In the Marvel Cinematic Universe, Nebula is an adopted (stolen really) daughter of Thanos. Over the years, when she didn’t live up to his standards, he replaced parts of her body with machinery.
Before all of the experiments started, Nebula was 5 foot 11 inches tall (actually the height of Karen Gillan, the actress who plays her in the movie).
Determine how long Thanos needs to make Nebula’s cybernetic humerus, fibula, and femur.
<table>
<thead>
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<th>A</th>
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<th>D</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Height (in)</td>
<td>24.8</td>
<td>36.05</td>
<td>34.92</td>
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<tr>
<td>2</td>
<td>55.26</td>
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<td>55.27</td>
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<td>8</td>
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<td>9</td>
<td>57.63</td>
<td>26.11</td>
<td>37.96</td>
<td>37.6</td>
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<td>26.63</td>
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<td>11</td>
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<td>26.31</td>
<td>37.75</td>
<td>37.6</td>
</tr>
<tr>
<td>12</td>
<td>58.33</td>
<td>26.84</td>
<td>38.5</td>
<td>38.8</td>
</tr>
</tbody>
</table>
How accurate were the size ratios in Antman?

The average height of a large ant is about 2-3 mm. Let’s assume they used a larger ant for Antman, so 3mm.
How accurate were the size ratios in Antman?

Antman is a little taller than this ant, plus he is not right next to it. Let’s assume Antman is 5 mm when small.
How accurate were the size ratios in Antman?
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How accurate were the size ratios in Antman?
Avenger’s BMI using Variation
Body Mass Index (BMI) varies directly with a person's weight in pounds and inversely with the square of their height in inches.

Black Widow

Height - 65 in
Weight - 131 lbs

\[
739.26 \times \frac{131}{65^2} \\
96843.06 \div 4225 = 22.921 \\
\]

Black Widow's BMI is 22.921
Captain America’s BMI

BMI = \frac{kw}{h^2}

BMI = 27

Height = 74 inches

Weight = 200 pounds

Solve for K \rightarrow

K = 738.045
THE HULK

Height: 7'9" (93 in)
Weight: 1225 lbs.
Constant (k): 738.045

\[
\frac{1225 \times (738.045)}{93^2} = \frac{904105.125}{8649} \approx 105
\]

Hulk's BMI = 105
Iron Man

Without Armor

- Height = 6'1" (73 inches)
- Weight = 225 lbs
- The equation is \( \text{BMI} = \frac{(739.26)(225)}{73^2} \)
- We simplify with multiplication
- \( \text{BMI} = \frac{166,333.5}{5,329} \)
- \( \text{BMI} = 31.21 \)

With Armor

- Height = 6'6" (78 inches)
- Weight = 425 lbs
- The equation is \( \text{BMI} = \frac{(739.26)(425)}{78^2} \)
- We simplify with multiplication
- \( \text{BMI} = \frac{314,185.5}{6,084} \)
- \( \text{BMI} = 51.64 \)
Black Widow

Height - 65 in
Weight - 131 lbs

\[
739.26 \times \frac{131}{65}^2
\]

\[96843.06/4225 = 22.921\]

Black Widow's BMI is 22.921
Ant Man

Normal

- Height = 6'0" (72 inches)
- Weight = 190 lbs
- The equation is $\text{BMI} = \frac{(739.26)(190)}{72^2}$
- Simplify with multiplication
- $\text{BMI} = \frac{140,459.4}{5189}$
- $\text{BMI} = 27.09$
Conic Sections with Marvel
Guardians Fight Scene
\[ y = -0.2x^2 + 0.1x + 4.1 \]
Graphing a Circle

Center: \((-0.16, -0.51)\)
Angle: 0

\[(x - a)^2 + (y - b)^2 = r^2\]

\[r = 2.4\]
\[-10 \rightarrow 10\]
\[a = 0.1\]
\[-10 \rightarrow 10\]
\[b = -0.1\]
\[-10 \rightarrow 10\]

\[(x - 0.1)^2 + (y + 0.1)^2 = 2.4^2\]
Inequalities

$$(x - 0.1)^2 + (y + 0.1)^2 \leq 2.4^2$$

Shield.png

Center: $(-0.14, -0.45)$
Width: 10.26
Angle: 0
Height: 9.27
Inequalities

\[(x - 0.1)^2 + (y + 0.1)^2 > 2.4^2\]
Thanos Hyperbola

\[
\frac{(x - 0.35)^2}{0.3^2} - \frac{(y - 1.8)^2}{0.8^2} = 1
\]
Student Examples

