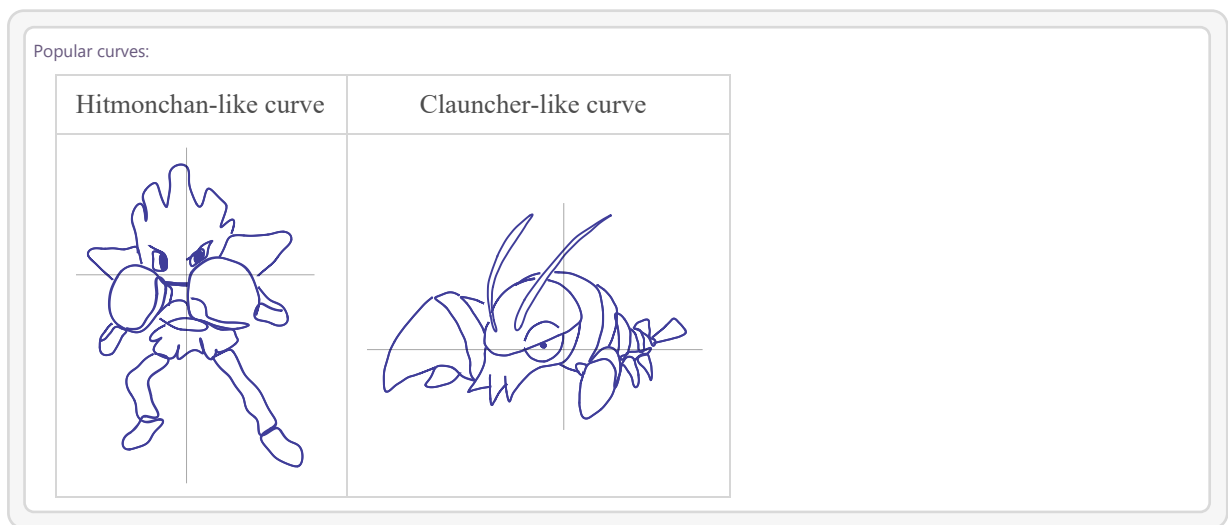


MATH:1260 Pokémath

The Mathematics of Pokémon Go[®]

Week 13 Monday, Spring 24



Plan for Today

- Module 3: To Be The Very Best!
 - Charge moves
 - Energy per turn

Reminders

- GW 11 in discussion Thursday
- HW 8 is due Wednesday
- Extra Credit is up on ICON
 - Make sure to discuss Extra Credit Project with me, we will agree on the possible points (up to 20)

– Newsweek!

Fast Moves and Charge Moves (Trainer Battles)

Fast Moves

Does some damage

Charges up the Charge Move with Energy

Charge Moves

Typically do more damage

Uses up Energy

Charge Move Mini Games

Can be shielded

- Each trainer has 2 shields per battle that can be used to negate a charge move.

Charge Moves

Charge moves require “Energy”

Each time you do a fast move, you store up energy.

A Pokemon can store up to 100 energy.



Fighting



Water

Turns

How many turns would it take to knock out Clauncher with Hitmonchan's Bullet Punch?

$$\frac{78 \text{ HP}}{3 \text{ dmg}} \cdot 2 \text{ turns} = 52 \text{ turns}$$

	attack	defense	HP	Fast Move	Power	Turns	Multiplier	unrdd damage	damage
Hitmonchan	76.1728268	79.1747116	53	Bullet Punch	6	2	0.8125	2.71862571	3
Clauncher	63.6394559	68.2960014	78	Smack Down	12	3	0.8125	3.91845251	4

