \le 0.1 \\ 0.6185 + 12.37(t-0.1) & 0.1 < t \end{cases}$

$s(t)_y = \begin{cases} 20 & 0 \le t \le 0.1 \\ 20 - 4.9(t-0.1)^2 & 0.1 < t \end{cases}$

3. a.



b. $10 + \frac{3}{4}(12-8) = s(12)$

$10 + \frac{3}{4}(4) = 10 + 3 = 13 \text{m} = s(12)$

c. $5 + \frac{5}{16}(t-4)^2 = s(t)$

$5 + \frac{5}{16}(6-4)^2 = s(6)$

$5 + \frac{5}{16}(2)^2 = 5 + \frac{5\cdot 4}{16} = 5 + \frac{5}{4} = 6.25$

$s(6) = 6.25 \text{m}$

4.

A. At B the object is stopped because the velocity (slope of the graph at B) there is zero. Between E and F the slope of the graph is the least. Therefore the velocity is the least (if we are not counting the stop).

B. From B to C the object is speeding up in the negative direction, same thing in between F and. G and part of the way between E and F the object is speeding up

C. C to just past E it is slowing down. It is also slowing down between A and B

D. It is turning turning around at B .

5. (Honors)

The object is speeding up in the negative direction until t_1. Then the object speeds up and then slows down in positive direction until t_2 when it stops at a position that is not as far away as the first position. Then the object speeds up in the negative direction until t_3. Then the object speeds up and the slows down in the positive direction until at t_4 it stops at a position that is not as far away as either the first or second positions. Then the object speeds up in the negative direction.