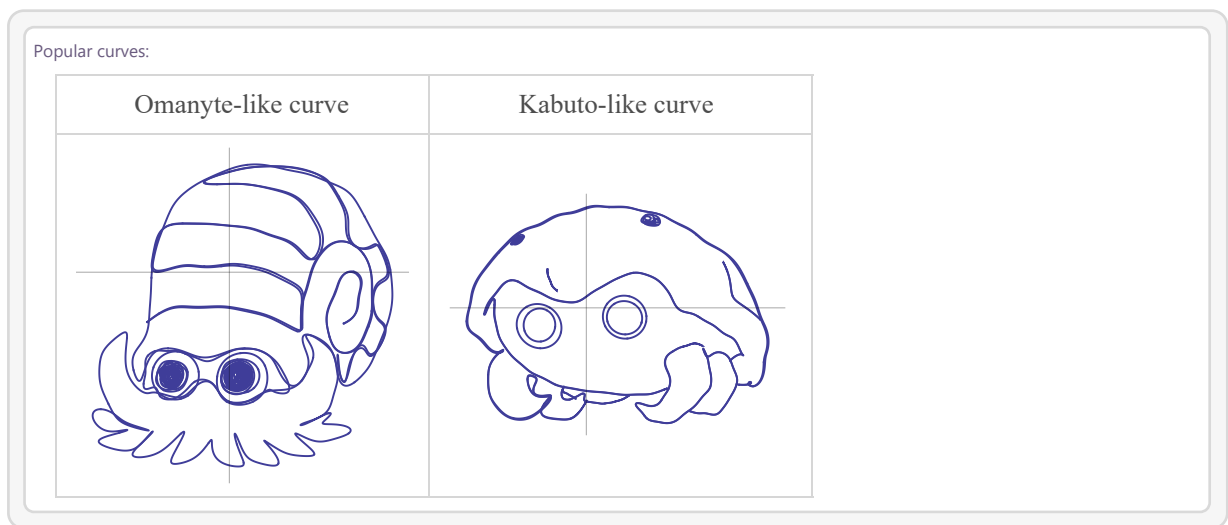


MATH:1260 Pokémath

The Mathematics of Pokémon Go[®]

Week 13 Wednesday, Spring 24



Plan for Today

- Module 3: To Be The Very Best!
 - Charge moves
 - Energy per turn, Average Energy per turn
 - Energy cost
 - Stat Buffs

Reminders

- GW 11 in discussion tomorrow.
- HW 8 is due tonight at midnight.
- HW 9 (last HW!) is due Wednesday April 24.
- Project 3 Stage 1 is due Wednesday April 24.
 - Battle Project!
- 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)

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**

Can **“buff” stats**

Predictions???



Water/Rock



Water/Rock

Fossil Pokémon: Ready for the Great League

Omanyte:

Lvl	CPM	Atk	Def		HP	CP
41	0.7953	135.201	126.4527	97.0266	97	1497.5777
						1497

Kabuto:

48	0.83029999	134.508598	127.8662	96.3148	96	1492.70654
						1492

Fast Move Summary

	Atk	Def	HP	Fast Move	Power	Energy	Turns	STAB	Effect.	Mult	Unred Dmg	Dmg	
Omanyte	135.201002	126.452702	97	water gun		3	3	1	1.2	1	1.56	2.47422969	3
Kabuto	134.508598	127.866198	96	mudshot		3	9	2	1	1.6	2.08	3.31876521	4



	Atk	Def	HP	Fast Move	Power	Energy	Turns	STAB	Effect.	Mult	Unred Dmg	Dmg	
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The Fast Move Only Battle

Average damage per turn taken by Kabuto from Omanyte's Water Gun?

$$\frac{3 \text{ dmg}}{1 \text{ turn}} = 3$$

Average damage per turn taken by Omanyte from Kabuto's Mudshot?

