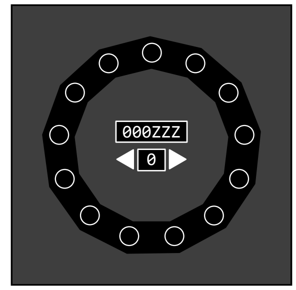
On the Subject of 27,644,437



A scientific calculator is recommended! Please use a scientific calculator! Use a scientific calculator!

The module contains:

- A circle of 13 white LEDs.
    - Ordered 0-12 clockwise from the top.
- A lower screen cycling through sets 0-12.
- An upper screen displaying a Base-36 number. (100000-ZZZZZZ)

A partition is a particular combination of subsets (groups) that can be made with a set of *n* elements. There are 27,644,437 possible partitions in a set of 13 elements, the LEDs being the elements, and the Base-36 number being the ID to the partition. Clicking the LEDs will toggle their presence in the selected subset, those being the letters A-M.

Partitions can be displayed in two ways:

- Set Partition: Shows which specific elements are in each subset:
  [[0], [2], [7], [1,8], [3,12], [5,10,11], [4,6,9]]
- Integer Partition: Shows how many elements are in each subset:
  [1, 1, 1, 2, 2, 3, 3]

Locate and submit the partition pointed to by Base-36 number in order to solve the module. Subsets are inputted in the order they were discovered using the **Instruction Table** on the next page.

Variables

The following is a list of variables that will appear regularly throughout the instructions. Each will always equal a numerical digit.

n	Element amount. Starts at 13, $n - r_1$ for each subset found.
r	Subset length $r_1 = 1 = [x]$ $r_2 = 2 = [x,x]$
j	Amount of a specific subset. $j_1 = 2 = [x], [x]$ $j_2 = 3 = [x,x], [x,x], [x,x]$

Instruction Table

1.	Convert the base of the module's serial number, becoming the "Base Index". See **Converting Bases** on Page 3.	Perform the following operation: Base Index % 27,644,437	Locate the cell in **Appendix B** on page 5 that matches with the Base Index.
2.	Take the PTF and IPC of the cell found in **Appendix B,** then plug into the formula.	Base Index − ((PTF + 1) − IPC) = Index A_1	
3.	Locate <u>Subset N</u>, the subset with the smallest *r* that has not been affixed a value. *If multiple subsets of r = 1 exist (j > 1), <u>Subset</u> N merges them (r = j_1).	Use the current <u>IPC</u> and the <u>SnC</u> of the current <u>Subset N</u>. **<u>IPC (Intgr Partition Combos):</u>** n! / (r_1! * r_2! * r_3!... * j_1! * j_2! * j_3!...) **<u>SnC (Subset N Combos):</u>** n! / (r! * (n − r)!)	**<u>CPSn (Combos per single value of Subset N):</u>** IPC / SnC = CPSn
4.	Find <u>SnV</u>; save it as a rounded down whole number AND its decimal form. **<u>Subset N Value(s):</u>** Index A_1 / CPSn = SnV	Count up to the <u>SnV</u>th (whole) combination of Subset N. See **Counting Subset Values** on Page 3. Save <u>Subset N</u> as part of the final answer (if r = j_1, unmerge elements).	Remove <u>Subset N</u>'s *r* from the integer partition.
5.	Recalculate <u>IPC</u> with <u>Subset N</u> removed. n = n − (Subset N's r) j_1 = j_1 − 1, j != 0	Separate two values of <u>SnV</u>: It's whole number form AND decimal form. (decimal(SnV) − whole(SnV)) * IPC = Index A_1	Index A_1 replaces Index A_2

6.	If Index $A_2 = 0$, continue from here. If not, repeat Steps 3-5 until it does.	If one subset is left, any unset elements may be added to it. This also applies if the rest of the subsets are subsets of r = 1. If multiple subsets are unset, use the first available combination for each subset in order of whichever subset would be Subset N next.	Once the correct partition is inputted, the module will solve.

Converting Bases

To convert from Base-36 to Base-10, take each letter's alphanumeric value and add 9 to it. Then starting from the leftmost number, multiply each number by 36^n. *n* in this case starts at 5, and decreases incrementally by one for the next number. Finally, add each product.

