Name _____ Period _____ Role (Circle one) Programmer/Driver

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Math Operations

Your Tasks (Mark these off as you go)

- ☐ Review arithmetic operations
- ☐ Apply unary operators
- ☐ Apply compound operators
- ☐ Have Ms. Pluska check off the above tasks
- ☐ Use the Math object to perform mathematical operations
- ☐ Apply random() to create a random number in a specified range
- ☐ Have Ms. Pluska check off the above tasks
- ☐ Brainstorm a program
- ☐ Receive credit for the group portion of this lab

☐ Review arithmetic operations

The basic arithmetic operations are as follows,

Operator	Description
+	addition
-	substraction
*	multiplication
/	division
%	modulus

Examples of how each of the above operators can be applied are illustrated below,

Addition

```
var x = 1;
var y = 2;
var z = x + y;  //3 is assigned to z
x = x + z;  //4 is re-assigned to x
console.log(z);   //3 is printed to the console
console.log(x + y);   //6 is printed to the console
console.log(x + 10);   //14 is printed to the console
console.log(10 + 10); //20 is printed to the console
```

Subtraction

```
var x = 1;
var y = 2;
var z = x – y;   //-1 is assigned to z
x = x – z;   //2 is re-assigned to x
console.log(z);   //-1 is printed to the console
console.log(x – y);   //0 is printed to the console
console.log(x – 10);   //-8 is printed to the console
console.log(10 – 10);   //0 is printed to the console
```

Multiplication

```
var x = 1;
var y = 2;
var z = x * y;  //2 is assigned to z
x = x * z;  //2 is re-assigned to x
console.log(z);  //2 is printed to the console
console.log(x * y);  //4 is printed to the console
console.log(x * 10);   //20 is printed to the console
console.log(10 * 10);   //100 is printed to the console
```

Division

```
var x = 1;
var y = 2;
var z = y/x;   //2 is assigned to z
x = z/x;   //2 is re-assigned to x
console.log(z);   //2 is printed to the console
console.log(x/y);   //1 is printed to the console
console.log(x/10);   //.2 is printed to the console
console.log(10/10);   //1 is printed to the console
```

Modulus

Modulus prints the remainder of a division operation. For example, console.log(5%3); will print 2. This is because when 5 is divided by 3, the remainder is 2. Modulus gives the remainder. Modulus also handles negatives. The answer to a%b has the same sign as a. The sign of b is ignored.

```
var x = 1;
var y = 2;
var z = x%y;     //1 is assigned to z
x = x%z;     //0 is re-assigned to x
console.log(z);   //1 is printed to the console
console.log(x%y);   //0 is printed to the console
console.log(x%10);   //0 is printed to the console
console.log(10%10);   //0 is printed to the console
```

Indicate what is printed for each of the following	

var x = 2;
var y = 3;
var z = x + y;
x = x + z;
console.log(x+1);	

var x = 1;
var y = 5;
var z = x - y;
x = x - z;
console.log(x-1);	

var x = 2;
var y = 3;
var z = x * y;
x = x * z;
console.log(x*2);	

var x = 9;
var y = 3;
var z = x/y;
x = x/z;
console.log(x/3);	

var x = 11;
var y = 3;
var z = x%y;
x = x%z;
console.log(x%2);	

☐ Apply unary operators

The unary operators are operations that require only one operand; they perform various operations such as incrementing/decrementing a value by one, negating an expression, or inverting the value of a boolean (a true/false variable type).

Incrementing a value by 1

The code below illustrates how to increment the variable x by 1

```
var x = 1;
x = x + 1;   //x is now 2
```

Incrementing a value by 1 can also be done using the ++ operator,

```
int x = 1;
console.log(x++);  //1 is printed to the consol, then x is incremented
console.log(++x);  //x is incremented first, then it's value, 3, is
printed to the consol.
```

Notice in the above example that ++ can come before or after the variable. If it comes *before* the variable, the variable is first incremented then printed. If it comes *after* the variable, the variable is first printed then incremented.

