DO NOT TURN THIS PAGE!!!!!

NAME: KEY

PHYSICS 4A
FALL 2013
EXAM 1

PARTIAL CREDIT will be given so do what you can and make sure that you show all work for each problem. **No credit will be given if no work is shown**. The point value of each question is indicated.

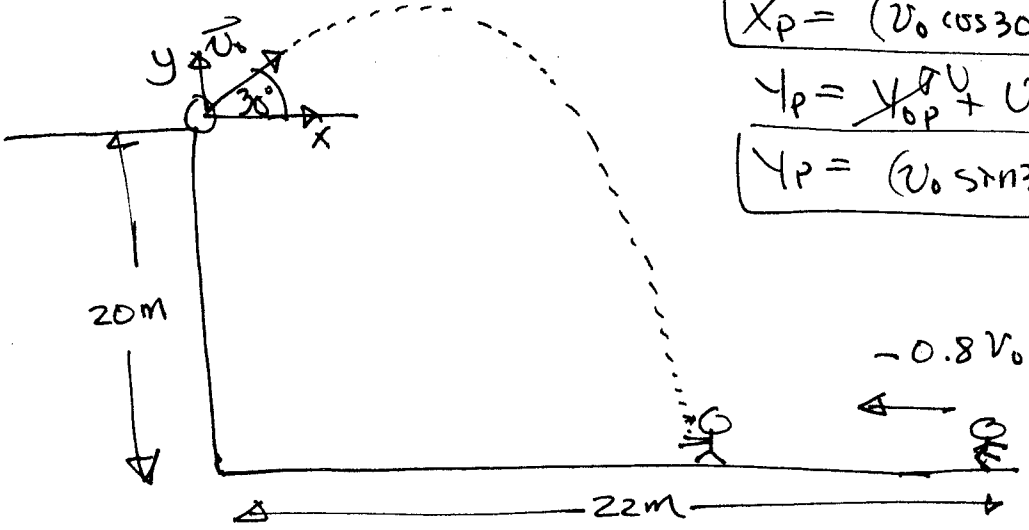
1. Just as you throw a package from the top of a 20 m high building with initial speed V_o at an angle of 30° with the horizontal, your friend, who is running toward the building at speed $0.8V_o$, is 22 m away. (15 pts)
   a) Calculate V_o in order for your friend to catch the package.
   b) How far from the building does your friend catch the package.
   c) Calculate the speed at which the friend catches the package.

$x_p = x_{op} + v_{op(x)}t + \frac{1}{2}a_{p(x)}t^2$

$x_p = (v_o \cos 30)t$

$y_p = y_{op} + v_{o(y)}t + \frac{1}{2}a_{p(y)}t^2$

$y_p = (v_o \sin 30)t - 4.9t^2$



$x_f = x_{of} + v_{of(x)}t + \frac{1}{2}a_f t^2$

$x_f = 22 - 0.8v_o t$

$y_f = -20\,m$

a) $x_p = x_f$

$(v_o \cos 30)t = 22 - 0.8v_o t$

$1.67v_o t = 22$

$v_o t = 13.2$

$y_p = y_f$

$\frac{1}{2}v_o t - 4.9t^2 = -20$

$\frac{1}{2}(13.2) - 4.9t^2 = -20$

$t = 2.3s$

$v_o = 5.7\frac{m}{s}$

b) $x_p = (5.7)\cos 30\,(2.3)$

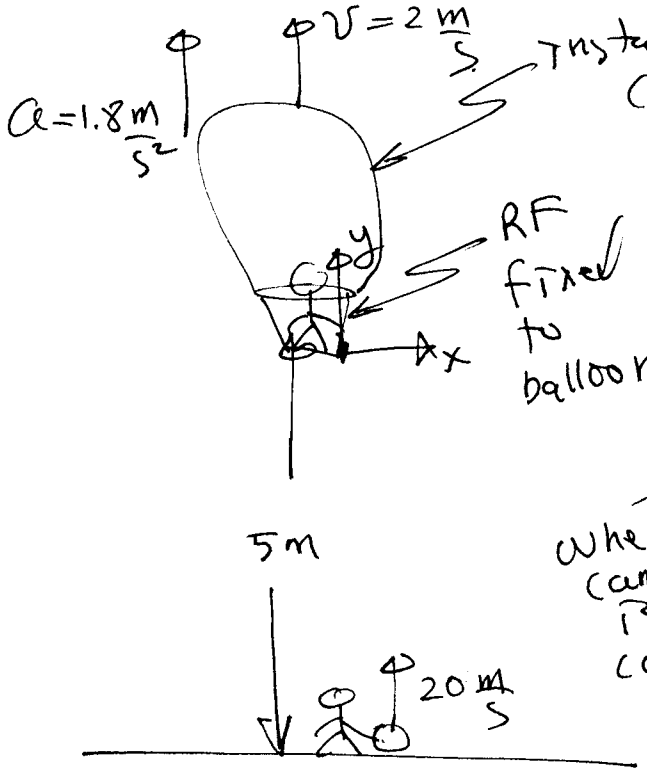
$x_p = 11.35\,m$

c) $v_{xp} = \frac{dx_p}{dt} = v_o \cos 30 = 4.9\frac{m}{s}$

$v_{yp} = \frac{dy_p}{dt} = v_o \sin 30 - 9.8t = -19.7\frac{m}{s}$

$v = \sqrt{v_{xp}^2 + v_{yp}^2} = 20.3\frac{m}{s}$

2. A hot air balloon has just lifted off from rest and is rising upward at a rate of 1.8 m/s^2. Suddenly one of the passengers realizes she has left her camera on the ground. A friend picks it up and throws it straight upward with an initial speed of 20 m/s. The passenger is 5.0 m above her friend and moving at 2.0 m/s when the camera is thrown. Using a reference frame fixed to the balloon at the instant the camera is thrown. (15 pts)
   a) Calculate the position of the passenger when she catches the camera.
   b) Calculate the speed of the camera.
   c) Calculate the displacement of the camera.



a) $y_p = 0$ (moving w/ RF)

$y_p = 0$

b) $y_p = y_c$ when camera is caught!