ABZ129 ⇒ 10, 11, 35, 1, 2, 9
(10 * 60,466,176) + (11 * 1,679,616) + (35 * 46,656) + (1 * 1,296) + (2 * 36) + (9 * 1)
= 624,771,873

Counting Subset Values

For a subset of r = 2, its combinations are ordered like so. Subsets with a higher r are ordered similarly:

SnV = 0 1 2 3
[0, 1], [0, 2], [0, 3], [0, 4], ..., [0, 9], [0, 10], [0, 11], [0, 12]
SnV = 12 13 14
[1, 2], [1, 3], [1, 4], ..., [1, 9], [1, 10], [1, 11], [1, 12],
SnV = 23 24
[2, 3], [2, 4], ..., [2, 10], [2, 11 [2, 12], ...

If a subset of r = 2 is given the values [4, 9], later subsets can not use either of the elements, as they are already fixed to a subset. Select the next available element(s).

If SnV is too large a number to count quickly, refer to **Appendix A** on the next page for a strategy that resembles C# code.

Appendix A

```
int v = the # of already set elements;
int x = 0; int y = 0; int w = 0;
for (int i = 0; until Subset N is solved; i + 1) {
    x = value in cell[column r , row v ];
    y + x;
    if (y > SnV) {
        SnV = SnV – (y – x);
        While avoiding already set elements:
            SubsetN[i] = value in cell[ row w, the leftmost column ];
        v = y + SubsetN[i] + 1
        r – 1; w = 0; }
    else if (y = SnV) {
        for (int i2 = 1; until Subset N is solved; i2++;) {
            SubsetN[i] = value in cell[ row w + i2, the leftmost column );
            i + 1; }
    w + 1; }
```

If SnV becomes low enough, you may go back to counting Subset N incrementally.

	1	2	3	4	5	6	7	8	9	10	11	12	13
0	1	12	66	220	495	792	924	792	495	220	66	12	1
1	1	11	55	165	330	462	462	330	165	55	11	1	
2	1	10	45	120	210	252	210	120	45	10	1		
3	1	9	36	84	126	126	84	36	9	1			
4	1	8	28	56	70	56	28	8	1				
5	1	7	21	35	35	21	7	1					
6	1	6	15	20	15	6	1						
7	1	5	10	10	5	1							
8	1	4	6	4	1								
9	1	3	3	1									
10	1	2	1										
11	1	1											
12	1												

Appendix B

In reading order, the list displays every possible integer partition that can be made in a list of 13 elements.

PTF = Partitions Thus Far (the index for each int. partition)
IPC = Integer Partition Combos (# of set partitions in an int. partition)

The Base Index matches with a cell if BOTH:

- Base Index is greater than the previous cell's PTF
- Base Index is less than or equal to the selected cell's PTF

Shade	~Amount	If a PTF surpasses a multiple(s) of one million partitions, the cell will be shaded for the sake of convenience. Format of cells: r_0, r_1, r_2, ..., [IPC] PTF
Light Gray	1,000,000	
Dark Gray	2,000,000	
Black	3,000,000	

13, [1] 0	12, 1, [13] 13	11, 2, [78] 91	11, 1, 1, [78] 169	10, 3, [286] 455
10, 2, 1, [858] 1313	10, 1, 1, 1, [286] 1599	9, 4, [715] 2314	9, 3, 1, [2860] 5174	9, 2, 2, [2145] 7319
9, 2, 1, 1, [4290] 11609	9, 1, 1, 1, 1, [715] 12324	8, 5, [1287] 13611	8, 4, 1, [6435] 20046	8, 3, 2, [12870] 32916
8, 3, 1, 1, [12870] 45786	8, 2, 2, 1, [19305] 65091	8, 2, 1, 1, 1, [12870] 77961	8, 1, 1, 1, 1, 1, [1287] 79248	7, 6, [1716] 80964
7, 5, 1, [10296] 91261	7, 4, 2, [25740] 117001	7, 4, 1, 1, [25740] 142741	7, 3, 3, [17160] 159901	7, 3, 2, 1, [102960] 262861

