Chapter – 16: Playing with Numbers

Exercise 16.1 (Page 255 of Grade8 NCRT)

Q1. Find the values of the letters in the following and give reasons for the steps involved.

```
    3 A
+ 2 5
-------
  B 2
```

Difficulty Level: Easy

What is the known/given?
Addition operation of two numbers

What is unknown?
Value of alphabets i.e. A and B.

Reasoning:
Each letter in the puzzle must stand for just one digit. Each digit must be represented by just one letter.

Solution:
The addition of A and 5 is giving 2 i.e., a number whose one's digit is 2. This is possible only when digit A is 7. In that case, the addition of A (7) and 5 will give 12 and thus, 1 will be the carry for the next step. In the next step,
$1 + 3 + 2 = 6$
Therefore, the addition is as follows.

```
    3  7
+ 2  5
--------
  6  2
```

Clearly, B is 6.
Hence, A and B are 7 and 6 respectively.

Q2. Find the values of the letters in the following and give reasons for the steps involved.

```
    4   A
+ 9   8
---------
C B  3
```

Difficulty Level: Easy

What is the known/given?
Addition operation of two numbers

What is unknown?
Value of alphabets i.e. A, B and C.

Reasoning:
Each letter in the puzzle must stand for just one digit. Each digit must be represented by just one letter.

Solution:
The addition of A and 8 is giving 3 i.e., a number whose ones digit is 3. This is possible only when digit A is 5. In that case, the addition of A and 8 will give 13 and thus, 1 will be the carry for the next step. In the next step,
$1 + 4 + 9 = 14$
Therefore, the addition is as follows.

$$
\begin{array}{r}
4\ 5 \\
+\ 9\ 8 \\
\hline
14\ \ 3
\end{array}
$$

Clearly, B and C are 4 and 1 respectively.
Hence, A , B , and C are 5, 4, and 1 respectively.

Q3: Find the values of the letters in the following and give reasons for the steps involved.

$$
\begin{array}{r}
1\ A \\
\times\ A \\
\hline
9\ A
\end{array}
$$

Difficulty Level: Medium

What is the known/given?
Multiplication operation of two numbers

What is unknown?
Value of alphabet i.e. A.

Reasoning:
Each letter in the puzzle must stand for just one digit. Each digit must be represented by just one letter.

Solution:
The multiplication of A and A gives a number whose one's digit is A again.
Hence, A must be 1 or 6.

Let A be 1,

Therefore, $A \times A = 1 \times 1 = 1 \neq 9$

So, this is not possible for any value of A .

Hence, A must be 6 only.

For A =6, we get $A \times A = 6 \times 6 = 36$

and 3 will be a carry for the next step.

$\therefore A \times 1 = 6 \times 1 + 3 (\text{Carried on}) = 9$

$$
\begin{array}{r}
1\ 6 \\
\times\ 6 \\
\hline
9\ 6
\end{array}
$$

Hence , the values of A= 6.

Q4: Find the values of the letters in the following and give reasons for the steps involved.

$$
\begin{array}{r}
A\ \ B \\
+\ 3\ \ 7 \\
\hline
6\ \ A
\end{array}
$$

Difficulty Level: Medium

What is the known/given?
Addition operation of two numbers

What is unknown?
Value of alphabets i.e. A and B.

Reasoning:
Each letter in the puzzle must stand for just one digit. Each digit must be represented by just one letter.

Solution:
The addition of A and 3 is giving 6. There can be two cases.

(1) First step is not producing a carry

In that case, A comes to be 3 as 3 + 3 = 6. Considering the first step in which the addition of B and 7 is giving A (i.e., 3), B should be a number such that the unit's digit of this addition comes to be 3. It is possible only when B = 6. In this case, $B = 6 + 7 = 13$. However, A is a single digit number. Hence, it is not possible.

(2) First step is producing a carry

In that case, A comes to be 2 as 1 + 2 + 3 = 6. Considering the first step in which the addition of B and 7 is giving A (i.e., 2), B should be a number such that the unit's digit of this addition comes to be 2. It is possible only when B = 5 and 5 + 7 = 12.

$$\begin{array}{r} 2\ 5 \\ +\ 3\ 7 \\ \hline 6\ 2 \end{array}$$

Hence, the values of A and B are 2 and 5 respectively.

Q5: Find the values of the letters in the following and give reasons for the steps involved.

$$\begin{array}{r} A\ \ B \\ \times\ \ \ \ 3 \\ \hline C\ A\ B \end{array}$$

Difficulty Level: Medium

What is the known/given?
Multiplication operation of two numbers

What is unknown?
Value of alphabets i.e. A, B and C.

