

1) (6 points each) Perform the indicated operation showing all carrying and borrowing that are needed. Convert only the answer to a Hindu-Arabic form. See the last page for the chart:

a)

$$\begin{array}{r}
 \begin{array}{c} \text{X} \end{array} \begin{array}{c} \text{9} \end{array} \begin{array}{c} \text{nnnn} \\ \text{nnnn} \\ \text{nn} \end{array} \begin{array}{c} \text{III} \end{array} \\
 + \begin{array}{c} \text{99} \end{array} \begin{array}{c} \text{nnn} \end{array} \begin{array}{c} \text{III} \end{array} \\
 \hline
 \begin{array}{c} \text{X} \end{array} \begin{array}{c} \text{99} \end{array} \begin{array}{c} \text{n} \end{array} \begin{array}{c} \text{IIII} \\ \text{III} \end{array}
 \end{array}$$

1 3 1 7

b)

$$\begin{array}{r}
 \begin{array}{c} \text{X} \end{array} \begin{array}{c} \text{999} \end{array} \begin{array}{c} \text{nnn} \\ \text{nnn} \\ \text{nn} \end{array} \begin{array}{c} \text{IIII} \\ \text{II} \end{array} \\
 - \begin{array}{c} \text{X} \end{array} \begin{array}{c} \text{999} \end{array} \begin{array}{c} \text{nn} \end{array} \begin{array}{c} \text{II} \end{array} \\
 \hline
 \begin{array}{c} \text{999} \end{array} \begin{array}{c} \text{nn} \end{array} \begin{array}{c} \text{III} \end{array} \\
 \begin{array}{c} \text{999} \end{array} \begin{array}{c} \text{nn} \end{array}
 \end{array}$$

7 4 3

2) (5 points each) Write the Roman Number for the given numbers below:

a) 3,224

MMMCCXXIV

b) 2,123,901

~~MMCCXXIII CMI~~

MMCXXIIICMI

3) (5 points each) Convert as directed:

a)  $\underbrace{\llllll}_{53} \lll \ll$  to Hindu-Arabic

53    11

$$53 \cdot 60' + 11 \cdot 60''$$

3191

b) 12,251 to Babylonian

$$12251 \div 3600 = 3 \text{ R } 1451$$

$$1451 \div 60 = 24 \text{ R } 11$$

$$11 \div 1 = 11 \text{ R } 0$$

$$60^2 = 3600$$


$$60^1 = 60$$

$$60^0 = 1$$

$\lll \lll \lll \lll \lll \lll$

32

4) (5 points each) Convert as directed:

a)  to Hindu-Arabic

 9

$$15 \cdot 20 + 9 \cdot 20^0 = \boxed{309}$$

b) 1,420 to Mayan

$$1420 = 3600 \quad 1420 \div 360 = 3 \text{ R } 340$$

$$20^1 = 20 \quad 340 \div 20 = 17 \text{ R } 0$$

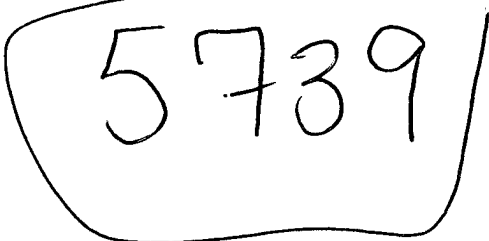
$$20^0 = 1 \quad 0 \div 1 = 0 \text{ R } 0$$




5) (2 points each) Write the given numbers in standard form:

a)  $5 \times 10^3 + 7 \times 10^2 + 3 \times 10^1 + 9 \times 10^0$

b)  $4 \times 10^3 + 6 \times 10^1 + 8 \times 10^0$





6) (4 points each) Using the expanded form numbers in 5a and 5b above, find the following. Be sure to show all carrying and borrowing that are necessary:

a) The sum

$$\begin{array}{r} 5 \times 10^3 + 7 \times 10^2 + 3 \times 10^1 + 9 \times 10^0 \\ + 4 \times 10^3 + 0 \times 10^2 + 6 \times 10^1 + 8 \times 10^0 \\ \hline 9 \cdot 10^3 + 7 \cdot 10^2 + 9 \cdot 10^1 + 17 \cdot 10^0 \\ 9 \cdot 10^3 + 7 \cdot 10^2 + \underbrace{9 \cdot 10^1 + 1 \cdot 10^1}_{10 \cdot 10^1} + 7 \cdot 10^0 \\ 9 \cdot 10^3 + 7 \cdot 10^2 + \underbrace{10 \cdot 10^1}_{100} + 7 \cdot 10^0 \\ \hline 9 \cdot 10^3 + 7 \cdot 10^2 + 100 + 7 \cdot 10^0 = 9807 \end{array}$$

