Martian Counting- Solutions

In the year 2107 it is quite common for school children to spend a year on Mars in a student exchange program. On your first day at Martian school you realise that the symbols they use for counting are different to the system you are familiar with. Your new teacher tries to help you understand the symbols they use by drawing some diagrams.

Step 1:

Can you fill in the missing entries in this table? Note that the O's are the straws end on and the (OOOOOO)'s are bundles of 6 straws.

O	1	(OOOOOO) O	11	(OOOOOO) (OOOOOO) O	**21**
OO	2	(OOOOOO) OO	12	(OOOOOO) (OOOOOO) OO	**22**
OOO	3	(OOOOOO) OOO	13	(OOOOOO) (OOOOOO) OOO	**23**
OOOO	4	(OOOOOO) OOOO	**14**	(OOOOOO) (OOOOOO) OOOO	**24**
OOOOO	5	(OOOOOO) OOOOO	**15**	(OOOOOO) (OOOOOO) OOOOO	**25**
(OOOOOO)	10	(OOOOOO) (OOOOOO)	**20**	(OOOOOO) (OOOOOO) (OOOOOO)	**30**

Teacher Note: Be careful not to say "ten" for 10; it needs a new name.
Suggestion: *martian-hand* for one group of 6 and no ones.
Then 14 is *martian-handy four,* 20 is *two martian-handy*.

Step 2:

After completing this table, you think about the number of fingers that Martians have (6) and realise that their system is really very similar to the one you use on Earth. Your new teacher now gives you some **addition** problems to do. Have a try! (The Martian children use rubber bands to make bundles of straws to show the number). The first one is done for you.

5 +1 10	2 +3 **5**	5 +14 **13**	13 +4 **21**	15 +33 **52**	21 +44 **105**	123 +45 **212**

Full details for the addition problems:

? 5 + 1
= ooooo + o
= (oooooo)
= 10 meaning 1 group of 6 (or 1 martian hand) and 0 ones.

? 2 + 3
= oo + ooo
= ooooo
= 5

? 5 + 4
= ooooo + oooo
= (oooooo) ooo
=13 meaning 1 group of 6 (or 1 martian hand) and 3 ones.
This number may be pronounced *martian handy three.*

? 13 + 4
= (oooooo) ooo + oooo
= (oooooo) (oooooo) o
= 21 meaning 2 group of 6 (or 2 martian hands) and 1 one.
This number may be pronounced as *two martian handy one.*

? 15 + 33
= (oooooo) ooooo + (oooooo) (oooooo) (oooooo) ooo
= (oooooo) (oooooo) (oooooo) (oooooo) (oooooo) oo
= 52 meaning 5 group of 6 (or 5 martian hands) and 2 ones.
This number may be pronounced as *five martian handy two.*

? 21 + 44
= (oooooo) (oooooo) o + (oooooo) (oooooo) (oooooo) (oooooo) oooo
= **[**(oooooo) (oooooo) (oooooo) (oooooo) (oooooo) (oooooo) **]** ooooo
=105 meaning that there is one bundle of 6 groups of 6 (represented by the **[]**'s) and 5 ones. A new name is needed, try *mar-martian hands*)
This number may be pronounced as *one mar-martian hand and five.*

? 123 + 45
=**[**(oooooo) (oooooo) (oooooo) (oooooo) (oooooo) (oooooo)**]** (oooooo) (oooooo) ooo
+ (oooooo) (oooooo) (oooooo) (oooooo) ooooo
= **[**(oooooo) (oooooo) (oooooo) (oooooo) (oooooo) (oooooo)**]**
[(oooooo) (oooooo) (oooooo) (oooooo) (oooooo) (oooooo)**]** (oooooo) oo
= 212 meaning that there are 2 bundles of 6 groups of 6 (2 mar-martian hands represented by the **[]**'s), one group of 6 (1 martian hand) and 2 ones.
This number may be pronounced as *two mar-martian hands, martian handy two*.

Step 3:

Next comes **subtraction**: (you may need to use the straws again). The first one is done for you.

