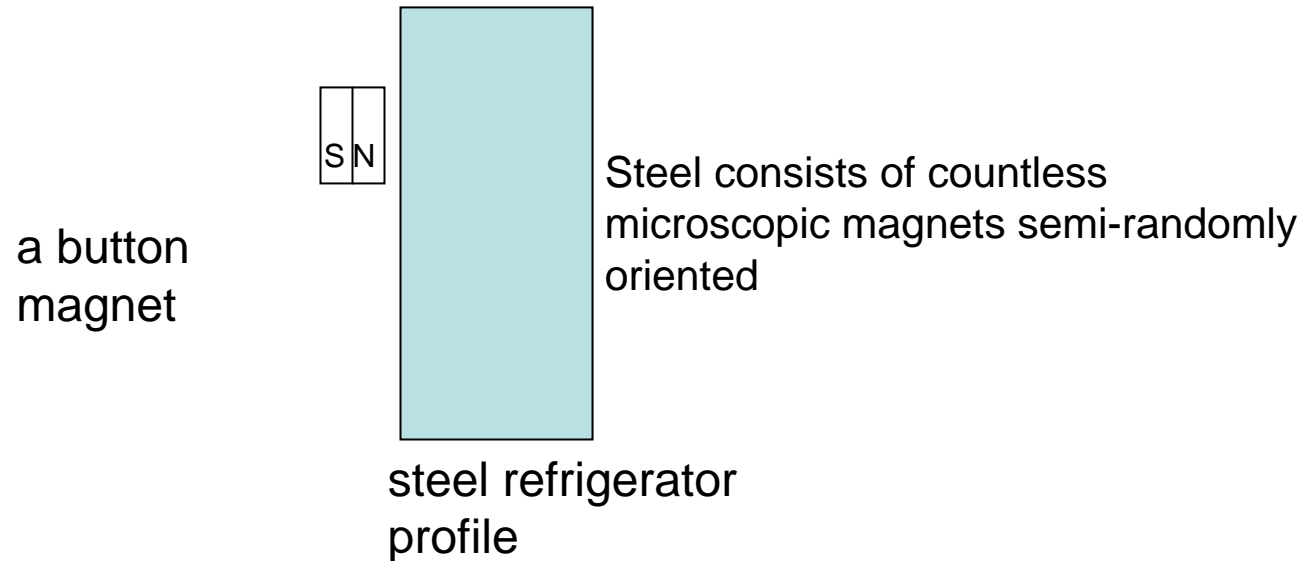


Today, we will answer the following Everyday Physics Question:

- Why do refrigerator magnets stick to the steel doors of a fridge ?
Is the fridge magnetic ?
- Why is it unwise to bring a strong magnet close to a credit card ?
- How do credit cards work ?
- How do hearing aids work ?



Why do “button magnets” stick to a refrigerator ?



- As you bring magnet close to steel, opposite poles shift closer to the button magnet's pole and like poles shift farther away.

(induced magnetic polarization)

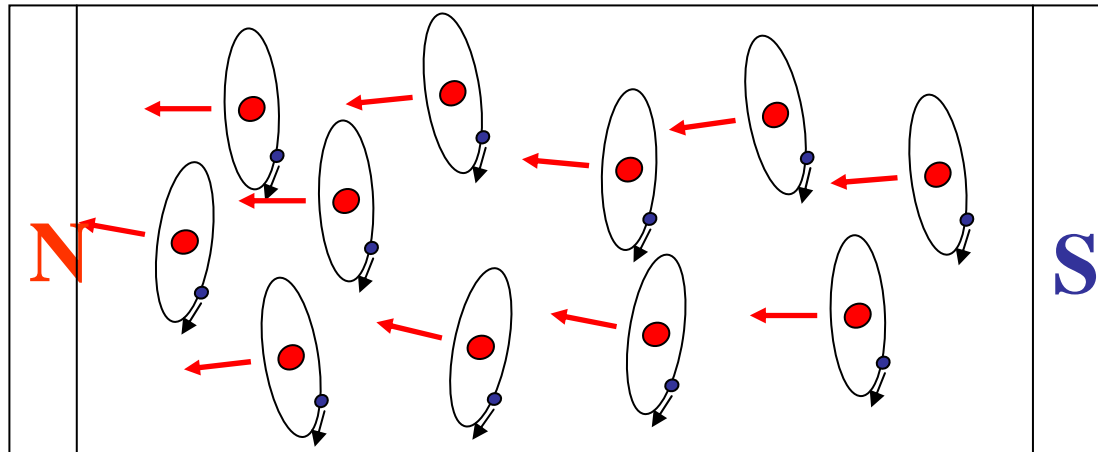
attraction



- If you flip the button magnet and bring it close, steel will polarize in the right way to attract those poles.
- WILL NOT WORK WITH ALUMINUM

Ferromagnetic Materials (e.g. Iron or steel – alloy of iron)

- contain large numbers of Magnetic dipoles that are randomly oriented
- but they could be polarized by a stronger magnet. Examples are iron and steel (an alloy of compound of iron)



-Eliminate the influencing magnet and this “induced magnetism” often does not disappear.

