

0+2=2

# Get off the earth!



WHEN THE BUTTON IS DOWN, THERE ARE THIRTEEN WARRIORS. STUDY THEIR FACES, POSTURES, SWORDS AND PIG-TAILS. THEN MOVE THE BUTTON UP, AND TELL WHICH ONE HAS VANISHED. WHERE DOES HE GO TO?

0+2=2

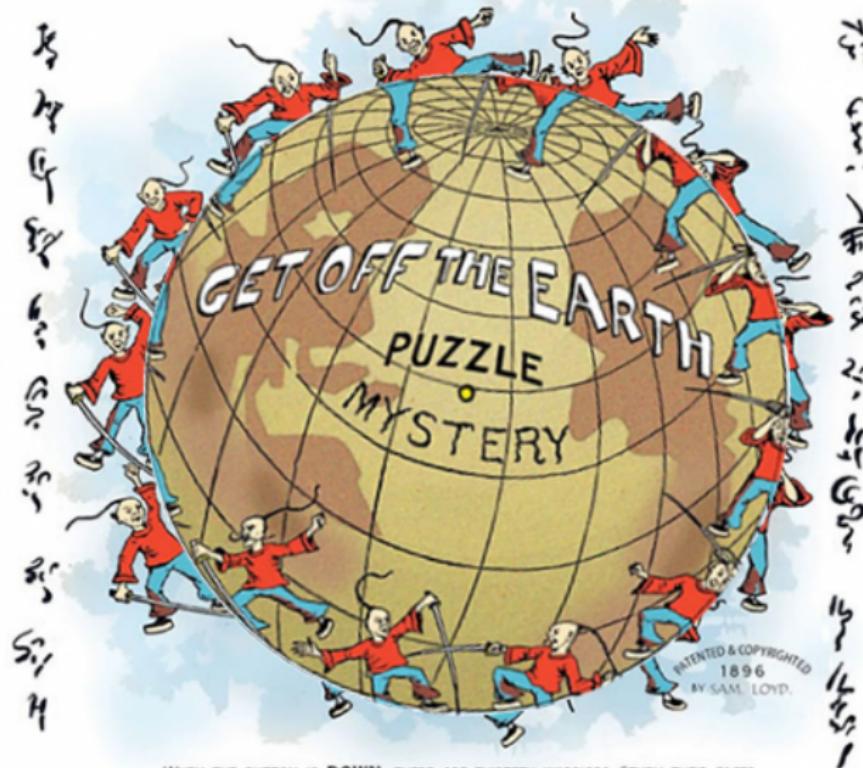
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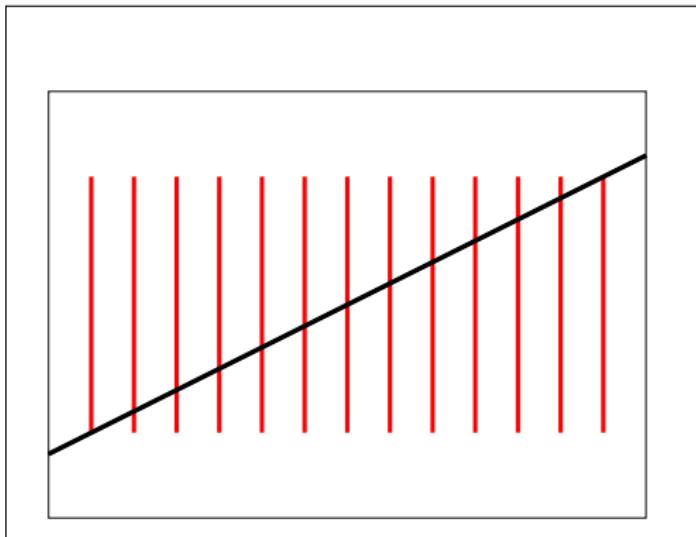
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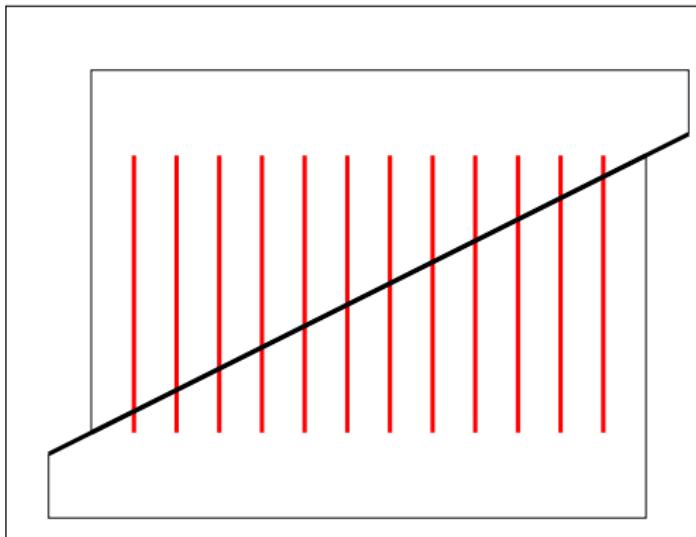
$$2+2=4$$

