1. i) Die Yield = Wafer yield x (1 + (Defects per unit area x Die Area)/a)-a

Note : The unit of Die size is not given, so considered unit as mm2

1 x (1+ (0.30 x 4)/ 5)-5

**Ans: 0.34**

ii) Looking from the die size, it might be little older technology. So the defect rate would have reduced in this case.

1. According to Moore’s law, the transistor doubles every 2 years. If the number of transistors in 2015 is X, then the number of transistors in 2025 is (2^5)X .

**Ans: 32 times**

1. 1/(1-0.5)+0.5/N = N / (0.5N + 0.5) => for N processors

1/(1-0.5)+0.5/N = 1000 / (0.5 x 1000 + 0.5) = 1.998 => for 1000 processors

1. Peak power consumption = 70.2 W

Number of servers = 14000W/70.2W= 199.4 ~ 199 systems

1. A) CPI for old processor (30 % x 1) + ( 20% x 2) + (40% x 3) + (10% x 5) = **2.4 cycles/instruction**

CPI for new processor (30 % x 1) + ( 20% x 2) + (40% x 3) + (10% x 13) = **3.2 cycles/instruction**

MIPS for old processor = 400/(2.4)**= 166.67 MIPS**

MIPS for new processor = 400/(3.2) **= 125 MIPS**

B) Dies per wafer = (pi x (Wafer diameter/2)^2)/ Die Area-

((pi x Wafer diameter)/ sqrt(2 x Die Area)) = (3.14 x 5^2)/0.12 –(3.14 x 10) /sqrt(2 x0.12)

= **590**

Die Yield = Wafer yield x (1 + (Defects per unit area x Die Area)/a)-a

0.75 x ( 1+ (2 x 12)/4)-4  = **0.0003123**

Cost of die = cost of wafer/(dies per wafer x die yield)

= (1000/(590 x 0.0003123)) = 5427.20

New processor calc

Dies per wafer = (pi x (Wafer diameter/2)^2)/ Die Area-

((pi x Wafer diameter)/ sqrt(2 x Die Area)) = (3.14 x 5^2)/0.10 –(3.14 x 10) /sqrt(2 x0.10)

= **714 approx**

Die Yield = Wafer yield x (1 + (Defects per unit area x Die Area)/a)-a

0.75 x ( 1+ (2 x 10)/4)-4  = **0.0005787**

Cost of die = cost of wafer/(dies per wafer x die yield)

= (1000/(714 x **0.0005787**)) = 2420.183

The cost of the new processor is very much less compared to the old processor and could see a significant change in the die yields. The change in die yields show that the performance of new processor is better than the old processor.

Notes: Die size is given in mm2 so converted to cm2 => 12 mm2 to 0.12 cm2

c) f= CPI for floating point instructions / Overall CPI

= 1.0/ 2.4 = 0.42

Maximum speedup = 1/(1-0.42) = 1.72

CPI for new processor (30 % x 1) + ( 20% x 2) + (40% x 3) + (10% x 1) = **2 cycles/instruction**

**MIPS for new processor = 200 MIPS**