

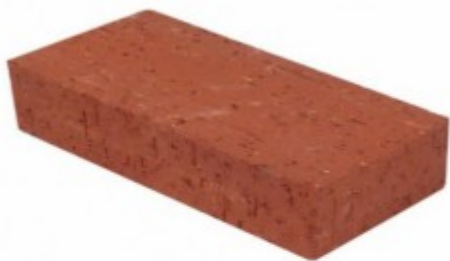
## **“Physics Gathered: A Visual Aid for Force and Mechanics Problems**

“Physics Gathered” is a set of physics simulation cards using the format of the existing card game “Magic: The Gathering”. Cards were generated using:

You can use the cards to lay down a simulation of just about any typical Force problem from Chapters 1-4 in the textbook.

Cards created Feb 2012 by Dr. Alex Antunes, artwork used without permission for educational use in classroom only, no assertion of rights is intended, product not intended for sale or distribution. Cards were created using the excellent M:TG card generator at <http://magic.falseblue.com/index.php>.

## Block



### Creature

mass = 10kg

$a_x = 0$  (initially at rest)

$a_y = 0$  (initially at rest)

*It's a red brick. It doesn't "do" anything on its own.*

1/1

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## Heavy Block



### Creature

mass = 25kg

$a_x = 0$  (initially at rest)

$a_y = 0$  (initially at rest)

*Shiny!*

1/1

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## Light Block



### Creature

mass = 2kg

$a_x = 0$  (initially at rest)

$a_y = 0$  (initially at rest)

*It might be lightweight, but it's still subject to the laws of physics!*

1/1

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## Floor



### Artifact

unmoveable

$y_a$  always zero (resists all vertical ('y') forces 100%, including gravity and  $F_n$ )

ignores x (has no effect on any 'x' forces or movements)

*Box not included!*

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## Friction



### Enchantment

resists movement

resists movement along its top (Resists movement along its surface based on how tightly the two surfaces are pressed together:  $F_f = \mu * F_n$ )

easiest to solve when flat (For a flat floor or similar,  $F_f = \mu * F_n$  and  $F_n = mg$  (unless someone is also pushing down). If on a ramp,  $F_n = mg * \cos(\text{angle of ramp})$ .)

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## Gravity



### Enchantment

always down

accelerates everything down ( $F_y = m * g$  where  $g = 9.8 \text{ m/s}^2$ .)

*(If you have mazz, I've got you.)*

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## Horizontal Pull



### Instant - Force

75 N

add  $F_x$  (Add  $F_x = 75\text{N}$  aka to the right (+x))

*Heave-ho!*

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## Horizontal Pull (reverse)



### Instant - Force

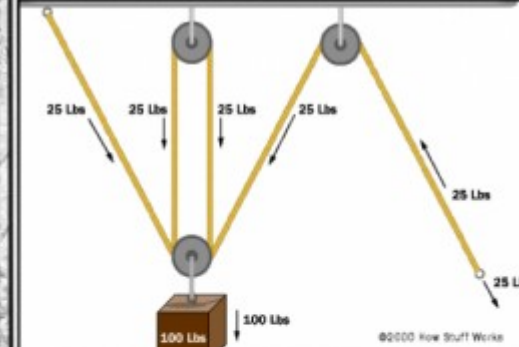
75 N

add  $F_x$  (Add  $F_x = -75\text{N}$  aka to the left (-x))

*What the heck is on the other end of the rope?*

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## Pulley



### Equipment

changes force directions

rope-able (Tension is same at both ends:  $T = F(\text{total})$  aka sum of all Forces acting on it, but it might be switching angles on you.)

connects accelerations (The accelerations of the objects at each end must be the same!  $a(1) = a(1)$ .)

*Don't freak out, it just changes directions.*

0/0

## Angled push



### Instant - Force

50 N

add  $F_y$  (Add  $F_y = 50\text{N} * \sin(\text{angle})$  down (-y))

add  $F_x$  (Add  $F_x = 50\text{N} * \cos(\text{angle})$  forwards (+x))

*is it just me, or does he have a big head?*

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## Angled push (reverse)



### Instant - Force

50 N

add  $F_y$  (Add  $F_y = 50\text{N} * \sin(\text{angle})$  down (-y))

add  $F_x$  (Add  $F_x = -50\text{N} * \cos(\text{angle})$  backwards (-x))

*Big-headed toddler forces duck in wrong direction.*

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## Horizontal Push



### Instant - Force

50 N

add  $F_x$  (Add  $F_x = 50\text{N}$  to the right (+x))

*The faster you push me, the further I go.*

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## Lift!



### Instant - Force

100 N

`add F_y(Add F_y = 100N up (+y))`

*Good form is important when fighting gravity.*

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## Horizontal Nudge



### Instant - Force

10 N

`add F_x(Add F_x = 10N to the right (+x))`

*Not all forces are nice.*

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## Horizontal Nudge (reverse)



### Instant - Force

10 N

`add F_x(Add F_x = -10N aka to the left (-x))`

*Same poke, different direction.*

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## Press!