## Mathematical perspective



$$2+2=4$$

## Mathematical perspective



$$4+2=6$$

## Making your own



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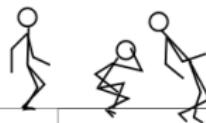
$$4+2=6$$

## Making your own



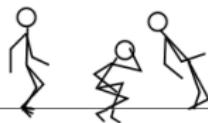
$$4+2=6$$

## Making your own



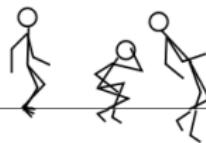
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## Making your own



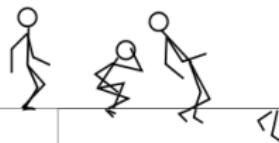
$$4+2=6$$

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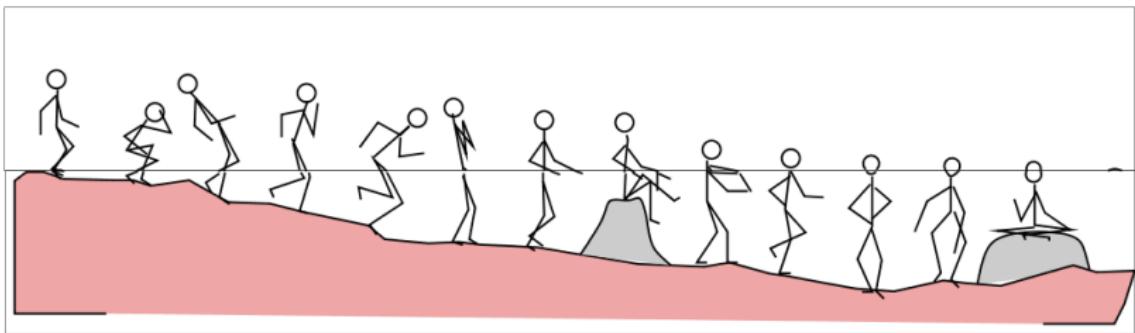
$$4+2=6$$

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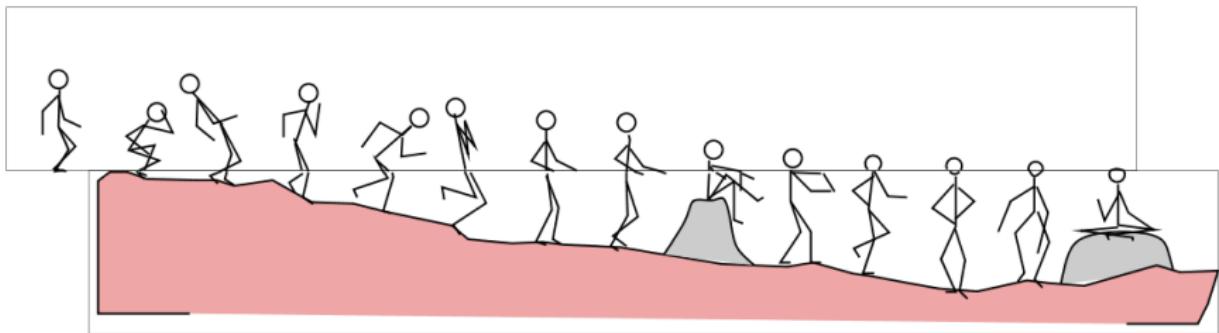
$$4+2=6$$

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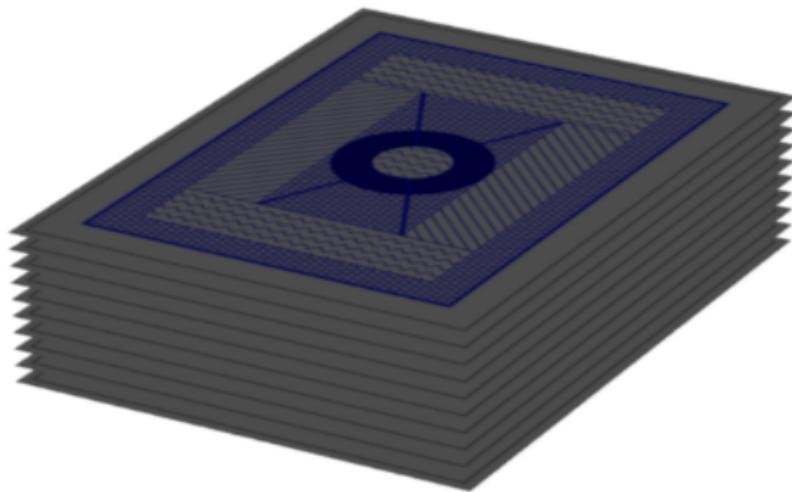
$$6+2=8$$

