**Explorations of Technology – Measuring Data**

**Bit –** A single binary digit, 0 or 1, express with lower case b.

**Byte** – Eight bits together, a single ASCII character can be stored in one byte, expressed with capital B.

**Data Prefixes**

|  |  |  |
| --- | --- | --- |
| **Unit of measurement** | **Actual # of Bytes** | **Actual # of Bits** |
| byte (B) |  |  |
| kilobyte (KB) |  |  |
| megabyte (MB) |  |  |
| gigabyte(GB) |  |  |
| terabyte (TB) |  |  |

**Rules for Conversion between Data types**

1. If converting from bits to bytes, you must divide by 8.
2. If converting from bytes to bits, you must multiply by 8.
3. If going down the table, for each row, you must divide by 1000.
4. If going up the table, for each row, you must multiply by 1000.

**Examples**

2.15 TB = GB

In this example, we are going to use rule #4, since we are going up one row (terabyte to gigabyte), so we just need to multiple by 1000. 2.15 \*1000 = **2150 GB**

25000 bits = KB

In this example, we are going to use rule # 1 (bits to bytes) and rule # 3 (down one row).

25000/8 = 3125 bytes 3125 Bytes/1000 = **3.125 Kilobytes (KB)**

.058 Gb = KB

In this example, we are going to use rule # 1 (bits to bytes) and rule # 4 twice, since we need to move up two rows to get from giga to kilo. The order in which you apply the rules doesn’t matter. I’m going to apply rule #4 first.

.058 \* 1000 = 58 (Gb to Mb), then 58 \*1000 (Mb to Kb) = 58000 Kb

Now I apply rule # 1, 58000 Kb / 8 = **7250 KB**

**Conversion Problems**

**Directions:** Convert the units of measurement in the left hand column to the units in the right hand column.

|  |  |
| --- | --- |
| **Start** | **Finish** |
| **45,000 bits** | **bytes** |
| **1.2 GB** | **bytes** |
| **3.42 TB** | **GB** |
| **2,400,000 bits**  | **Mb** |
| **.357 MB** | **Gb** |
| **35,900 Kb** | **Bytes** |
| **1.941 Tb** | **GB** |
| **9,600,000,000,000 bits** | **TB** |
| **77,200 KB** | **Gb** |
| **84,000 Gb** | **MB** |

**Bandwidth**

Bandwidth is simply the measurement of how many bits you can send per second. (**bps**) This is the measurement that Internet Service Providers, like Xfinity or AT&T use to advertise their Internet products.

The process of converting bandwidth is the same as what you did above. You need simply add the “ps” to the end of your conversion. (Mbps, GBps, etc…)

**Calculating Time to Download/Upload**

You should be able to calculate data transfer time, given a bandwidth and amount of data to transfer. Follow these steps to do this:

1. Get the bandwidth and data size into the same units.
2. Divide the data size by the bandwidth to get the number of seconds the transfer will take.
3. Convert seconds into minutes, hours, days. If there are more than 60 seconds, you should convert to minutes. If there are more than 60 minutes, you should convert to hours. If there are more than 24 hours, you should convert to days. Use this table to help:

|  |  |  |
| --- | --- | --- |
| **Conversion** | **Math** | **Example** |
| Seconds to Minutes | Divide seconds by 60 | 2400 seconds / 60 = 40 minutes |
| Minutes to Hours | Divide minutes by 60 | 420 minutes / 60 = 7 Hours |
| Hours to Days | Divide hours by 24 | 72 hours / 24 = 3 Days |

**Examples:**

Example # 1: You want to download a 4.7 GB DVD image. Your home internet speed is 20 Mbps. How long will this take?

**Step # 1** – (Get data and bandwidth to same units. So we convert 4.7 GB into Mb. Using rules # 2 and # 4. 4.7 \*1000 \* 8 = **37600 Mb**

**Step # 2** –(Divide data size by bandwidth) 37600 Mb / 20 Mbps = **1880 seconds**

**Step # 3** – (We have more than 60 seconds, so convert to minutes) 1880 seconds / 60 = **31.333 minutes** Answer

Example # 2 – You want to copy a 2.2 TB file onto a portable hard drive. The drive can copy data at 480 Mbps. How long will this take?

**Step # 1** – Convert 2.2 TB to Mb. Again, using rules #2 and #4 (twice) - 2.2 \* 1000\*1000\*8 = **17,600,000 Mb**

**Step # 2**  - 17,600,000 Mb/ 480 Mbps = **36,667 seconds**

**Step # 3** – 36,667 / 60 = 611 minutes 611 minutes/60 (mins to hours) = **10.19 Hours** Answer

**Problems**

You want to download a compressed file, full of family photos to your cell phone. The file size is 90 MB. You are in Caledonia and only get 3G, which caps you at 384 Kbps. How long will it take?

You want to download a Blu-ray movie, which is 20 GB in size. Your home Internet has a bandwidth of 6 Mbps. How long will it take you to download this movie?

You recently acquired a pirated version of Microsoft Office and want to upload it to an FTP (download) server. The image is 1.5 GB in size. You are using a weak Wifi signal to upload it which only allows upload speeds of 250 Kbps. How long will it take to upload?

You are hacking into the pentagon and want to download the file contains all American assets in the Middle East. The file is 13.5 TB in size. Your Internet allows you to download at a rate of 100 Mbps. How long will it take you to download this file?