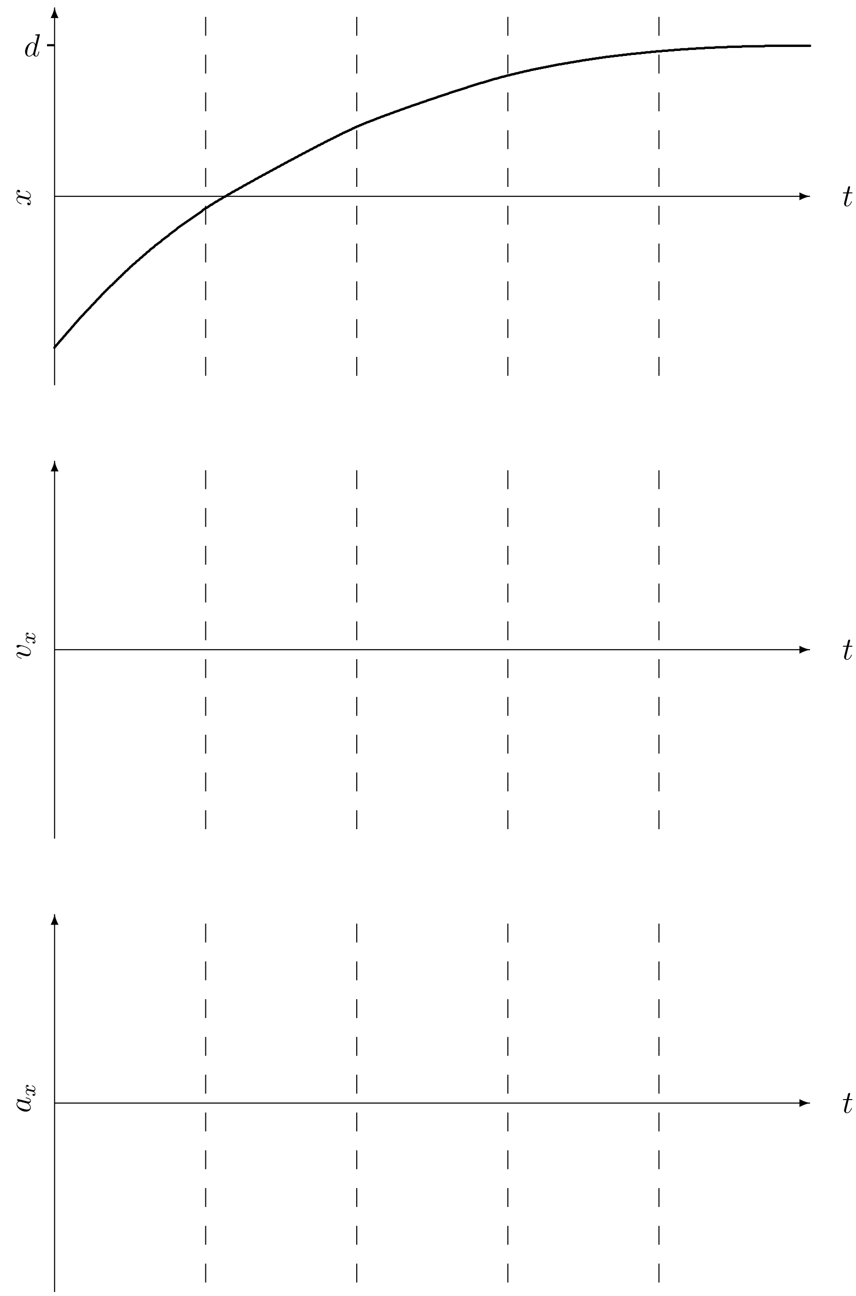
Assignment 1; Phys 185 Name ____________

Note: You can ask me for help; for example, have me check if an answer is correct. Talk to me: you'll learn some physics, and that's the point of the course.

1. (20 points) The top graph displays how position depends on time for an object that gradually, but ever more slowly, approaches $x = d$. Make a qualitative sketch of the corresponding velocity versus time and acceleration versus time graphs for this motion.



2. (40 points) The distance from London to Sydney is 1.70×10^7 m. You take a supersonic flight that covers this distance in exactly $T = 2.00$ hours. Say the flight takes a time t_a to accelerate from rest, reaching a constant cruising speed of v_c, and then while landing, takes the same time t_a to decelerate. For a commercial flight that will be taken by people with varying health conditions, the magnitude of the horizontal component of the acceleration imposed on the passengers should not exceed $2g$ ($g = 9.80$ m/s^2) for longer than three minutes. Calculate t_a for this maximum $a_x = 2g$, and determine whether this flight can be safe.

3. (40 points) You launch a projectile on a level surface on a planet with acceleration due to gravity g, starting from $x_0 = y_0 = 0$, with initial speed v_0 and angle θ with the x-axis. But you're facing a strong horizontal wind, so that the motion has a non-zero $a_x = -w$, where w is a positive constant that stands for the magnitude of the acceleration due to the wind.

(a) Write down the equations for position and velocity components as a function of time:

$v_x(t) =$ $x(t) =$

$v_y(t) =$ $y(t) =$

(b) Find the *range* of the projectile: an equation for how far it will travel until it hits the ground again.

(c) Check your result: when you set $w = 0$, you should get the same equation for the range as you have in your class notes.

(d) The range is positive when $w <$ [an expression involving g and θ]. Find this inequality. Would it make physical sense for the range to be negative?

(e) See what happens when $w = g$ and $\theta = 45°$. Interpret your result in this case—what does the motion look like?

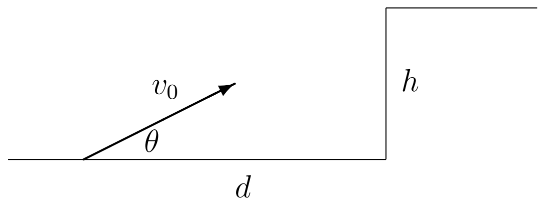
Extra Problems (not graded)

4. (0 points) You have a cannon that launches rubber balls with an initial speed of $v_0 = 12.6$ m/s. You set it at an angle $\theta = 38°$ above the horizontal, and shoot a ball at a high vertical wall standing a distance $l = 9.20$ m in front of the cannon.

(a) Find symbolic expressions for v_x and v_y at the instant before the rubber ball hits the wall. Then plug in the numbers and find their values.

(b) The instant *after* the rubber ball bounces off the wall, the y-component of its velocity remains the same as it was just before it hit the wall. But the x-component of its velocity reverses its direction (same magnitude, opposite sign). Find out where, relative to the cannon, the ball falls back to the ground.

5. (0 points) You're on a moon with no atmosphere, and acceleration due to gravity g. You have a cannon that can shoot a ball out beyond the crater wall with height h a distance d away. The angle of the cannon with the horizontal is θ, and the initial speed of the ball is v_0.



(a) Find an inequality describing the conditions under which the ball will make it out of the crater.

(b) Using your inequality, you should find that there is an angle below which the ball will never make it out, no matter how large v_0 is. Find this angle. Then explain what your result means—physically, what is going on?