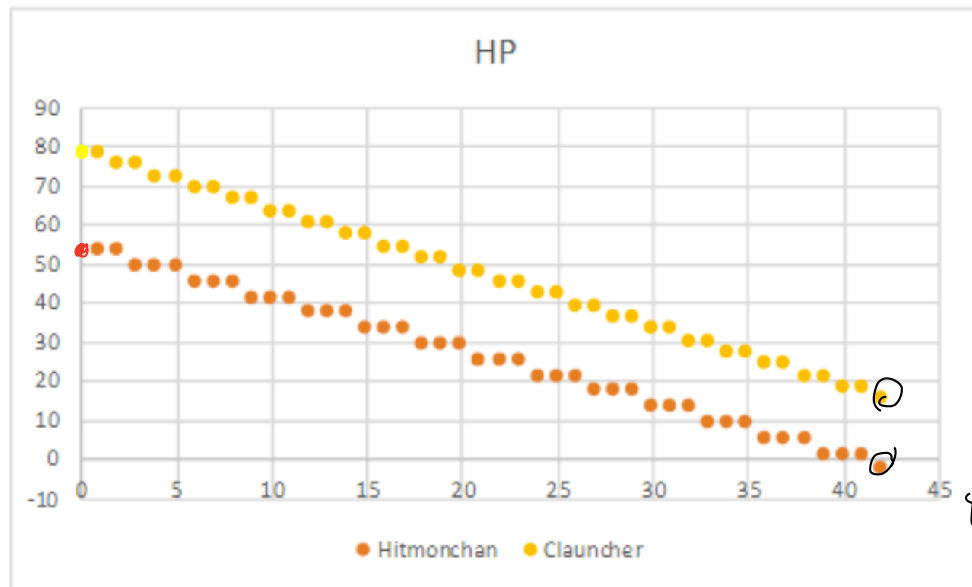
Turns

How many turns would it take to knock out Hitmonchan with Clauncher's Smack Down?

$$\frac{53 \text{ HP}}{4 \text{ dmg}} \cdot 3 \text{ turns} = 38 \text{ turns}$$

	attack	defense	HP	Fast Move	Power	Duration	Multiplier	unrdd damage	damage
Hitmonchan	76.1728268	79.1747116	53	Bullet Punch	6	2	0.8125	2.71862571	3
Clauncher	63.6394559	68.2960014	78	Smack Down	12	3	0.8125	3.91845251	4

Rate of Change, Who Wins?



Clauncher
wins!

turns

Hitmonchan vs Clauncher: Charging Up

[https://bulbapedia.bulbagarden.net/wiki/List_of_moves_\(GO\)](https://bulbapedia.bulbagarden.net/wiki/List_of_moves_(GO))

Each time Hitmonchan uses Bullet Punch: Hitmonchan gains 7 energy.



↳ 2 turns

charge move

Ice Punch requires 40 energy. So we will have enough after which **turn**?

$$\frac{40 \text{ energy}}{7 \text{ energy per hit}} = 6 \text{ hits}$$

$$6 \text{ hits} \cdot 2 \text{ turns} = 12 \text{ turns}$$

Clauncher charging up

→ 3 Turns

Each time Clauncher uses Smack Down: Clauncher gains 8 energy.



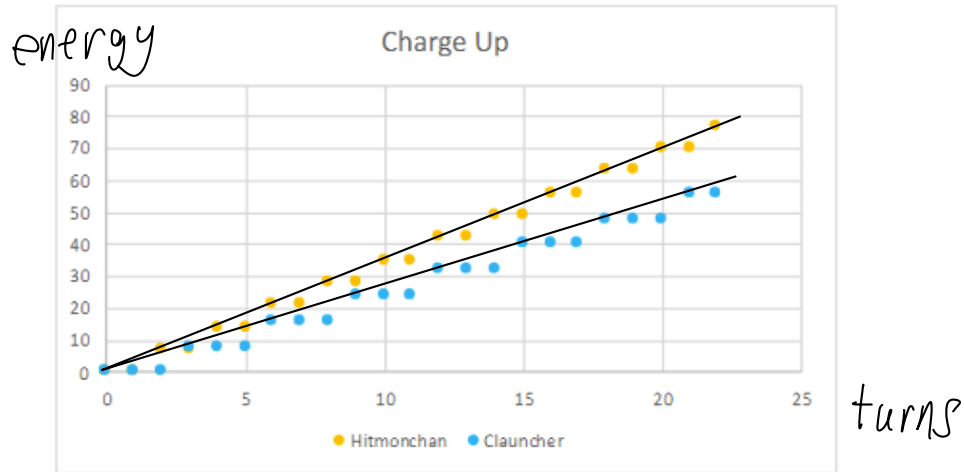
Charge Move

Top hat: Aqua jet requires 45 energy. So we will have enough after which **turn**?

$$\frac{45 \text{ energy}}{8 \text{ energy per hit}} = 5.625 \rightarrow 6 \text{ hits}$$

$$6 \text{ hits} \cdot 3 \text{ turns} = 18 \text{ turns}$$

Hitmonchan Charges up Faster



What “rate of change” could we observe using a linear model?

$\frac{\text{Energy}}{\text{turns}} \rightarrow \text{average energy per turn}$

Charge Moves change the Battle!

