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Engineering

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"An engineer is someone who can do for ten cents what any damn fool can do for a dollar" Henry Ford

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"An engineer is someone who can do for ten cents what any damn fool can do for a dollar" Someone else (not Henry Ford)

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"Do not believe every quotation you read on the internet" Alexander the Great

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Scientific laws applied in the real world to help humanity.

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The story of the refrigerator door.

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ヘロト 人間 とくほとく ほとう

A brilliant engineering solution to two problems.

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ヘロト 人間 とくほとくほとう

A puzzle. Why do refrigerator doors stick? A little video I made earlier

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$$\frac{PV}{T} = C$$

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A puzzle. Why does my tea taste better in a bone china mug?

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A puzzle. Why is my bone china mug thinner than my other mug?

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Where else is this principle applied?

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Reactiontime $\propto 2^{0.1T}$

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If it is not counterintuitive, it is not worth knowing.

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Who said that?

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- All science would be superfluous if the outward appearance and the essence of things directly coincided.
- If the way things really are was the same as they look, then science would be unnecessary.
- Karl Marx, edited by Engels, Capital, Volume III (1894), Chapter 48, section III

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Let's check out our physical principles (Thanks to Physical Concepts Inventory)

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Big truck hits little car head on. Which exerts the bigger force on the other?

- 1. Truck on car?
- 2. Car on truck?
- 3. Equal?

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We close the switch:

The brightness of lamps A and B

- (a) Increases
- (b) Decreases
- (c) Stays the same

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We close the switch: The brightness of lamp C

- (a) Increases
- (b) Decreases
- (c) Stays the same

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We close the switch:

The total power being dissipated in the circuit

- (a) Increases
- (b) Decreases
- (c) Stays the same

白マイド・ボー

Is the Steam Engine important?

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Who invented the Steam Engine?

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Who invented the Steam Engine?



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How did he invent the Steam Engine?



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How did he invent the Steam Engine?



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How did he invent the Steam Engine?



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How did he invent the Steam Engine?



Chris Stephenson

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How did he invent the Steam Engine?



Chris Stephenson

How did he invent the Steam Engine?



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What is the boiling point of water?

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Heat a pan of water to 100 degrees. Why doesn't it all turn into steam at once?

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"My attention was first directed in the year 1759 to the subject of steam-engines by the late Dr Robinson .

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He goes on to say that he conducted some experiments on the force of steam "about the year 1761" - by which time he was 25.

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The Steam Engine

The latent heat of steam.

10. I found that the Amentity of weiter - word for prejection in five engines was much Greater Them of thought was nacespoury to Cool the Quantity of montos of water contained in the Steam Jown to below he boiling point I migai " part of boiling weter with 30 parts of Cald water & found it only heated to the aroth metalal mean between The two heats & that it was scarcely somethy heated to the finger.) took a glags take & envorted it outs The nose of a tec withe Sp the other and being pour of in ald water I famil a small enverende of the Water on the fre on matering the

The Steam Engine

The latent heat of steam. a Table of the perticulions of the foregoing Ex personerite 900 760 89.4 46.4 1159.5 947.5 48.5 17500 708. 86.5 42.5 1136.9 924.9 x 17500 44.5 44.5 899. 98. 54. 1149.1 937.1 17500 17300 44.5 467.5 73.5 29.5 1175-6 963-6 he. 17500 44.5 369. 67.25 23. 1150. 946. 17500 47.5 642. 87. 40. 1177.3 965.3 5. 7. 17500 49. 688.5 84.5 36. 1155. 948. 8. 17500 49. 675. 07.5 41. 1150.5 938.5 9. 17500 48. 680.5 86.5 42. 1166.5 954. 5 10. 17500 45. 664.25 85.5 11. 1165.66 953.66 99.2. × 11. 17600 48. 975. 102. 57.5 1134. 5 3 4 G 2 1 7 P

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Santral: What do these pictures have in <u>common?</u>



Santral: What do these pictures have in common?



Santral: What do these pictures have in common?



Santral: What do these pictures have in common?



Why 3? Why not 2 or 4? Why are the insulators so long?

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V = IRW = VIso $I = \frac{W}{V}$

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We want to transmit W watts. SO We choose to do this at V volts $I = \frac{W}{V}$ The resistance of our cable is *R*, so our transmission loss, w, is $w = IR = \frac{WR}{V}$ More volts, less loss.

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AC/DC The war of the currents.

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ヘロト 人間 とくほ とくほとう

AC/DC The war of the currents.



Thomas Edison Mister DC

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AC/DC The w<u>ar of the currents</u>.



Nikolai Tesla Mister AC

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AC/DC The war of the currents.



Thomas Edison: "Solve this problem and I will give you 50,000 dollars"

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AC/DC The w<u>ar of the cur</u>rents.



Nikolai Tesla: "Solved. Where's my money?"

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AC/DC The war of the currents.



Thomas Edison: "You don't yet understand the American sense of humour"

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AC/DC The w<u>ar of the cur</u>rents.



Thomas Edison: The fate of dogs, cats, Topsy the elephant and William Kemmler.

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sin(x) + sin(x + 120) + sin(x + 240) =?

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Even in 1980, there was still DC generation in the US and the UK.

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A beautiful piece of engineering

The Bosphorus Bridge.

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The Bosphorus Bridge. What about its social utility?

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Computer hardware design

What motivated computer hardware design?

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1980: Berkeley RISC project ve DARPA VLSI project.

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1985 ARM: "Acorn Research Machines"

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ARM: "Acorn Research Machines" When the first chip was tested, it appeared to be drawing zero current.

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ARM: "Acorn Research Machines" The first chip drew only 0.5 watt

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ヘロト 人間 とくほと 人間と

A modern ARM System on a Chip (SoC) -STM32L

- Ultra-low-power mode: 280 nA with backup registers (3 wakeup pins)
- Ultra-low-power mode + RTC: 900 nA with backup registers (3 wakeup pins)
- Low-power run mode: down to 9 μA
 Dynamic run mode: down to 177 μA/MHz

So why are all our computers CISC?

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So why are all our computers CISC? Intel was richer.

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ARM: "Acorn Research Machines" Then "Advanced RISC Machines". (Acorn went bust long ago.) Now ARM

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To date , 50.000.000.000 ARM processors have been produced

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This is a lot more than Intel. Maybe 10 times, Maybe 20. Who knows?

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In 2013 10.000.000 ARM processors were produced

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Many of these are "Systems on a Chip"

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Which engineer designed

- the original ARM instruction set?
- the very first SoC?
- the Firepath processor in almost every ADSL modem?

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Chips and devices



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Chips and devices



Good engineering and bad engineering.

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"Equal" games are not always equal.

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"Good engineering" is not an objective criterion in an unequal society..

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