Flipping Burger Parabola
Landing on the ground

The ball will hit the ground at 14.438
Gimli Toss

Approximately where Gimli will land. (3.5, 3)

Landing point, if there were no obstacles. (0,0)

Vertex (8.488, 4.81)

(7.5, 4.75)

(5.4)
How fast are the Clones being created?
Clone Facts

• 200,000 units are ready
• 1 million more well on the way
• Jedi Master Sifo-Dyas was killed almost 10 years ago
• Group of young clones created about 5 years ago
• Due to growth acceleration, clones mature in half the time.
Probability with Sabacc
Sabacc Setup

**Rules of Sabacc**

There are 3 suits (called staves) — circles, triangles, and squares.
There are 20 cards in each stave (split between red and green) and 2 zero cards.
The 3 staves are of equal value.
The green cards have a positive value: +1, +2, +3, +4, +5, +6, +7, +8, +9, +10
The red cards have a negative value: -1, -2, -3, -4, -5, -6, -7, -8, -9, -10

**Cards**

- **Positive Stave**
  - Values: +1 to +10
  - Shapes: Circles

- **Negative Stave**
  - Values: -1 to -10
  - Shapes: Triangles

- **Zero Stave**
  - Values: 0
  - Shapes: Squares
Sabacc Rules

**Objective**
The object of the game is to score as close to zero as you can with your cards.

**Setup**
Choose someone to be the dealer. That player is the dealer for the first round, the player to their left is the dealer for the next round, and so on. The dealer also plays:

1. The dealer shuffles the deck. Then deals two cards facedown to each player, beginning with the player to the dealer's left. Players can look at their cards but should not show them to the other players.
2. The dealer places the remaining deck face down in the center of the group. This is the Draw Pile.
3. The dealer takes the top card from the Draw Pile and places it face up next to the deck. This is the Discard Pile.

**Gameplay**
The game is played in three rounds. Each player takes one turn per round. The player to the dealer's left always goes first. Each player has the option to gain a card, swap a card, stand, or junk. Players can never swap a card without receiving one in return.

1. Calculate your hand. Remember, green cards are positive numbers, and red cards are negative numbers. The object is to have cards with a score of zero. You should always have a minimum of two cards in your hand.
2. When it is your turn, choose one of the following options:
   a. Gain – take the top card from the Draw Pile. You may keep the card or you may discard. If you pick the option of discarding, you must discard before you draw.
   b. Swap – take the top card from the Discard Pile and place a card from your hand face up on the Discard Pile.
   c. Stand – you do nothing. Stand if you do not wish to take a card or discard on this turn.
   d. Junk – if you feel you cannot win with the cards in your hand then you can place all your cards face up in the Discard Pile and exit the game. - If only one player is left they instantly win the game.

End your turn and the player to your left begins their turn.

3. After each player has taken their turn that is the end of the round. The dealer rolls the Sabacc Dice. If the dealer rolls a double, all players cards are placed in the Discard Pile. The dealer then deals new cards to all players. Each player receives the same amount of cards that they discarded. If the dice are different, players keep their cards.

4. After all three rounds are played and the Sabacc Dice have been rolled the third and final time, all players show their hands by placing their cards face up in front of them. The player to the left of the dealer reveals their cards first, followed by the player to their left, and so on.

5. The player with the best hand wins! (see Winning Hands pages)
Sabacc Winning Hands

**WINNING HANDS**

A positive number (total score or individual card) is always better than an equal negative number.

**PURE SABACC**
Zero with exactly two rare cards.

**FULL SABACC**
Zero with exactly three rare cards.

**FLY**
Zero with four of a kind (except 10s) and a rare card.

**YEE-HAA**
Zero with one pair and a rare card.

**RYHLEI**
Zero with a positive three of a kind and a negative pair (or vice versa).

**SQUADRON**
Zero with four of a kind.

**CEE WHIZ**
Zero with these specific cards: four positions (1-6) and one negative (10) or four negatives (10-6) and one positive (11).