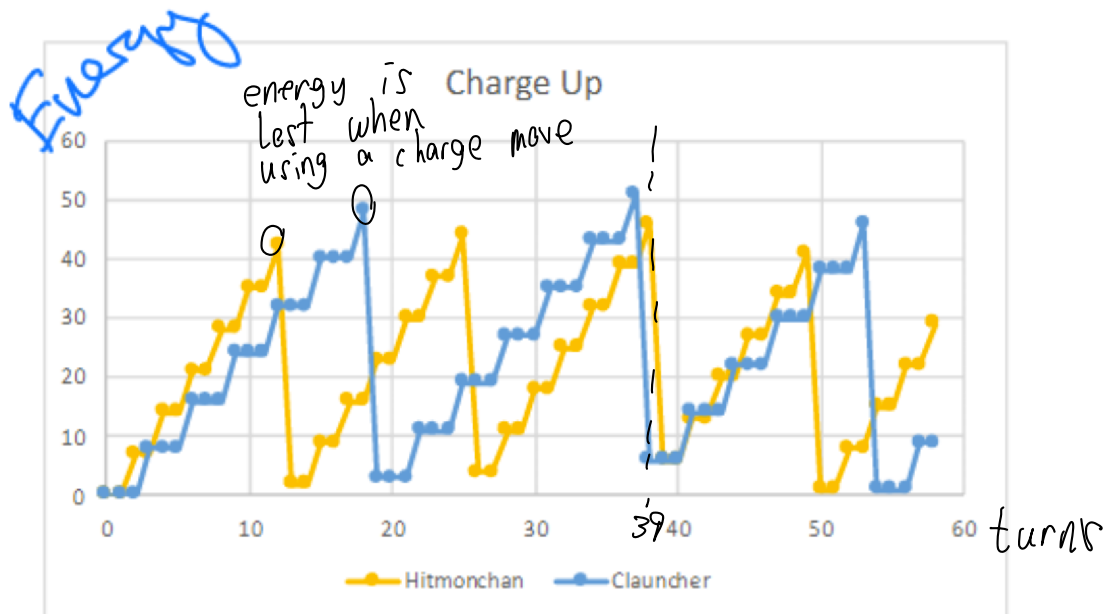


If both Pokémon use their charge moves as soon as they have enough energy...

Clauncher does a charge move on turns 19 and 38. Hitmonchan uses a shield on both, so they do 0 damage.

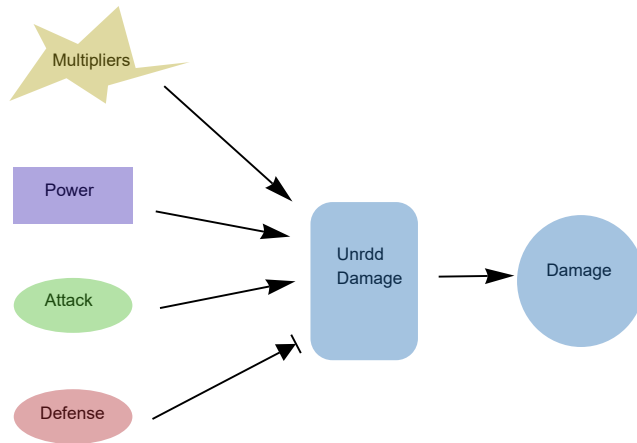
Hitmonchan does a charge move on turns 13 and 26. Clauncher uses a shield on both, so they do 0 damage.

On turn 39 Hitmonchan has 5 HP and Clauncher has 24 HP. Hitmonchan uses a charge move that will hit.



Hitmonchan uses the charge move Ice Punch.

Damage for Charged Moves



Unrounded Damage = *Attacker's Atk*

$$\frac{1}{2} * \text{Power} * \frac{\text{Attack}}{\text{Defense}} * \text{Multiplier}$$

Damage = *Defender's Def*

$$\lfloor \text{Unrounded Damage} \rfloor + 1$$

Multiplier has all the same options as before, but with a **new mini game multiplier**.

Type Effectiveness Chart

TYPE OF DEFENDING POKEMON

		DEFENSE																	
		NORMAL	FIRE	WATER	GRASS	ELECTRIC	ICE	FIGHTING	POISON	GROUND	FLYING	PSYCHIC	BUG	ROCK	GHOST	DRAGON	DARK	STEEL	FAIRY
Type of Attacking MOVE	NORMAL													-	✖			-	
	FIRE		-	-	+		+						+	-		-		+	
	WATER		+	-	-					+				+		-			
	GRASS		-	+	-				-	+	-		-	+		-		-	
	ELECTRIC			+	-	-				✖	+					-			
	ICE		-	+	+		-			+	+					+		-	
	FIGHTING	+					+		-		-	-	-	+	✖		+	+	-
	POISON				+				-	-				-	-			✖	+
	GROUND		+		-	+			+		✖		-	+				+	
	FLYING				+	-		+					+	-				-	
	PSYCHIC							+	+			-					✖	-	
	BUG		-		+			-	-		-	+			-		+	-	-
	ROCK		+				+	-		-	+		+					-	
	GHOST	✖										+			+		-		
	DRAGON															+		-	✖
	DARK							-				+			+		-		-
	STEEL		-	-		-	+							+				-	+
	FAIRY		-					+	-							+	+	-	

