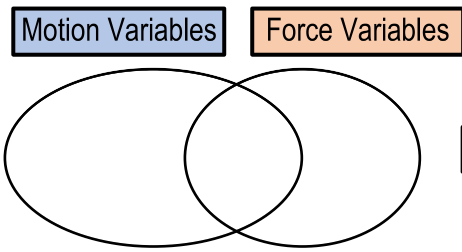
CONCEPT: SOLVING 1D MOTION PROBLEMS WITH FORCES

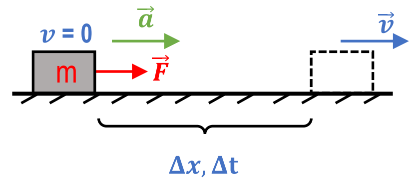
● **Remember:** Forces cause objects to accelerate, changing its speed **or** direction.

- To solve problems combining force variables & motion variables, use ________ ***and*** ____________________.

UAM EQs
(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) $\Delta x = \frac{1}{2}(v_{0x} + v_x) t$



$\Sigma F = ma$



- 5 variables, 3-4* EQs
- Need 3/5 knowns

- 3 variables, 1 EQ
- Need 2/3 knowns

EXAMPLE: A 20 kg block on a horizontal, frictionless surface is pushed and accelerates to 30m/s from rest in 6s. Calculate the magnitude of the applied force exerted on the block.

FORCES
1) Draw FBD: W,F_A,T,N,f
2) Write $\Sigma F = ma$
3) Solve

● Acceleration a is the ________ between force & motion problems.

- If you get "stuck" using **F=ma**, use UAM equations to solve, and vice versa!

PROBLEM: An 800-kg car is traveling along a horizontal road directly towards a cliff. The driver notices and brakes, resulting in a 5,000-N net force slowing the car down. If the car's initial speed was 20 m/s and the car stops just before going over the cliff, how far away was the car from the cliff when the driver hit the brakes?

A) 1250 m
B) 0.03 m
C) 64 m
D) 32 m

UAM EQs
(1) $\mathbf{v_x = v_{0x} + a_x t}$
(2) $\mathbf{v_x^2 = v_{0x}^2 + 2a_x \Delta x}$
(3) $\mathbf{\Delta x = v_{0x} t + \frac{1}{2} a_x t^2}$
*(4) $\mathbf{\Delta x = \frac{1}{2}(v_{0x} + v_x) t}$

FORCES
1) Draw Free-Body Diagram
2) Write $\Sigma F = ma$
3) Solve

PROBLEM: A 1000-kg rocket is taking off from rest, accelerating vertically upward. During the first 20 seconds of its motion, the force of gravity on the rocket (acting downwards) is 10,000 N, the engines provide 25,000 N of thrust (upward), and the average force of air resistance opposing the rocket's motion is 5,000 N. What is the rocket's velocity after 20 s?

A) 200 m/s
B) 400 m/s
C) 600 m/s
D) 800 m/s

UAM EQs
(1) $\mathbf{v_x = v_{0x} + a_x t}$
(2) $\mathbf{v_x^2 = v_{0x}^2 + 2a_x \Delta x}$
(3) $\mathbf{\Delta x = v_{0x} t + \frac{1}{2} a_x t^2}$
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FORCES
1) Draw Free-Body Diagram
2) Write $\Sigma F = ma$
3) Solve