

Base 10 and other bases

Possible Digits	0, 1	0, 1, 2	0, 1, 2, 3	0, 1, 2, 3, 4	0, 1, 2, 3, 4, 5	0, 1, 2, 3, 4, 5, 6	0, 1, 2, 3, 4, 5, 6, 7	0, 1, 2, 3, 4, 5, 6, 7, 8, 9 A, B, C, D, E, F,	
Base Ten	Base Two	Base Three	Base Four	Base Five	Base Six	Base Seven	Base Eight	Base 16	Base Ten
0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1
2	10	2	2	2	2	2	2	2	2
3	11	10	3	3	3	3	3	3	3
4	100		10	4	4	4	4	4	4
5	101			10	5	5	5	5	5
6					10	6	6	6	6
7						10	7	7	7
8	1000						10	8	8
9		100						9	9
10								A	10
11								B	11
12	1100				20			C	12
13								D	13
14						20		E	14
15				30				F	15
16	10000		100				20	10	16
17								11	17
18		200			30			12	18
19			103					13	19
20			110	40				14	20
21						30		15	21
22								16	22
23								17	23
24	11000				40		30	18	24
25	11001	221		100				19	25
26								1A	26
27			123						27
28						40			28
29	11101								29
30	11110	1010	132	110	50	42	36	1E	30

Base 10 and other bases

Possible Digits	0, 1	0, 1, 2	0, 1, 2, 3	0, 1, 2, 3, 4	0, 1, 2, 3, 4, 5	0, 1, 2, 3, 4, 5, 6	0, 1, 2, 3, 4, 5, 6, 7	0, 1, 2, 3, 4, 5, 6, 7, 8, 9 A, B, C, D, E, F,	
Base Ten	Base Two	Base Three	Base Four	Base Five	Base Six	Base Seven	Base Eight	Base 16	Base Ten
0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1
2	10	2	2	2	2	2	2	2	2
3	11	10	3	3	3	3	3	3	3
4	100	11	10	4	4	4	4	4	4
5	101	12	11	10	5	5	5	5	5
6	110	20	12	11	10	6	6	6	6
7	111	21	13	12	11	10	7	7	7
8	1000	22	20	13	12	11	10	8	8
9	1001	100	21	14	13	12	11	9	9
10	1010	101	22	20	14	13	12	A	10
11	1011	102	23	21	15	14	13	B	11
12	1100	110	30	22	20	15	14	C	12
13	1101	111	31	23	21	16	15	D	13
14	1110	112	32	24	22	20	16	E	14
15	1111	120	33	30	23	21	17	F	15
16	10000	121	100	31	24	22	20	10	16
17	10001	122	101	32	25	23	21	11	17
18	10010	200	102	33	30	24	22	12	18
19	10011	201	103	34	31	25	23	13	19
20	10100	202	110	40	32	26	24	14	20
21	10101	210	111	41	33	30	25	15	21
22	10110	211	112	42	34	31	26	16	22
23	10111	212	113	43	35	32	27	17	23
24	11000	220	120	44	40	33	30	18	24
25	11001	221	121	100	41	34	31	19	25
26	11010	222	122	101	42	35	32	1A	26
27	11011	1000	123	102	43	36	33	1B	27
28	11100	1001	130	103	44	40	34	1C	28
29	11101	1002	131	104	45	41	35	1D	29
30	11110	1010	132	110	50	42	36	1E	30

Practice # _____ Date: _____ Section: _____ Name: _____

Find the next five numbers before and after

Before	Base 5 (0,1,2,3,4)	After
		$(4220)_5$
$(4214)_5$		

Before	Base 4 (0,1,2,3)	After
		$(3323)_4$
$(3322)_4$		

Find the next five numbers before and after

Before	Base 2 (0,1)	After
		$(1111)_2$
$(1110)_2$		

Before	Base 3 (0,1,2)	After
		$(1000)_3$
$(222)_3$		

Practice # Date: _____ Section: _____ Name: _____

Find the next five numbers before and after

Before	After
$(4204)_5$	$(4220)_5$
$(4210)_5$	$(4221)_5$
$(4211)_5$	$(4222)_5$
$(4212)_5$	$(4223)_5$
$(4213)_5$	$(4224)_5$
$(4214)_5$	$(4230)_5$