Type Effectiveness Multiplier

Find the **row** corresponding to the **type of the move** used by the attacking Pokemon. Find the **column** corresponding to the **type of the defending Pokemon**.

+ Means “super effective” so the multiplier is 1.6

-- Means “not very effective” the multiplier is .625

X Means “almost immune” so the multiplier is $(.625) \times (.625) = .390625$

Defenders with Two Types

If the defender has two types, do the process above for each type. Then multiply the two results together.

New Multiplier! Mini Game

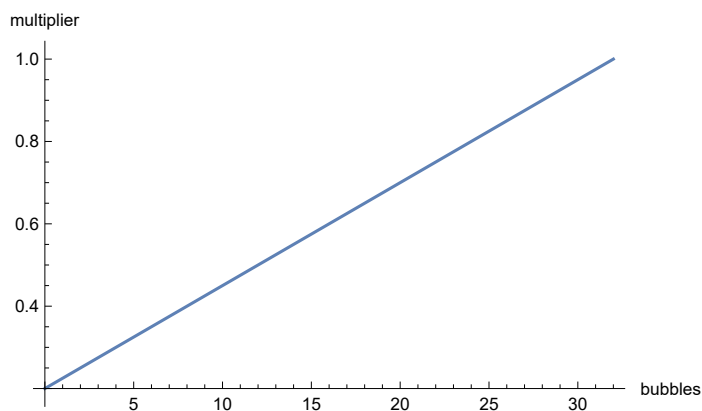
When you use a charge move during a battle a mini game will begin where animated bubbles move across the screen in a specific pattern based on the type of the charge move.

Each mini game has 32 bubbles.

Your score depends on how many of the bubbles you tap during the game.

Pokemon GO players are unclear how exactly the bubbles affect damage. The best hypothesis is

Mini Game Multiplier = $.2 + \text{bubbles} * .025$



So Now Who will Win?

Hitmonchan's Attack: 76.2

Clauncher's Defense: 68.2

Ice Punch's Power: 55

Hitmonchan's Type: Fighting

Clauncher's Type: Water

Ice Punch's Type: Ice

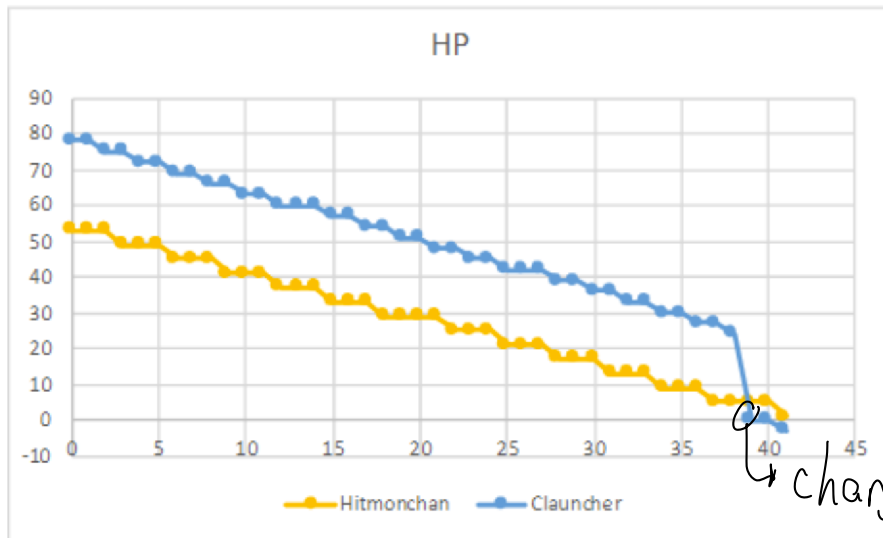
bubbles = 32

Dmg of Ice Punch

$$\frac{1}{2} \cdot 55 \cdot \frac{76.2}{68.2} \cdot 1.3 \cdot .625 \cdot 1 = 24.96$$

$$\rightarrow [24.96] + 1 = 25$$

So Now Who will Win?



change move hits

Hitmonchan wins!