12	5	24	23	35	543
-3	-4	-12	-14	+15	-231
5	**1**	**12**	**5**	**20**	**312**

Full details for the subtraction problems:

- 5 - 4
  = o𝍸𝍸𝍸𝍸
  = 1

- 24 - 12
  = (oooooo) (𝍸𝍸𝍸𝍸𝍸𝍸) 𝍸𝍸oo
  = (oooooo) oo
  = 12 meaning that there is one group of 6 (1 martian hand) and 2 ones.
  This number may be pronounced as *martian handy two*.

- 23 - 14
  = (ooooo𝍸) (𝍸𝍸𝍸𝍸𝍸𝍸) 𝍸𝍸𝍸
  = ooooo
  = 5

- 35 - 15
  = (oooooo) (oooooo) (𝍸𝍸𝍸𝍸𝍸𝍸) 𝍸𝍸𝍸𝍸𝍸
  = (oooooo) (oooooo)
  = 20 meaning that there are 2 groups of 6 (2 martian hands).
  This number may be pronounced as *two martian hands.*

- 543 - 231
  = **[**(oooooo) (oooooo) (oooooo) (oooooo) (oooooo) (oooooo)**]**
  [(oooooo) (oooooo) (oooooo) (oooooo) (oooooo) (oooooo)**]**
  [(oooooo) (oooooo) (oooooo) (oooooo) (oooooo) (oooooo)**]**
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  = **[**(oooooo) (oooooo) (oooooo) (oooooo) (oooooo) (oooooo)**]**
  [(oooooo) (oooooo) (oooooo) (oooooo) (oooooo) (oooooo)**]**
  [(oooooo) (oooooo) (oooooo) (oooooo) (oooooo) (oooooo)**]**
  (oooooo) oo
  = 312 meaning that there are 3 lots of 6 groups of 6 (3 mar-martian hands), 1 group of 6 (1 martian hand) and 2 ones. This number may be pronounced as *three mar- martian hands, martian handy two.*

Step 4:

Use straws to help you to fill in the following **multiplication** table. Some are already done for you.

*	0	1	2	3	4	5	10
0	**0**	**0**	**0**	0	**0**	**0**	**0**
1	**0**	**1**	2	**3**	**4**	**5**	**10**
2	**0**	**2**	**4**	**10**	12	**14**	**20**
3	**0**	**3**	**10**	13	**20**	**23**	**30**
4	**0**	**4**	12	**20**	**24**	**32**	**40**
5	**0**	**5**	**14**	**23**	**32**	41	**50**
10	**0**	10	20	**30**	**40**	**50**	**100**

Eg. 5 * 2
= oo oo oo oo oo
= (oooooo) oooo
= 14. This reads as *martian handy four*.

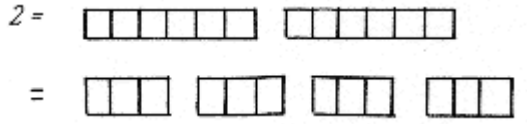
Teacher Note: When a number is multiplied by the base number 10 (either our normal ten or 1 martian hand), the original number moves one column to the left and a zero is written in the ones column. This should be discussed and explored, rather than just memorising the "rule" "add a zero" as this rule is often misapplied by students.
A Number Slide demonstrates this very well.

Step 5:

When the teacher tries to explain **division** you realise that Martians use a system rather like our decimals but they write the symbol **:** (pronounced 'dit') when the parts are smaller than one. Look at the following divisions and see if you understand them (use straws again).

12 ÷ 2 = 4 23 ÷ 3 = 5 2 ÷ 4 = 0:3 2 ÷ 10 = 0:2 13 ÷ 2 = 4:3

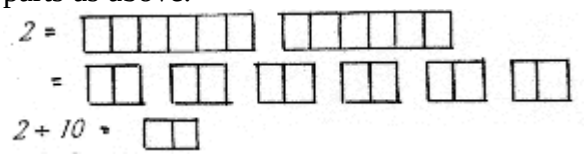
- 12 = (oooooo) oo = {oooo} {oooo} so 12 ÷ 2 = oooo = 4
- 23 = (oooooo) (oooooo) ooo = {ooooo} {ooooo} {ooooo} so 23 ÷ 3 = ooooo = 5
- 2 ÷ 4 - To divide 2 by 4, split the two ones each into six parts, shown here magnified.