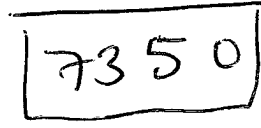
b) The difference

$$\begin{array}{r} 5 \cdot 10^3 + 7 \cdot 10^2 + 3 \cdot 10^1 + 9 \cdot 10^0 \\ - 4 \cdot 10^3 + 0 \cdot 10^2 + 6 \cdot 10^1 + 8 \cdot 10^0 \\ \hline 5 \cdot 10^3 + 6 \cdot 10^2 + 13 \cdot 10^1 + 9 \cdot 10^0 \\ 4 \cdot 10^3 + 0 \cdot 10^2 + 6 \cdot 10^1 + 8 \cdot 10^0 \\ \hline 1 \cdot 10^3 + 6 \cdot 10^2 + 7 \cdot 10^1 + 1 \cdot 10^0 \\ \hline 1671 \end{array}$$

7) (4 points) Find the product of  $70 \times 105$  using the method below:

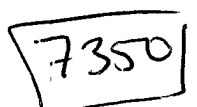
a) Egyptian Multiplication

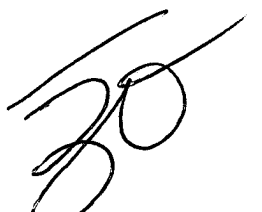
1	105	6720
2	210	420
4	420	210
8	840	
16	1680	
32	3360	
64	6720	



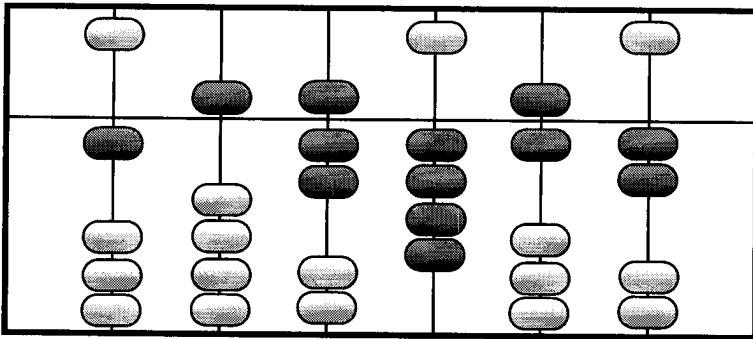
b) The Lattice Method

	1	0	5	
0	0	0	3	7
7	0	0	0	0
	3	5	0	





8) (4 points) Find the value below shown in the Japanese abacus:



157,462

9) (4 points) Write the first 12 counting numbers (starting with 1) in base 5:

1 2 3 4 10 11 12 13 14 20 21 22

10) (4 points) Count from  $52D_{\text{sixteen}}$  to  $536_{\text{sixteen}}$ . You do not have to write the *sixteen* each time:

52D 52E 52F 530 531 532 533 534 535 536

11) (5 points a, b; 10 points c) Convert the following numbers to the given base:

8) Convert the following numbers to the given base:

a)  $514_{\text{seven}}$  to base 10

$$5 \cdot 7^2 + 1 \cdot 7^1 + 4 \cdot 7^0 = \boxed{256}$$

b) 2,330 to base 8

$$\begin{aligned} 8^3 &= 512 & 2330 \div 512 &= 4 \text{ R } 282 \\ 8^2 &= 64 & 282 \div 64 &= 4 \text{ R } 26 \\ 8^1 &= 8 & 26 \div 8 &= 3 \text{ R } 2 \\ 8^0 &= 1 & 2 \div 1 &= 2 \text{ R } 0 \end{aligned}$$

$\boxed{4432_{\text{eight}}}$

c)  $1412_{\text{six}}$  to base 9

$$1 \cdot 6^3 + 4 \cdot 6^2 + 1 \cdot 6^1 + 2 \cdot 6^0 = 368$$

$$\begin{aligned} 9^2 &= 81 \\ 9^1 &= 9 \\ 9^0 &= 1 \end{aligned}$$

$$\begin{aligned} 368 \div 81 &= 4 \text{ R } 44 \\ 44 \div 9 &= 4 \text{ R } 8 \\ 8 \div 1 &= 8 \text{ R } 0 \end{aligned}$$

$\boxed{448_{\text{nine}}}$

12) (2 points each) Write the bases associated with each everyday object:

a) A pull-string lamp:

2

b) A traffic light:

3

c) A calendar:

12

365