

Clash of clans (LP)

Solve the following optimization problem

- Train your troops to have max hit points
- Train your troops to have max attack damage
- Train your troops to minimize the training time



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How much damage it
can tolerate



How much damage it
can cause



How long does it take to
train



How much does it cost
to train

Clash of clans (LP)

Miner (Level 1)



Damage per second: 80

Hitpoints: 550

Training Cost: 4200 Elixir

Training Time: 90s

Favorite target:

Damage type:

Targets:

Housing Space:

Movement speed:

ANY

Single Target

Ground

6

32

These sneaky shovelers burrow underground, pass beneath walls and pop up right next to their targets. While underground, Miners cannot be damaged and will not trigger traps, but still gain bonuses from spells.

Dragon (Level 7)



Damage per second: 310

Hitpoints: 3900

Training Cost: 22000 Elixir

Training Time: 3m

Favorite target:

Damage type:

Targets:

Housing Space:

Movement speed:

ANY

Area Splash

Ground & Air

20

16

The might of the dragons is known throughout the land. This scaly terror of the skies feels no mercy and nothing will escape the fiery splashes of his breath.

Goblin (Level 7)



Damage per second: 52

Hitpoints: 101

Training Cost: 200 Elixir

Training Time: 7s

Favorite target:

Damage type:

Targets:

Housing Space:

Movement speed:

Resources (Damage x2)

Single Target

Ground

1

32

These pesky little creatures only have eyes for one thing: LOOT! They are faster than a Spring Trap, and their hunger for resources is limitless.

Wizard (Level 9)



Damage per second: 230

Hitpoints: 230

Training Cost: 4200 Elixir

Training Time: 90s

Favorite target:

Damage type:

Targets:

Housing Space:

Movement speed:

ANY

Area Splash

Ground & Air

4

16

The Wizard is a terrifying presence on the battlefield. Pair him up with some of his fellows and cast concentrated blasts of destruction on anything, land or sky!

P.E.K.K.A (Level 3)



Damage per second: 310

Hitpoints: 3500

Training Cost: 18000 Elixir

Training Time: 3m

Favorite target:

Damage type:

Targets:

Housing Space:

Movement speed:

ANY

Single Target

Ground

25

16

Is P.E.K.K.A a knight? A samurai? A robot? No one knows! P.E.K.K.A's armor absorbs even the mightiest of blows.

Baby Dragon (Level 1)



Damage per second: 75

Hitpoints: 1200

Training Cost: 5000 Elixir

Training Time: 1m 30s

Favorite target:

Damage type:

Targets:

Housing Space:

Enraged bonus damage:

Movement speed:

ANY

Area Splash

Ground & Air

10

x2

20

This fire-breathing hatchling is shy around other air units, but leave it alone and it'll throw a fit! When not around other air units, Baby Dragons become enraged and gain bonus damage and attack speed.

Balloon (Level 8)



Damage per second: 236

Damage when destroyed: 268

Hitpoints: 840

Training Cost: 5500 Elixir

Training Time: 30s

Favorite target:

Damage type:

Targets:

Housing Space:

Movement speed:

Defenses

Area Splash

Ground

5

10

These promoted skeletons have traded in their joy of destroying walls for a joy of destroying defenses. Deploy them to take out pesky mortars and cannons!

Wall Breaker (Level 8)



Damage: 100

Hitpoints: 92

Training Cost: 2000 Elixir

Training Time: 15s

Favorite target:

Damage type:

Targets:

Housing Space:

Movement speed:

Walls (Damage x40)

Area Splash

Ground

2

24

Nothing warms a Wall Breaker's cold and undead heart like blowing up walls. A squad of them will make way for your ground units, and they will do it with a BANG!

Electro Dragon (Level 3)



Damage per second: 300

Damage when destroyed: 360

Hitpoints: 4200

Training Cost: 36000 Elixir

Training Time: 6m

Favorite target:

Damage type:

Targets:

Housing Space:

Movement speed:

ANY

Single Target

Ground & Air

30

12

Possessing iron-tough scales and a breath of devastating lightning, the Electro Dragon's favorite thing is raining destruction from above. When vanquished, the Electro Dragon even pummels the ground with lightning strikes!

