For the test you should be able to solve the following:

1. Given an algorithm where the fraction that the program is serial (*f*) is .15, what is the speedup on 2, 4, 8, 16 and an infinite number of processors. You may ignore communication costs and the problem size is fixed.
2. What is the efficiency at 2, 4, 8 and 16 processes?

p	**2**	**4**	**8**	**16**	**∞**
speedup	1.74	2.76	3.90	4.92	6.67
efficiency	0.87	0.69	0.49	0.31	N/A

3. Solve problem 1 for a non-infinite number of processors where the serial portion *s* of a parallel execution is .15
4. What is the efficiency of each?

p	**2**	**4**	**8**	**16**
speedup	1.95	3.55	6.95	13.75
efficiency	0.925	0.888	0.869	0.859

5. Given a 1000 machine cluster, what must *s* and *f* be to obtain an efficiency of 80%?

An efficiency of 80% yields a speedup of 800 on one thousand processors. Thus:

$800 = 1000 - (1-p)s = 1000 - 999s$
$999s = 1000 - 800 = 200$
$s = 200/999 = .2002$

$1/(f+(1-f)p)/p = .8$
$1/(f+(1-f)1000) = 800$
$1000/(1000*f + (1- f)) = 800$
$1000 = 800*(1000*f + (1- f))$
$200 = 799{,}200*f$
$.00025 = f$

6. Given the following two tables, what can you say about the scalability of the two programs that yield these results? If the scaling is poor, is it a result of Amdahl's Law or an increasing degree of sequential execution/overhead in the program? If the scaling is good, why do you think it is?

For the first table, scalability will be excellent since the serial portion of the program is decreasing with an increasing number of processors. The program should be able to scale indefinitely.

In the second case the experimentally determined serial portion of the program is increasing with the number processors and will come to dominate the computation, and so it will likely not scale well to large number of processors. Since the experimentally determined serial portion of the program is increasing and not staying constant their are overheads that are growing with the number of processors, and not simply a fraction of the serial program, so it is not just Amdahl's law that is causing issues.

p	**2**	**4**	**8**	**16**	**32**	**64**
Ψ	1.8	3.6	7.2	14.4	28.8	57.6
e	0.111	0.037	0.0158	0.007	0.004	0.002

p	**2**	**4**	**8**	**16**	**32**	**64**
Ψ	1.9	3	4	5	5.5	5.7
e	0.053	0.111	0.143	0.147	0.155	0.162