**STRAIGHT KEYHOLE**
Zero with a run of four.

**KANTHAS WILD**
Zero with three of a kind.

**RULE OF TWO**
Zero with two pairs.

**SABACC WITH MOST CARDS**
Zero with the most total cards.

**SABACC WITH HIGHEST VALUE CARDS**
Zero with the highest positive or negative card value.

**BEATS**

**BEATS**
Sabacc Winning Hands Continued

SABACC WITH HIGHEST SINGLE VALUE CARD
Zero with the highest single positive number card.
**If the positive number card total is the same, the higher positive number wins.**

BEATS

NULRHEK
Closet to Zero

BEATS

NULRHEK WITH POSITIVE SCORE
Closet to Zero with a positive number
**If players have the same total card sum and same integer, the positive number wins.**

BEATS

NULRHEK WITH MOST CARDS
Closest to Zero with the most cards
**If players have the same sum, the player with the most total cards wins.**

BEATS

NULRHEK WITH HIGHEST VALUE CARDS
Closest to Zero with the highest positive card total.
**The higher total of 13 (sum of +9 and +4) beats 12 (sum of +7 and +5).**

BEATS

SINGLE BLIND DRAW
If all scenarios prior result in a tie, each remaining player must take one card from the draw pile. The player closest to Zero wins.
**If players have the same number, the positive number wins.**
If players tie, they draw again until a winner is determined.
How fast is Yoda?
Yoda jump
Information

- Yoda is 2.2 ft tall
- Count Dooku is 6.3 ft tall
Geometry in Suicide Squad.2016

Feat. Dead Shot.

https://www.youtube.com/watch?v=C_sK64tcFqM
When Dead Shot was helping his daughter do homework, he and his daughter both discussed how to find the hypotenuse of a triangle. They discuss if Dead Shot were to shoot someone from the top of a building, they would need to know the angles. Though they did not give a specific examples, I thought it was a super cool and relevant.
In Futurama, Fry has a bank account with .93 cents dated back to year 2000. In the year 3000, he had 4.3 billion due to compound interest. The question is: what is the interest given that information? The interest is 2.25%.
More Futurama, because...it’s great.

- When Bender visits a hauntier mansion he sees 1010011010 written in red on a mirror above a fireplace,

- Which converts binary to decimal...

- 666
Family Guy
Street math
Where is Louie?

https://www.youtube.com/watch?v=stXG3np-BWE
Time = Distance/Speed
Explained by Dudes on a corner.

- During this Family guy scene, two guys are wondering where their friend is.
- After one presents the question, the other friend gives clues to the possible answer.
- One, we know Louie walks at about 5 miles per hour. Two, we know the distance to be traveled is 6.2 miles per hour. Three, we know he left his house around 2:15, it is currently 3:00 and he has yet to arrive.
- Since we know he isn’t at his destination, let’s figure out when he should be there.
- If Time = Distance/Speed; then Time = 6.2/5. Time = 1.24.
- However, we need to convert the .24 to mins by multiplying by 60 since there are 60 mins in an hour.
- Meaning, the final answer is 1 hour and 14.4 mins. So, Louie shouldn’t arrive for another 30 mins... if he didn’t stop by his girl's house.
Hard Knocks Cleveland Browns

Carl Nassib, member of the Cleveland Browns, 2018.

https://www.youtube.com/watch?v=uN9WSgeETCo
Compound Interest
Explained by Carl Nassib

The Situation.

- Carl Explains to his teammates a simple math equation to help them with their financial futures.
- He simply says if you have $1 million in an account receiving 10% interest, after 7 years, you will double your money.
- His answer shown equals, $1.948, almost doubling an investors money.

Carl's Problem

- \[ 1 \times 1.1 \times 1.1 \times 1.1 \times 1.1 \times 1.1 \times 1.1 \times 1.1 = 1.948. \]
- Simplified the equation is also, \[ A = (P)(1+\frac{R}{N})^{{N\cdot{T}}} \]
- \[ P = \text{Principle} \] and \[ T = \# \text{ of years} \]
- In this situation, \[ A = 1000000(1+.10/1)^{(1\cdot7)} = 1.948717.1 \text{ is correct.} \]
- Carl, part time financial advisor, full time football player; good luck finding a 10% compound interest.
Night School
Rooftop scene
Kevin Hart and the Gang try the jump.
https://www.youtube.com/watch?v=bgZWbi1o8bY
Solving Right Triangles

