

2021A30

CHANGE OF BASE

ANSWERS

Level 1: The following tables follow the same process as the example.

NUMBER: 101101101 ₂									
	1	0	1	1	0	1	1	0	1
POSITION	8	7	6	5	4	3	2	1	0
EXPONENT EXPRESSION	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
VALUE OF DIGIT	$1 * 2^8$	$0 * 2^7$	$1 * 2^6$	$1 * 2^5$	$0 * 2^4$	$1 * 2^3$	$1 * 2^2$	$0 * 2^1$	$1 * 2^0$
FINAL VALUE	256	0	64	32	0	8	4	0	1
SUMMED VALUE	$256 + 0 + 64 + 32 + 0 + 8 + 4 + 0 + 1 = 365$								

NUMBER: 100001 ₂							
	1	0	0	0	0	0	1
POSITION	6	5	4	3	2	1	0
EXPONENT EXPRESSION	2^6	2^5	2^4	2^3	2^2	2^1	2^0
VALUE OF DIGIT	$1 * 2^6$	$0 * 2^5$	$0 * 2^4$	$0 * 2^3$	$0 * 2^2$	$0 * 2^1$	$1 * 2^0$
FINAL VALUE	64	0	0	0	0	0	1
SUMMED VALUE	$64 + 0 + 0 + 0 + 0 + 0 + 1 = 65$						

NUMBER: 1111111 ₂								
	1	1	1	1	1	1	1	1
POSITION	7	6	5	4	3	2	1	0
EXPONENT EXPRESSION	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
VALUE OF DIGIT	$1 * 2^7$	$1 * 2^6$	$1 * 2^5$	$1 * 2^4$	$1 * 2^3$	$1 * 2^2$	$1 * 2^1$	$1 * 2^0$
FINAL VALUE	128	64	32	16	8	4	2	1
SUMMED VALUE	$128 + 64 + 32 + 16 + 8 + 4 + 2 + 1 = 255$							

For this last number, we can notice that is one less than 100000000 which would be 2^8 or 256. Therefore, we can say:

$$256 - 1 = 255$$

This simplifies the math greatly!

Level 2:

The process for base-16 is very similar to base-2! We can use a table like we did for Level 1.

NUMBER: DADCABFAD ₁₆									
	D	A	D	C	A	B	F	A	D
POSITION	8	7	6	5	4	3	2	1	0
EXPONENT EXPRESSION	16^8	16^7	16^6	16^5	16^4	16^3	16^2	16^1	16^0
VALUE OF DIGIT	$13 * 16^8$	$10 * 16^7$	$13 * 16^6$	$12 * 16^5$	$10 * 16^4$	$11 * 16^3$	$15 * 16^2$	$10 * 16^1$	$13 * 16^0$
FINAL VALUE	55,834,574,848	2,684,354,560	218,103,808	12,582,912	655,360	45,056	3,840	160	13
SUMMED VALUE	$55,834,574,848 + 2,684,354,560 + 218,103,808 + 12,582,912 + 655,360 + 45,056 + 3,840 + 160 + 13 = 58,750,320,557$								

While this is quite a bit of work, it did save us some space. The hexadecimal representation is only 9 digits, and the decimal representation is 11 digits. When automating the base conversion process, the space saving is a nice perk!



Our turbines produce a lot of data because of all the computers that help control them. These computers all run, lightning-fast, on the base-2 system.