Decrementing a value by 1

The code below illustrates how to decrement the variable y by 1

```
int y = 10;
y = y – 1;  //y is now 9
```

Decrementing a value by 1 can also be done using the **--** operator,

```
var y = 10;
console.log(y--);  //10 is printed to the consol, then y is decremented
console.log(--y);  //y is decremented first, then it's value, 8, is
printed to the consol
```

Notice in the above example that -- can come before or after the variable. If it comes *before* the variable, the variable is first decremented then printed. If it comes *after* the variable, the variable is first printed then decremented.

Indicate what is printed for each of the following	

var x = 1;
x = x + 3;
console.log(x++);
console.log(++x);	

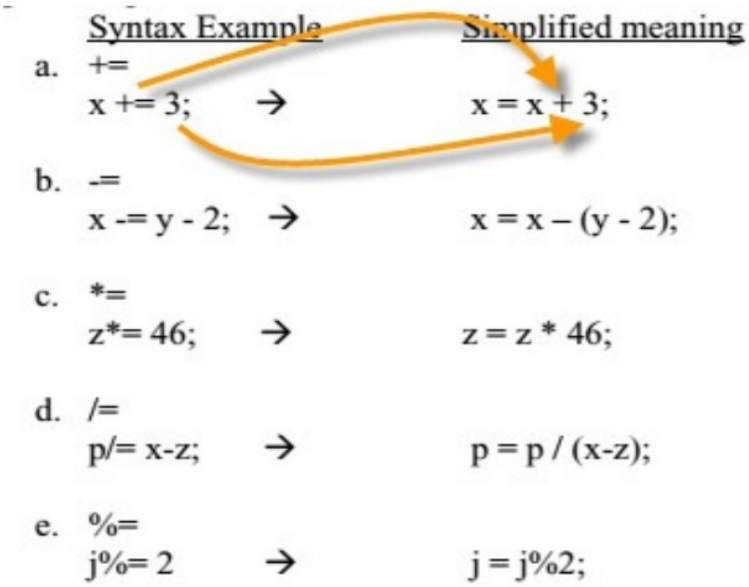
var y = 10;
y = y - 3;
console.log(y--);
console.log(--y);	

☐ Apply compound operators

A compound assignment operator is an operator that performs a calculation and an assignment at the same time. In the below example, x can be re-assigned explicitely using *x = x + 5*; x can also be re-assigned using the addition compound operator.

```
var x = 10;
x = x + 5;  //x is 15
x += 5;   //x is now 20
```

Compound operators can be applied to all the arithmetic operations. How this is done is illustrated below,



Indicate what is printed for each of the following	

var x = 1;
x += 8;
console.log(x++);
console.log(++x);	

var y = 11;
var d = 2;
y -= 3+d;
console.log(y++);
console.log(++y);	

var z = 3;
var i = 2;
z *= 5+i;
console.log(z++);
console.log(z--);	

var w = 15;
var y = 1;
w /= 3+y;
console.log(++w);
console.log(--w);	

var z = 15;
var y = 1;
z %= 3+y;
console.log(++z);
console.log(z--);	

☐ Have Ms. Pluska check off the above tasks

Before you continue have Ms. Pluska check off the above tasks

Do not continue until you have Ms. Pluska's (or her designated TA's) signature _____

☐ Use the Math object to perform mathematical operations

The built in Math object in javascript allows us to perform calculations that go beyond the simple arithmatic operations we've seen. An example of how the Math object can be applied is illustrated below. The example below computes the square root of 17. The result is assigned to the variable p.

```
var p = Math.square(17); //prints 4.123105625617661
```

In the above example,

- *var p* is the variable to which the result of the Math operation is assigned
- *Math. i*s the notation we use to access the library of Math functions in javascript
- *square(17)* is the operation we want to perform on the number 17. In this case, it is the square root.

Javascript provides an extensive library of Math operations. Below is a description of some of them.