Reasoning:
Each letter in the puzzle must stand for just one digit. Each digit must be represented by just one letter.

Solution:
The multiplication of 3 and B gives a number whose one's digit is B again.
Hence, B must be 0 or 5.

Let B be 5.
Multiplication of first step $= 3 \times 5 = 15$
1 will be a carry for the next step.

We have, $3 \times A + 1 = CA$

This is not possible for any value of A.
Hence, B must be 0 only. If B = 0, then there will be no carry for the next step.
We should obtain, $3 \times A = CA$

That is, the one's digit of $3 \times A$ should be A. This is possible when A=5 or 0.

However, A cannot be 0 as AB is a two-digit number.

Therefore, A must be 5 only. The multiplication is as follows.

$$\begin{array}{r} 5\ \ 0 \\ \times\ \ \ \ 3 \\ \hline 1\ 5\ 0 \end{array}$$

Hence, the values of A, B, and C are 5, 0, and 1 respectively.

Q6: Find the values of the letters in the following and give reasons for the steps involved.

$$\begin{array}{r} A\ B \\ \times\quad 5 \\ \hline C\,A\,B \end{array}$$

Difficulty Level: Medium

What is the known/given?
Multiplication operation of two numbers

What is unknown?
Value of alphabets i.e. A, B and C.

Reasoning:
Each letter in the puzzle must stand for just one digit. Each digit must be represented by just one letter.

Solution:
The multiplication of B and 5 is giving a number whose one's digit is B again. This is possible when $B = 5$ or $B = 0$ only.

In case of B = 5, the product, $B \times 5 = 5 \times 5 = 25$
2 will be a carry for the next step.

We have, $5 \times A + 2 = CA$, which is possible for A=2 or 7
The multiplication is as follows.

$$\begin{array}{r} 2\ 5 \\ \times\ 5 \\ \hline 1\,2\,5 \end{array} \qquad \begin{array}{r} 7\ 5 \\ \times\ 5 \\ \hline 3\,7\,5 \end{array}$$

If $B = 0$,
$B \times 5 = B$
$0 \times 5 = 0$
There will not be any carry in this step.
In the next step, $5 \times A = CA$
It can happen only when $A = 5$ or $A = 0$

However, A cannot be 0 as AB is a two-digit number.

Hence, A can be 5 only. The multiplication is as follows.
Hence, there are 3 possible values of A, B and C.
     (i) 5, 0, and 2 respectively
     (ii) 2, 5, and 1 respectively
     (iii) 7, 5, and 3 respectively

Q7: Find the values of the letters in the following and give reasons for the steps involved.

$$
\begin{array}{r}
A\ B \\
\times\quad 6 \\
\hline
B\ B\ B
\end{array}
$$

Difficulty Level: Medium

What is the known/given?
Multiplication operation of two numbers

What is unknown?
Value of alphabets i.e. A and B.

Reasoning:
Each letter in the puzzle must stand for just one digit. Each digit must be represented by just one letter.

Solution:
The multiplication of 6 and B gives a number whose one's digit is B again.
It is possible only when $B = 0, 2, 4, 6,$ or 8

If $B = 0$, then the product will be 0. Therefore, this value of B is not possible.

If $B = 2$, then $B \times 6 = 12$ and 1 will be a carry for the next step.

$6A + 1 = BB = 22 \Rightarrow 6A = 21$ and hence, any integer value of A is not possible.

If $B = 6$, then $B \times 6 = 36$ and 3 will be a carry for the next step.

$6A + 3 = BB = 66 \Rightarrow 6A = 63$ and hence, any integer value of A is not possible.

If $B = 8$, then $B \times 6 = 48$ and 4 will be a carry for the next step.

$6A + 4 = BB = 88 \Rightarrow 6A = 84$ and hence, $A = 14$. However, A is a single digit number.

Therefore, this value of A is not possible.

If $B = 4$, then $B \times 6 = 24$ and 2 will be a carry for the next step.

$6A + 2 = BB = 44 \Rightarrow 6A = 42$ and hence, $A = 7$

The multiplication is as follows.

$$
\begin{array}{r}
7\ 4 \\
\times\quad 6 \\
\hline
4\ 4\ 4
\end{array}
$$

Hence, the values of A and B are 7 and 4 respectively.

Q8: Find the values of the letters in the following and give reasons for the steps involved.

$$
\begin{array}{r}
\text{A} \ \ 1 \\
+ \ 1 \ \ \text{B} \\
\hline
\text{B} \ \ 0 \\
\hline
\end{array}
$$

Difficulty Level: Medium

What is the known/given?
Addition operation of two numbers

What is unknown?
Value of alphabets i.e. A and B.

