

Mathematical Card Tricks

Ten self-working tricks, grouped by the mathematics that makes them work. No sleight of hand, no practice, and nothing taken on trust — every claim here is one you can check with a deck on the table.

From **sleightless.com** — free browser trainers for card magic and mentalism. Every trick in this book can be played through on the site, from either chair.

What makes a trick self-working

A self-working trick has no move to fumble. You do not palm, force, or false-shuffle anything. You deal, you count, and the mathematics does the part that looks like skill.

That sounds like a compromise, and it is the opposite of one. A trick that depends on sleight of hand fails when your hands are cold, when somebody is watching your left thumb, or when you have not practiced in a month. A trick that depends on arithmetic fails only if arithmetic fails. It works the thousandth time exactly as well as the first, and it works while you talk.

The cost is that you have to understand it. A move can be copied from a video. A principle has to be followed, because the moment somebody cuts when you expected them to deal, you need to know whether that matters. Every trick in this book therefore comes in three parts: **the effect** as the spectator sees it, **the method** as you perform it, and **why it works** — the part most explanations leave out, and the part that lets you recover when a spectator does something unexpected.

HOW THIS BOOK IS ARRANGED

Not by difficulty, and not by how impressive the ending is. By the mathematics, because once you have seen a principle used twice you start spotting it in tricks you were never taught.

Parity — a quantity that cannot change	3
1. The Piano Trick	3
2. The Four Robbers	4
Base three — counting in a system with three digits	5
3. The 21 Card Trick	5
4. The 27 Card Trick	6
Base two — counting in a system with two digits	7
5. The Binary Card Trick	7
Arithmetic that wraps — working modulo 13	8
6. The 13 Card Trick	8
7. The Si Stebbins Stack	9
Order that survives a shuffle	10
8. The Gilbreath Principle	10
9. The Faro Shuffle	11

A free choice that cannot go wrong	12
---	----

10. Out of This World	12
-----------------------	----

Three numbers worth knowing	13
------------------------------------	----

A WORD ON WHERE THESE CAME FROM

Almost nothing in this book is new, and none of it is mine. Where a trick has a known inventor I have named them. Several of these are old enough that their origin is genuinely unknown, and I have said so rather than guess.

Parity is whether a number is odd or even. It is the humblest idea in mathematics and it does more work in card magic than any other, because some actions cannot change it however many times you repeat them. If a quantity starts even and every move you allow preserves evenness, then it is even at the end — no matter what the spectator did in between. That is the whole engine of the next two tricks.

TRICK ONE

The Piano Trick

THE EFFECT

Your spectator holds their hands out, palms down, like someone about to play the piano. You tuck pairs of cards between their fingers, then one single card. You split every pair into two piles, deal them out, and the odd card is found — to nobody's surprise. Then you show that the pile it went into is the only one with an odd number of cards, and that this was decided before you began.

THE METHOD

1. Have them hold both hands out, palms down, fingers spread.
2. Slide **pairs** of cards into the gaps between their fingers — two cards at a time, eight pairs in all.
3. Into the last gap, put a **single** card. Say it plainly: "and one on its own."
4. Take the pairs back one at a time. Split each pair, one card to a pile on your left, one to a pile on your right. The single card goes to whichever pile you name.
5. Both piles now have eight cards. The pile that received the single has nine. Turn them over and count.

WHY IT WORKS

Every pair contributes exactly one card to each pile, so after all eight pairs the two piles are equal by construction — and they are equal whatever order you take the pairs in, and whichever hand you take them from. There is nothing to remember and nothing to control.

The single card is the only thing that breaks the tie, so the pile it lands in is the odd one. You chose that pile, and you chose it in the open, at the start. The trick is not that the odd card is found; it is that the spectator watches a free-looking process produce a result you named before it started.

WHERE IT GETS ITS STRENGTH

Say "one on its own" out loud and then move on quickly. People remember the pairs and forget the single, and the ending lands hardest on the ones who forgot.

TRICK TWO

The Four Robbers

THE EFFECT

Four robbers — the four jacks — break into a house, one to each floor. The house is the deck. You put a jack on each of four piles, gather everything, and when the police arrive all four jacks are back together on top, having met on the roof.

THE METHOD

1. Beforehand, place the four jacks on top of the deck. This is the only setup, and it can be done while spreading the cards face up looking for "the robbers."
2. Tell the story. Deal three cards face down from the top into a pile — these are the top three cards of the deck, not jacks. Say the robbers are going in.
3. Deal the next four cards into four separate piles, one each: these are the four jacks, and they are now at the bottom of each pile. Nobody sees them.
4. Deal the rest of the deck across the four piles, left to right, until it is gone.
5. Gather the piles in order and turn the deck over. The four jacks are together.

