Ball Drop Time Calculation

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1 Initial calculations

I am trying to calculate the exact time that it would take for
a smooth sphere (the ball) to reach the ground if free falling from 10 metre

Our variables are

- a = acceleration
- h = height
- t = time, which our target is 0

For our case, acceleration will be equal to the acceleration of gravity 9.8 m / s^2
And our initial height will be 10 m

So we know the kinematic equation of $h = vt + \frac{1}{2}at^2$ [1]

from which we can figure out the formula $t = \sqrt{\frac{2h}{a}}$

So we can fill in stuff + solve the $2h$ getting $\sqrt{\frac{20}{9.8}}$

And then finally do $\sqrt{2.04} = 1.428$ s

So we know that the time for our item to fall to the ground starting from 10 m,
WITHOUT factoring in air resistance is approximately 1.428 s.
But that's not exact, so now we're going to factor in air resistance.
Which is important because it can effect our times,
more info on drag force (air resistance) at [2]

2 Factoring in air resistance

First we need to define our sizes

$$m = 56\text{g} = 0.056\,\text{kg}$$
$$D = 6.55\text{cm} = 0.0655\,\text{m}$$
$$A = \pi(\frac{D}{2})^2 = 0.0033 \quad \text{[3]}$$

Now we'll define the environment we're in

$$T \approx 10\,^{\circ}\text{C} = 283.15\,\text{K}$$
$$E \approx 30\,\text{ft}$$
$$\rho \approx 1.2466 \quad \text{[4]}$$

Almost there, just need to define our forces

$$C_d \approx 0.470.2\,\text{cm} \quad \text{[5]}$$
$$a_g = 9.8$$

$$F_g = ma_g = (0.056)(9.8) \approx 0.549$$
$$F_d = \frac{1}{2}\rho v^2 C_d A = 0.6233(v^2)0.47 \times 0.0033 = 0.00096v^2 \quad \text{[6]}$$
$$F_n = F_g - F_d = 0.549 - 0.00096v^2 = 0.549$$

Finally we define our formulas which we'll use for calculations

$$a = a_g - a_d = a_g - \frac{F_d}{F_g} = 9.8 - \frac{0.00096v^2}{0.549} = 9.8 - 0.00175v^2$$
$$v = u + at$$
$$h = h - vt$$

3 Final calculations

We will do our first set of calculations in python, we will use $\Delta t = 0.01$ s

```
h = 10.0
v = 0.0
t = 0.0
dt = 0.01
while h > 0:
    a = 9.8 - 0.00175 * v**2
    v += a * dt
    h -= v * dt
    t += dt
    print(f"|{t:.2f}|{a:.2f}|{v:.2f}|{h:.2f}|")
```

t	a	v	h
0.00	9.8	0	10
0.01	9.80	0.10	10.00
0.02	9.80	0.20	10.00
0.03	9.80	0.29	9.99
0.04	9.80	0.39	9.99
...	...	...	...
1.39	9.49	13.48	0.52
1.40	9.48	13.57	0.38
1.41	9.48	13.66	0.24
1.42	9.47	13.76	0.11
1.43	9.47	13.85	-0.03

WAIT we hit negative height, that's bad so we need to go back a tiny bit. We'll use python again with a smaller time step ($\Delta t = 0.001$)
and an accuracy of 3 decimals. That changes our table to this:

t	a	v	h
0.00	9.8	0	10
0.001	9.800	0.010	10.000
0.002	9.800	0.020	10.000
0.003	9.800	0.029	10.000
0.004	9.800	0.039	10.000
...	...	...	...
1.429	9.465	13.843	0.045
1.430	9.465	13.853	0.031
1.431	9.464	13.862	0.017
1.432	9.464	13.872	0.003
1.433	9.463	13.881	-0.011

Just for the sake of time we'll go with 1.432, a height of 0.003 is good enough.
In conclusion, the time for it to hit the ground is around 1.43 s,
but if you want the real answer, I did more calculations to get

t	a	v	h
1.43274	9.46293	13.87838	0.00000

Another thing I did was turn the data I got into a graph, so here it is:

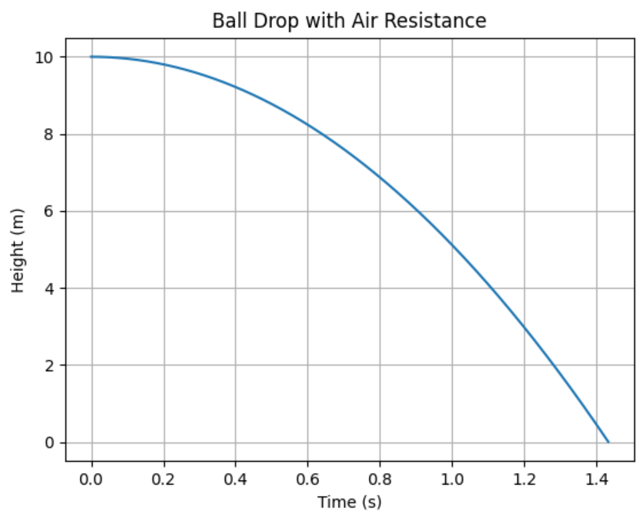

Figure 1: Graph of results

References

[1] Wikipedia Contributors. “Kinematic equations,” Wikipedia, Accessed: Feb. 12, 2026. [Online]. Available: https://en.wikipedia.org/wiki/Kinematics_equations

[2] NASA. “What is drag,” NASA, Accessed: Feb. 12, 2026. [Online]. Available: https://www1.grc.nasa.gov/beginners-guide-to-aeronautics/what-is-drag/

[3] Wikipedia Contributors. “Area of a circle,” Wikipedia, Accessed: Feb. 12, 2026. [Online]. Available: https://en.wikipedia.org/wiki/Area_of_a_circle

[4] Wikipedia Contributors. “Density of air,” Wikipedia, Accessed: Feb. 12, 2026. [Online]. Available: https://en.wikipedia.org/wiki/Density_of_air

[5] Wikipedia Contributors. “Drag coefficient,” Wikipedia, Accessed: Feb. 12, 2026. [Online]. Available: https://en.wikipedia.org/wiki/Drag_coefficient

[6] Wikipedia Contributors. “Drag (physics),” Wikipedia, Accessed: Feb. 12, 2026. [Online]. Available: https://en.wikipedia.org/wiki/Drag_(physics)