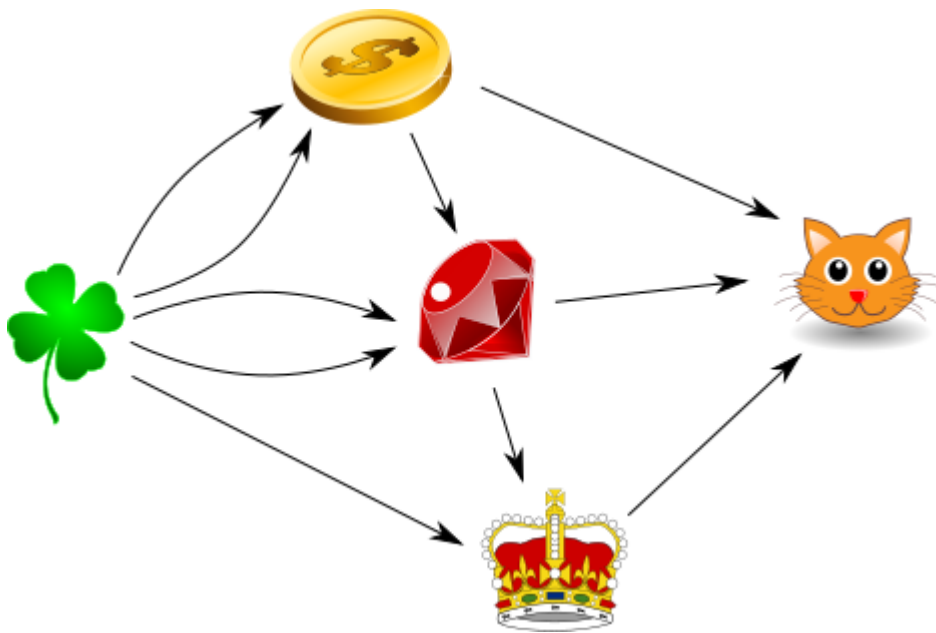# Beaver the Alchemist ◈◈◈

Beaver the Alchemist can convert objects into other objects. He can convert:

• Two clovers into a coin

• A coin and two clovers into a ruby

• A ruby and a clover into a crown

• A coin, a ruby, and a crown into a kitten.

After objects have been converted to another object, they disappear.

QUESTION

How many clovers does Beaver the Alchemist need to create one kitten?

A. 5

B. 10

C. 11

D. 12

Answer

The correct answer is C. 11.

Explanation of the answer

For those familiar with this kind of problem, a very short explanation is as follows.

kitten	=	1 coin	+ 1 ruby	+ 1 crown
	=	2 clovers	+ 2 clovers + 1 coin	+ 1 clover + 1 ruby
	=	2 clovers	+ 2 clovers + 2 clovers	+ 1 clover + 2 clovers + 1 coin
	=	2 clovers	+ 2 clovers + 2 clovers	+ 1 clover + 2 clovers + 2 clovers
	=	11 clovers		

For some readers this explanation is too terse and so an equivalent more wordy explanation follows.

We can decompose the problem of creating a kitten into three more manageable problems of creating three other objects as follows:

To create a kitten we need a coin, a ruby, and a crown.

Decomposing each of these leads us to (all new decomposition text in blue colour):

To create a kitten we need a coin, a ruby, and a crown.
1. To create a coin we need two clovers.
2. To create a ruby we need a coin and two clovers.
3. To create a crown we need a ruby and a clover.

If we stopped our decomposition at this point we could say that to create a kitten we need a ruby, a coin, and five clovers (see underlining). However, the ruby and coin can be decomposed further. Another decomposition step leads to (all new decomposition text in blue colour):

To create a kitten we need a coin, a ruby, and a crown.
1. To create a coin we need two clovers.
2. To create a ruby we need a coin and two clovers.
    i. To create a coin we need two clovers.
    ii. We don't need to decompose the other two clovers further.
3. To create a crown we need a ruby and one clover.
    i. To create a ruby we need a coin and two clovers.
    ii. We don't need to decompose the one clover further.

If we stopped our decomposition at this point we could say that to create a kitten we need a coin and nine clovers (see underlining). However, the coin can be decomposed further. Another decomposition step leads to (all new decomposition text in blue colour):

To create a kitten we need a coin, a ruby, and a crown.
  1. To create a coin we need <u>two clovers</u>.
  2. To create a ruby we need a coin and two clovers.
      i. To create a coin we need <u>two clovers</u>.
      ii. We don't need to decompose the other <u>two clovers</u> further.
  3. To create a crown we need a ruby and one clover.
      i. To create a ruby we need a coin and two clovers.
          a. To create a coin we need <u>two clovers</u>.
          b. We don't need to decompose the other <u>two clovers</u> further.
      ii. We don't need to decompose the <u>one clover</u> further.

We have decomposed the kitten into clovers so we cannot decompose any more. Combining all of the underlined clovers leads us to say that to create a kitten we need 11 clovers.

This answer is overly long. If we were smart we could have skipped step 3.i. because we already calculated what is needed for a ruby in step 2. We could also have skipped steps 2.i. and 3.i.a. because we already calculated what is needed for a coin in step 1.

Connection to computational thinking

Decomposition: This task is an example of *breaking into parts*. To solve the question for one kitten, we can first answer the same question for each of; a coin, a ruby, and a crown. We can then combine these answers to solve the original question. We can repeat this strategy for each object until we reach a clover, or another object whose value in clovers is known.