Reasoning:
Each letter in the puzzle must stand for just one digit. Each digit must be represented by just one letter.

Solution:
The addition of 1 and B is giving 0 i.e., a number whose one's digits is 0. This is possible only when digit B is 9. In that case, the addition of 1 and B will give 10 and thus, 1 will be the carry for the next step. In the next step,
$1 + A + 1 = B$
Clearly, A is 7 as $1 + 7 + 1 = 9 = B$
Therefore, the addition is as follows.

$$
\begin{array}{r}
7 \ \ 1 \\
+ \ 1 \ \ 9 \\
\hline
9 \ \ 0 \\
\hline
\end{array}
$$

Hence, the values of A and B are 7 and 9 respectively.

Q9: Find the values of the letters in the following and give reasons for the steps involved.

$$
\begin{array}{r}
2 \ \ \text{A} \ \ \text{B} \\
+ \ \text{A} \ \ \text{B} \ \ 1 \\
\hline
\text{B} \ \ 1 \ \ 8 \\
\hline
\end{array}
$$

Difficulty Level: Medium

What is the known/given?
Addition operation of two numbers

What is unknown?
Value of alphabets i.e. A and B.

Reasoning:
Each letter in the puzzle must stand for just one digit. Each digit must be represented by just one letter.

Solution:
The addition of B and 1 is giving 8 i.e., a number whose one's digits is 8. This is possible only when digit B is 7. In that case, the addition of B and 1 will give 8. In the next step,
$A + B = 1$
Clearly, A is 4.

$4 + 7 = 11$ and 1 will be a carry for the next step. In the next step,
$1 + 2 + A = B$
$1 + 2 + 4 = 7$

Therefore, the addition is as follows.

$$
\begin{array}{r}
2\ 4\ 7 \\
+\ 4\ 7\ 1 \\
\hline
7\ 1\ 8 \\
\end{array}
$$

Hence, the values of A and B are 4 and 7 respectively.

Q10: Find the values of the letters in the following and give reasons for the steps involved.

$$
\begin{array}{r}
1\ 2\ A \\
+\ 6\ A\ B \\
\hline
A\ 0\ 9 \\
\end{array}
$$

Difficulty Level: Medium

What is the known/given?
Addition operation of two numbers

What is unknown?
Value of alphabets i.e. A and B.

Reasoning:
Each letter in the puzzle must stand for just one digit. Each digit must be represented by just one letter.

Solution:
The addition of A and B is giving 9 i.e., a number whose ones digits is 9. The sum can be 9 only as the sum of two single digit numbers cannot be 19. Therefore, there will not be any carry in this step.

In the next step, $2 + A = 0$
It is possible only when A $= 8$
$2 + 8 = 10$ and 1 will be the carry for the next step.
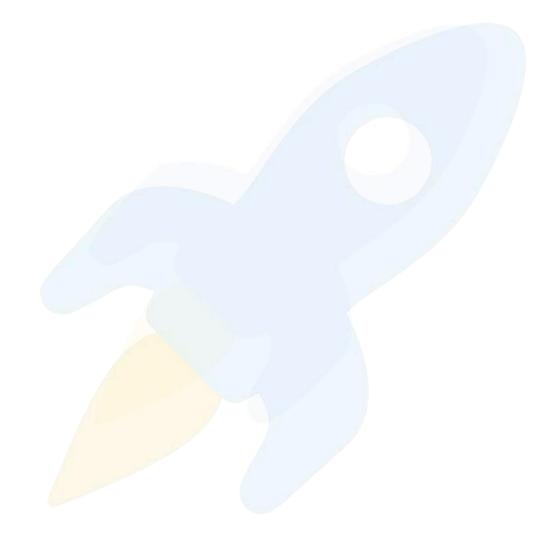$1 + 1 + 6 = A$

Clearly, A is 8. We know that the addition of A and B is giving 9. As A is 8, therefore, B is 1.

Therefore, the addition is as follows.

$$
\begin{array}{r}
1\ 2\ 8 \\
+\ \ 6\ 8\ 1 \\
\hline
8\ 0\ 9
\end{array}
$$

Hence, the values of A and B are 8 and 1 respectively.

Chapter – 16: Playing with Numbers

Exercise 16.2 (Page 260 of NCERT Grade 8)

Q1: If $21y5$ is a multiple of 9, where y is a digit, what is the value of y?

Difficulty Level: Easy

What is the known/given?
A puzzled number

What is unknown?
Value of the alphabet i.e. y.