WHY IT WORKS

This one is not parity, and it is honest to say so — it is here because it is the first trick that teaches you to think about *where a card ends up* rather than what it is. A jack placed at the bottom of a pile stays at the bottom of that pile no matter how many cards are dealt on top of it. Gathering the four piles in order therefore stacks the four bottoms together.

The story does the concealing. Everyone is following four robbers through a house, and nobody is tracking the fact that four specific cards went to four specific places and were never disturbed.

We count in tens because we have ten fingers. Nothing about arithmetic requires it. Count in threes and every number is written with the digits 0, 1, and 2, where each place is worth three times the one to its right — so 12 in base three means one three and two ones, which is five.

This matters for cards because dealing into three piles and asking which pile a card is in extracts exactly one base-three digit. Ask three times and you have three digits, which is enough to name one position in twenty-seven. The next two tricks are the same idea at two different settings.

TRICK THREE

The 21 Card Trick

THE EFFECT

Twenty-one cards, dealt into three columns. Your spectator thinks of one and tells you only which column it is in. You gather, deal again, ask again. After the third time you name their card.

THE METHOD

1. Deal twenty-one cards face up into three columns of seven, dealing across rather than down: one to each column in turn.
2. Ask which column their card is in. Do not ask which card.
3. Gather the three columns so that the named column goes **in the middle**. This is the only rule, and it is the whole trick.
4. Repeat twice more: deal into three columns, ask, gather with the named column in the middle.
5. After the third gather, their card is the eleventh — the exact middle of twenty-one. Deal ten and turn over the next.

WHY IT WORKS

Sandwiching the named column between the other two cuts the possible positions to a third and centres what remains. Twenty-one candidates become seven, then seven become three, then three become one. Three deals is enough because three cubed is twenty-seven, which is more than twenty-one — you have more precision than you need, which is why the card arrives at the centre one deal early and stays there.

The spectator's answers are three base-three digits, and they hand them to you themselves. You are not reading them; you are collecting them.

THE COMMON MISTAKE

Gathering with the named column on top or bottom instead of the middle. It still converges, but to a different position, and if you then deal ten and turn over the eleventh you will be wrong. Middle, every time.

TRICK FOUR

The 27 Card Trick

THE EFFECT

The same beginning — twenty-seven cards, three deals, three answers. But this time you ask your spectator to name any position from one to twenty-seven *before* you start, and their card arrives there.

THE METHOD

1. Ask them to name a number from 1 to 27. Subtract one, and write the result in base three as three digits. Twenty is 202: two nines, no threes, two ones.
2. Read those digits **right to left**. Each digit tells you where the named column goes on that gather: 0 means on top, 1 means in the middle, 2 means on the bottom.
3. Deal twenty-seven cards into three columns of nine, dealing across. Ask which column. Gather using the first digit.
4. Deal, ask, and gather twice more, using the second and third digits.
5. Count down to the number they named. Their card is there.

THEY SAY	MINUS ONE	BASE THREE	GATHERS, IN ORDER
1	0	000	top, top, top
14	13	111	middle, middle, middle
20	19	201	middle, top, bottom
27	26	222	bottom, bottom, bottom

WHY IT WORKS

Twenty-seven is three cubed, so every position from 0 to 26 has exactly one three-digit base-three address. Each gather writes one digit of that address: putting the named column on top means no cards above it in that round, the middle means one column's worth, the bottom means two.

The 21 card trick converges to a fixed position because you always write the same digit. This one lets the spectator choose the destination, because you write whichever digits they asked for. It is the same mechanism with the answer made adjustable — and that is why it fools people who already know the 21.

SUBTRACT ONE, ALWAYS

Positions are counted from one and base-three addresses start at zero. Skip the subtraction and every card lands one place late.

TRICK FIVE

The Binary Card Trick

THE EFFECT

You hand over five cards, each covered in numbers. Your spectator thinks of any number from 1 to 31 and hands back only the cards their number appears on. You add nothing visibly, and name it at once.

THE METHOD

Add the top-left number of each card they hand back. That is the answer. The five corner numbers are 1, 2, 4, 8, and 16.

CARD	CORNER	CONTAINS EVERY NUMBER WHOSE...
A	1	ones place is 1
B	2	twos place is 1
C	4	fours place is 1
D	8	eights place is 1
E	16	sixteens place is 1

WHY IT WORKS

Every whole number has exactly one way of being written as a sum of distinct powers of two. Nineteen is $16 + 2 + 1$ and nothing else. So the set of cards a number appears on is that number, written in binary — and handing back the cards is handing back the digits.

Your spectator is not choosing which cards to give you. The number chose for them, before they had it in mind.