Before	After
$(3311)_4$	$(3323)_4$
$(3312)_4$	$(3330)_4$
$(3313)_4$	$(3331)_4$
$(3320)_4$	$(3332)_4$
$(3321)_4$	$(3333)_4$
$(3322)_4$	$(10000)_4$

Find the next five numbers before and after

Before	After
$(1001)_2$	$(1111)_2$
$(1010)_2$	$(10001)_2$
$(1011)_2$	$(10010)_2$
$(1100)_2$	$(10011)_2$
$(1101)_2$	$(10100)_2$
$(1110)_2$	$(10101)_2$

Before	After
$(210)_3$	$(1000)_3$
$(211)_3$	$(1001)_3$
$(212)_3$	$(1002)_3$
$(220)_3$	$(1010)_3$
$(221)_3$	$(1011)_3$
$(222)_3$	$(1012)_3$

Conversion from other bases to base 10

Hint: we use expansion with given base.

1) Convert $(213)_4$ to base 10.

Step 1) Write the number in expanded form $2(4^2) + 1(4^1) + 3(4^0)$

Step 2) $2(16) + 1(4) + 3(1) = 32 + 4 + 3 = 39$

2) Convert $(10011)_2$ to base 10.

Step 1) Write the number in expanded form $1(2^4) + 0(2^3) + 0(2^2) + 1(2^1) + 1(2^0)$

Step 2) $1(16) + 0(8) + 0(4) + 1(2) + 1(1) = 16 + 0 + 0 + 2 + 1 = 19$

3) Convert $(234)_5$ to base 10.

Step 1) Write the number in expanded form $2(5^2) + 3(5^1) + 4(5^0)$

Step 2) $2(25) + 3(5) + 4(1) = 50 + 15 + 4 = 69$

4) Convert $(ABE)_{16}$ to base 10.

Step 1) Write the number in expanded form $A(16^2) + B(16^1) + E(16^0)$

Step 2) $A(256) + B(16) + E(1) = 10(256) + 11(16) + 14(1) = 2750$

Base Conversion **Date:** _____ **Section:** _____ **Name:** _____

1. Convert 1010101_{two} to base ten 1. **85**

2. Convert 404_{five} to base ten 2. **104**

3. Convert 4205_{six} to base ten 3. **941**

4. Convert 1221_{three} to base ten 4. **52**

5. Convert $3B2_{sixteen}$ to base ten 5. **946**

6. Convert 1010111_{two} to base ten 6. **87**

7. Convert 432_{five} to base ten 7. **117**

8. Convert 1542_{six} to base ten 8. **422**

9. Convert 12121_{three} to base ten 9. **41**

10. Convert $ABE_{sixteen}$ to base ten 10. **2750**

11. Convert $BAD_{sixteen}$ to base ten 11. **2989**

12. Convert $2FAD_{sixteen}$ to base ten 12. **12205**

Conversion from base 10 to other Bases

Important: The **answer** is the **last quotient** and **remainder numbers** from left to right.

5) Convert 39 to base **Four**

	Divide by 4	Quotient	Remainder
Step 1	$39 \div 4$	9	3
Step 2	$9 \div 4$	2	1
	Stop because quotient is smaller than base		
	Answer $(213)_4$		

6) Convert 19 to base **Two**

	Divide by 2	Quotient	Remainder
Step 1	$19 \div 2$	9	1
Step 2	$9 \div 2$	4	1
Step 3	$4 \div 2$	2	0
Step 4	$2 \div 2$	1	0
	Stop because quotient is smaller than base		
	Answer $(10011)_2$		

7) Convert 500 to base **Five**

	Divide by 5	Quotient	Remainder
Step 1	$500 \div 5$	100	0
Step 2	$100 \div 5$	20	0
Step 3	$20 \div 5$	4	0
	Stop because quotient is smaller than base		
	Answer $(4000)_5$		

8) Convert 2750 to base **Sixteen**

Important, You need to know that in base sixteen, **10=A**, **11=B**, **12=C**, **13=D**, **14=E**, **15=F**

	Divide by 16	Quotient	Remainder
Step 1	$2750 \div 16$	14	14=E
Step 2	$171 \div 16$	10=A	11=B
	Stop because quotient is smaller than base		
	Answer $(ABE)_{16}$		

PQ3 # _____ Date: _____ Section: _____ Name: _____

Convert each of the following from base ten to the indicated base.