## Puzzle of the five cups

**Invariance**

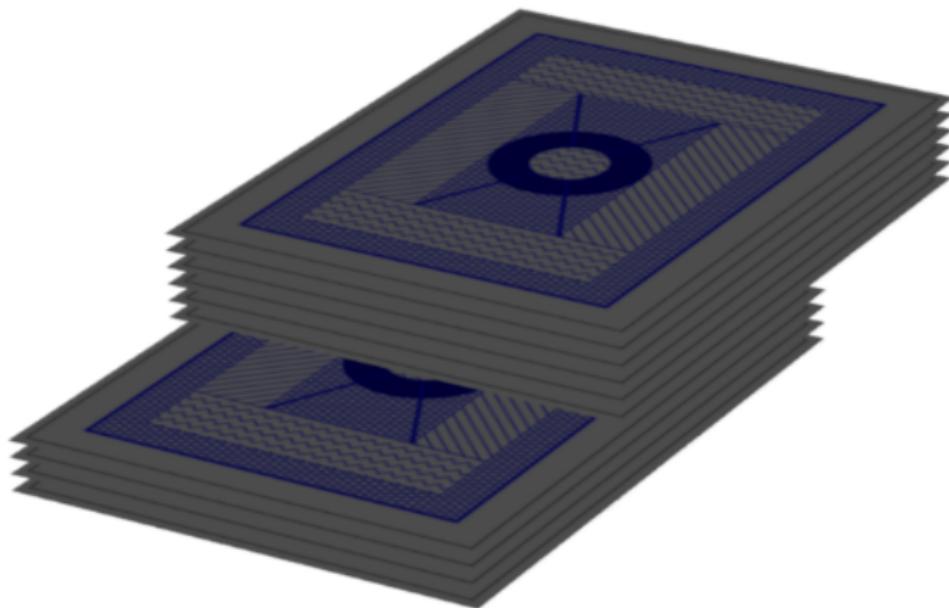
$8+2=10$

Cut



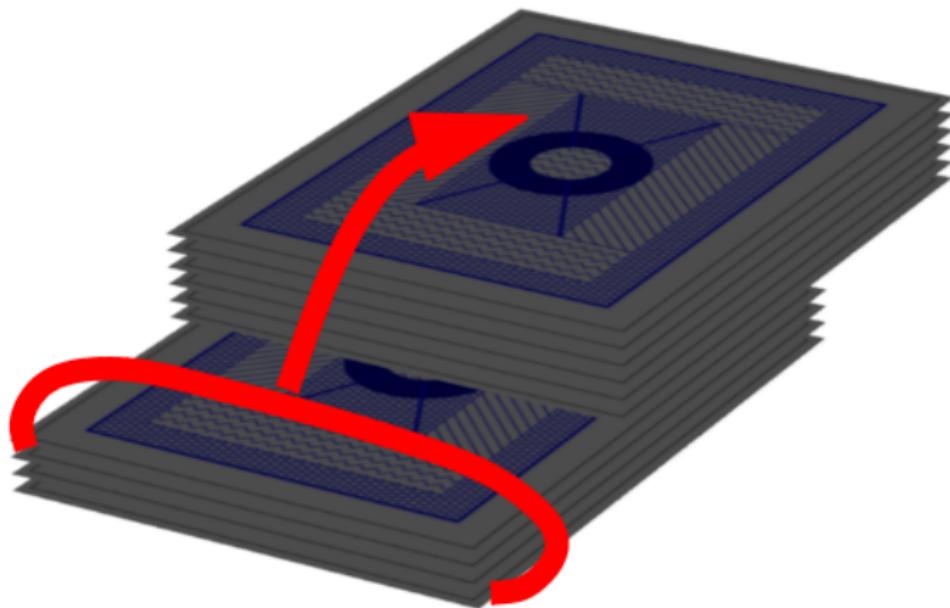
$8+2=10$

Cut



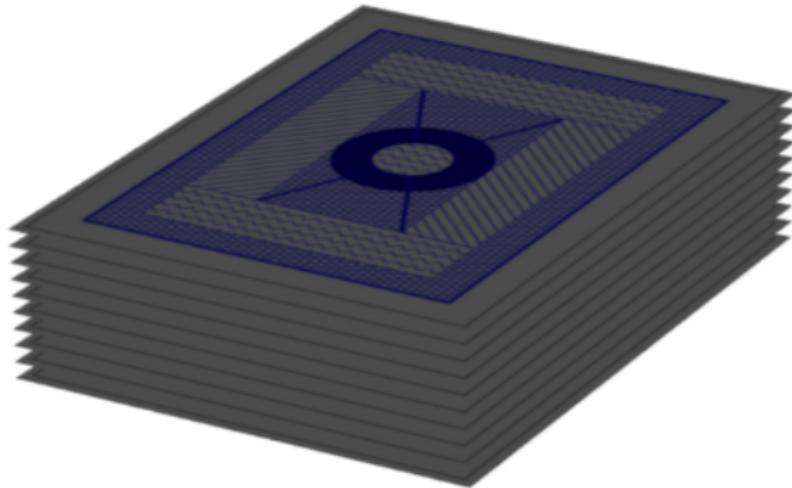
$8+2=10$

Cut



