(1) Processors with a lower clock rate execute the same binary programs faster than the processors with a higher clock rate. How is this possible?

A processor with a lower CPI can perform better (can execute programs in shorter time) than another processor with a higher clock rate.

(2) For the following performance metrics for processors, show which way each metric is better:

- **Execution time**: short \(\quad\) long \hspace{1cm} \text{[short]}
- **Clock rate**: low \(\quad\) high \hspace{1cm} \text{[high]}
- **Clock cycle time**: short \(\quad\) long \hspace{1cm} \text{[short]}
- **CPI**: small \(\quad\) large \hspace{1cm} \text{[small]}

(3) What are “super-scalar datapath processors”?

Super-scalar processors are those processors that has more than one scalar datapath.
(4) What are “data hazards”? Show an example of the data hazard (using assembly instructions).

Data hazards are the slow-down of a pipeline processors due to data-dependency between instructions.

```
move $t1, $t2:
add $t3, $t1, 5:
```

```
Pipeline stalls
```

(5) What are “control hazards”? Show an example of the control hazard (using assembly instructions).

Control hazards are the slow-down of a pipeline processors due to loading incorrect instructions after a conditional branch instruction.

```
bne $s0, $s1, Next
```

For the conditional branch instruction:

1. the processor assumed that a branch (jump) will not take place and the processor loads “instruction 1”

2. against the assumption, the branch instruction takes a jump