Homework 1

1.

A)

I) $Wafer\_X\_area = r^2\pi = \left(\frac{0{,}16m}{2}\right)^2 \cdot \pi = (0{,}08m)^2\pi = 0{,}022\,m^2 = \boxed{201\,cm^2}$

$Die\_X\_area = \frac{wafer\_X\_area}{dies\_per\_wafer} = \frac{201\,cm^2}{64} = \boxed{3.14\,cm^2}$

II) $Wafer\_Y\_area = r^2\pi = \left(\frac{0{,}2m}{2}\right)^2\pi = (0{,}1m)^2\pi = 0{,}01m^2\cdot\pi = 0{,}0314\,m^2 = \boxed{314\,cm^2}$

$Die\_Y\_area = \frac{water\_Y\_area}{dies\_per\_water} = \frac{314\,cm^2}{100} = \boxed{3.14\,cm^2}$

$\boxed{B}$) Yield_x=?

1)

$\text{Defected\_Dies\_X} = 201\ cm^2 \cdot 0.02\ \frac{\text{defects}}{cm^2} = \underline{4.02}$ defected diodes

$\Rightarrow \text{Yield\_X} = \frac{64 - 4.02}{64} = \boxed{0.94}$

$\text{cost\_per\_die\_X} = \frac{\text{cost\_per\_wafer\_x}}{\text{dies\_per\_wafer\_x} - \text{defected\_dies\_x}} = \frac{15}{64 - 4.02} = \boxed{0.25}$ per die

11)

$\text{defected\_dies\_Y} = 314\ cm^2 \cdot 0.03\ \frac{\text{defects}}{cm^2} = \underline{9.42}$

$\text{yield\_Y} = \frac{100 - 9.42}{100} = \frac{90.58}{100} = \boxed{0.9}$

$\text{cost\_per\_die\_Y} = \frac{\text{cost\_per\_wafer\_y}}{\text{dies\_per\_wafer\_y} - \text{defected\_dies\_y}} = \frac{24}{100 - 9.42} = \frac{24}{90.58} = \boxed{0.266}$ per diode

C)

	cost	# dies	defect / cm²
X	$15 \cdot 0.8 = \boxed{12}$	$64 \cdot 1.1 = \boxed{70.4}$	$0.02 \cdot 1.15 = \boxed{0.023}$
Y	$24 \cdot 0.8 = \boxed{19.2}$	$100 \cdot 1.1 = \boxed{110}$	$0.03 \cdot 1.15 = \boxed{0.0345}$

A) i) Wafer's area stays the same!

$$die\_X\_area = \frac{201\ cm^2}{70.4} = \boxed{2.85\ cm^2}$$

ii)

$$die\_Y\_area = \frac{314\ cm^2}{110} = \boxed{2.85\ cm^2}$$

B) i)

$$defect\_X = 201\ \cancel{cm^2} \cdot 0.023\ \frac{dif}{\cancel{cm^2}} = \underline{4.623}$$

$$yied\_x = \frac{70.4 - 4.623}{70.4} = \underline{0.93}$$

$$cost\_die\_X = \frac{12}{70.4 - 4.623} = \frac{12}{65.37} = \underline{0.18}$$

ii)

$$defect\_Y = 314\ cm^2 \cdot 0.0345\ \frac{def}{cm^2} = \underline{10.8\ def}$$

$$yield\_Y = \frac{110 - 10.8}{110} = \frac{99.2}{110} = \underline{0.9}$$

$$cost\_die\_Y = \frac{19.2}{110 - 10.8} = \frac{19.2}{99.2} = \underline{0.19}$$

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2.

$F_1 = 3GHz$, $F_2 = 1.5\ GHz$

A) $T_1 = \frac{1}{F_1} = \frac{1}{3\cdot 10^9} = 0.\dot{3}\cdot 10^{-9}s$; $T_2 = \frac{1}{1.5\cdot 10^9} = 0,\dot{6}\cdot 10^{-9}s$

clock cycle → seconds per cycle

T_1 and T_2 are the solutions to this part if by clock cycles you mean clock cycle of P_1 and clock cycle of P_2

	R	T	J
	0.3	0.5	0.2
	30 %	50 %	20 %
	.3	.5	.2
P_1	2	4	3
P_2	3	3	3

→ in billions

$P_{C1} = 2\cdot 0.3 + 4\cdot 0.5 + 3\cdot 0.2 = \boxed{3.2\cdot 10^9}$

$P_{C2} = 3\cdot 0.3 + 3\cdot 0.5 + 3\cdot 0.2 = \boxed{3.0\cdot 10^9}$

P_{C1} and P_{C2} is the solution if by clock cycles you meant total clock cycles of P_1 and total clock cycles of P_2

$0.3 = 0.9\cdot 10^9$

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... if by clock cycles you meant ...

B)

$P_{c1}\_R = 2 \cdot 0.3 = 0.6$ billion cycles

$P_{c1}\_I = 4 \cdot 0.5 = 2$ billion cycles

$P_{c1}\_J = 3 \cdot 0.2 = 0.6$ billion cycles

$P_{c2}\_R = 3 \cdot 0.3 = 0.9 \cdot 10^9$

$P_{c2}\_I = 3 \cdot 0.5 = 1.5 \cdot 10^9$

$P_{c2}\_J = 3 \cdot 0.2 = 0.6 \cdot 10^9$

$$CPI_1 = P_{c1}\_avg = \frac{3{,}2 \cdot 10^9 \text{ cycles}}{2+4+3} = \frac{3{,}2 \; 10^9 \text{ cycle}}{9} = 0.35 \cdot 10^9 \; \frac{\text{cycle}}{\text{instruction}}$$

$$CPI_2 = P_{c2}\_avg = \frac{3.0 \cdot 10^9 \text{ cycles}}{3+3+3} = 0.\dot{3} \cdot 10^9 \; \frac{\text{cycle}}{\text{instr}}$$

c)

$$ET_1 = P_{c_1} \cdot T_1 = 3.2 \cdot \cancel{10^9}\ \cancel{\text{cycle}} \cdot 0.\dot{3} \cdot \cancel{10^{-9}}\ \frac{s}{\cancel{\text{cycle}}} = \boxed{1.0\dot{6}\ s}$$

$$ET_2 = P_{c_2} \cdot T_2 = 3. \cancel{10^9}\ \cancel{\text{cycle}} \cdot 0.\dot{6} \cdot \cancel{10^{-9}}\ \frac{s}{\cancel{\text{cycle}}} = \boxed{1.99\ s}$$

D)

$$\frac{ET_2}{ET_1} = \frac{1.\dot{9}\dot{9}\ \cancel{s}}{1.0\dot{6}\ \cancel{s}} = 1.875 \Rightarrow P_1 \text{ is } 1.875 \text{ times faster.}$$