

TOPIC: PERFORMING COMPUTATIONS IN DIFFERENT BASES

Addition in Bases Other Than 10



◆ To add in bases other than 10, *add* the digits in _____, then *convert* to the indicated base and *carry* if needed.

Recall	Addition in Base 10	New	Addition in Other Bases
	$\begin{array}{r} \textcolor{violet}{1} \\ 28 \\ + 14 \\ \hline \textcolor{teal}{42} \end{array}$ $8 + 4 = 12 \geq 10$ Put down the $\textcolor{teal}{2}$ Carry the $\textcolor{violet}{1}$ $2 + 1 + \textcolor{violet}{1} = 4$		$\begin{array}{r} 34_8 \\ + 16_8 \\ \hline \end{array}$ $4 + 6 = \underline{\hspace{1cm}} [< \geq] 8$ Convert to base 8: Put down the _____ Carry the _____ $3 + 1 + \underline{\hspace{1cm}} = \underline{\hspace{1cm}} = [< \geq] 8$ Convert to base 8: Put down the _____ Carry the _____

◆ You can check your work by converting everything to base 10 and seeing if you get a _____ statement.

PRACTICE

Perform the addition below in the indicated base, then check by converting to base 10 and adding.



Hint: Add digits in base 10, then convert to indicated base and carry as needed.

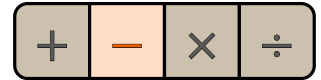
(A) $1011_{\text{two}} + 1101_{\text{two}}$

(B) $A7_{16} + 3C_{16}$

(C) $2A_{12} + 239_{12}$

TOPIC: PERFORMING COMPUTATIONS IN DIFFERENT BASES

Subtraction in Bases Other Than 10



◆ To subtract in other bases, *subtract* the digits in base 10, but when *borrowing*, the # you borrow is the other base.

Recall	Subtraction in Base 10	New	Subtraction in Other Bases
	$\begin{array}{r} 3 \ 12 \\ 42 \\ - 29 \\ \hline 13 \end{array}$ 2 < 9, so we borrow 10 $12 - 9 = 3$ $3 - 2 = 1$		$\begin{array}{r} 52_8 \\ - 35_8 \\ \hline \end{array}$ 2 [$< \geq$] 5, so we borrow ____ ____ - 5 = ____ ____ [$< \geq$] 3, so we borrow ____ ____ - 3 = ____

◆ Just like adding, check your work by converting *everything* to base 10 and seeing if you get a true statement.

PRACTICE

Perform the subtraction below in the indicated base, then check by converting to base 10 and subtracting. 💡 *Hint: If you need to borrow, the number you borrow is the base.*

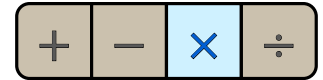
(A) $1011_{\text{two}} - 1101_{\text{two}}$

(B) $A7_{16} - 3C_{16}$

(C) $239_{12} - A3_{12}$

TOPIC: PERFORMING COMPUTATIONS IN DIFFERENT BASES

Multiplication in Bases Other Than 10



◆ To multiply in other bases, *multiply* the digits in base 10 then *convert* to the indicated base and *carry* if needed.

Recall	Multiplying in Base 10	New	Multiplying in Other Bases
	$\begin{array}{r} 1 \\ 23 \\ \times 4 \\ \hline 92 \end{array}$ $4 \times 3 = 12$ Put down the 2 Carry the 1 $4 \times 2 + 1 = 9$		$\begin{array}{r} 35_6 \\ \times 4_6 \\ \hline \end{array}$ $4 \times 5 = \underline{\hspace{2cm}}$ Convert to base 6: Put down the <u> </u> Carry the <u> </u> $4 \times 3 + \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$ Convert to base 6: Put down the <u> </u> Carry the <u> </u>

◆ When multiplying 2-digit numbers, use the same process as above, but don't forget the .

EXAMPLE

Compute $23_4 \times 12_4$. Perform all calculations in base 4.

PRACTICE

Perform the multiplication below in the indicated base, then check by converting to base 10 and multiplying. 💡 Hint: Multiply digits in base 10, then convert to the indicated base.

(A) $101_{\text{two}} \times 11_{\text{two}}$

(B) $17_8 \times 11_8$

(C) $1A_{16} \times 3_{16}$

TOPIC: PERFORMING COMPUTATIONS IN DIFFERENT BASES

Division in Bases Other Than 10



- ◆ To divide in other bases, follow the steps of long division, but do every step using the rules & digits of that base.

Recall	Dividing in Base 10	New	Dividing in Other Bases
	$\begin{array}{r} 27 \\ 5 \overline{)135} \\ \underline{-10} \\ 35 \\ \underline{-35} \\ 0 \end{array}$ How many times does 5 go into 1? $\rightarrow 0$ How many times does 5 go into 13? $\rightarrow 2$ $5 \times 2 = 10$ Subtract $13 - 10 = 3$ Bring down the 5 and repeat. How many times does 5 go into 35? $\rightarrow 7$ $5 \times 7 = 35$ Subtract $35 - 35 = 0$		$5_6 \overline{)343_6}$ How many times does 5_6 go into 3_6? $\rightarrow$ ____ How many times does 5_6 go into 34_6? $\rightarrow$ ____ $5_6 \times$ ____ = ____ Subtract $34_6 -$ ____ = ____ Bring down the 3_6 and repeat. How many times does 5_6 go into ____? $\rightarrow$ ____ $5_6 \times$ ____ = ____ Subtract _____

- ◆ When you have no other digits to bring down, you're done. The amount _____ is the **remainder**.

EXAMPLE

Divide $212_6 \div 4_6$ by performing the calculation in base 6. Verify with multiplication in base 6.

PRACTICE

Perform the division below in the indicated base, then check by converting to base 10 and dividing.

Hint: Follow the steps of long division but do every step in the indicated base.

(A) $1010_{\text{two}} \div 10_{\text{two}}$

(B) $133_4 \div 2_4$

(C) $9C_{16} \div 4_{16}$