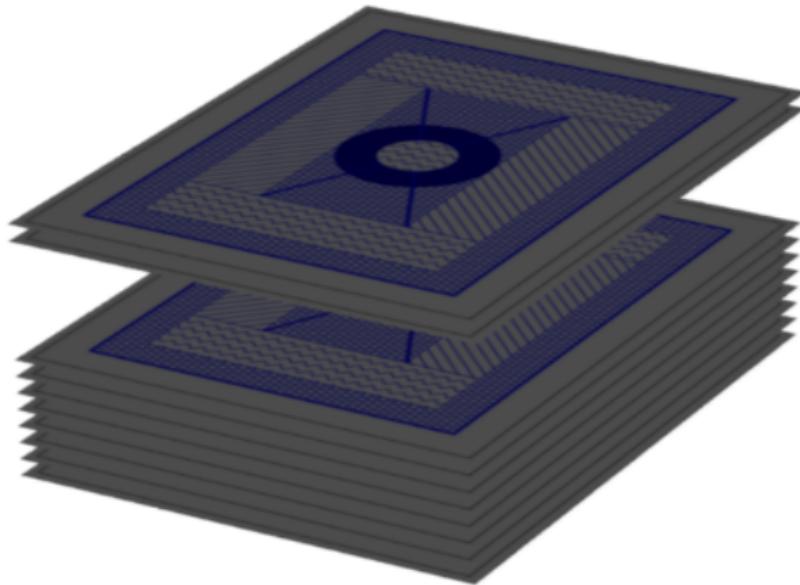
$$10+2=12$$

Flip top two together



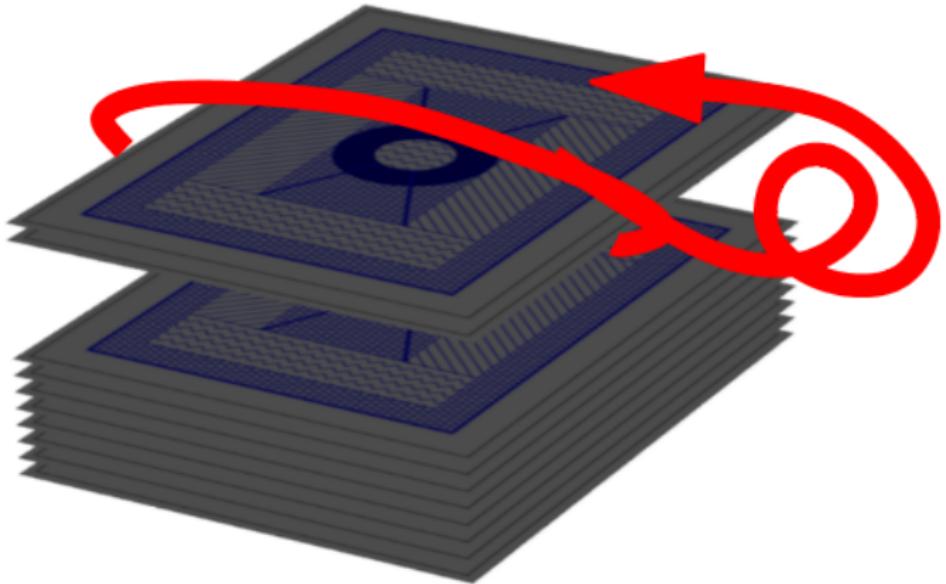
$$10+2=12$$

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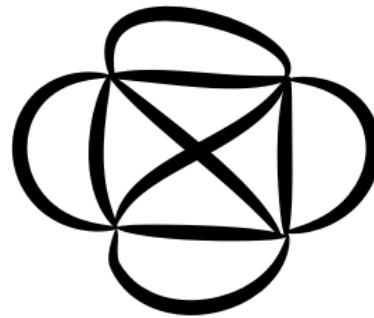
$$12+2=14$$

