Video Notes for Newton's Second Law

Central Questions:

- What does Newton's Second Law say?
- How can one use Newton's Second Law to predict the effect that changes in net force or mass have upon acceleration?

Newton's Second Law:

The acceleration (a) is directly proportional to the net force (F_{net}) experienced by the object and inversely proportional to the mass (m) of the object. These proportionalities are often expressed by the equation $a = F_{net} / m$.

Acceleration and Net Force

Acceleration is directly proportional to the net force.
By whatever factor the net force is changed, the acceleration is changed by the same factor.

Double F_{net} → Double a   Triple F_{net} → Triple a

Halve F_{net} → Halve a

Practice

An object has an acceleration of 24 m/s/s. If the net force acting upon this object were _______, then its new acceleration would be ______ m/s/s.

	Original Accel'n	Δ made to F_{net} (1st blank)	Δ made to Accel'n	New Accel'n (m/s/s)
#1	24 m/s/s	doubled	x 2	48 m/s/s
#2	24 m/s/s	tripled	x 3	72 m/s/s
#3	24 m/s/s	halved	÷ 2	12 m/s/s
#4	24 m/s/s	quartered	÷ 4	6 m/s/s

Acceleration and Mass

Acceleration is inversely proportional to the mass.
By whatever factor the mass is changed, the acceleration is changed by the inverse or reciprocal factor.

Double m → Halve a   Triple m → One-third a

Halve m → Double a

Practice

An object has an acceleration of 24 m/s/s. If the mass of this object were _______, then its new acceleration would be ______ m/s/s.

	Original Accel'n	Δ made to m (1st blank)	Δ made to Accel'n	New Accel'n (m/s/s)
#1	24 m/s/s	doubled	÷2	12 m/s/s
#2	24 m/s/s	tripled	÷3	8 m/s/s
#3	24 m/s/s	halved	x2	48 m/s/s
#4	24 m/s/s	quartered	x4	96 m/s/s

Changes to Both Variables

When both net force and mass are changed, you must make two changes to the acceleration value to determine the new value.
Be systematic. Take your time. Organize your solution. Apply the same principles.

Practice

An object has an acceleration of 24 m/s/s. If the net force were tripled and the mass were doubled, then its new acceleration would be ______ m/s/s.

Two changes: Triple F_{net}; Double m

Triple F_{net} ➡ Triple a ➡ x 3

Double m ➡ Halve a ➡ ÷ 2

a_{new} = (24 m/s/s) x 3 ÷ 2 = **36 m/s/s**