Ex15

26

Clash of clans (LP)

Ice Golem (Level 1)

Damage per second: 24

Freeze time when destroyed: 4s

Hitpoints: 2500

Training Cost: 220 Dark Elixir

Training Time: 3m

Favorite target: Defenses

Damage type: Single Target

Targets: Ground

Housing Space: 15

Movement speed: 12

The Ice Golem has a chilling personality and absolutely zero sense of humour. He Frosts over everything he touches. Freezes his surroundings when destroyed and ices up when talked to at a party. On defense his Freeze effect is smaller and has a shorter duration.

Hog Rider (Level 8)

Damage per second: 148

Hitpoints: 810

Training Cost: 100 Dark Elixir

Training Time: 45s

Favorite target: Defenses

Damage type: Single Target

Targets: Ground

Housing Space: 5

Movement speed: 24

Having tamed the fierce leaping hog, the Hog Rider punishes those who hide behind their puny walls! Fueled by Dark Elixir, these warriors have never known defeat!

Golem (Level 2)

Damage per second: 40

Damage when destroyed: 400

Hitpoints: 5400

Training Cost: 250 Dark Elixir

Spawned units: 2

Training Time: 5m

Favorite target: Defenses

Damage type: Single Target

Targets: Ground

Housing Space: 30

Movement speed: 12

The mighty Golem loves to soak up damage! When destroyed, it explodes and splits into Golemites. The resulting Golemites have one-fifth the Golem's strength and hitpoints.

Witch (Level 5)

Damage per second: 180

Hitpoints: 480

Training Cost: 275 Dark Elixir

Max summoned units: 14

Training Time: 3m

Favorite target: ANY

Damage type: Area Splash

Targets: Ground & Air

Housing Space: 12

Movement speed: 12

The Witch never fights alone, constantly raising dead warriors from past battles to lead her attacks. Upgraded Witches raise more skeletons at a time.

Bowler (Level 4)

Damage per second: 90

Hitpoints: 390

Training Cost: 140 Dark Elixir

Training Time: 1m

Favorite target: ANY

Damage type: Area Splash

Targets: Ground

Housing Space: 6

Movement speed: 14

This big blue dude digs the simple things in life - Dark Elixir drinks and throwing rocks. His massive boulders bounce off of their target and hit again behind it for a double strike!

Minion (Level 4)

Damage per second: 46

Hitpoints: 72

Training Cost: 7 Dark Elixir

Training Time: 18s

Favorite target: ANY

Damage type: Single Target

Targets: Ground & Air

Housing Space: 2

Movement speed: 32

This terror of the skies was born out of Dark Elixir. Undetectable by the Seeking Air Mine, Minions materialize with ease, but are fragile in our world.

Valkyrie (Level 7)

Damage per second: 178

Hitpoints: 1450

Training Cost: 190 Dark Elixir

Training Time: 1m 30s

Favorite target: ANY

Damage type: Area Splash

Targets: Ground

Housing Space: 8

Movement speed: 24

A master of the two-handed axe, this glorious warrior runs between nearby buildings and can shred several troops or buildings at once with her whirlwind blow!

Lava Hound (Level 4)

Damage per second: 16

Damage when destroyed: 250

Hitpoints: 7200

Training Cost: 570 Dark Elixir

Spawned units: 14

Training Time: 5m

Favorite target: Air Defense

Damage type: Single Target

Targets: Ground

Housing Space: 30

Movement speed: 20

These fiery beasts can't resist chasing after Air Defenses, providing excellent protection for other troops. Once destroyed, they erupt into many smaller, weaker menaces.

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Solve the following optimization problem

$$OF_1 = \sum_i x_i Attack_i$$

$$OF_2 = \sum_i x_i Hit_i$$

$$OF_3 = \sum_i x_i time_i$$

$$\sum_i x_i Housing_i \leq Camp$$

$$\sum_i x_i TrainingCost_i \leq Elexsir$$