CZ3001
Advanced Computer Architecture

LAMS 2 - Parallel processing, Pipelining and Power Dissipation

1. * The CPI required by two processors P1 and P2, for the programs which you want to run are 2 and 4 respectively. Given that P1 and P2 can operate at maximum clock frequencies of 100 MHz and 200MHz respectively. Which processor will you choose?

Clue: Note that clock period is reciprocal of clock frequency, and the power consumed by a processor increases linearly with clock frequency.

Choose one of the following answers.

✔ ◉ P1	The correct answer is P1. Execution time= IC* CPI* clk period Execution time of both P1 and P2 are the same. Since P2 has a higher clock frequency, P2 will consume more power. Hence P1 is the chosen processor as it is more efficient.
○ P2	
○ Both of them	
○ None of the above	

Marks for this submission: 1/1.

2. * The CPI required by two processors, P1 and P2, for the programs which you want to run are 4 and 2 respectively. It is found that both the processors give the same performance. Find the ratio of maximum usable clock frequencies of P1 and P2. Which processor will you choose?

Clue: Note that clock period is reciprocal of clock frequency, and the power consumed by a processor increases linearly with clock frequency.

Choose one of the following answers.

- P1
- ✔ P2

The correct answer is P2.

Execution time= IC* CPI* clk period
Execution time of both P1 and P2 are the same.
Clock period_1/Clock period_2 = CPI_2/CPI_1 =2/4.
Clock period of P1 is less than that of P2. So clock frequency of P1 is more than that of P2 and will consume more power. Hence P2 is the chosen processor.

- Both of the above
- None of the above

Marks for this submission: 1/1.

3. * Consider two machines M1 and M2. The CPI required by M1 and M2 for the programs which you want to run are 2 and 3, respectively. The minimum clock period of M1 and M2 can 30 ns and 20 ns, respectively. Which processor will you choose?

Clue: Note that clock period is reciprocal of clock frequency, and the power consumed by a processor increases linearly with clock frequency.

Choose one of the following answers.

✔ ◉ M1	The correct answer is M1. Execution time= IC* CPI* clk period Execution time of both M1 and M2 are the same. As M2 has shorter clock period, it will have higher frequency and will consume more power. Hence M1 is the chosen processor.
○ M2	
○ Both of them	
○ None of the above	

Marks for this submission: 1/1.

4. * State which of the following computational tasks has inherent concurrency (task that is easier to do parallelization):

Task A: c1=a1.b1, c2=a2.b2, and c3=a3.b3.
Task B: p=((a1+b1+c1).a2+b2).c2.

Choose one of the following answers.

✔ A	The correct answer is Task A. Task A has inherent concurrency since three subtasks are to be executed independently by different processors.Good for parallelization.
B	
Both A and B	
None of the above	

Marks for this submission: 1/1.

5. * State which of the following computational tasks is suitable for pipelining:

Task A: c1=a1.b1, c2=a2.b2, and c3=a3.b3.
Task B: p=((a1+b1+c1).a2+b2).c2.

Choose one of the following answers.

- A
- ✔ B

  The correct answer is Task B.

  Task B is shows sequential operation and can be pipelined as follows:
  n1=a1+b1+c1,
  n2=n1*a2,
  n3=n2+b2,
  p=n3*c2
  You will learn more details on pipelining in module 4
- Both A and B
- None of the above

Marks for this submission: 1/1.

6. * Consider a processor is consuming 60 Watt dynamic power and 10 Watt static power at present. If the operating clock frequency is reduced to half, what will be the total energy consumption in five minutes?

Choose one of the following answers.

- 21 kJ
- ✔ 12 kJ

The correct answer is 12 kJ

Operating Clk frequency is halved. Hence dynamic power is halved= 60 watt/2 = 30 watt
Total power= dynamic power + static power = 30 + 10 = 40 Watt
Total energy for 5 minutes=$E_{(J)} = P_{(W)} \times t_{(s)}$ = 5 * 60 sec (40 Watt) = 12000 J

- 350 J
- 200 J

Marks for this submission: 1/1.

7. * Consider a processor which is consuming 75 Watt dynamic power and 10 Watt static power at present. If the leakage current is increased by 10%, what will be the total power consumption?

Choose one of the following answers.

✔ 86 W	The correct answer is 86 W If the leakage current is increased by 10%, then static power will also increase 10%. Hence total static power= 10+1 = 11 Watt. Total power = 75+11 = 86 Watt
11 W	
85 W	
10 W	

Marks for this submission: 1/1.

8. * Consider a processor which is consuming 70 Watt dynamic power and 10 Watt static power at present. If all inputs are set to zero, what will be the total power consumption?

Choose one of the following answers.

- 80 W
- 70 W
- 0 W
- ✔ 10 W

The correct answer is 10 W

If all inputs are not switching, the switching factor = 0 and hence dynamic power = 0 Watt. Total power = dynamic power + static power = 0+10 =10 Watt

Marks for this submission: 1/1.

9. * We know that heat sink reduces temperature. But can heat sink help in reducing the total power consumption?

Choose one of the following answers.

✔ ◉ Yes	The correct answer is Yes. Heat sink can reduce temperature and hence reduce the leakage power. So it helps to reducing total power consumption.
○ No	

Marks for this submission: 1/1.

* 10(a) The operating voltage is reduced to half, from V to V/2.
Assume that the processor will run at maximum operating frequency and the maximum operating frequency is proportional to the operating voltage.

Calculate by what factor the power consumption will change due to static power consumption.

Choose one of the following answers.

- 2
- 4
- ✔ ½

The correct answer is ½.

P(st) is directly proportional to V. So, if the operating voltage is reduced by half, then static power consumption will be reduced by a factor of 2.

- ¼

Marks for this submission: 1/1.

* 10(b) With reference to the above question, calculate by what factor the power consumption will change due to dynamic power consumption.

Choose one of the following answers.

- 2
- 8
- ½
- ✔ ⅛

The correct answer is ⅛.

P(dyn) is proportional to V*V*f and all of them are halved. Hence the answer is (⅛).

Marks for this submission: 1/1.