MAKING THE CARDS

Card A lists every odd number: 1, 3, 5, 7 ... 31. Card B lists 2, 3, 6, 7, 10, 11 ... Or generate them from the rule: a number belongs on a card if that power of two appears in its binary form. Five cards reach 31; six reach 63.

A clock face does arithmetic that wraps: four hours after ten is two, not fourteen. Cards do the same with thirteen, because each suit has thirteen ranks. Count three past the queen and you are at the two. Once you are willing to let numbers wrap, a deck becomes a sequence you can do arithmetic on.

TRICK SIX

The 13 Card Trick

THE EFFECT

Your spectator deals the deck into several face-up piles, choosing where to stop each one, while you look away. You turn back to a table of piles you never touched, and name the exact number of cards left in your spectator's hand.

THE METHOD

1. They turn a card face up and count out loud from its value up to thirteen, dealing a card face down for each count. A seven means counting "eight, nine ... thirteen" — six cards on top.
2. That pile is done. They start another the same way, and keep going until there are not enough cards left to finish one.
3. They hand you the leftovers. Count the piles.
4. Turn over the top card of each pile and add the values. Add ten. Then subtract the number of piles, multiplied by thirteen.

WHY IT WORKS

Every completed pile holds exactly fourteen minus its face card in cards — one for the face card, then thirteen minus its value on top. So a pile's size and its face value always add to fourteen, whatever card started it.

That means the whole deck is accounted for by simple arithmetic: fifty-two cards, minus fourteen for each pile, plus the face values back. Rearranging gives the leftovers, and the ten in the recipe is what fifty-two leaves behind once you have taken the thirteens out. Nothing is being remembered. You are solving one equation the spectator built for you.

TRICK SEVEN

The Si Stebbins Stack

THE EFFECT

A deck that can be cut as often as anyone likes, spread face down, and still tell you the name of any card taken from it — because you saw the one above it.

THE METHOD

1. Arrange the deck so each card is **three higher** than the one before, wrapping past king back to ace, and the suits repeat in a fixed cycle. Clubs, hearts, spades, diamonds is the usual one.
2. So: ace of clubs, four of hearts, seven of spades, ten of diamonds, king of clubs, three of hearts, and onwards.
3. Let anyone cut, as often as they like. Cuts do not disturb a cycle.
4. When a card is taken, glimpse the card now on the bottom, or the one above the gap. Add three and step the suit forward once. That is their card.

WHY IT WORKS

The stack is a loop, not a line. Adding three each time and wrapping at thirteen visits every rank before returning to the start, because three and thirteen share no factor — and the four-suit cycle turns over at a different rate, so the whole deck is one unbroken sequence of fifty-two.

Cutting a loop and rejoining it leaves a loop. That is why the spectator can cut all day: they change where the sequence begins, and the sequence is all you use.

THE ONE THING THAT BREAKS IT

A genuine shuffle. Cuts are safe and should be encouraged, loudly and often. Riffle shuffles are not, so keep the deck moving and hand it over only for cutting.

Everyone knows shuffling destroys order. That is mostly true and precisely wrong, and the gap between those two is where the next two tricks live.

TRICK EIGHT

The Gilbreath Principle

THE EFFECT

You arrange a deck so the colors alternate — red, black, red, black — and show it. Your spectator deals some of it face down into a pile, riffle shuffles the two halves together genuinely, and hands it back. You deal the shuffled deck in pairs, and every pair is one red and one black.

THE METHOD

1. Set the deck in strict alternating colors. This is the only preparation.
2. Have them deal roughly half into a pile on the table. This reverses that half, which is the step that matters.
3. Have them riffle the two halves together, as sloppily as they like.
4. Deal the result in pairs. Each pair holds one of each color.

WHY IT WORKS

Dealing into a pile reverses that half, so the two halves now run in opposite color order — where one has red at the top, the other has black. A riffle shuffle interleaves them without reordering either, so whichever half the first card falls from, the second card of the pair must come from a packet whose next card is the opposite color.

The spectator's shuffle is genuinely free and genuinely random. It just cannot break this particular property, because the property does not depend on order — only on the two halves running opposite ways.

THE STEP PEOPLE SKIP

The deal-into-a-pile is not padding. Without that reversal the two halves run the same way and the pairs come out matching instead of mixed. Norman Gilbreath published the principle in 1958.

TRICK NINE

The Faro Shuffle

THE EFFECT

Not a trick so much as a fact worth owning: shuffle a deck perfectly eight times and it returns to exactly the order it started in.

THE METHOD

A faro shuffle cuts the deck into two halves of twenty-six and interleaves them perfectly, one card at a time. An **out-faro** keeps the original top card on top. Eight consecutive out-faros restore a fifty-two card deck completely.

