MATH 103 – Arithmetic in Various Bases, Addition Algorithms

1. What are the first 15 counting numbers in each of the following bases?
   (a) Base *six*
   (b) Base *two* (binary)

2. Make the following conversions.
   (a) Convert the base ten number 508 to base five.
   (b) Convert 372_{eight} to base ten.
   (c) Convert 10101_{two} to base seven.

3. Compute the following sums using the bases shown and sketch the base pieces that represent each term in your computation. Compare this to the standard algorithm for addition.
   (a) $65 + 58$
   (b) $124_{five} + 34_{five}$
   (c) $23_{four} + 31_{four}$
   (d) $111_{two} + 101_{two}$

4. Compute the following differences using the bases shown and sketch the base pieces that represent each term in your computation. Compare this to the standard algorithm for subtraction.
   (a) $123 - 54$
   (b) $213_{five} - 42_{five}$
   (c) $451_{seven} - 63_{seven}$
   (d) $212_{three} - 121_{three}$

5. Products of positive integers are sometimes viewed as repeated sums. Sketch base pieces that represent the following products as repeated sums and regroup to determine that sum.
   (a) 4×132
   (b) $3_{five} \times 12_{five}$
   (c) $2_{four} \times 33_{four}$

6. Calculate each product in the given base by making a rectangular grid and covering it with the minimum number of pieces for that base.
   (a) 22×15
   (b) $13_{five} \times 21_{five}$

7. In base *ten* we find that multiplying by 10 is very easy. Is there an analagous computation that is easy to do in other bases?

8. The book describes right-to-left, left-to-right, and partial sum algorithms for addition. Calculate the following sums using each of these three algorithms.
   (a) $347 + 189$
   (b) $324_{five} + 241_{five}$
   (c) $667_{eight} + 54_{eight}$