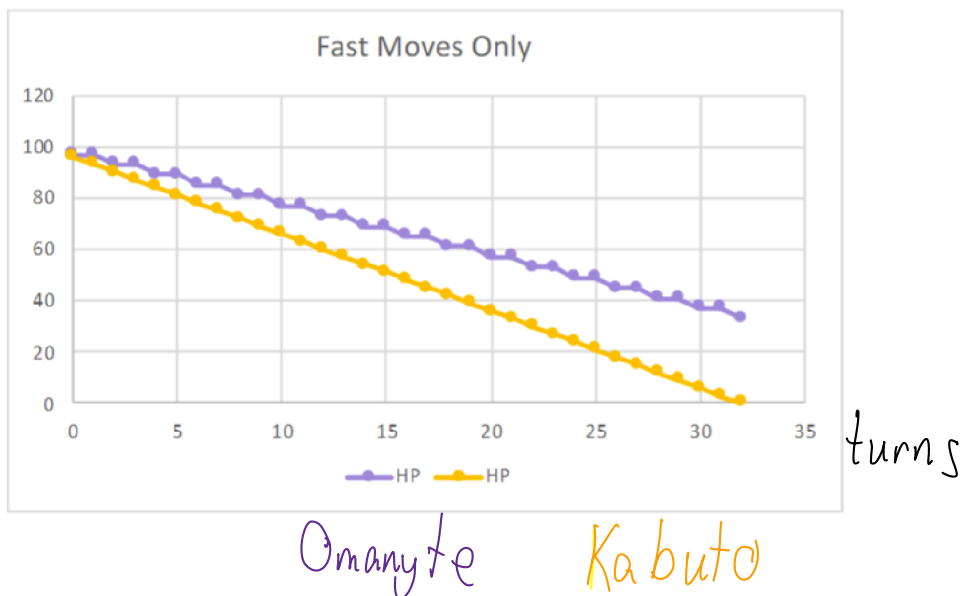
$$\frac{4 \text{ dmg}}{2 \text{ turns}} = 2$$

Who will win?

Omanyte

On what turn?

$$\frac{96}{3} = 32 \text{ turns}$$



The Fossil Battle: Charging up

	Atk	Def	HP	Fast Move	Power	Energy	Turns	STAB	Effect.	Mult	Unreel Dmg	Dmg
Omanyte	135.201002	126.452702	97	water gun	3	3	1	1.2	1	1.56	2.47422969	3
Kabuto	134.508598	127.866198	96	mudshot	3	9	2	1	1.6	2.08	3.31876521	4

Average energy per turn from Omanyte's Water Gun?

