Math Challenge

Washington Middle School
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New Numbers

Instructions:
Steve forgot what numbers are, so he decided to make up his own. Here are some numbers that he invented:

31254, 132, 3761542, 4132, 216435, 2413

Toby tried to write down some numbers too, but Steve told him that they didn't count as numbers:

13321, 243, 6754138, 541532, 332

Exercise 1.
Cross out all the numbers that don't count according to Steve.

615324, 1327645, 31514, 12345, 541, 7, 41532, 3521, 312, 4132, 13542, 1, 14263675

Exercise 2.
a) Write down all the 1-digit numbers for Steve. How many are there?

b) Write down all the 2-digit numbers. How many are there?

c) Write down all the 3-digit numbers. How many are there?

d) Write down all the 4-digit numbers. How many are there?

e) Can you find a formula for the number of n-digit numbers?

Exercise 3.
Next, Steve decided to invent a new version of multiplication. Here are some of his results:

213 · 321	=	231
2143 · 4321	=	3412
21435 · 54321	=	45231
214356 · 654321	=	563421
2143567 · 7654321	=	6745321
21435678 · 87654321	=	78564321
321 · 213	=	312
4321 · 2413	=	3142
54321 · 13524	=	42531
654321 · 234651	=	156432
7654321 · 2543671	=	1763452
1324 · 3421	=	3241
1324 · 3412	=	3142
1324 · 3142	=	3412
1324 · 1342	=	1432
1324 · 1324	=	1234
1324 · 1432	=	1342
123 · 123	=	123
123 · 321	=	321
123 · 231	=	231
132 · 231	=	213
213 · 213	=	123
213 · 321	=	231
213 · 123	=	213
321 · 321	=	123
231 · 231	=	312
231 · 213	=	132
23145 · 41253	=	12453
3761542 · 2617534	=	1432576

Try to figure out how to multiply these numbers for Steve:

312 · 132	=	______________________
52143 · 14235	=	______________________
21 · 21	=	______________________
1347652 · 3614527	=	______________________
4321 · 2341	=	______________________

Exercise 4.
Now Steve starts to sort his numbers into odds and evens:

Evens	Odds
12	21
123	132
231	321
312	213
1234	1243
1423	1432
4132	4312
3412	3142
3761542	31425
31452	51243
2345176	12345687
4321	12345876
12345786	

Sort the following numbers into evens and odds:

13245, 1234, 623415, 21, 312, 3142, 24531, 987654321

Evens	Odds

Exercise 5.
How many 1-digit even numbers are there?

2-digit even numbers?

3-digit even numbers?

Any conjectures on what the pattern is? Can you prove your conjecture?