1. Convert 53 to base **Two** 1. 110101

2. Convert 63 to base **Three** 2. 2100

3. Convert 153 to base **Eight** 3. 231

4. Convert 95 to base **Five** 4. 340

5. Convert 2603 to base **Sixteen** 5. A2B

6. Convert 75 to base **Four** 6. 1023

7. Convert 87 to base **Three** 7. 10020

8. Convert 501 to base **Eight** 8. 765

9. Convert 115 to base **Five** 9. 430

10. Convert 486 to base **Sixteen** 10. 1E6

Practice on Base conversion

For each problem: first convert to base 10 and then to the given base

		Base 10	Given Base
1	$(234)_6$	<i>Answer:94</i>	Base 2 <i>Answer: 1011110</i>
2	$(536)_7$	<i>Answer:272</i>	Base 9 <i>Answer:332</i>
3	$(1111011)_2$	<i>Answer:123</i>	Base 16 <i>Answer:7B</i>
4	$(CAB)_{16}$	<i>Answer:3243</i>	Base 8 <i>Answer:6253</i>
5	$(3333)_5$	<i>Answer:468</i>	Base 7 <i>Answer:1236</i>
6	$(443)_6$	<i>Answer:171</i>	Base 16 <i>Answer:AB</i>

Find the digit in the given base on the right side to be equal to the number given the right with the given base

- 1) $(5x6)_7 = (2042)_5$ *Answer: $x = 3$*
- 2) $(11x21)_3 = (311)_6$ *Answer: $x = 0$*
- 3) $(3x2)_7 = (AA)_{16}$ *Answer: $x = 5$*

Practice: *Convert from one base to another base* Date: _____ Section: _____ Name: _____

- 1 Convert 505_{six} to base *eight* 1) *271 eight*

2. Convert 2210_{three} to base *five* 2) *300 five*

- 3 Convert 6253_{eight} to base *sixteen* 3) *CAB sixteen*

4. Convert 1234_{five} to base *sixteen* 4) *C2 sixteen*

- 5 Convert $2AC_{\text{sixteen}}$ to base *nine* 5) *840 nine*

6. Convert 1010001_{two} to base *six* 6) *213 six*

7. Convert 432_{five} to base *four* 7) *1311 four*

8. Convert 3205_{six} to base *sixteen* 8) *2D5 sixteen*

9. Convert 1211_{three} to base *nine* 9) *54 nine*

- 10 Convert $2A3_{\text{sixteen}}$ to base *five* 10) *10200 five*

Practice Add the numbers with the same bases Date: _____ Section: _____ Name: _____

1) $342_{five} + 404_{five} =$

1) 1301_{five}

2) $342_{six} + 404_{six} =$

2) 1150_{six}

3) $4205_{six} + 3345_{six} =$

3) 11554_{six}

4) $4205_{eight} + 3345_{eight} =$

4) 7552_{eight}

5) $10101_{two} + 11101_{two} =$

5) 1100110_{two}

6) $1010111_{two} + 1110101_{two} =$

6) 11001100_{two}

7) $BBC_{sixteen} + ABC_{sixteen} =$

7) $1678_{sixteen}$

8) $BAD_{sixteen} + ABE_{sixteen} =$

8) $166B_{sixteen}$

9) $ABE1_{sixteen} + DAD2_{sixteen} =$

9) $186B3_{sixteen}$

10) $ABCD_{sixteen} + BABA_{sixteen} =$

10) $16687_{sixteen}$

Practice Subtract the numbers with the same bases Date: _____ Section: _____ Name: _____

1) $3213_{four} - 1122_{four} =$

1) 2031_{four}

2) $3213_{five} - 1122_{five} =$

2) 2041_{five}

3) $403_{five} - 304_{five} =$

3) 44_{five}

4) $4205_{eight} - 3346_{eight} =$

4) 637_{eight}

5) $11010_{two} - 10101_{two} =$

5) 101_{two}

6) $10000_{two} - 1_{two} =$

6) 1111_{two}

7) $54321_{six} - 12345_{six} =$

7) 41532_{six}

8) $BAD_{sixteen} - ABE_{sixteen} =$

8) $EF_{sixteen}$

9) $FACE_{sixteen} - DEAD_{sixteen} =$

9) $1C21_{sixteen}$

10) $DEAD_{sixteen} - BEEF_{sixteen} =$

10) $1FBE_{sixteen}$