



## Learning Reminders

Make generalisations; Understand and use simple formulae.

This machine does two things, one after the other, to each input.

input	output
2	5
3	7
10	21
100	201

do fit function rule

do not fit function rule

input 3 digits

output 3 digits

input values

output values

check values

Input 2 numbers and try to guess the rule of the function machine.

Someone has tested some inputs and outputs. Look at them and see if you can work out what the machine is doing...

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input	output
2	19
3	29
5	49
10	99

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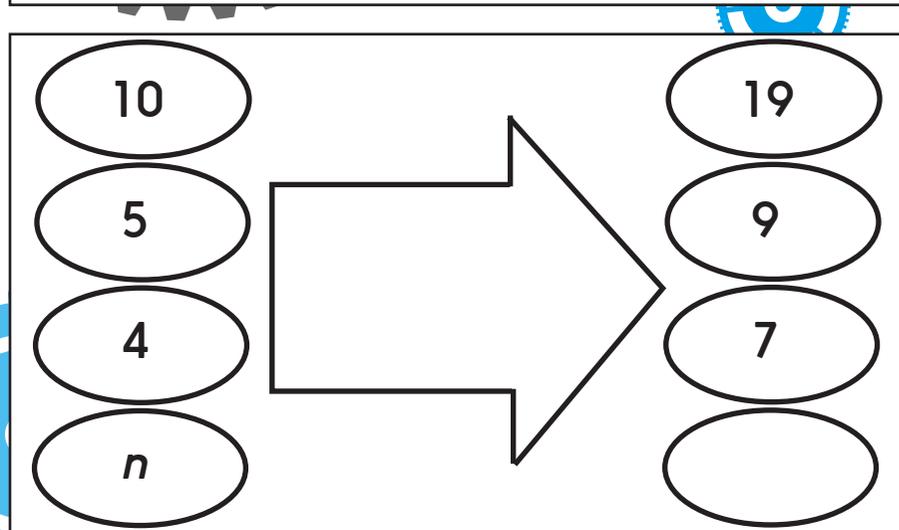
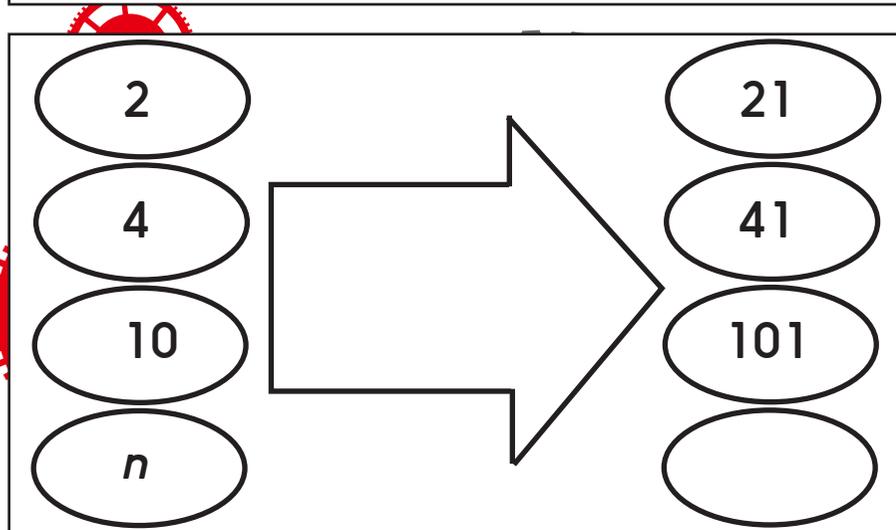
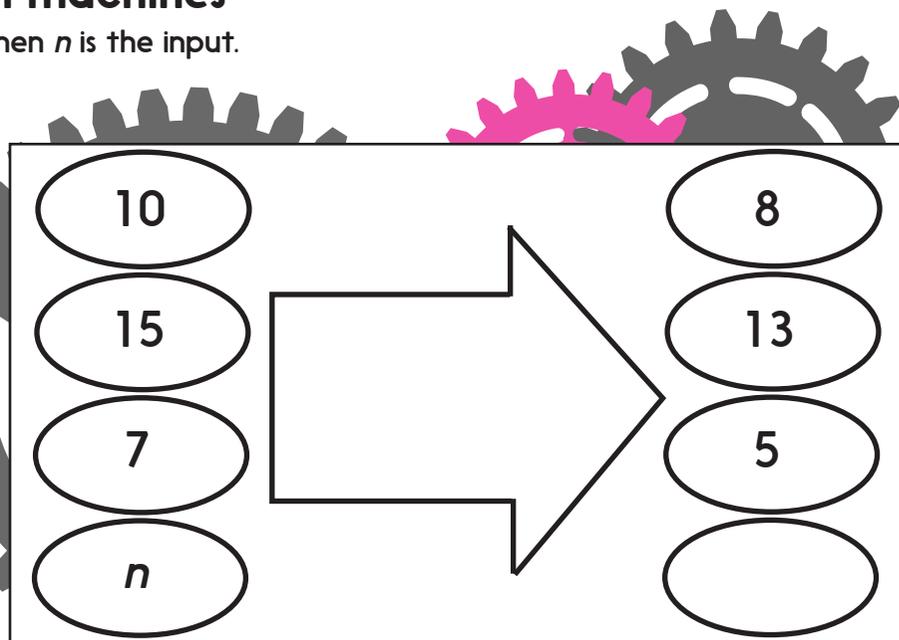
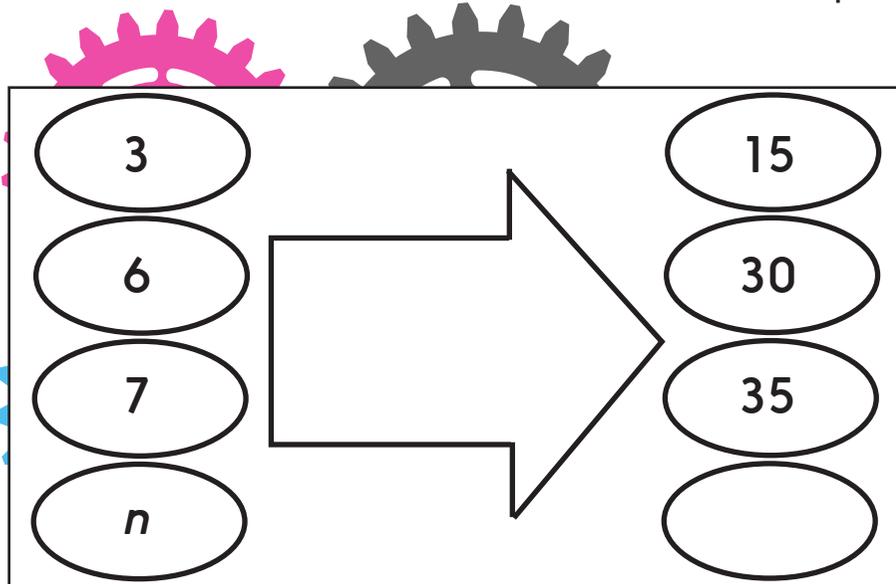
### Function machine rules