### Instant - Force

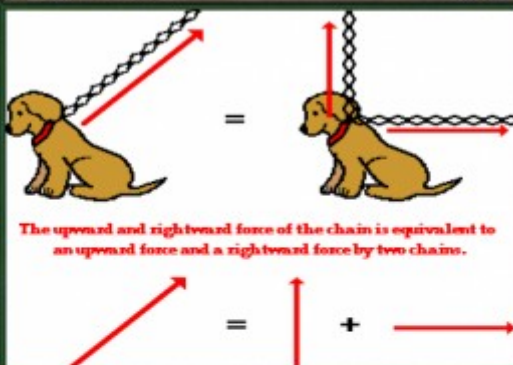
100 N

`add F_y(Add F_y = -100N up (-y))`

*You and gravity are teaming up.*

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## Angled pull



*The upward and rightward force of the chain is equivalent to an upward force and a rightward force by two chains.*

### Instant - Force

50 N

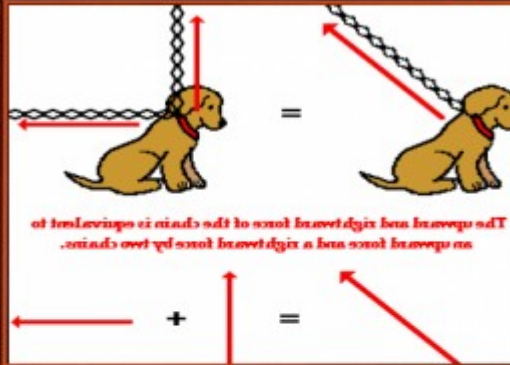
`add F_y(Add F_y = 50N * sin(angle) up (+y))`

`add F_x(Add F_x = 50N * cos(angle) forward (+x))`

*Pick any angle you want. Poor doggy.*

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## Angled pull (reverse)



*of tens leviage is nials add to axol hawet dgr a hua axol hawetp asT .nials ovet yd axol hawet dgr a hua axol hawetp as*

### Instant - Force

50 N

`add F_y(Add F_y = 50N * sin(angle) up (+y))`

`add F_x(Add F_x = -50N * cos(angle) backwards (-x))`

*Poor backwards doggy.*

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## Horizontal Push (reverse)



### Instant - Force

50 N

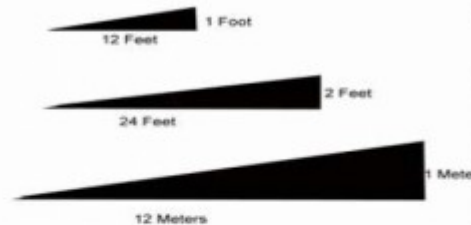
**add  $F_x$** (Add  $F_x = -50N$  aka to the left (-x))

*It's all a matter of perspective.*

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## Ramp

Examples of 1:12 Ramps



### Artifact

unmoveable

**variable angle**(An object pushed up or down with some Force(total) can be split into  $F_x = F(\text{total}) * \cos(\text{angle})$ ,  $F_y = F(\text{total}) * \sin(\text{angle})$ )

**may have friction**(Friction uses normal force  $F_n = F_y * \cos(\text{angle})$ )

*Remember downward forces include gravity (mg) but also anyone pushing down on it!*

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## Reverse direction!



### Sorcery - Force modifier

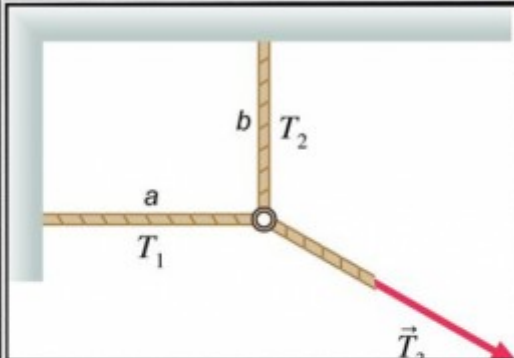
only useable on Force cards

**Reverse direction of forces** (New  $F_x = -F_x$  and New  $F_y = -F_y$ )

*It was either this, or make another dozen Force card variants.*

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## Floating ring



### Equipment

changes force directions

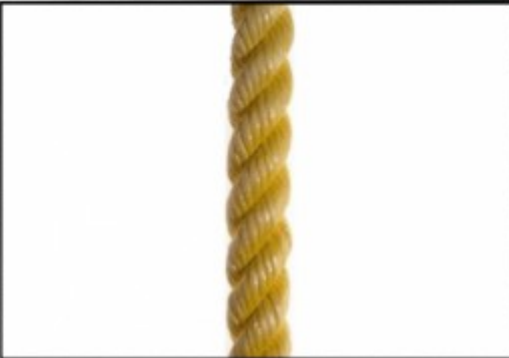
**rope-able**(Tensions must balance:  $T_{x(\text{in})} = T_{x(\text{out})}$  and  $T_{y(\text{in})} = T_{y(\text{out})}$ )

*It just connects things, it doesn't do any work itself!*

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0/0

## Rope



### Equipment

connects 2 items

**rope**(Tension is same at both ends:  $T = F(\text{total})$  aka sum of all Forces acting on it)

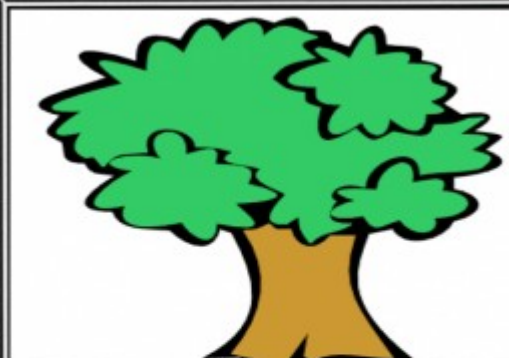
**connects accelerations** (The accelerations of the objects at each end must be the same!  $a(1) = a(2)$ .)

*Provides no forces, just connects things.*

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0/0

## Tree



### Artifact

unmoveable

**a always zero**(resists all forces 100%)

**Rope-able**(provides 100% Tension back to any applied rope force (in any direction))

*Resistance is handy.*

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