The answer is 3 sixths (needs a new name) ie 3 martian fingernails, also

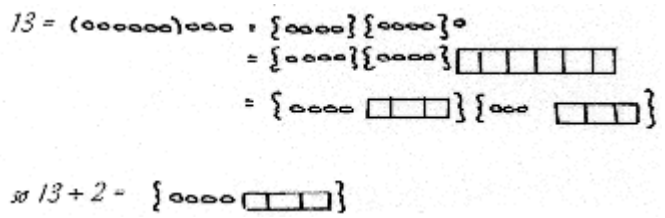
called zero dit three.
= 0 : 3

- 2 ÷ 10 -To divide 2 by 1 martian hand (six), split the two ones each into six parts as above.



= 0 : 2 *(This may be pronounced as zero dit two)*

- 13 ÷ 2



= 4 : 3 *(This may be pronounced as four dit three)*

Teacher Note: When a number is divided by the base number 10 (either our normal ten or 1 martian hand), the original number moves one column to the right. This should be discussed and explored, rather than just memorising the "rule" "move the decimal point" as this rule is often misapplied by students. ***A Number Slide demonstrates this very well.***

Step 6:

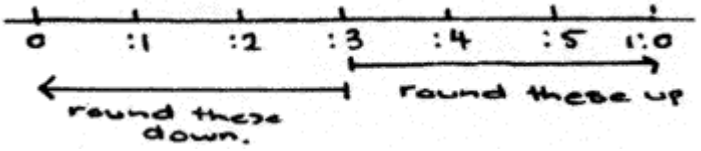
Minka, one of the Martian children, is having trouble with the number 000120**:**3000. She is unsure whether it is correct to write as 12**:**3, leaving out all the zeros. What can you say to help her?

- 000**120 : 3**000 The first three zeros and the last three zeros aren't necessary although the numbers in bold are. The first three zeros tell us that there aren't any mar-mar-martian hands or any larger number, and the last three digits tell us that there aren't any sixths of sixths or smaller numbers.
  The '1' tells us that there is 1 mar-martian hand,
  the '2' tells us that there are 2 martian hands,
  the '0' says there are no ones,
  the '3' denotes the 'fractional part' of the number. In this case 3/6 therefore it would be correct to write 120 : 3

Step 7:

Monto is another student in your class. He is trying to make sensible answers by rounding some of his results. First he needs to round 531**:**41 to the nearest whole number. Can you think of a rule for rounding to help him?

- He gets 532. On Earth we use the base ten number system and so these digits suggest rounding down (0, 1, 2, 3, 4) while these digits suggest rounding up (5, 6, 7, 8 and 9). The earthly convention for the midpoint is to round up (eg we round 37.5 up to 38). On Mars they only have the digits 0, 1, 2, 3, 4 and 5 so the digits 0, 1, 2 suggest that the number is rounded down and the digits 3, 4, 5 suggest rounding up. The following portion of a numberline indicates this:



Rounding these to the nearest whole number:

- 21 **:** 45 ≃ 22. (4 indicates the entire number is rounded up because 21:45 is closer to 22 than to 21)
- 3 **:** 153 ≃ 3 (1 indicates the entire number is rounded down because 3:153 is closer to 3 than to 4)
- 14 **:** 354 ≃ 15 (3 indicates the entire number is rounded up because 14:354 is closer to 15 than to 14)
- 15 **:** 354 ≃ 20 In this number there are: 1 group of 6 + 5 ones + 3 dits + some smaller parts. This number will be rounded up due to this digit 3 (as discussed above). So the number will become: 1 group of 6 + 5 ones + 1 more which is 2 groups of 6 (with no ones) which is written as 20.