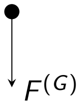
PHYS2350: Forces

Dr. Wolf

Fall 2024

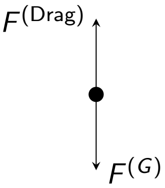
Part I(a): Free-body diagrams

(i)



$$\vec{a} = (0, -g)$$

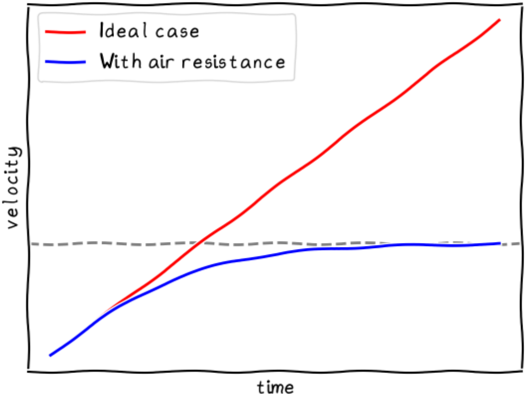
(ii)



$$\vec{a} = (0, 0)$$

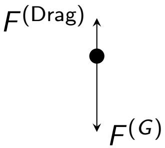
Part I(b) Graph

Your graphs should look something like this:



Part I(c): Free-body diagrams

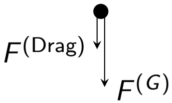
(i)



Acceleration is *down*:

$$|\vec{a}| < g$$

(ii)



Acceleration is *down*

$$|\vec{a}| > g$$

T

he drag force has the same *magnitude* at both instants, but a different *direction*

Part II - Calculating terminal speed

Assuming vertically downward is the positive direction

(a) $v > 0$ implies:

$$ma = mg - c_1 v - c_2 v^2$$

(b) $v < 0$ implies:

$$ma = mg + c_1 v + c_2 v^2$$

(c) For terminal velocity, $a = 0$. This implies:

$$0 = mg - c_2 v_T^2 \implies v_T = \sqrt{\frac{mg}{c_2}}$$

Checking units

Since $c_2 v^2$ is a force, c_2 must have units of:

$$\frac{\text{Force}}{(\text{velocity})^2} = \frac{\text{N}}{\text{m}^2/\text{s}^2} = \frac{\text{kgm}/\text{s}^2}{\text{m}^2/\text{s}^2} = \frac{\text{kg}}{\text{m}}$$