Operation	Example	Description
abs	Math.abs(n);	returns the absolute value of n
pow	Math.pow(n, p);	Returns the the number n raised to the p power
sqrt	Math.sqrt(n);	Returns the square root of n
ceil	Math.ceil(n);	Returns the highest whole number from n
floor	Math.floor(n);	Returns the lowest whole number form n
min	Math.min(a, b);	Returns the smaller of a and b
max	Math.max(a, b);	Returns the larger of a and b
random	Math.random();	Returns a random number in the range (0 <= r < 1)
round	Math.round(n);	Returns n rounded to the nearest whole number
PI	Math.PI	Returns 3.141592653589793

Indicate what is printed for each of the following.
(a) Write code that will take the square root of a variable x and store the result in y
(b) Write code that will generate a random number from 0 up to 1.
(c) Indicate what is printed (i) console.log(Math.ceil(-157.2)); (ii) console.log(Math.floor(-157.2)); (iii) console.log(Math.ceil(157.2)); (iv) console.log(Math.floor(157.2)); (v) console.log(Math.round(-157.2)); (vi) console.log(Math.min(-157.7, 157.7)); (vii) cconsole.log(Math.min(-157.7, 157.7)); (viii) console.log(Math.pow(2, 3));

☐ Apply random() to create a random number in a specified range

Many applications you will create will require a random number. For example, what if you needed to write a program to generate a number that represented a face from a 6-sided die, or a card from a 52 card deck?

The random() function generates a random number between 0 and 1, where 0 is inclusive, but 1 is not. The below code is illustrative,

```
console.log(Math.random()); //prints a random var from 0 up to 1
```

To create a number in a different range, say 0 up to 10, simply multiply the result of Math.random() by the desired range. An example is shown below,

```
console.log(Math.random()*10);  //prints a random var from 0 up to 10
```

Recall, however that the random() method returns a decimal number. The below code illustrates how to generate a random integer from 0 up to 10,

```
var randomNumber = Math.random()*10;
console.log(Math.floor(randomNumber)); //prints a random integer from 0 up
to 10
```

The above examples, illustrate how to scale the random() method to a specified range. The example below illustrates how to shift the range of the random number.

```
var randomNumber1 = (Math.random()*10) + 100;
console.log(randomNumber); //prints a random number from 100 to 110

var randomNumber2 = (Math.random()*10) – 100;
console.log(randomNumber2);  //prints a random number from -100 to -90
```

Write code that could be used to create a random number within each of the specified ranges below	
0 – 1 (1 not inclusive)	
0 – 52 (52 is inclusive)	
100 – 200 (200 is not inclusive)	
-100 – 0; (0 is inclusive)	
-50 – 10; (10 is not inclusive	

☐ Brainstorm a program

With your partner, brainstorm code that could be used to solve each of the following challenges. Write your code on a separate sheet of paper and attach it to this lab.

Challenge 1

Write code that could be used to prompt a user for a number, then print the reverse of the number to the screen. Your code should work for any number with 4 digits. Consider the number below,

var number = 1234;

When your code is ran, “4321” should print to the console.

Below are more examples,

int data type	**result**
var n1 = 3455;	5543
var n2 = 8767;	7678
var n3 = 2468;	8642

Challenge 2

Write a random number generator. Your generator should prompt the user for two numbers. The first number should be negative. The second number should be greater than the absolute value of the first number. The numbers will represent the range. Once the input is received your program should generate two random integers within the range specified, where the lowest number is inclusive but the highest number is not. Consider the example below,

```
Type a negative number: -5
Type a postive number that is greater than 5: 50
You got a -4 and a 36
```

Challenge 3

Consider the program your wrote previously. Write a random number generator, such that each time the page is refreshed and random number between 1 and 9 (both 1 and 9 are inclusive) is generated. Use this number to randomly make the monster appear at a random location on your grid.

☐ Receive Credit for the group portion of this lab

- Indicate the names of all group members.
- Make sure both you and your partner have completed the above tasks
- Have Ms. Pluska check off the group tasks
- Submit your lab to the needs to be graded folder to receive credit for the group portion of this lab.
- Do not submit your lab until you have Ms. Pluska’s (or her designated TA’s) signature

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