Name ___Solutions____ Discrete I, Quiz 26

Use the code below to answer the following questions.

```
x = 17
for i from 0 to n-1
   x = x * (x-2)
```

1) Assuming all arithmetic can be done in hardware, what is the asymptotic runtime of this algorithm?

$$O(n)$$

2) Assuming all arithmetic can be done in hardware, what is the asymptotic space requirement of this algorithm?

$$O(1)$$

3) If n is large enough that the arithmetic needs to be done in software, what is the asymptotic space requirement of this algorithm?

If m is the size of the largest value that x gets to, it is

$$O(\log(m))$$

Exactly what this is, is unclear. To find an upper bound, let us assume that the third line is "`x=x*x`". In this case we construct the table below to see the first four values of n:

n	x
1	17^2
2	17^4
3	17^8
4	17^{16}

From this we see that the value of x is $O\left(17^{2^n}\right)$. Hence the space requirement is:

$$O\left(\log\left(17^{2^n}\right)\right) = O(2^n \cdot \log(17)) = O(2^n)$$