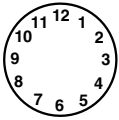


## ENRICHMENT ACTIVITY 2-2A

### Clock Arithmetic



- On a clock, 3 hours after 7 is 10, so  $7 + 3 = 10$ .
- On a clock, 4 hours after 9 is 1, so  $9 + 4 = 1$ .
- On a clock, 12 hours after 3 is 3, so  $3 + 12 = 3$ .
- On a clock, 8 hours after 9 is 5, so  $9 + 8 = 5$ .

These answers have been placed in the table below.

a. Complete the table using the numbers on the clock and clock addition.

+	1	2	3	4	5	6	7	8	9	10	11	12
1												
2												
3												3
4												
5												
6												
7			10									
8												
9				1			5					
10												
11												
12												

b. Answer the following questions using the set of clock numbers and clock addition.

1. Is the set closed under clock addition? \_\_\_\_\_
2. Is clock addition commutative? (Test some cases.) \_\_\_\_\_
3. Is clock addition associative? (Test some cases.) \_\_\_\_\_
4. What is the additive identity for these clock numbers?  
(Hint: It cannot be 0 because 0 is not in the set of clock numbers.) \_\_\_\_\_
5. Below each clock number, write its additive inverse.  
(Remember that the number and its inverse must add up to the identity.)

Number	1	2	3	4	5	6	7	8	9	10	11	12
Inverse												

## ENRICHMENT ACTIVITY 2-2B

### Digital Addition and Digital Multiplication

*Regular Arithmetic*

Answers contain as many digits as needed.

$4 + 8 = 12$

$4 \times 8 = 32$

$6 + 4 = 10$

$6 \times 4 = 24$

*Digital Arithmetic*

Answers contain only the digit in the ones place.

$4 \oplus 8 = 2$

$4 \otimes 8 = 2$

$6 \oplus 4 = 0$

$6 \otimes 4 = 4$

1. Complete the table using digital addition.

$\oplus$	0	2	4	6	8
0					
2					
4					
6					
8					

2. Write *Yes* if the property is true and *No* if it is not true for the set  $\{0, 2, 4, 6, 8\}$  under the operations of digital addition  $\oplus$ .

a. Closure under  $\oplus$  \_\_\_\_\_

b. Commutative under  $\oplus$   
(Test some cases.) \_\_\_\_\_

c. Associative under  $\oplus$   
(Test some cases.) \_\_\_\_\_

d. Name the identity element  
from this set for  $\oplus$ . \_\_\_\_\_

e. Next to each number, write its  
inverse under  $\oplus$  so that  
“Number  $\oplus$  Inverse = Identity.”

$0 \oplus \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$

$2 \oplus \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$

$4 \oplus \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$

$6 \oplus \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$

$8 \oplus \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$

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3. Complete the table using digital multiplication.

$\otimes$	0	2	4	6	8
0					
2					
4					
6					
8					

4. Write *Yes* if the property is true and *No* if it is not true for the set  $\{0, 2, 4, 6, 8\}$  under the operations of digital multiplication  $\otimes$ .

a. Closure under  $\otimes$  \_\_\_\_\_

b. Commutative under  $\otimes$   
(Test some cases.) \_\_\_\_\_

c. Associative under  $\otimes$   
(Test some cases.) \_\_\_\_\_

d. Name the identity element  
from this set for  $\otimes$ . \_\_\_\_\_

e. Zero has no multiplicative inverse.  
Next to each nonzero number,  
write its inverse under  $\otimes$  so that  
“Number  $\otimes$  Inverse = Identity.”

$2 \otimes$  \_\_\_\_\_ = \_\_\_\_\_

$4 \otimes$  \_\_\_\_\_ = \_\_\_\_\_

$6 \otimes$  \_\_\_\_\_ = \_\_\_\_\_

$8 \otimes$  \_\_\_\_\_ = \_\_\_\_\_

5. Does  $\otimes$  distribute over  $\oplus$  for this set of numbers? (Test some cases.) \_\_\_\_\_

**Conclusion:** If all 11 properties of the set are true, then  $\{0, 2, 4, 6, 8\}$  is a field under the operations of  $\oplus$  and  $\otimes$ .

Is this a field? \_\_\_\_\_

If not, what failed? \_\_\_\_\_