## Instructions

- ▶ Give a random cut.
- ▶ Remember the bottom card.
- ▶ Take the top card to the bottom.
- ▶ Flip the top card.
- ▶ Random cut.
- ▶ Flip top two cards together.
- ▶ Repeat the above two steps 3 times.
- ▶ Give me the packet.

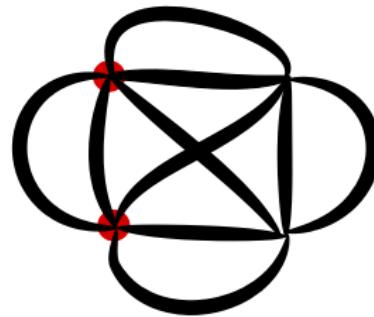
$14+2=16$

From high school days



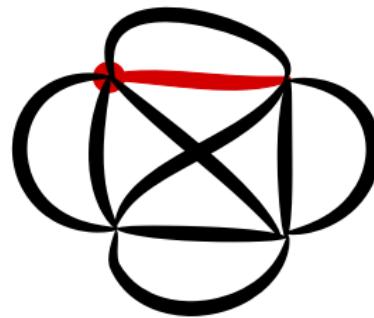
$14+2=16$

From high school days



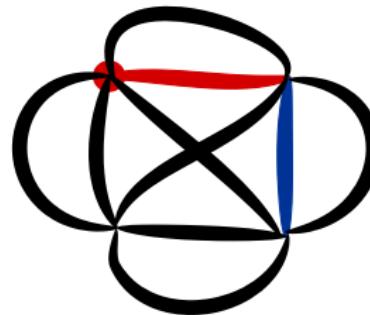
$14+2=16$

From high school days



$14+2=16$

From high school days



$$16+2=18$$

## Euler's theorem

Consider a diagram consisting of some points joined by some lines such that you can go from any point to any other point. Then you can draw this diagram without lifting your pen and without reusing any line if and only if

either

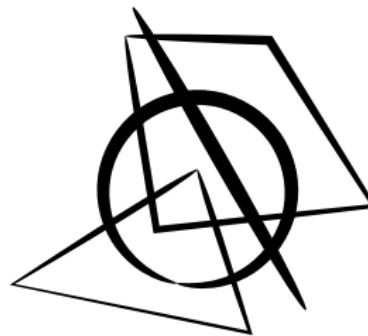
only an even number of lines meet at each point

or

an odd number of lines meet at exactly two points

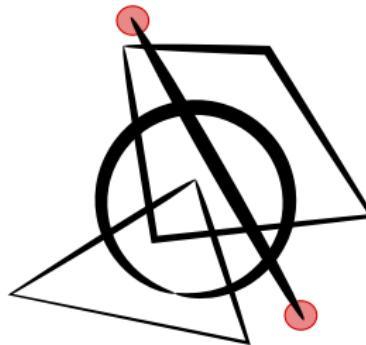
$$18+2=20$$

## An example



$$18+2=20$$

## An example



$$20+2=22$$

## Mind reading magic

$$22+2=24$$

Did I do it without **any** information?

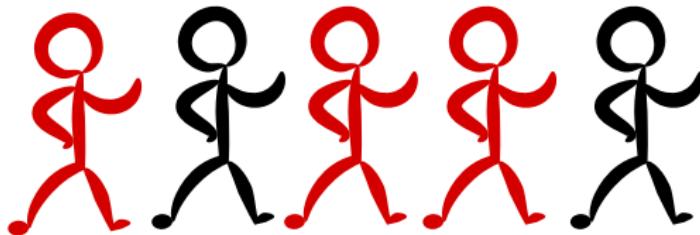
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$$22+2=24$$

Did I do it without **any** information?

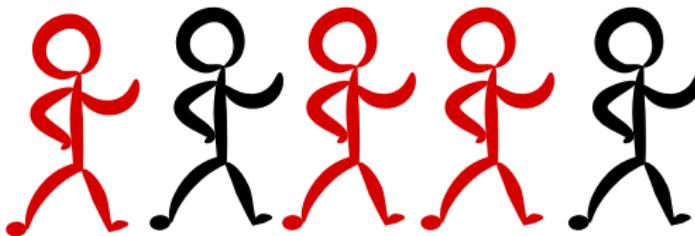
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$$22+2=24$$

Did I do it without **any** information?

