

# POTW #12-17 Arithmetic

## The Order Of Operations Needed For An Explicit Result

John Snyder, FSA  
February 6, 2012  
11:45 EST

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### Problem

Create the number 24 using exactly two threes and two sevens. You may not use decimals and may only use addition, subtraction, multiplication, and/or division operations. You must also remain in Base 10.

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### Solution

#### ■ Summary

The solution is:

$$24 = \left(\frac{3}{7} + 3\right)7$$

#### ■ Analysis

We'll use *Mathematica* to find the solution. First we define all possible permutations for the operations taken 3 at a time and the input values taken 4 at a time.

```
In[1]:= func = Permutations[{Plus, Subtract, Times, Divide}, {3}];  
nums = Permutations[{3, 3, 7, 7}, {4}];
```

The following function loops through the permutations and searches for a working relationship. If such a relationship is found it returns the order of operations and the order in which the values are used. If no solution is found it returns a suitable message.

```
In[3]:= test[] := Module[{},  
  Catch[Do[f = func[[t];  
    Do[n = nums[[s];  
      If[f[[3]][f[[2]][f[[1]][n[[1]], n[[2]]], n[[3]]], n[[4]]] == 24,  
        Throw[{{f[[1]], f[[2]], f[[3]]}, {n[[1]], n[[2]], n[[3]], n[[4]]}], {s, 1, Length[nums]}],  
      {t, 1, Length[func]}];  
    "No solution found"]];
```

The solution is found instantly.

```
In[4]:= test[]
```

```
Out[4]= {{Divide, Plus, Times}, {3, 7, 3, 7}}
```

We use the output from our function to construct the solution.

```
In[5]:= Times[Plus[Divide[3, 7], 3], 7] // HoldForm
```

```
Out[5]=  $\left(\frac{3}{7} + 3\right)7$ 
```

We show that this is equal to 24 as required.

```
In[6]:= ReleaseHold[%]
```

```
Out[6]= 24
```