7, 3, 1, 1, 1, [34320] 297180	7, 2, 2, 2, [25740] 322920	7, 2, 2, 1, 1, [77220] 400140	7, 2, 1, 1, 1, 1, [25740] 425880	7, 1, 1, 1, 1, 1, 1, [1716] 427596
6, 6, 1, [6006] 433602	6, 5, 2, [36036] 469638	6, 5, 1, 1, [36036] 505674	6, 4, 3, [60060] 565734	6, 4, 2, 1, [180180] 745914
6, 4, 1, 1, 1, [60060] 805974	6, 3, 3, 1, [120120] 926094	6, 3, 2, 2, [180180] 1106274	6, 3, 2, 1, 1, [360360] 1466634	6, 3, 1, 1, 1, 1, [60060] 1526694
6, 2, 2, 2, 1, [180180] 1706874	6, 2, 2, 1, 1, 1, [180180] 1887054	6, 2, 1, 1, 1, 1, 1, [36036] 1923090	6, 1, 1, 1, 1, 1, 1, 1, [1716] 1924806	5, 5, 3, [36036] 1960842
5, 5, 2, 1, [108108] 2068950	5, 5, 1, 1, 1, [36036] 2104986	5, 4, 4, [45045] 2150031	5, 4, 3, 1, [360360] 2510391	5, 4, 2, 2, [270270] 2780661
5, 4, 2, 1, 1, [540540] 3321201	5, 4, 1, 1, 1, 1, [90090] 3411291	5, 3, 3, 2, [360360] 3771651	5, 3, 3, 1, 1, [360360] 4132011	5, 3, 2, 2, 1, [1081080] 5213091
5, 3, 2, 1, 1, 1, [720720] 5933811	5, 3, 1, 1, 1, 1, 1, [72072] 6005883	5, 2, 2, 2, 2, [135135] 6141018	5, 2, 2, 2, 1, 1, [540540] 6681558	5, 2, 2, 1, 1, 1, 1, [270270] 6951828
5, 2, 1, 1, 1, 1, 1, 1, [36036] 6987864	5, 1, 1, 1, 1, 1, 1, 1, 1, [1287] 6989151	4, 4, 4, 1, [75075] 7064226	4, 4, 3, 2, [450450] 7514676	4, 4, 3, 1, 1, [450450] 7965126
4, 4, 2, 2, 1, [675675] 8640801	4, 4, 2, 1, 1, 1, [450450] 9091251	4, 4, 1, 1, 1, 1, 1, [45045] 9136296	4, 3, 3, 3, [200200] 9336496	4, 3, 3, 2, 1, [1801800] 11138296
4, 3, 3, 1, 1, 1, [600600] 11738896	4, 3, 2, 2, 2, [900900] 12639796	4, 3, 2, 2, 1, 1, [2702700] 15342496	4, 3, 2, 1, 1, 1, 1, [900900] 16243396	4, 3, 1, 1, 1, 1, 1, 1, [60060] 16303456

4, 2, 2, 2, 2, 1, [675675] 16979131	4, 2, 2, 2, 1, 1, 1, [900900] 17880031	4, 2, 2, 1, 1, 1, 1, 1, [270270] 18150301	4, 2, 1, 1, 1, 1, 1, 1, 1, [25740] 18176041	4, 1, 1, 1, 1, 1, 1, 1, 1, 1, [715] 18176756
3, 3, 3, 3, 1, [200200] 18376956	3, 3, 3, 2, 2, [600600] 18977556	3, 3, 3, 2, 1, 1, [1201200] 20178756	3, 3, 3, 1, 1, 1, 1, [200200] 20378956	3, 3, 2, 2, 2, 1, [1801800] 22180756
3, 3, 2, 2, 1, 1, 1, [1801800] 23982556	3, 3, 2, 1, 1, 1, 1, 1, [360360] 24342916	3, 3, 1, 1, 1, 1, 1, 1, 1, [17160] 24360076	3, 2, 2, 2, 2, 2, [270270] 24630346	3, 2, 2, 2, 2, 1, 1, [1351350] 25981696
3, 2, 2, 2, 1, 1, 1, 1, [900900] 26882596	3, 2, 2, 1, 1, 1, 1, 1, 1, [180180] 27062776	3, 2, 1, 1, 1, 1, 1, 1, 1, 1, [12870] 27075646	3, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, [286] 27075932	2, 2, 2, 2, 2, 2, 1, [135135] 27211067
2, 2, 2, 2, 2, 1, 1, 1, [270270] 27481337	2, 2, 2, 2, 1, 1, 1, 1, 1, [135135] 27616472	2, 2, 2, 1, 1, 1, 1, 1, 1, 1, [25740] 27642212	2, 2, 1, 1, 1, 1, 1, 1, 1, 1, 1, [2145] 27644357	2, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, [78] 27644435
1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, [1] 27644436				