1) (20 points) Women's Basketball.

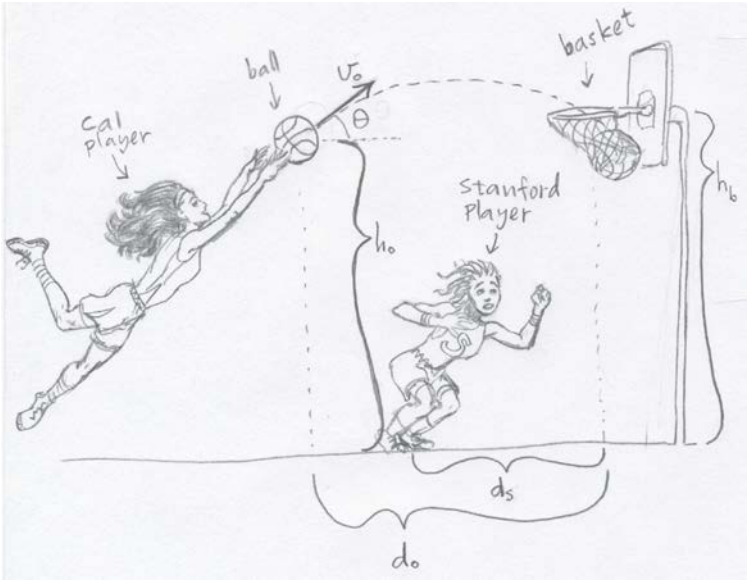
The score is tied as the clock winds down in the final seconds of the Cal − Stanford Women's Basketball game. A Cal player has the ball and makes a jump shot, releasing the ball from a height of h_o above the ground and a horizontal distance d_o from the basket, which is a height h_b above the ground, as shown in the diagram.

a) What is the magnitude of the ball's acceleration at the highest point of its trajectory? As always, show your work and/or justify your answer.

b) If the ball's trajectory is initially at an angle of θ above the horizontal, then what initial speed v_o is required so that the ball lands in the basket on its downward trajectory?

c) Expressed as a function of v_o and θ, what is the smallest value of the ball's speed as it travels from the Cal player to the basket?

d) A Stanford player standing a horizontal distance d_S from the basket starts to run towards the basket at the moment the ball is released. If the Stanford player starts from rest and then runs with a constant acceleration until she reaches the basket, what acceleration does she need to maintain to reach the basket at the same time that the ball does? Express your answer as a function of any combination of g, d_S, d_o, v_o and θ.



2) (20 points) Racecar driver

At a crucial moment near the end of a Nascar race, the driver of the car close behind the leader sees an opportunity and depresses the gas pedal in such a way as to make the car's velocity obey the following equation:

$v(t) = A + Bt^2$

where v is the car's velocity in m/s, t is the elapsed time in s, A and B are positive constants, and $t = 0$ is the exact time when the driver starts to make his move. The car is traveling along a straight piece of the racetrack for this entire problem.

a) What are the physical units of the constants A and B?

b) What is the formula for the acceleration of the car as a function of time starting at $t = 0$?

c) What is the formula for the position of the car along the track as a function of time starting at $t = 0$? Set the position of the car to 0 at $t = 0$.

d) If the numerical values of A and B are 80 and 6, respectively (with the units you found for each of them above), then how far does the car get after 2 seconds?