Grading rubric:

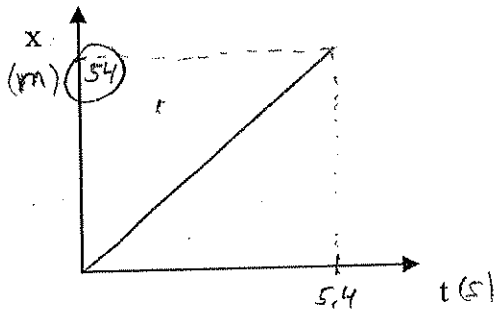
12 pts - shape of graphs (2 pts. each)

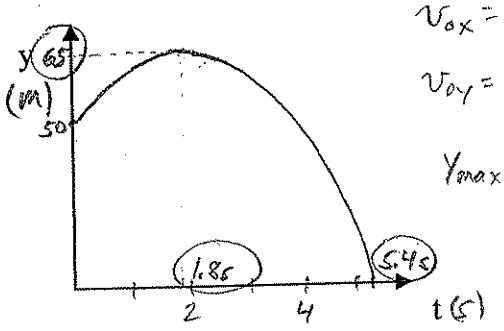
4 pts. - units of m, m/s, m/s^2, s

6 pts. - critical values: $X_f, V_x, Y_{max}, t_1, t_f, V_{oy}, V_{fy}, a_y$

22 ptr.

27. (22 points) A rock is thrown with an initial speed of 20 m/s at an angle of 60 degrees above horizontal off the edge of a cliff that is 50 m high. Sketch the graphs of vertical and horizontal displacement, velocity, and acceleration as functions of time. Be sure to label the graphs to indicate the numerical values and units for any critical points during the flight of this rock. Show relevant calculations in the space to the right of the graphs.



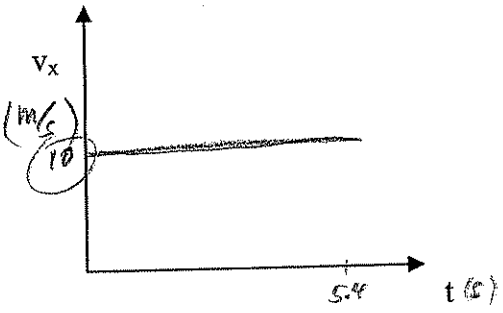


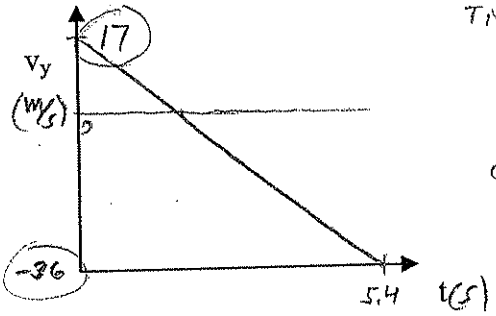
$v_{0x} = v_0 \cos 60° = \boxed{10\ m/s}$

$v_{0y} = v_0 \sin 60° = \boxed{17.3\ m/s}$

$y_{max} = \frac{v_{0y}^2}{2g} = \frac{(17.3\ m/s)^2}{2(9.8\ m/s^2)}$

$y_{max} = \boxed{15.3\ m}$ (above launch ht.)





Time to y_{max}:

$t_1 = \frac{v_{0y}}{g} = \frac{17\ m/s}{9.8\ m/s^2} = \boxed{1.77\ s}$

check: $t_1 = \sqrt{\frac{2y}{g}} = 1.77\ s$ ✓

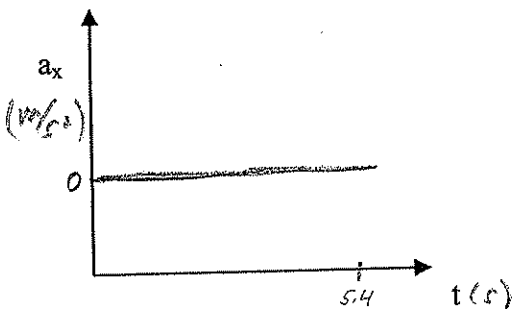
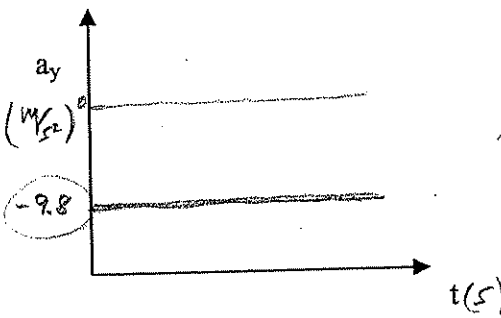
Time from y_{max} to y_f:

$y = 50\ m + 15.3\ m = \boxed{65.3\ m}$

$t_2 = \sqrt{\frac{2(65.3\ m)}{9.8\ m/s^2}} = 3.65\ s$

$t = t_1 + t_2 = \boxed{5.42\ s}$

$v_{yf} = g t_2 = (-9.8\ m/s^2)(3.65\ s)$

$v_{yf} = \boxed{-35.8\ m/s}$

$x = v_x t = (10\ m/s)(5.42\ s) = \boxed{54\ m}$