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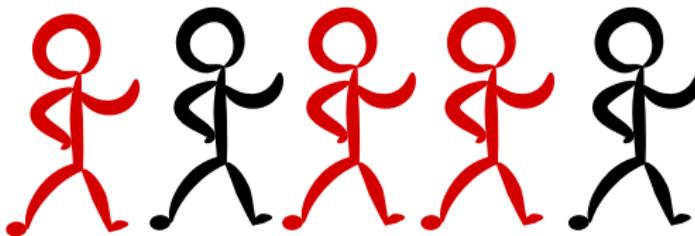


How many such patterns are possible?

$$22+2=24$$

Did I do it without **any** information?

---



How many such patterns are possible?

**Ans:**  $2^5$ .

$$24+2=26$$

A deck of (at most) 32 cards

$$24+2=26$$

A deck of (at most) 32 cards

Hmmm...so you used an arranged deck!

$$24+2=26$$

**A deck of (at most) 32 cards**

---

**Hmmm...so you used an arranged deck!**

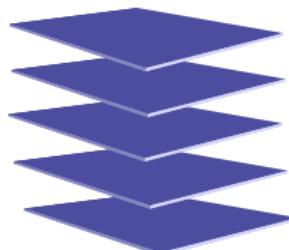
**But did we not shuffle it thoroughly?**

$$24+2=26$$

## A deck of (at most) 32 cards

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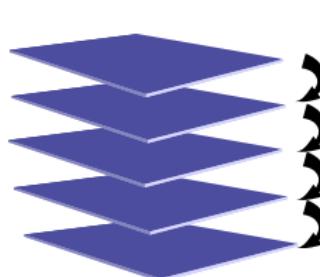
A  
B  
C  
D  
E

$$24+2=26$$

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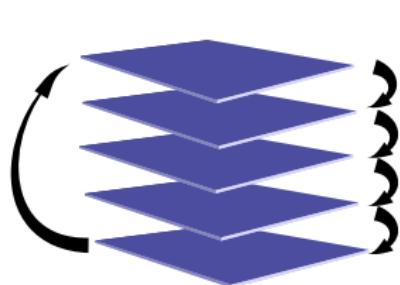
A  
B  
C  
D  
E

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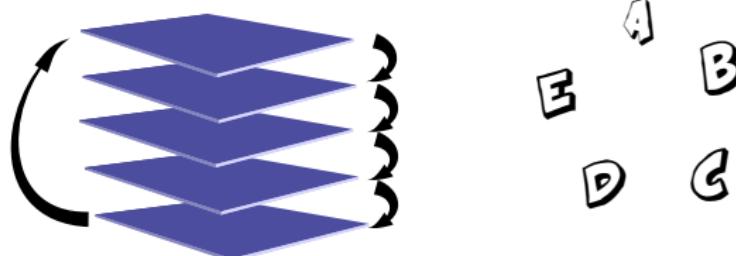
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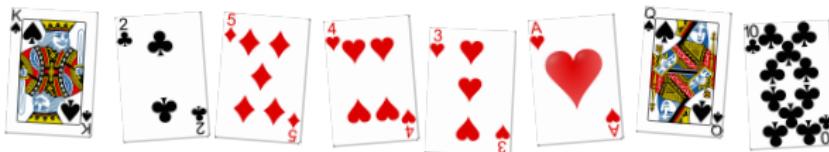


$$26+2=28$$

OK, cyclical arrangement. But how?

$26+2=28$

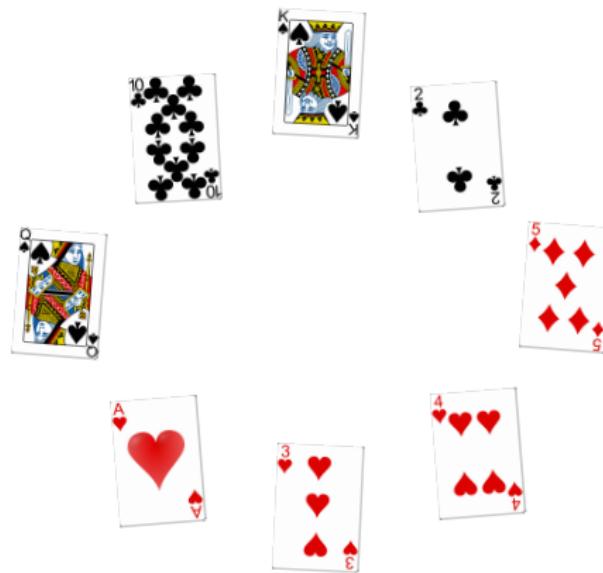
OK, cyclical arrangement. But how?