WHY IT WORKS

A perfect out-faro sends the card at position p to a predictable new position: it doubles it, and wraps around modulo fifty-one. Doing that eight times means multiplying by two eight times — 256 — and 256 leaves a remainder of one when divided by fifty-one. Every card returns to where it began.

The number is a property of fifty-two cards, not of shuffling in general. A deck of a different size takes a different number of faros, and some sizes take a great many.

HONEST ABOUT DIFFICULTY

This is the one thing in this book that is not self-working. A genuine faro takes real practice. The mathematics is free; the shuffle is not.

TRICK TEN

Out of This World

THE EFFECT

Someone who has never held a deck sorts forty-eight face-down cards into reds and blacks, one at a time, by guessing — and gets every single one right. Paul Curry published it in 1942, and magicians have called it the best card trick ever made for eighty years.

THE METHOD

1. Sort the deck beforehand: every red together, every black together. This is the whole preparation and it must be done before you sit down.
2. At the table, take two cards off the top and two off the bottom. A sorted deck has one color at each end, so this hands you two reds and two blacks without appearing to look for anything.
3. Put one red and one black down as markers. Keep the other two where you can reach them.
4. Let them place every card, face down, onto whichever marker they choose. They cannot be wrong, so let them take as long as they like.
5. At the halfway point — after card twenty-four — add the two spare markers, each onto the line whose marker is the other color. Say something about having favored one side.
6. Let them finish, then gather the two lines. One of them gets picked up from the far end, which reverses it.
7. Turn them over a group at a time.

WHY IT WORKS

While the deck is feeding cards of one color, both lines are equally right — the spectator is making a free choice that cannot be wrong, because every card available at that moment is the same color.

The part almost nobody explains: the two markers must be different colors, but both lines receive the same color at the same time. So one line comes out perfect and the other comes out **exactly inverted** — right cards, right order, labels the wrong way round. That is a gift, because a line that is backwards in a completely predictable way is put right by reversing it, and reversing a line is indistinguishable from picking it up.

THE ONLY THING THAT GOES WRONG

Adding the spare markers at the wrong moment. Early and late cost the same, and neither can be repaired: both lines end up part-wrong instead of one cleanly inverted. Count as they deal.

52 factorial

The number of orders a deck can be in is $52 \times 51 \times 50 \times \dots \times 1$, written $52!$ and equal to roughly 8×10^{67} . It is a number large enough that a properly shuffled deck has, with near-certainty, never existed before in that order and never will again.

How many shuffles randomize a deck

Bayer and Diaconis showed in 1992 that about **seven** riffle shuffles bring a deck close to random. The seven is not folklore — it is the point at which the distance from randomness falls off sharply.

It does come with a condition that is usually dropped. The seven assumes the deck is cut near the middle each time. Sellke, Shi, and Wang showed in 2026 that when the cuts are careless, closer to **fourteen** shuffles are needed. If you are shuffling to actually randomize, cut near the middle or shuffle twice as long.

Why a deck has 52 cards

You will often read that the deck encodes the calendar: fifty-two cards for fifty-two weeks, four suits for four seasons, thirteen ranks for thirteen lunar months, and the values adding to 364 — 365 with a joker.

The arithmetic is real. The history is not. Fifty-two is where European decks settled after centuries of variation — Italian, German, and Spanish decks used other counts, and the joker was added in America in the 1860s for euchre, centuries after the deck's size was fixed. A story invented after the fact to explain a number is not the reason for that number.

Where to go next

Every trick in this book has a page on **sleightless.com** where you can play it through in your browser — from the spectator's chair to see the effect, and from the magician's to practice the one decision each trick asks of you. Nothing is gated and nothing needs an account.

The Piano Trick	sleightless.com/tricks/piano-trick/
The Four Robbers	sleightless.com/tricks/four-robbers/
The 21 Card Trick	sleightless.com/tricks/21-card-trick/
The 27 Card Trick	sleightless.com/tricks/27-card-trick/
The Binary Card Trick	sleightless.com/tricks/math/binary-card-trick/
The 13 Card Trick	sleightless.com/tricks/count-to-13/
The Si Stebbins Stack	sleightless.com/tricks/si-stebbins/
The Gilbreath Principle	sleightless.com/tricks/math/gilbreath-principle/
The Faro Shuffle	sleightless.com/tricks/math/faro-shuffle/
Out of This World	sleightless.com/tricks/out-of-this-world/
52 factorial	sleightless.com/tricks/math/52-factorial/
How many shuffles	sleightless.com/tricks/math/how-many-shuffles/
Why 52 cards	sleightless.com/tricks/math/why-52-cards/

Mathematical Card Tricks · sleightless.com · Free to download, print, copy, and hand out. If you teach with it, no permission is needed. Sources for the historical claims are cited on the matching pages.