$$\frac{3 \text{ energy}}{1 \text{ turn}} = 3$$

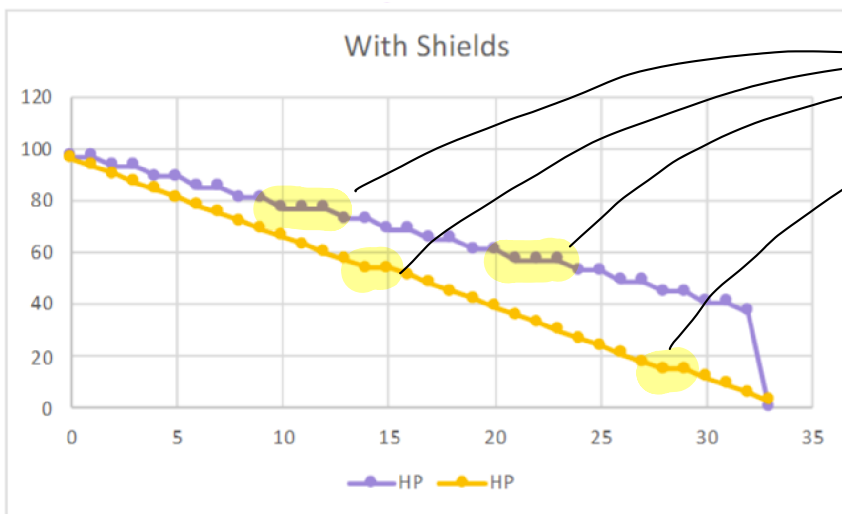
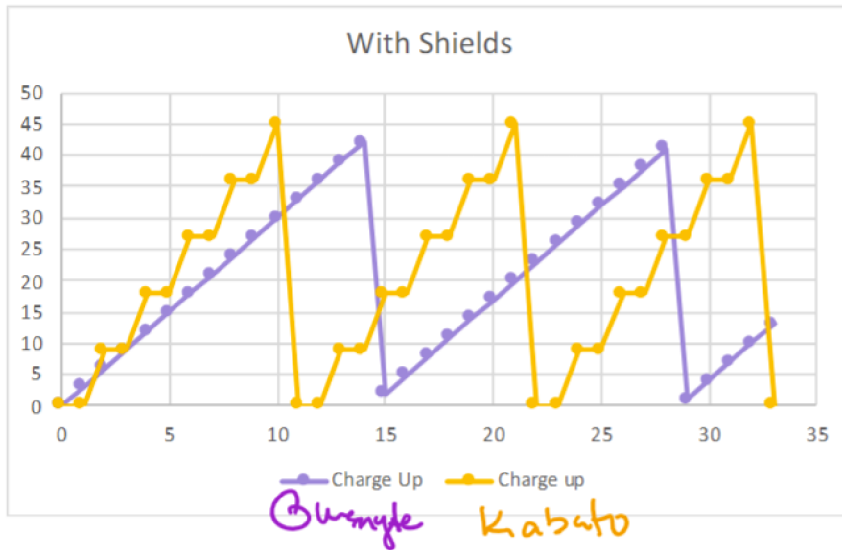
Top Hat: Average energy per turn from Kabuto's Mudshot?

$$\frac{9 \text{ energy}}{2 \text{ turns}} = 4.5$$



What is circled in red? Hint: Kabuto's charge move Aqua Jet requires 45 energy to use.

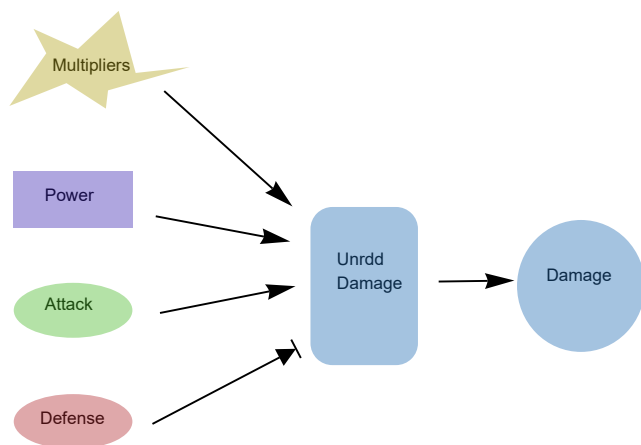
The Race to Charge Up



Damage for Charged Moves

On turn 32 Omanyte had 37 HP and Kabuto had 6 HP. Kabuto Hits Omanyte with Aqua Jet on turn 33. Will the Aqua Jet do enough damage to give Kabuto the win?

This one will be close!!!



Unrounded Damage =

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

Damage =

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

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
ATTACK	NORMAL														✗			-	
	FIRE	-	-	+		+							+	-		-		+	
	WATER	+	○	-						+			○			-			
	GRASS	-	+	-					-	+	-		-	+		-		-	
	ELECTRIC		+	-	-					✗	+					-			
	ICE	-	-	+		-				+	+					+		-	
	FIGHTING	+					+		-		-	-	-	+	✗		+	+	-
	POISON				+				-	-				-	-			✗	+
	GROUND		+		-	+			+		✗		-	+				+	
	FLYING				+	-		+					+	-				-	
	PSYCHIC							+	+			-					✗	-	
	BUG		-		+			-	-		-	+			-		+	-	-
	ROCK		+				+	-		-	+		+					-	
	GHOST	✗										+			+		-		
	DRAGON															+		-	✗
	DARK							-				+			+		-		-
	STEEL		-	-		-	+						+					-	+
	FAIRY		-					+	-							+	+	-	

Type of Attacking MOVE

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.