$$\underline{2^3 = 8 \text{ cards}}$$

$$26+2=28$$

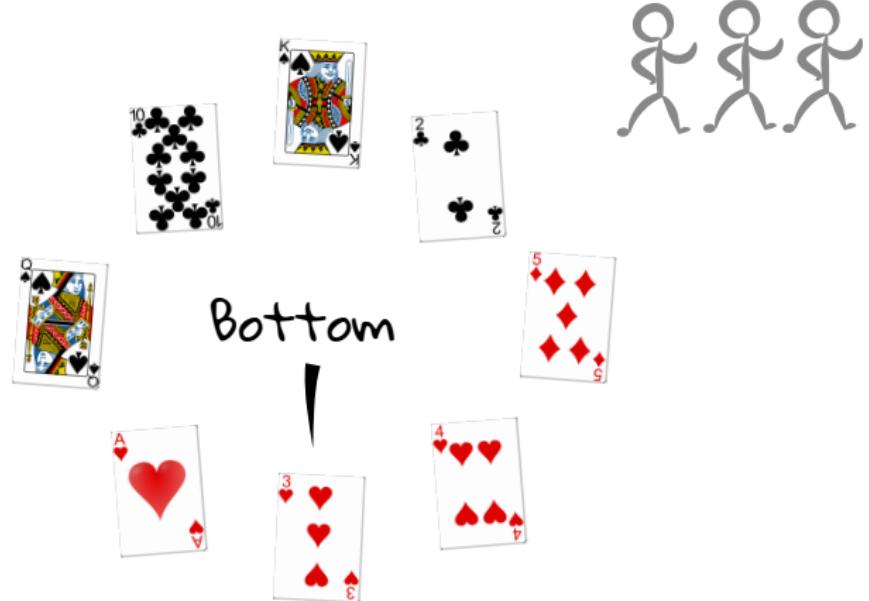
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Is this arrangement OK?

