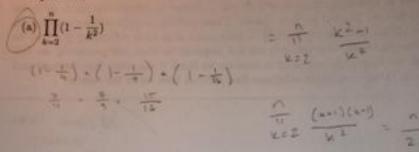
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Summer Travel Post (Private) number: @ 1575

2. (12 points) Simplify the following expressions as much as possible, without using an calculator (either hardware or software). Do not approximate. Express all rational numbers as improper fractions. Show your work in the space provided, and write your answer in the box provided.



Answer for (a):

(b) 31000 mod 7

2° mil 7 . \$1

Seemy of process that a marple of 6

2' mil 7 . 3

2' mil 7 . 3

2' mil 7 . 4

2' mil 7 . 4

3' mil 7 . 4

Answer for (b): (4)

 $\sum_{r=1}^{\infty} (\frac{1}{2})^r$

さいないないないない

Answer for (c):

(d) $\frac{\log_7 81}{\log_7 9}$

Answer for (d): 2

(e) $\log_2 4^{2n}$

Answer for (e): 4 A

(f) $\log_{17} 221 - \log_{17} 13$

Asswer for (f):

3. (8 points) Find the formula for $1 + \sum_{j=1}^{n} j! j$, and show work proving the formula is correct using induction.

 (8 points) Indicate for each of the following pairs of expressions (f(n), g(n)), whether f(n) is O, Ω , or Θ of g(n). Prove your answers to the first two items, but just GIVE an answer to the last two.

(a) $f(n) = 4^{\log_4 n}$ and g(n) = 2n + 1.

tens & O(gen) $f(n) \in \partial (g(n))$ Answer for (a): Ciguistin (Cigin)

(b) $f(n) = n^2$ and $g(n) = (\sqrt{2})^{\log_2 n}$.

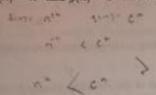
Answer for (b): $f(n) \in Q(g(n))$

(c)
$$f(n) = \log_2 n!$$
 and $g(n) = n \log_2 n$.
 $\lfloor n \rfloor_2 n!$ we note $n \log_2 n$

(5 4 m) (Com)

Answer for (c): f(n) (D (g(n))

(d) f(n) = n^k and g(n) = cⁿ where k, c are constants and c is >1.



Answer for (d): $f(n) \neq O(g(n))$

5. (9 points) Solve the following recurrence relations for integer vs. If no solution exists, please explain the result.

(a) $T(n) = T(\frac{n}{2}) + 5$, T(1) = 1, assume n is a power of 2. $T(\frac{n}{4}) + T(1) = 1$

T(+) + 1+5 + 6 T(+) + T(+) + 6 T(+) + 6+5 = 11

T(8) - 10 - 16

Tinte Tinto

Answer for (a):

TINIT

(b) $T(n) = T(n-1) + \frac{1}{n}$, T(0) = 0. $T(1) = T(1) + \frac{1}{n}$, T(0) = 0. $T(1) = T(1) + \frac{1}{n}$, T(0) = 0. $T(2) = T(1) + \frac{1}{n}$, T(0) = 0. $T(1) = \frac{1}{n}$, $T(1) = \frac{1}{n}$, $T(2) = \frac{1}{n}$.

+(4): 11

Harmonie Tem) = \$ 1/1c

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Answer for (b): T(m): 2 /L

- 6. (10 points) Suppose function call parameter passing costs constant time, independent of the size of the structure being passed.
 - (a) Give a recurrence for worst case running time of the recursive Binary Search function in terms of n, the size of the search array. Assume n is a power of 2. Solve the recurrence.

Recurrence:	T(n)-T(2)-d
Base case:	T 603 = C.
Recurrence Solution:	Tense of Igens)

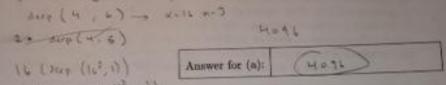
(b) Give a recurrence for worst case running time of the recursive Merge Sort function in terms of n, the size of the array being sorted. Solve the recurrence.

Recurrence:	T(0)027(\$) - Km
Base case:	T(1) = (.
Running Time:	Ting = o(n)gen)

7. (10 points) Consider the pseudocode function below

```
derp( x, n )
   if( n == 0 )
      return 1;
   if( n % 2 == 0 )
      return derp( x^2, n/2 );
   return x * derp( x^2, (n - 1) / 2);
```

(a) What is the output when passed the following parameters: x=2, n=12. Show your work (activation diagram or similar).



(b) Briefly describe what this function is doing.

(c) Write a recurrence that models the running time of this function. Assume checks, returns, and arithmetic are constant time, but be sure to evaluate all function calls. [Hint: what is the most n could be at each level of the recurrence?]

(d) Solve the above recurrence for the running time of this function.