Mini Game-icon swiping

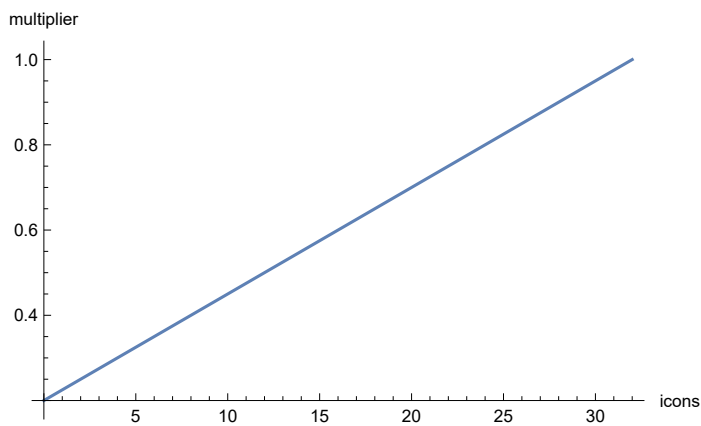
When you use a charge move during a battle a mini game will begin where animated bubbles move across the screen in a specific pattern.

Each mini game has 32 bubbles.

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

The internet is unclear how exactly the bubbles affect damage. The best guess is

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



$$.2 + \text{bubbles} \cdot 0.025$$

$$\left\lfloor \frac{1}{2} \cdot \text{Power} \cdot \frac{\text{Attack}}{\text{Defense}} \cdot \text{Multiplier} \right\rfloor + 1$$

Final Turns: Who Wins?

On turn 32 Omanyte had 37 HP and Kabuto had 6 HP. Kabuto Hits Omanyte with Aqua Jet on turn 33.

Kabuto's Attack: 135.2

Kabuto's Type: Water/Rock

Omanyte's Defense: 127.9

Omanyte's Type: Water/Rock *super effective • not very eff.*

Aqua Jet's Power: 45

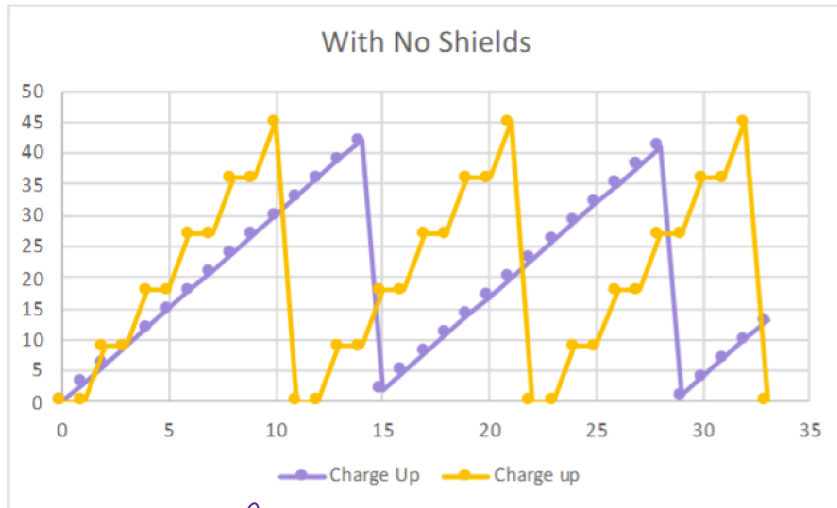
Aqua Jet's Type: Water

$$\left\lfloor \frac{1}{2} \cdot 45 \cdot \frac{135.2}{127.9} \cdot 1.3 \cdot 1.2 \cdot \underbrace{1.6 \cdot 0.625}_{=1} \right\rfloor + 1$$