Reasoning:
If the sum of all the digits of a number is equal to 9, then the number is a multiple of 9.

Solution:
If a number is a multiple of 9, then the sum of its digits will be divisible by 9.
Sum of digits of $21y5 = 2 + 1 + y + 5 = 8 + y$
Hence, $8 + y$ should be a multiple of 9.
This is possible when $8 + y$ is any one of these numbers 0, 9, 18, 27, and so on ...

However, since y is a single digit number, this sum can be 9 only.
$$8 + y = 9$$
$$y = 9 - 8$$
$$y = 1$$
Therefore, y should be 1 only.

Q2: If $31z5$ is a multiple of 9, where z is a digit, what is the value of z? You will find that there are two answers for the last problem. Why is this so?

Difficulty Level: Easy

What is the known/given?
A puzzled number

What is unknown?
Value of the alphabet i.e. y.

Reasoning:
If the sum of all digits of a number is equal to 9, then the number is a multiple of 9.

Solution:
If a number is a multiple of 9, then the sum of its digits will be divisible by 9.

Sum of digits of $31z5 = 3+1+z+5 = 9+z$
Hence, $9+z$ should be a multiple of 9.
This is possible, when $9+z$ is any one of these numbers 0, 9, 18, 27, and so on ...
However, since z is a single digit number, this sum can be either 9 or 18.

$$9+z = 9$$
$$z = 9-9$$
$$z = 0$$

Therefore, z should be either 0 or 9.

Q3: If $24x$ is a multiple of 3, where x is a digit, what is the value of x? (Since $24x$ is a multiple of 3, its sum of digits $6+x$ is a multiple of 3; so $6+x$ is one of these numbers: 0, 3, 6, 9, 12, 15, 18.... But since x is a digit, it can only be that $6+x = 6$ or 9 or 12 or 15. Therefore, $x=0$ or 3 or 6 or 9. Thus, x can have any of four different values)

Difficulty Level: Easy

What is the known/given?
A puzzled number

What is unknown?
Value of the alphabet i.e. x.

Reasoning:
If the sum of the digits of a number is divisible by 3, then the given number is a multiple of 3.

Solution:
Since $24x$ is a multiple of 3, the sum of its digits is a multiple of 3.
Sum of digits of $24x = 2+4+x = 6+x$

Hence, $6+x$ is a multiple of 3.
This is possible when $6+x$ is any one of these numbers 0, 3, 6, 9, and so on ...

$$\text{For,} 6+x = 0 \Rightarrow x = 0-6 = -6$$
$$\text{For,} 6+x = 3 \Rightarrow x = 3-6 = -3$$
$$\text{For,} 6+x = 6 \Rightarrow x = 6-6 = 0$$
$$\text{For,} 6+x = 9 \Rightarrow x = 9-6 = 3$$
$$\text{For,} 6+x = 12 \Rightarrow x = 12-6 = 6....\text{soon}$$

Since x is a single digit number, the sum of the digits can be 6 or 9 or 12 or 15 and thus, the value of x comes to 0 or 3 or 6 or 9 respectively.
Thus, x can have its value as any of the four different values 0, 3, 6, or 9.

Q4: If 31z5 is a multiple of 3, where z is a digit, what might be the values of z?

Difficulty Level: Easy

What is the known/given?
A puzzled number

What is unknown?
Value of the alphabet i.e. z.

Reasoning:
If sum of the digits of a number is divisible by 3, then the given number is a multiple of 3.

Solution:
Since 31z5 is a multiple of 3, the sum of its digits will be a multiple of 3.
That is, $3+1+z+5 = 9+z$ is a multiple of 3.
This is possible when $9+z$ is any one of 0, 3, 6, 9, 12, 15, 18, and so on ...

$$\text{For,} 9+z = 0 \Rightarrow z = 0-9 = -9$$
$$\text{For,} 9+z = 3 \Rightarrow z = 3-9 = -6$$
$$\text{For,} 9+z = 6 \Rightarrow z = 6-9 = -3$$
$$\text{For,} 9+z = 9 \Rightarrow z = 9-9 = 0$$
$$\text{For,} 9+z = 12 \Rightarrow z = 12-9 = 3$$
$$\text{For,} 9+z = 15 \Rightarrow z = 15-9 = 6$$
$$\text{For,} 9+z = 18 \Rightarrow z = 18-9 = 9$$

Since z is a single digit number, the value of $9+z$ can only be 9 or 12 or 15 or 18.
and thus, the value of z comes to 0 or 3 or 6 or 9 respectively.

Thus, z can have its value as any one of the four different values 0, 3, 6, or 9.

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