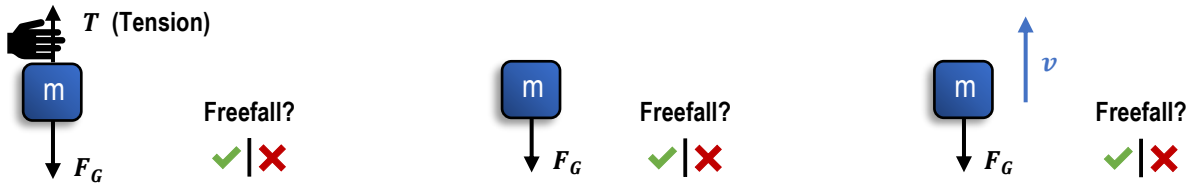
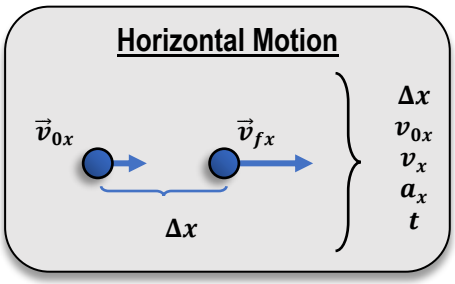
CONCEPT: INTRO TO VERTICAL MOTION & FREE FALL

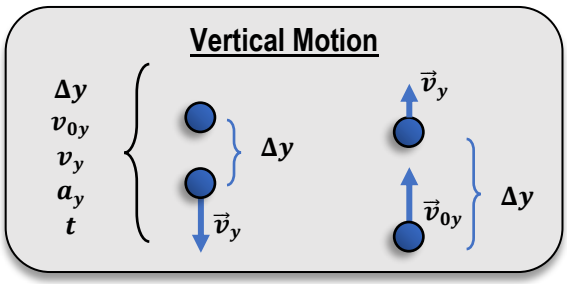
● Objects are in **free fall** if the *only* force acting on them is _____ (F_G), even if they're moving *upwards*.



● Objects in **free fall** experience _____, so we use **UAM Equations** to solve problems.



Horizontal UAM Equations
(1) $v_x = v_{0x} + a_x t$
(2) $v_x^2 = v_{0x}^2 + 2a_x \Delta x$
(3) $\Delta x = v_{0x} t + \frac{1}{2} a_x t^2$
(4) $\Delta x = \left(\frac{v_{0x}+v_x}{2}\right) t$



Vertical UAM Equations
(1) $v_y = v_{0y} + a_y t$
(2) $v_y^2 = v_{0y}^2 + 2a_y \Delta y$
(3) $\Delta y = v_{0y} t + \frac{1}{2} a_y t^2$
(4) $\Delta y = \left(\frac{v_{0y}+v_y}{2}\right) t$

- Objects in free fall always ***accelerate*** *down* with free fall acceleration **(g)**

g (on Earth) *always* = 9.8m/s² → (Regardless of weight!)

a_y = ± g = ____ 9.8m/s²

EXAMPLE: You drop a ball from rest from a 100 m-tall building. Calculate the ball's velocity right before hitting the ground.

MOTION w/ ACCELERATION
1) Draw Diagram & list 5 variables
2) Identify known & target variables
3) Pick UAM Eq. ***without*** "Ignored" Variable
4) Solve

● **PRO-TIP:** If you always take the UP direction as **positive**, then $a_y = -g = -9.8 \frac{m}{s^2}$

PRACTICE**:** A rock is thrown upward with a speed of 27.0 m/s from the roof of a 31.0-m-tall building. The rock doesn't hit the building on its way back down and lands in the street below**. (a)** What is the speed of the rock just before it hits the street? **(b)** How much time elapses from when the rock is thrown until it hits the street?

MOTION w/ ACCELERATION
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2) Identify known & target variables
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4) Solve

Vertical UAM Equations
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PRACTICE**:** A student throws a set of keys vertically upward to her sorority sister who is in a window 14.00 m above**.** The second student catches the keys 1.50 s later**. (a)** With what initial velocity were the keys thrown? **(b)** What was the velocity of the keys just before they were caught?

MOTION w/ ACCELERATION
1) Draw Diagram & list 5 variables
2) Identify known & target variables
3) Pick UAM Eq. ***without*** "Ignored" Variable
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Vertical UAM Equations
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