- The first function machine:  $\times 2, + 1$ . If  $n$  is the input, the number we put into the machine, we can write the output as  $2n + 1$ , which means we double the input, then add 1.
- The second function machine:  $\times 10, - 1$ . If  $n$  is the input, we can write the output as  $10n - 1$ .

## Practice Sheet Mild

### Function machines

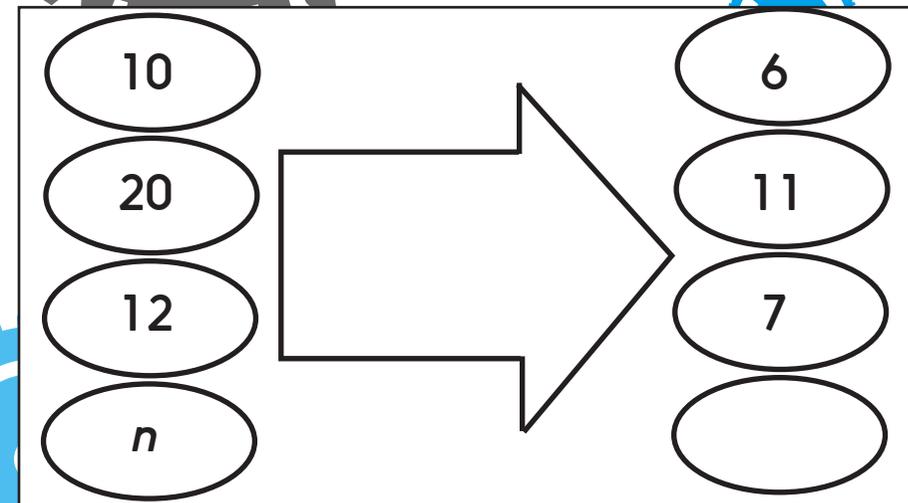
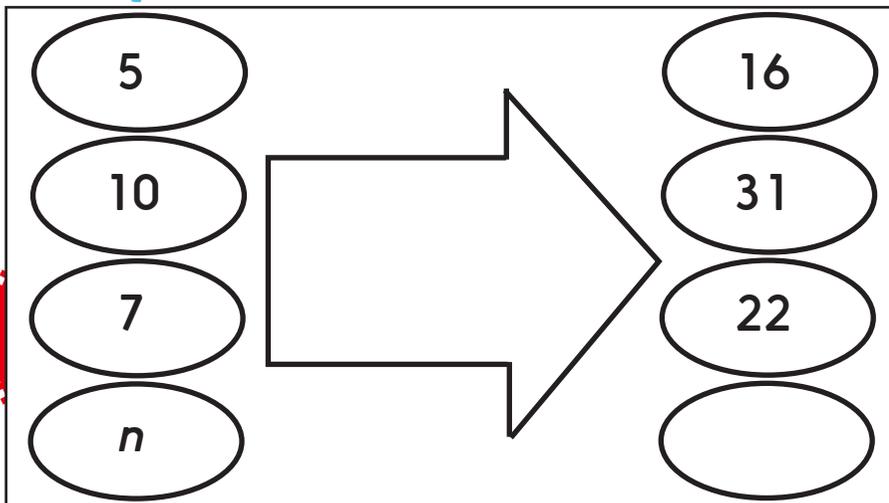
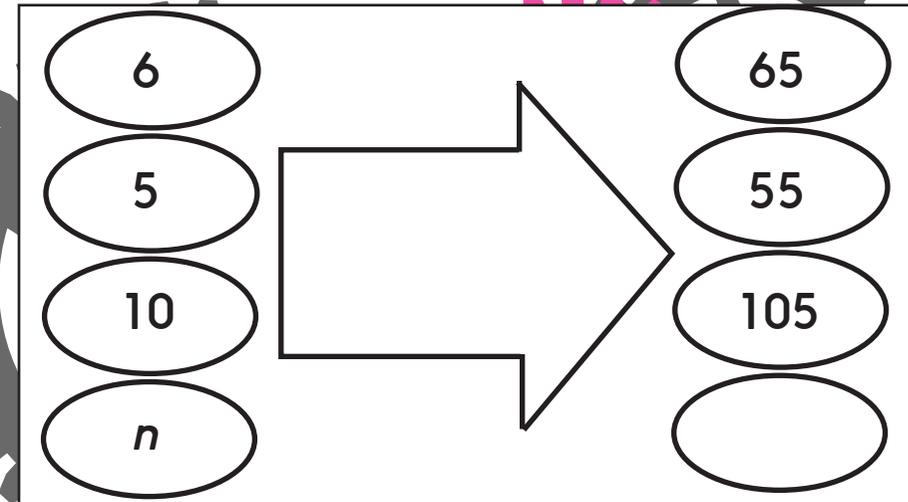
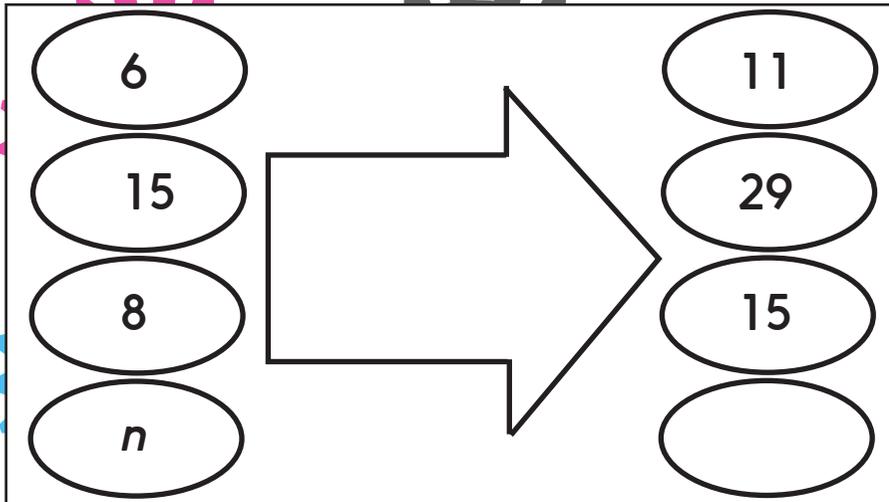
Work out what each function machine does. Write the output when  $n$  is the input.