$y_c = y_{oc} + v_{oc} t + \frac{1}{2} a_{cb} t^2$

$y_{oc} = -5\,m$

$v_{oc} = 20 \frac{m}{s} - 2 \frac{m}{s} = 18 \frac{m}{s}$

$a_{cb} = a_{cE} + a_{Eb}$

$= a_{cE} - a_{bE}$

$= -9.8 \frac{m}{s^2} - 1.8 \frac{m}{s^2}$

$a_{cb} = -11.6 \frac{m}{s^2}$

$y_c = -5 + 18t - 5.8t^2$

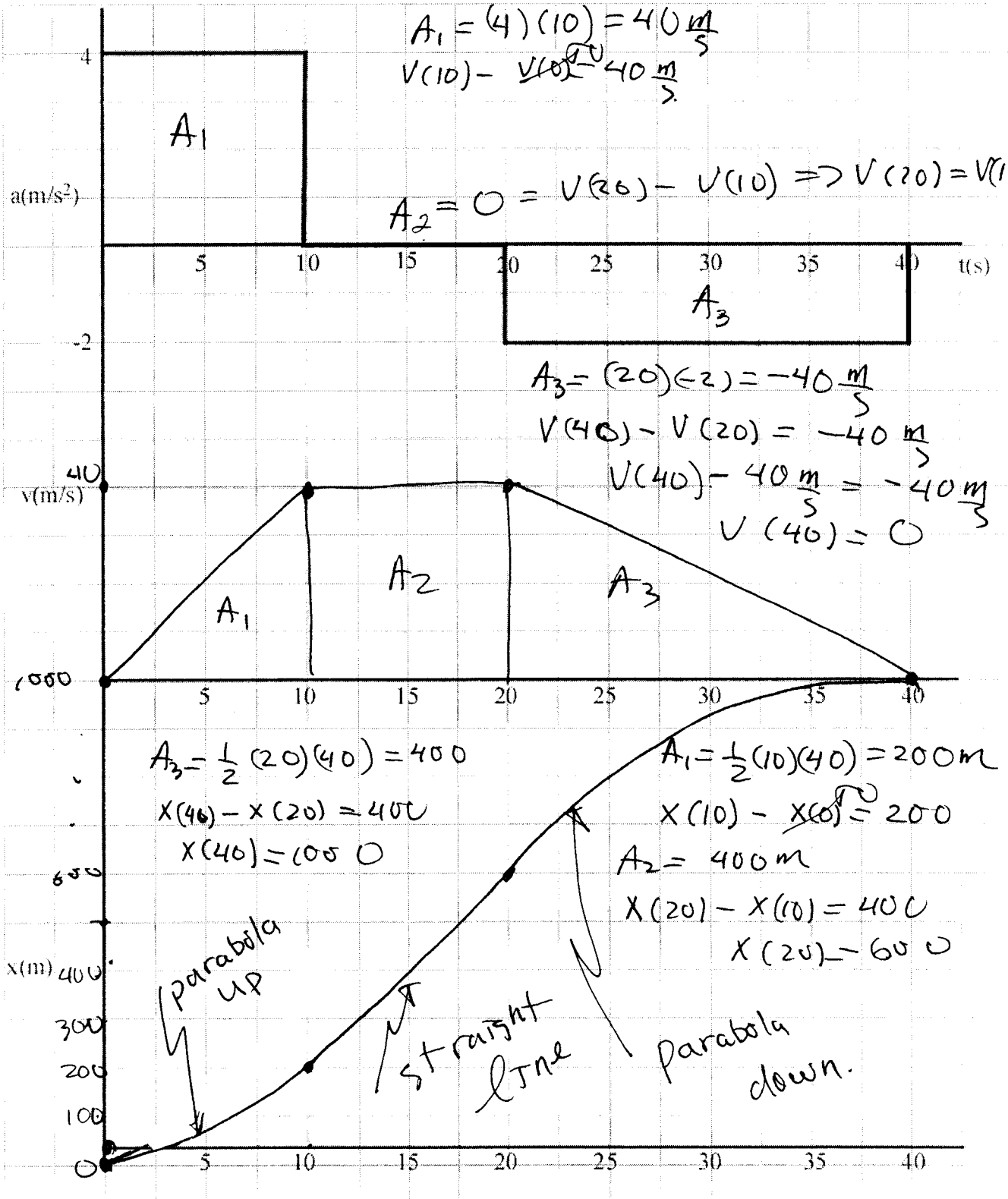
$y_p = y_c \Rightarrow t = 0.31$ or 2.80

$v_c = \frac{dy_c}{dt} = 18 - 11.6t$

$= 14.4 \frac{m}{s}$

c) $\Delta y = 5\,m$

3. Given the acceleration graph for a model car determine the v vs. t and x vs. t graph. Assume that at t = 0, x = 0 and v = 0. (10 pts)



4. Define the following terms **without any mathematical definitions**: (2 pt each)

1. Unit-vector dimensionless vector, one unit in length, used to specify direction in space

2. Inertial reference frame RF moving w/ constant $\vec{v}$

3. Projectile Any object given an initial velocity then follows path determined by gravity and air resistance

4. Trajectory path of motion of a projectile

5. Commutative Law of Vector Addition Vectors can be added in any order.