Parallel Computing and Performance Metrics Questions

1. Given a processor with a clock speed of 3.2 GHz and 4 cores, calculate the theoretical peak FLOPS. Assume that a base level of performance where each core can perform one floating-point operation per clock cycle.

2. A CPU has a clock speed of 2.5 GHz and 8 cores. Assuming each core can perform 4 double-precision floating-point operations per clock cycle, what is the peak FLOPS for this CPU?

3. In the problem 2, if single precision floating-point operations are used, what is the peak FLOPS for the CPU?

4. A supercomputer cluster has 10,000 CPU cores, and each core operates at a clock speed of 3.2 GHz. If each core can perform 8 gigaflops (GFLOPS), what is the peak FLOPS for this cluster?

5. A supercomputer consists of 5,000 processing nodes, each with a clock speed of 2.8 GHz. If each node can perform 4 teraflops (TFLOPS), what is the peak FLOPS for this supercomputer?

6. A supercomputer consisting of 442 processing nodes, where each node has 2x20 Intel 6148 cores, and each core operates at a clock speed of 2.4 GHz, calculate the peak TFLOPS for this supercomputer? Each core can perform 32 double-precision floating-point operations per clock cycle.

7. A parallel algorithm executes on 8 cores in 120 seconds. If the same algorithm runs sequentially in 800 seconds, find the speedup and efficiency.

8. In a cluster, a simulation task is divided among 16 nodes, and it takes 120 seconds to complete. If you increase the number of nodes to 32 and the time reduces to 80 seconds, compute the strong scaling efficiency.

9. In a parallel application, 90% of the code can be parallelized. Calculate the maximum speedup that can be achieved regardless of the number of processors.

10. A simulation program can parallelize 90% of its workload. If it takes 100 seconds to run sequentially and 10 seconds to run on 20 processors, compute the speedup on 20 processors. Is the provided problem statement accurate?