## Practice Sheet Hot

### Function machines

Work out what each function machine does. Write the output when  $n$  is the input.



#### Challenge

Create your own two step function machine. Choose 3 inputs and find their outputs, swap with a partner. Can you discover each other's secret function?

## Practice Sheets Answers

### Function machines (mild)

$$3 \times 5 = 15$$

$$6 \times 5 = 30$$

$$7 \times 5 = 35$$

$$5n$$

$$10 - 2 = 8$$

$$15 - 2 = 13$$

$$7 - 2 = 5$$

$$n - 2$$

$$2 \times 10 + 1 = 21$$

$$4 \times 10 + 1 = 41$$

$$10 \times 10 + 1 = 101$$

$$10n + 1$$

$$10 - 1 + 10 = 19$$

$$5 - 1 + 5 = 9$$

$$4 - 1 + 4 = 7$$

$$2n - 1$$

### unction machines (hot)

$$6 - 1 + 6 = 11$$

$$15 - 1 + 15 = 29$$

$$8 - 1 + 8 = 15$$

$$2n - 1$$

$$6 \times 10 + 5 = 65$$

$$5 \times 10 + 5 = 55$$

$$10 \times 10 + 5 = 105$$

$$10n + 5$$

$$5 \times 3 + 1 = 16$$

$$10 \times 3 + 1 = 31$$

$$7 \times 3 + 1 = 22$$

$$3n + 1$$

$$10 \div 2 + 1 = 6$$

$$20 \div 2 + 1 = 11$$

$$12 \div 2 + 1 = 7$$

$$n \div 2 + 1$$

## A Bit Stuck? Function detectives

Look at the inputs and outputs. What calculation(s) is each machine doing?

3	15
4	20
10	50
100	500

2	13
3	14
5	16
10	21

10	3
20	13
15	8
7	0

2	40
3	60
4	80
5	100
10	200

***S-t-r-e-t-c-h:***

Can you write a formula for each machine where  $n$  is the input?

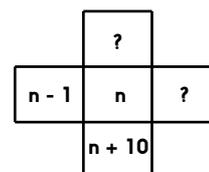
## Investigation

### Stars and crosses

1. Ring a number on the 1-100 grid that is not in a row or column on the edge of the square.
2. Ring the number below, the number above, the number to the left and the number to the right to form a cross.
3. Find the total of the five numbers and make a record of this along with the central number of the cross.
4. Repeat elsewhere on the grid. Can you see a relationship between the central number and the sum of the five numbers in the cross?
5. Why do you think that this relationship holds? Write a formula for finding the total of the five numbers in any cross laid out like this.
6. Now ring numbers in a bigger cross with nine, thirteen or even more numbers! See if you can predict the total. You may want to use a calculator to speed up the process if your cross is really big.

13	14	15
23	24	25
33	34	35

14
23
24
25
+ 34
120
24



13	14	15	16	17
23	24	25	26	27
33	34	35	36	37
43	44	45	46	47
53	54	55	56	57

### Challenge

Choose one of the shapes below, and try and find a way of finding the total of numbers in that shape anyway or anywhere on the grid. Or make up your own shape!

12	13	14	15	16	17	18	19	20
22	23	24	25	26	27	28	29	30
32	33	34	35	36	37	38	39	40
42	43	44	45	46	47	48	49	50
52	53	54	55	56	57	58	59	60

## Investigation

### Stars and crosses

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

## Investigation

### Stars and crosses

1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54
55	56	57	58	59	60	61	62	63
64	65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80	81