$$26+2=28$$

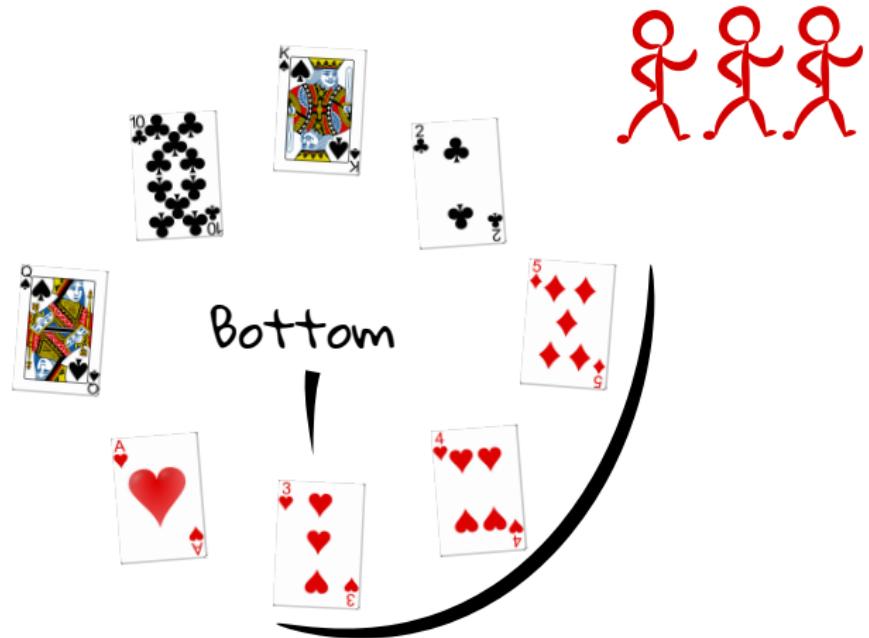
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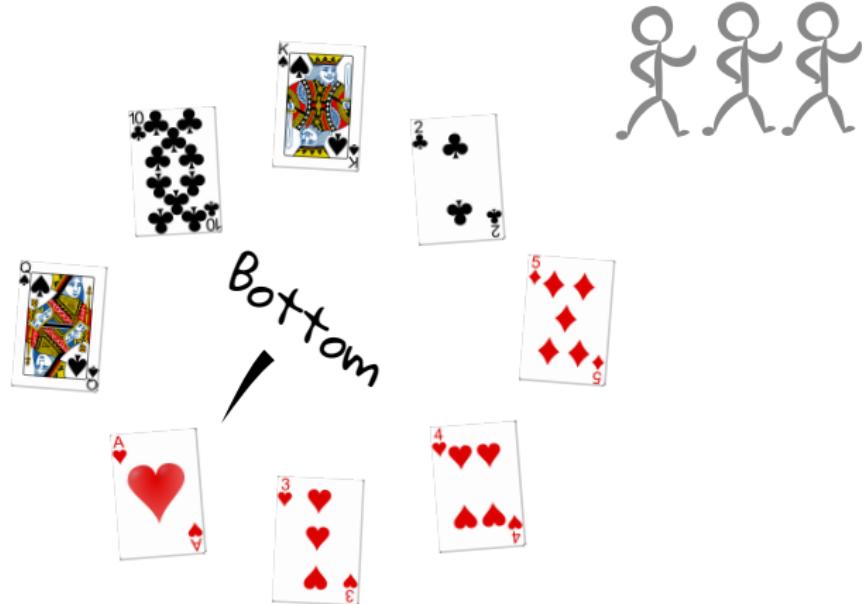
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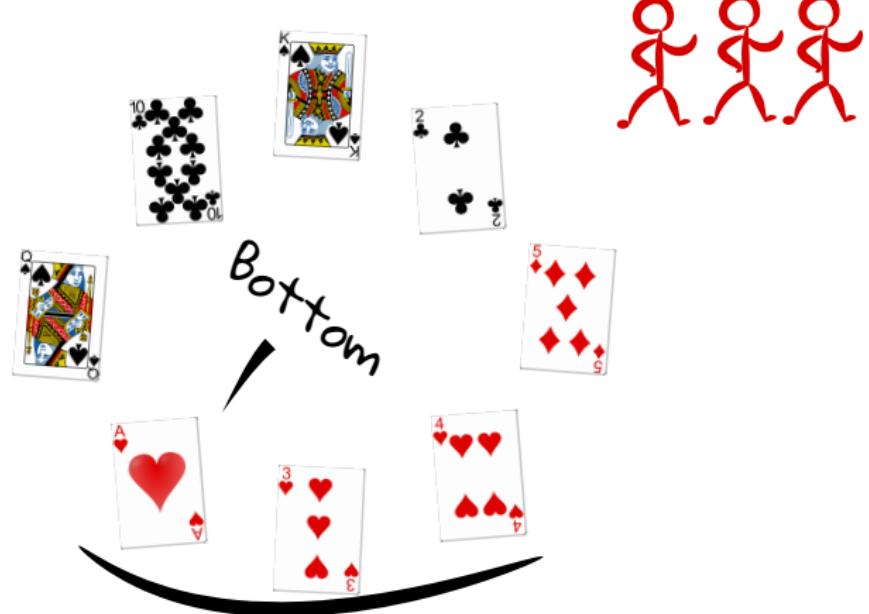
OK, cyclical arrangement. But how?



Is this arrangement OK?

$$26+2=28$$

OK, cyclical arrangement. But how?



Is this arrangement OK?

$$28+2=30$$

So we need...

...a cyclical pattern where all consecutive triples have distinct red-black patterns.



$$28+2=30$$

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$$28+2=30$$

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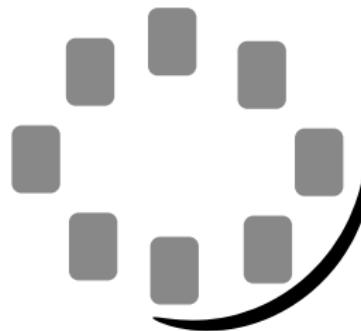
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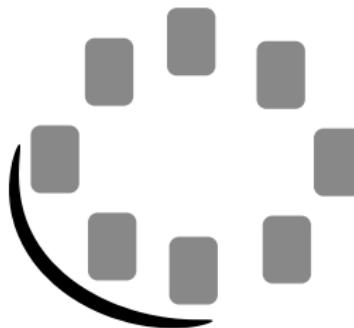
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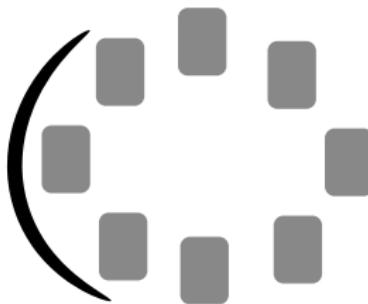
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How to find such a pattern?

$$28+2=30$$

So we need...

...a cyclical pattern where all consecutive triples have distinct red-black patterns.



**How to find such a pattern?  
Does one really exist at all?**