

STUDENT VERSION

Animal Fall

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SIMIODE

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STATEMENT

The following is a problem from [1, p. 45, Exercise 28].

When an animal of mass m falls in air, two forces act on it: gravity, $m * g$, and a force due to air friction. Assume that the frictional force is proportional to the speed v .

- a) Write a differential equation for v based on Newton's second law, $F = m(dv/dt)$.
- b) Solve this differential equation.
- c) Assume that the animal is spherical, with radius a and density ρ . Also, assume that the frictional force is proportional to the surface area of the animal. Determine the terminal speed (speed of descent in steady state) as a function of a .
- d) Use your result in part (c) to interpret the following quote by J. B. S. Haldane[2] : "You can drop a mouse down a thousand - yard mine shaft; and arriving at the bottom, it gets a slight shock and walks away. A rat is killed, a man is broken, a horse splashes."
- e) Added: Offer any comments on how a given animal may mitigate or at least reduce this terminal velocity.

REFERENCES

- [1] Hobbie, Russell K. and Bradley J.Roth. 2007. *Intermediate Physics for Medicine and Biology, Fourth Edition.*, New York: Springer Science and Business Media.
- [2] Haldane, J. B. S. 1985. *On Being the Right Size and Other Essays.* Oxford UK: Oxford University Press.