

5. [10 points] A mathematician proposed\* that the velocity,  $v(t)$ , of a sprinter running less than 300 meters might satisfy the differential equation  $\frac{dv}{dt} = k(v - R)$ , for some constants  $k$  and  $R$ . For a sprint, it makes sense that  $v(0) = 0$ .

(a) [4 points of 10] Find the general solution to this differential equation.

(b) [2 points of 10] Find the particular solution to the initial value problem. (Your answer may involve the constants  $k$  and  $R$ .)

(c) [4 points of 10] Linford Christie won the men's 100 meter race in the 1993 World Track Championships in a time of 9.87 sec. If one second into the race he had reached 51% of his maximum possible speed, find values for the parameters  $k$  and  $R$  in the problem.

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\* *J.B. Keller, in Physics Today, Sept. 1973*