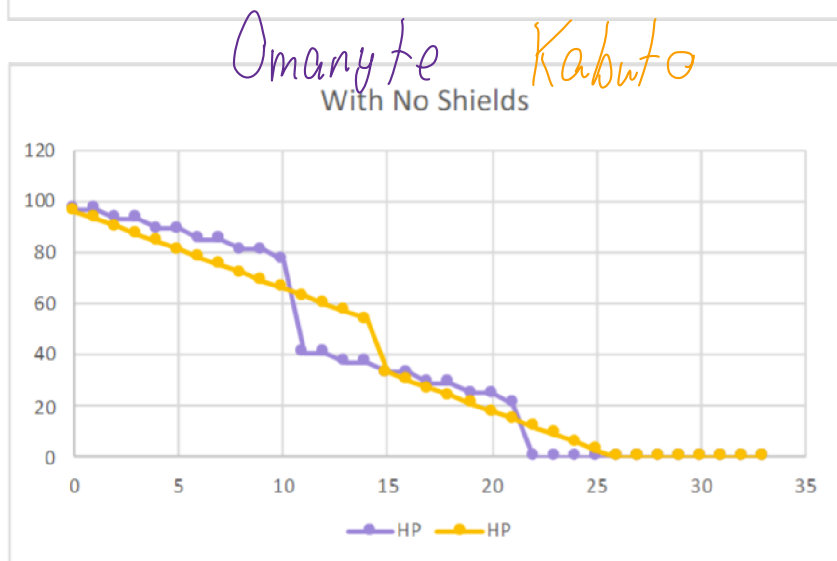
38 dmg

Kabuto wins!

What if there were No Shields?



turns



turns

Bubble Beam has a “Stat Modification”

When Omanyte hits Kabuto with Bubble Beam (on turn 15), it lowers Kabuto’s Attack.

In-battle modification

Since February 15, 2019, in [Trainer Battles](#), some Charged Attacks have a chance of modifying either the user's or target's Attack and/or Defense stats after it is cast, regardless if the target uses a Protect Shield. These stats are undone if the Pokémon is switched out.

For a full list of these moves and their effects, see [List of Charged Attacks](#)

Stage multipliers									
Stage	-4	-3	-2	-1	0	+1	+2	+3	+4
Multiplier	$\frac{4}{8}$	$\frac{4}{7}$	$\frac{4}{6}$	$\frac{4}{5}$	$\frac{4}{4}$	$\frac{5}{4}$	$\frac{6}{4}$	$\frac{7}{4}$	$\frac{8}{4}$

→ applied to the stat directly.

Bubble Beam has a "Stat Modification"

Will the stat buff save Omanyte? Mudshot was dealing 3 damage per 2 turns. What if we reduce Kabuto's attack?

Kabuto's Attack: $135.2 \left(\frac{4}{5} \right)$

Omanyte's Defense: 127.9

Mudshot's Power: 3

Aqua Jet's Power: 45

Kabuto's Type: Water/Rock

Omanyte's Type: Water/Rock \rightarrow super eff.

Mudshot's Type: Ground

Aqua Jet's Type: Water

$$\left[\frac{1}{2} \cdot 3 \cdot \frac{135.2 \left(\frac{4}{5} \right)}{127.9} \cdot 1.3 \cdot 1.6 \right] + 1 = [2.64] + 1$$

$= 3 \text{ dmg from Mudshot}$

Aqua Jet = 30 dmg \rightarrow Not enough to knock out Omanyte.

Kabuto had already shielded 2 Bubble Beams from Omanyte by the time Kabuto used Aqua Jet. Does the Aqua Jet still defeat Omanyte?