**Addition, Subtraction, Multiplication:**

1. Rounding 1: When w multiplying numbers that are easily rounded up such as ending 8 or 9, use the subtraction method. For example, 49 x 16:
   1. Round up 49 to 50;
   2. 50 x 16 = 800
   3. 49 x 16 = 50 x 16 – 1 x 16 = 784
2. Rounding 2: For some subtractions, do additions first then subtract. For example, 632 – 478:
   1. Round up 478 to 500;
   2. 632 – 500 = 132;
   3. 632 – 478 = 632 – 500 + 22 = 132 + 22 = 154
3. For some additions, do rounding first. For example 76 + 81:
   1. Round up 81 to 90;
   2. 76 + 90 = 166;
   3. 76 + 81 = 76 + 90 –9 = 166 –9 = 157
4. The add/subtract method for squaring: example 46 x 46
   1. 46 x 46 = (46 – 4) x (46 + 4) + 16 = 42 x 50 + 16 = 2116
5. Squaring double-digit numbers ending in 5: For example, x5
   1. X5 \* x5 = x \* (x + 1) \* 100 + 25
6. Binomial Theorem for squaring: ab x ab

* (10a + b) x (10a + b) = 100 x a x a + 2 x 10 x a x b + b x b
* 41 x 41 = 40 x 40 + 2 x 40 x 1 + 1 = 1681

1. Multiplying by 5 equals to multiplying by 10 then divide by 2:
   1. 79 \* 5 = 79 x 10 / 2 = 395
2. Multiplying by 11:
   1. 42 x 11 = 400 + (4 + 2) x 10 + 2 =462
   2. 89 x 11 = 800 + (8 + 9) x 10 + 9 = 979
3. For two digit number multiplications, if the tenth digits are the same and the sum of the unit digits equals to 10, then xy \* xz = x \* (x + 1) \* 100 + y \* z:
   1. 82 \* 88 = 8 \* 9 \* 100 + 2 \* 8 = 7216
4. Redistribution numbers: 49 + 96
   1. 49 + 96 = 50 – 1 + 95 + 1 = 145
5. Divide and conquer: 25 x 16
   1. 25 x 32 = 25 x 4 x 8 =800
6. Use 5 x 2, 25 x 4, 125 x 8 combinations

**Factoring:**

1. Divisibility by 6:

* Even number
* Sum of all digits is divisible by 3

1. Divisibility by 18:

* Even number
* Sum of all digits is divisible by 9

1. Divisibility by 4: If a number’s last two digits is divisible by 4, then whole number is divisible by 4;
2. Divisibility by 8: if a number’s last three digits is divisible by 8, then whole number is divisible by 8;
3. If the sum of a number’s all digits is divisible by 3 or 9, then 3 or 9 is a factor of the number.
4. To determine if a number has 7 as a factor, take the last digit off the number, double it and subtract the doubled number from the remaining number. If the result is evenly divisible by 7, then the original number is divisible by seven. This can be repeated: for example 2492
   1. 249: ----- take off the last digit 2
   2. 249 – 4 = 245 = 35 x 7 or
   3. 24 – 5 x 2 = 14 = 2 x 7
5. To determine if a number has 13 as a factor, take the last digit off the number, add four times the last digit to the remaining leading truncated number. If the result is divisible by 13, the so is the original number. Repeat: for example 12818
   1. Truncate the last digit: 1281
   2. Add four times of the last digit: 4 x 8 = 32
   3. 1281 + 32 = 1313 = 101 x 13
6. To determine if a number is divisible by 11, subtract the last digit from the remaining leading truncated number. If the number is divisible by 11, so is the original number: example 8679
   1. 867 – 9 = 858 = 78 x 11
7. To determine if a number is divisible by 17, subtract five times of the last digit from the remaining leading truncated number. If the result is divisible by 17, then is the original number: example 7752
   1. 775 – 5 x 2 = 765
   2. 76 – 5 x 5 = 51 = 3 x 17
8. To determine if a number is divisible by 19, add two times the last digit to the remaining leading truncated number, if the result is divisible by 19, so is the original number: example 14307
   1. 1430 + 2 x 7 = 1444
   2. 144 + 2 x 4 = 152
   3. 15 + 2 x 2 = 19

**Others:**

1. Converting 9ths into decimals:
   1. 1/9 = 0.1111111111……
   2. 2/9 = 0.2222222222……
   3. :
   4. :
   5. :
   6. 8/9 = 0.8888888888……
   7. 9/9 = 0.9999999999…… = 1
2. Decimal representations of the 11ths:
   1. 1/11 = 0.09090909……
   2. 2/11 = 0.18181818……
   3. :
   4. :
   5. :
   6. 9/11 = 0.81818181……
   7. 10/11 = 0.9090909……