Teresa attempts to solve problem

- Teresa attempts to use the Pythagorean theorem when trying to solve a problem. Her friends want to estimate the distance between the rooftop of one building to the rooftop of another.
- Assuming the building is 15 feet tall and the distance between the buildings is 6 feet.
- She sets up the problem using the formula; $a^2 + b^2 = c^2$
- $15^2 + 6^2 = c^2$
- Before she can solve the problem, one of her friends jumps to the other building.
- Solving her problem; if she had a sweet TI-83 Plus calculator she would come with the answer of approximately 16.15 feet.
- Using the Law of Cosines, she could double check her answer setting up the problem; $c^2 = a^2 + b^2 - 2(ab)\cos C$
- The problem would be; $c^2 = 15^2 + 6^2 - 2(15)(6)\cos 90$.
- When solving this problem using a graphing calculator, the Answer will also read as 16.15 feet.
- Unfortunately for Kevin Hart and his team, they didn’t have a calculator and the next jumper didn’t make the leap.
Linear Equations

My wife and I were going to a baseball game in Atlanta along with my mom. The babysitter had to cancel at the last minute so we had to buy extra tickets to bring my son and my sister wanted to come also. We bought the original tickets with the military discount we weren’t able to get the other two with the discount so we ended up paying more for those with the military discount we paid. For Friday’s game the total was $70 for three with the discount and two without and Saturday’s game was $80 but we were only able to get two with a discount and three without. What was the difference between the two different types of tickets?

1. First let's figure what X and Y equals, X=discount tickets Y=no discount
2. Then set up your problem 3x+2y=$70 2x+3y=$80
3. Then find LCD of 3 and 2, which is 6 so problem will look like this now
   2(3x+2y=$70) = 6x+4y=$140
   -3(2x+3y=$80) =-6x-9y=-$240   *Solve
   -5y=-$100 *Divided by -5
   y=$20 ($20 for no discounted tickets)
Linear Equations

Now that we know $y = $20 we can find out $x$ by plugging in $y$ in the equation.

\[\begin{align*}
3x + 2(20) &= 70 \\
3x + 40 &= 70 \quad \text{*minus 40} \\
3x &= 30 \quad \text{*Divided by 3} \\
x &= 10 \quad \text{(Discounted tickets were $10)}
\end{align*}\]

So the price for discounted was $10 compared to $20 non discounted tickets.
Rational Equations

I am a mechanic in the Army and it usually takes me roughly all day or 6 hrs to do a service on a vehicle, but today my buddy Matt is working with me and it takes him 8 hrs to do the same type of service on the trucks. Together we should knock this out quicker, so how much quicker?

1. Write out how many hours it takes each person - Paul=6 hours, Matt=8 hours

2. Write out the equation

\[
\frac{S}{6} + \frac{S}{8} = \frac{6S+8S}{48} = \frac{48}{14}
\]

*Then divided by 14 on both sides

\[
S = \frac{24}{14} \approx 1.71 \times 3\text{ hrs}
\]

*Slightly over 3 hrs

TEAMWORK DIVIDES THE TASK & MULTIPLIES THE SUCCESS
Exponentials

It appears to be the start of a zombie apocalypse, we started the day with just one person infected now there's two, it appears that the rate is doubling what will happen by the end of the week if this trend continues and we don't stop it!?

\[ y = 1(1 + 1.00)^x = 2^x \]

1 = how many zombies started with
1.00 = growth rate

Day 1 = 2  Day 4 = 16  Day 7 = 128
Day 2 = 4  Day 5 = 32  The outbreak will eventually
Day 3 = 8  Day 6 = 64  get out of control!
TEAM-WORK

I clean ours platoon bay, it takes me 2 hours to clean up, a new guy just graduated from basic training, he needs 3 hours to finish what I do. If we clean bay together, how much time do we need to finish ours platoon bay?
P=platoon bay

using x/2+x/3=1
find out the GLN is 6

6(x/2+x/3=1)
simplifie the formula
3x+2x=6 > 5x=6   x=6/5
As the result, I found that if we work together to clean up our platoon bay, it takes us 1.2 hours to finish cleaning.

Team work
QUESTIONS / COMMENTS??
THANK YOU FOR ATTENDING!!

Contact Information

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How large is Simba’s Kingdom?
Dr. Strange’s Portals

• Dr. Strange has a certain spell he can cast that will open 60 random portals.

• If he is about to open 2 of these portals, how likely is it that he opens 2 of the 15 freezing portals?
JYN’S DISGUISE

Jyn needs to disguise herself as a Stormtrooper in order to infiltrate their base. The mean height for a Stormtrooper is 6 feet with a standard deviation of 0.3 feet.

