### 1. Counting Things…

What benefits do humans gain from the ability to count?

a)

b)

c)

### 2. Imagine a World…

Imagine if every phenomenon of our natural world was reduced to only one of **two** states. For example, if it wasn’t *cold* it would be *hot*. Or how about if you were not *short* you were *tall* with no in between? All people would be either *young* and at some point they became, instantly, *old*! When it wasn’t *morning* it would be, instantly, *night*. (*Yikes!)*

Think of four additional concepts (universally, earthly, humanly, or otherwise) that might be reduced to one of **two** possible states. (*As strange as it might seem, computers and similar digital technology view the world in this way*)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Distance** |  |  |  |  |
| near |  |  |  |  |
| far |  |  |  |  |

### 3. Imagine a (Binary) Odometer…

An *odometer* is a device we use to measure the distance travelled by a vehicle. The word derives from the Ancient Greek words *hodós* ("path" or "gateway") and *métron* ("measure"). A practical bicycle version of this device has the 10 decimal digits etched onto the four cylindrical wheels, however, for this thought experiment, you are to imagine that it counts the distance in *binary*!

a) For the *binary* odometer, how many digits are etched onto **each** of the four wheels?

b) How many **4-digit** numbers can the odometer display?

c) What would the odometer display after you had traveled?

i) 2 km?

ii) 3 km?

iii) 7 km?

c) How far would you have travelled just before the odometer rolls over to **0000** again? km

d) Imagine a custom version of this odometer in which you could add additional wheels.

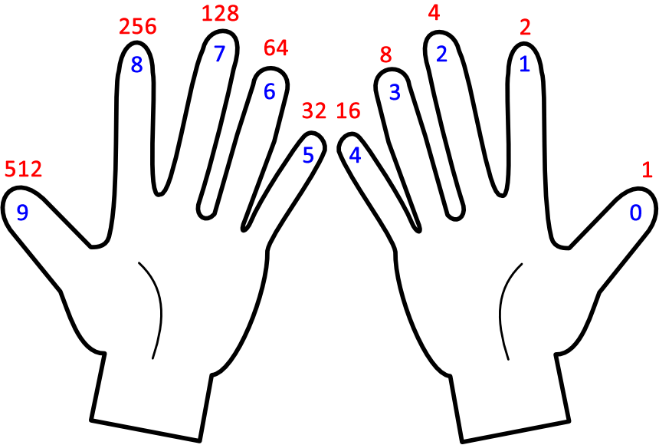
i) Add a **5th**  cylindrical wheel. How far could you ride before the display rolls over? km

ii) Add a **6th** cylindrical wheel. How far could you ride before the display rolls over? km

iii) Add a **7th** cylindrical wheel. How far could you ride before the display rolls over? km

iv) Finally, add an **8th** cylindrical wheel. How far could you ride before the display rolls over? km

### 4. Different Number Systems…

As a result of the concept of **place value**, numbers of equal value are expressed differently in various bases. Numbers relating to computer concepts are more easily written in bases that are powers of 2, such as 2 (binary), 8 (octal) and 16 (hexadecimal). Complete all the missing entries in the table below…

|  |  |  |  |
| --- | --- | --- | --- |
| **Binary  Base 2** | **Octal (Base 8)** | **Decimal (Base 10)** | **Hexadecimal (Base 16)** |
| **0000.** | **00.** | **00.** | **00.** |
| **0001.** | **01.** | **01.** | **01.** |
| **0010.** | **02.** | **.** | **02.** |
| **0011.** | **.** | **.** | **03.** |
| **.** | **04.** | **.** | **.** |
| **.** | **05.** | **.** | **.** |
| **.** | **.** | **.** | **.** |
| **.** | **07.** | **.** | **.** |
| **.** | **10.** | **.** | **.** |
| **.** | **11.** | **.** | **.** |
| **.** | **.** | **10.** | **.** |
| **1011.** | **.** | **11.** | **.** |
| **.** | **.** | **.** | **0C.** |
| **.** | **.** | **.** | **0D.** |
| **.** | **16.** | **.** | **.** |
| **.** | **.** | **.** | **.** |
| **.** | **.** | **.** | **10.** |

### 5. Really Difficult (Binary) Odometer Question…

OK, you’ve heard of a *decimal* point and you likely know what its purpose is. The modified binary odometer has a ***binary*** point between the two rightmost binary digits. If you had one of these mounted on your handlebars, how far would you have ridden when the odometer displays **111.1**?

**Answer: \_\_\_\_\_\_\_\_\_km**