-in such materials, there are magnetic “domains” – groups of magnetic dipoles that cannot be demagnetized (In each domain, they all point in one direction).

- When you take away the magnet, the steel is slightly still magnetized.

Example of Materials that easily demagnetizes:

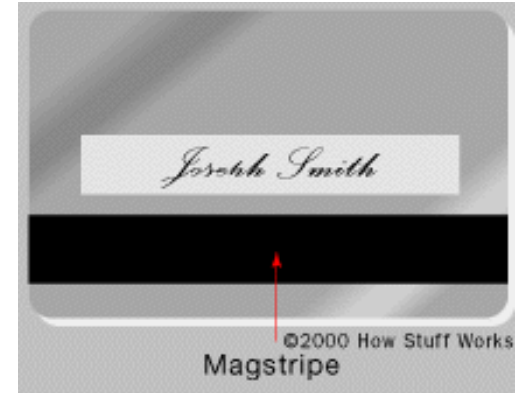
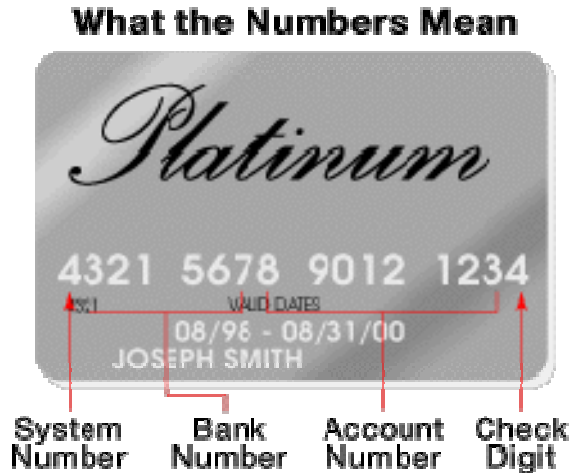
Chemically Pure Iron – a soft material, has few flaws and impurities that keep domains from being pinned against them and therefore, maintained.

How do Credit Cards work ?

Historical Tidbits:

- began in the 1920s: hotels/oil companies issued them to customers
- 1950: Diners Club issued the 1st universal credit card
- 1958: AMEX followed suit
- 1959: Bank of America started a national bank plan for the credit card in California; eventually became national, renamed VISA in 1976
- Master Charge followed, eventually becoming Mastercard

What do the numbers mean ?

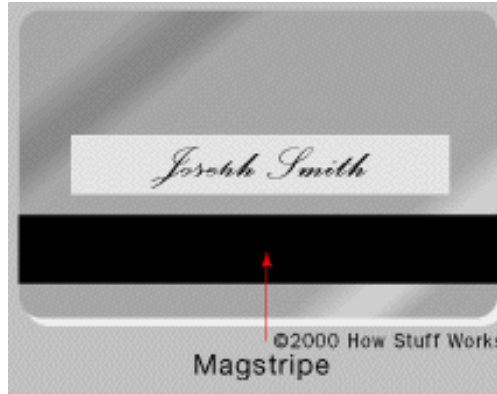


First Digits:

- 3 - Travel/Entertainment Cards:
 AMEX (37-), Diners Club (38-)
- 4 - VISA
- 5 - Mastercard
- 6 - Discover

Magnetic Stripe

- has tiny bar magnets made from (ferromagnetic) iron powder mixed with a "binder".
- can be magnetize by exposure to magnetic fields
- 3 1/10" wide tracks of magnets



A “bit” corresponds to the information in a magnet:

A bit can take on only 2 values:

1 or 0

0 – magnet points in 1 way

1 – magnet points other way



Track 1: 210 “bits” per inch (bpi), and holds 79 6-bit characters

Track 2: 75 bpi, and holds 40 4-bit characters

Track 3: 210 bpi, and holds 107 4-bit characters

Track 3 contains info on Encrypted PIN, country code, authorized amount (unstandardized info)