Jyn is 5.25 feet. How likely is she to find a suit her size?
How fast did Woody and Buzz have to go to catch the truck?
Quicksilver's Speed

How fast can Quicksilver run?
According to one fan’s website, he calculated that the Stormtroopers only hit their target 4.2% of the time.

If you were in a battle with the Stormtroopers and had to cross an area where they could take 10 shots at you, what is the probability that at least one of them will hit you?
Now the big question!!!

Was the length of Rapunzel’s hair realistic?
Vision's Miss

Near the end of Captain America: Civil War, Vision is trying to hit Falcon but mis-aims and hits War Machine instead. What was the angle error of his aim?
AT WHAT RATE WOULD THE DEAD TAUNTAUN HEAT UP LUKE?
AT WHAT RATE WOULD LUKE COOL DOWN AFTER THAT?
Would they be able to load all of the gold on the wagon to make the get away?
Spiderman swings in a cosine pattern. He starts at the top of the building, swings down and back up to his original height before repeating the pattern. Create the formula to simulate his swing.
HOW LARGE IS THE CLONE ARMY?

WHAT GROWTH RATE WOULD BE NEEDED TO GET TO THAT SIZE IN TIME?
WHAT IS THE CIRCUMFERENCE AND AREA OF ATLANTIS?
Calculate Groot’s Growth Rate

12'4"

5'4"

10"

6"
HOW FAST DO THE AT-AT MACHINES MOVE? DID LUKE HAVE TIME TO SAVE HIS CO-PILOT?
How high would Buzz really have to jump from to bounce to the height of the plane?
HOW LARGE IS THE "A" ON THE AVENGERS TOWER?
Determine the launch conditions for R2-D2 to be able to successfully get the light saber to Luke.
Arlo & Family needs to know how much corn their silo will hold to feed them for an entire winter.
Based on the three times Loki “dies” in the Marvel Universe, approximately how many times did he fake his death over his lifespan?
HOW MANY TIMES WOULD YOU NEED TO ROLL WATTO'S CHANCE CUBE TO BE ABLE TO DETERMINE IT IS LOADED?
If Ernesto had everyone at the party wear Sombrero's in his 8,579 sqft mansion, how many square feet does each person take up? How many guests can attend with sombrero's on?
How long would it take to walk to Asgard?
WHAT IS THE SPEED OF THE POD RACERS?
HOW LONG WOULD IT TAKE TO THAW ARENDELLE?
How long would it take to repopulate Earth if half the population (humans, animals, and insects) were destroyed?
ESTIMATE THE SPEED OF THE CLOSING WALLS AND DETERMINE HOW MUCH TIME THEY HAD TO GET THEM STOPPED IN TIME.
IS THE SIZE OF THIS ELEPHANT SKULL REALISTIC?
How many people could fit in the ship shown in Infinity War?
HOW FAR DID LUKE AND LEIA SWING?
HOW LONG WOULD IT TAKE FOR THE SIGNAL TO REACH THE ENTIRE GREAT WALL?
How much could Antman lift if he had the strength of an ant?
WHAT CONDITIONS ARE NEEDED FOR C-3PO'S ODDS OF SUCCESS TO BE ACCURATE?
How many pounds per square centimeter would this web need to hold?
WHAT ARE THE SIZE RATIOS (DIAMETER, SURFACE AREA, VOLUME) BETWEEN THE DEATH STAR AND STAR KILLER BASE?
HOW MANY EXPLODING PUMPKINS ARE NEEDED TO COVER ENTIRE CASTLE AREA?
Assuming a constant deceleration, how far did the Milano travel during the crash?
WE KNOW HAN SHOT FIRST....

......BUT HOW BAD OF A SHOT MUST GREEDO HAVE BEEN TO MISS HAN SOLO FROM THIS DISTANCE?
THE TWILIGHT BARK IS A CANINE MESSAGING SYSTEM FROM 101 DALMATIANS.

HOW LONG WOULD IT TAKE THE MESSAGE TO REACH ALL OF LONDON?
WHAT WOULD THE INITIAL BLAST VELOCITY NEED TO BE FOR THE SHOCKWAVE TO NEARLY KNOCK TONY OVER?
RECREATE THE LASER REBOUND SCENE FROM STAR WARS TO DETERMINE IF THE SHOT WOULD HAVE MISSED EVERYONE
Based on the wing flap speed, how large is this eagle? Is it reasonable? (Inverse variation)
WHAT IS DRAX’S LAUNCH ANGLE AND INITIAL VELOCITY?
HOW LARGE IS THE DEATH STAR?