✖ Products to Know ✖

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Review these once a day until you know them. All of them. All the time. Always.

* Most students know their multiplication tables up to 10 x 10 or 12 x 12.
  That's insufficient. KNOW THE MULTIPLICATION TABLE UNTIL AT LEAST 20 x 20.
  If for some reason you never properly learned even 10 x 10, or,
  you're using an "alternative" involving say your fingers,
  even if that's reliably correct, that's going to hold you back immensely,
  in which case contact me and I will help you learn it in an expedient timeline.

* KNOW Perfect Squares up to 20, backwards and forwards.
  Plus some cubes and quads.
  Memorize all these in random order (not in the order presented below).

```
 0 x  0 =   0
 1 x  1 =   1     (Note: "^" means "to the power of" that is exponentiation)
 2 x  2 =   4     2^3 = 8
 3 x  3 =   9     3^3 = 27    3^4 = 81
 4 x  4 =  16     4^3 = 64    4^4 = 256
 5 x  5 =  25     5^3 = 125   5^4 = 625
 6 x  6 =  36     6^3 = 216
 7 x  7 =  49
 8 x  8 =  64     8^3 = 512
 9 x  9 =  81
10 x 10 = 100    10^3 = 1000
11 x 11 = 121
12 x 12 = 144
13 x 13 = 169
14 x 14 = 196
15 x 15 = 225 +
16 x 16 = 256 +
17 x 17 = 289
18 x 18 = 324
19 x 19 = 361
20 x 20 = 400

25 x 25 = 625 +
```

+ = these multiplications tend to come up often enough either directly or indirectly

Furthermore, be able to note these numbers coming up in passing!
So for instance, if you see 169 it could be a helpful hint to something going on in a problem involving 13 (13x13=169).

Be able to note multiples of the above numbers too!
For instance, 288 should leap out at you as 144 (12x12) x 2.

Also, knowing these become handy in many Pythagorean Theorem problems, etc.!

* KNOW "Teen" multiplications, backwards and forwards
  These often become "forgotten" factors.
  As such, many students might otherwise think say 51 is a prime number; it's not!

13 x 3 = 39 (not prime)

16 x 2 = 32
16 x 3 = 48 +
16 x 4 = 64 +
16 x 5 = 80

17 x 2 = 34
17 x 3 = 51 +
17 x 4 = 68
17 x 5 = 85

18 x 2 = 36
18 x 3 = 54
18 x 4 = 72
18 x 5 = 90

19 x 2 = 38
19 x 3 = 57 +
19 x 4 = 76
19 x 5 = 95

+ = these multiplications tend to come up often enough either directly or indirectly

* This fact family tends to come up often:
  105 / 3 = 35
  .: 35 x 3 = 105

* This fact family tends to come up often too:
  90 / 6 = 15

* Make use of the Commutative Property of Multiplication
  a x b = b x a

  Therefore when you have a computation such as 34 x 56
  A way to double check it is to do 56 x 34 and see if you get matching answers

  (Ditto for addition: 56 + 34 is the same as 34 + 56)

* Check your divisions too:

  515 / 5 = 103

  That means 5 x 103 = 515 ; it checks out

If you don't know the following fluidly, you MUST MUST MUST:
* Fractions

YOU SHOULD KNOW THESE WITHOUT EVEN THINKING:
1/2 = 50% = 0.50 = 0.5 1/4 = 25% = 0.25
1/5 = 20% = 0.20 = 0.2 1/10 = 10% = 0.10 = 0.1

And be as fluid with 2/4, 3/4, 2/5, 3/5, 4/5, and 2...9/10, again without thinking.

Review these once a day until you know them, as you really want to know these too:
* More Fractions

$\frac{1}{8} = 0.125$ (half of 1/4)

.: 3/8 = 3 * 0.125 = 0.375, etc
.: 1/16 = half of 1/8 = 0.0625, etc.

$\frac{1}{3} = 0.\overline{3}$

.: $2/3 = 0.\overline{6} \approx 0.67$

.: $1/6$ = half of $1/3 = 0.1\overline{6} \approx 16.67\%$

$\frac{1}{9} = 0.\overline{1}$

.: $2/9 = 0.\overline{2}$, $5/9 = 0.\overline{5}$

$\frac{1}{12}$ = half of $1/6 = .08\overline{3} \approx 8.33\%$

$\frac{1}{7}$ = 0.1428plusmanymoredigits (just remember via 2x7=14, double is 28)

$\frac{1}{11} = .\overline{09} \approx 9.091\%$

Know all these backward and forwards, memorizing if need be.

Also it you were to see say $0.\overline{4}$ it should leap out to you that's 4/9, and so forth for many of these.

You should also be aware of how repeating decimals map to fractions
(I cover this in another PDF).

* 1 mile = 5280 feet
  The use of a mile comes up often enough in standardized testing. Often you're asked to do unit conversions to/from it, or it's involved in a circumference/revolution calculation, cancelling out a numerator/denominator, etc. It's worth at least a cursory review of numbers that could come up involving mile computations, not so much to literally worry about computations involving miles but to get familiar with some of the numerical fluidity you should be considering. (So do not necessarily memorize this section, but understand why I've put it here.)

  Remember that in addition to the factors shown below that there are times when their negative forms may come into play (I worded it this way as many definitions/contexts of factors don't include negative numbers, and yet the solution may involve say −66 x −80).

Factor Pairs of 5280

```
 1 × 5280 = 5280
 2 × 2640 = 5280
 3 × 1760 = 5280
 4 × 1320 = 5280
 5 × 1056 = 5280
 6 ×  880 = 5280
 8 ×  660 = 5280
10 ×  528 = 5280   10
11 ×  480 = 5280      11
12 ×  440 = 5280
15 ×  352 = 5280         15
16 ×  330 = 5280         16
20 ×  264 = 5280   20
22 ×  240 = 5280      22
24 ×  220 = 5280
30 ×  176 = 5280   30
32 ×  165 = 5280
33 ×  160 = 5280      33
40 ×  132 = 5280   40
44 ×  120 = 5280      44
48 ×  110 = 5280
55 ×   96 = 5280      55
60 ×   88 = 5280   60
66 ×   80 = 5280      66

80 ×   66 = 5280   80
88 ×   60 = 5280      88
96 ×   55 = 5280
110 ×  48 = 5280   110 110
120 ×  44 = 5280   120
132 ×  40 = 5280
160 ×  33 = 5280   160
165 ×  32 = 5280
176 ×  30 = 5280
220 ×  24 = 5280   220 220
240 ×  22 = 5280   240
264 ×  20 = 5280
330 ×  16 = 5280   330 330
352 ×  15 = 5280
440 ×  12 = 5280   440 440
480 ×  11 = 5280
528 ×  10 = 5280
660 ×   8 = 5280   660 660
880 ×   6 = 5280   880 880
1056 ×  5 = 5280
1320 ×  4 = 5280
1760 ×  3 = 5280
2640 ×  2 = 5280
```

Note how many factors are multiples of 11, 10, and both 11 and 10.
Also many multiples of 12.

Also note 15 and 16.
And by use of 15 that means 3 and 5; and by use of 16 that means 4

60 is in there too, which might involve contexts in a problem where say there are feet per minute or seconds, etc. and this creates a kind of heads up.
And so on for all of 60s factors too.

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