Used routinely

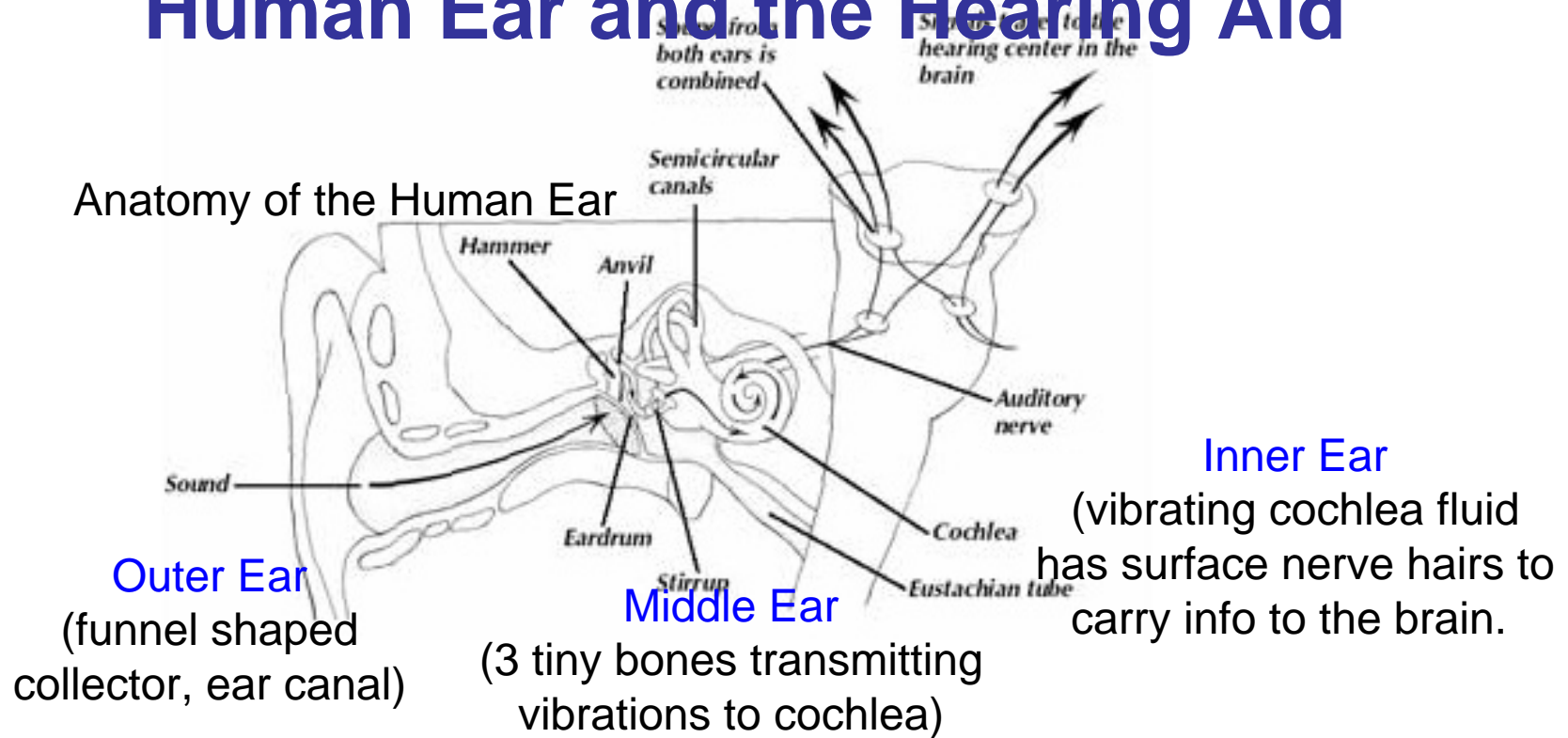
Contains a sentinel code (1 character), account # (up to 19 characters), expiration (4 characters), spacers (1 character), country code (3 characters), discretionary data (up to 40 characters)

Example of a Transaction Authentication

1. Merchant swipes the card thru a card reader (EDC – Electronic Data Capture POS – Point-of-Sale Terminal) which dials out via a modem to an “acquirer”.
2. Acquirers – organizations which gather info at 1200 bits per second to provide payment guarantee, checks the info from the magstripe for merchant id, valid number, expiration, credit limit, usage.
3. A PIN is entered by customer. PINs are not on the card, or if so, are encrypted (hidden in a code). Alternatively, a cash machine might encrypt your entered pin and looks for it in the bank’s database.
4. Once this encrypted information is verified, the payment is approved.

More modern cards have a ‘microprocessor chip’ – an integrated circuit built in. 1984 – France began using such “smart cards” that have more storage and Processing power.

Human Ear and the Hearing Aid



1. A sound travels down the outer ear's canal and makes the eardrum vibrate like a membrane or drum.
2. These vibrations are passed on by 3 middle-ear bones: hammer, anvil and stirrup.
3. The stirrup makes the fluid inside the cochlea vibrate. These vibrations are detected by tiny nerve hairs on the inside surface of the cochlea) a snail-shaped organ.
4. The auditory nerve carries these signals to the brain for interpretation.
5. Loss of hearing happens in many ways: infection in the middle ear where pus accumulates to lead to temporary or permanent deafness. Accidents or genetics can also damage eardrums and cochlea nerve endings.

How do Hearing Aids Work ?



1. Sound waves reach a microphone which converts air density (pressure) fluctuations into electric currents and voltages.
2. These signals are amplified by the “volume control”/amplifier and fed into the tone hook that is custom-fit to a personal earmold snugly fit into the outer ear.
3. Depending on hearing test results before a hearing aid is made, the required volume amplification or “gain” is calculated. This is translated into a gain versus frequency curve (below) needed to offset hearing loss. Hearing loss also depends on the frequency of the sound.

