Unit 3: Dynamics

3.1 Newton's Laws

Dynamics: the study of the forces that cause change in a system.

A force is a push or a pull exerted on an object. Forces can cause objects to speed up , slow down , or change direction as they move.

Newton's Laws

1st: An object at rest will remain at rest and an object travelling at a constant velocity will continue travelling at a constant velocity unless acted upon by an unbalanced force.

ex. A car accelerates around a corner and encounters ice. When the car loses grip the car travels... in a line tangent to the curve where splippage occurred

ex. The old table cloth trick... the objects want to stay at rest

https://video.search.yahoo.com/yhs/search;_ylt=AwrWnfThzuFboEAA0RgPxQt.;_ylu=X3oDMTB0NjZjZzZhBGNvbG8DZ3ExBHBvcwMxBHZ0aWQDBHNlYwNwaXZz?p=tablecloth
ck&vm=r&type=dhm_A0LEX_set_bcr__alt__ddc_srch_searchpulse_net&hspart=domaindev&hsimp=yhs-st_emea&ei=UTF-8&fr=yhs-domaindev-st_emea#id=2&vid=9f15cb65f5e5fce11ab7ae9f3b95ee18&action=view

2nd: The acceleration of an object is inversely proportional to its mass and directly proportional to the unbalanced force applied to it. It should be noted that Force is a vector.

From above we know that...

$\vec{a} \propto \frac{1}{m}$ also $\vec{a} \propto \vec{F}$

proportional

higher mass means lower acceleration

higher force → higher $\vec{a}$

combined we get

$\vec{F} \propto k m \vec{a}$

as it happens $k = 1$

$\therefore \vec{F} = m\vec{a}$

Note: one Newton is about equal to the force of gravity on an apple.

In the 2nd law, we are always referring to $\vec{F}_{net}$, the overall force on an object.

$\vec{F} = m\vec{a}$ gives units of $F = kg \cdot m/s^2$ = Newtons ex. A slingshot imparts a 10 N force on a 10 gram stone. What is the stones acceleration?

$\vec{F}_{net} = 10\ N$

$m = 10g = 0.01kg$

$\frac{\vec{F}}{m} = \frac{m\vec{a}}{m}$

$\vec{a} = \frac{10\ N}{0.01\ kg}$

$\vec{a} = 1000\ m/s^2$ [in the direction of the applied force]

Ex. A Formula-1 race car can do 0 to 100 km/h in 2.5 seconds. If the car and driver weigh 800 kg, what if the net force delivered by the car? [forward = ⊕]

given: $\vec{v}_1 = 0$

$\vec{v}_2 = 100 km/h = 27.\overline{7}\ m/s$

$\Delta t = 2.5\ sec.$

$m = 800\ kg$

$\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{27.\overline{7} - 0}{2.5s} = 11.\overline{1}\ m/s^2$

Now: $\vec{F} = m\vec{a}$

$= (800\ kg)(11.\overline{1}\ m/s^2)$

$= 8888.\overline{8}\ N$

or $9 \times 10^3\ N$ [forward]

3rd: For every action, there is an equal and opposite reaction

https://www.youtube.com/watch?v=kKKM8Y-u7ds

practice: photocopy #3 - 12, 19ac, 20ab, 21, 23, 25, 27, 30