

## Standard Cell Libraries Assignment Solutions

**Table – 1 :Cell counts and types**

	Cadence_RAK (slow.lib)	Nangate_OCL ( Nangate_OCL _slow.lib)	Nangate_15nm (NanGate_15nm_OCL_worst _low_conditional_nldm.lib)	Skywater HS (sky130_fd_sc_hs__ ff_150c_1v95.lib)
Total No. of Cells	477	134	76	376
<b>DFFs</b>				
Total no. of DFFs	118	16	4	45
No. of DFFs with reset	16	8	2	12
No. of DFFs with set	31	8	2	10
No. of negative edge-triggered DFFs	7	0	4	6
<b>NAND gates</b>				
Count of 2-input NAND gates	10	3	2	7
Count of 3-input NAND gates	10	3	2	6
Count of 4-input NAND gates	14	3	2	9
<b>Muxes</b>				
Count of 2-input muxes*	12	2	1	6
Count of 3-input muxes*	8	0	0	0
Count of 4-input muxes*	8	0	0	3

**Table – 2 :Cell Drive Strengths**

	Cadence_RAK	Nangate_OCL	Nangate_15nm	Skywater HS
<b>Inverter</b>				
Total count	10	6	6	5
Max drive strength	X20	X32	X16	X16
Min drive strength	XL	X1	X1	X1
<b>Buffer</b>				
Total count	8	6	6	5
Max drive strength	X20	X32	X16	X16
Min drive strength	X2	X1	X1	X1
<b>NAND2</b>				
Total count	6	3	2	4
Max drive strength	X8	X4	X2	X8
Min drive strength	XL	X1	X1	X1
<b>DFFs</b>				
Total count	5	2	1	3
Max drive strength	X8	X2	X1	X4
Min drive strength	X1	X1	X1	X1

**Table – 3 :Cell pin capacitances and area**

Cell	Input Pin	Cadence_RAK	Nangate_OCL	Nangate_15nm	Skywater HS
Inverter	XL	0.00057002	NA	NA	NA
	X1	0.000892926	1.643743	0.819034	0.00305000
	X2	0.00154426	3.135991	1.639203	0.00546000
	X3	0.00218144	NA	NA	NA
	X4	0.0028463	6.114219	3.280298	0.01096000
	X6	0.00420495	NA	NA	NA
	X8	0.00543709	11.807388	6.562154	0.02173000
	X12	0.00851568	NA	NA	NA
	X16	0.0110848	24.694640	13.126691	0.04466000
	X20	0.0141623	NA	NA	NA
	X32	NA	48.557758	NA	NA
Buffer	X1	NA	0.934558	0.851488	0.00277
	X2	0.000601595	1.703888	0.839939	0.00254
	X3	0.000887549	NA	NA	NA
	X4	0.00153457	3.251947	1.679345	0.00369
	X6	0.00154584	NA	NA	NA
	X8	NA	6.359827	3.359534	0.084
	X12	0.00219344	NA	5.039592	NA
	X16	0.00287393	12.270698	6.719911	0.1695
	X20	0.00359149	NA	NA	NA
	X32	NA	25.711127	NA	NA
NAND2	XL	0.000544596	NA	NA	NA
	X1	0.000839362	1.568247	0.659530	0.00286
	X2	0.00167474	3.002658	1.307426	0.0055
	X4	0.00323744	5.884222	NA	0.00796
	X6	0.00474325	NA	NA	NA
	X8	0.00600265	NA	NA	0.01613

**Table – 4 :Operating Conditions (P-V-T)**

In the skywater HS and MS libraries, for what P-V-T conditions are dotlibs available? Report this in a table like the following:

**Skywater lib hs(P-V-T)**

dotlib file name	P	V (volts)	T (°C)
Sky130_fd_sc_hs__ff_150c_1v95.lib	1.0000	1.95	150
Sky130_fd_sc_hs__ss_100c_1v60.lib	1.0000	1.60	100
Sky130_fd_sc_hs__ss_150c_1v60.lib	1.0000	1.60	150
Sky130_fd_sc_hs__tt_025c_1v80.lib	1.0000	1.80	25

**Skywater lib ms(P-V-T)**

dotlib file name	P	V (volts)	T (°C)
Sky130_fd_sc_ms__ff_150c_1v95.lib	1.0000	1.95	150
Sky130_fd_sc_ms__ff_n40c_1v95_pwr1kg.lib	1.0000	1.95	-40
Sky130_fd_sc_ms__ss_100c_1v60.lib	1.0000	1.60	100
Sky130_fd_sc_ms__ss_150c_1v60.lib	1.0000	1.60	150
Sky130_fd_sc_ms__tt_025c_1v80.lib	1.0000	1.80	25

**Table – 5 :Physical Design**

Extract data from the LEF files, including techlef, to fill out the following table

	Cadence_RAK	NangateOpenCellLibrary	Nangate_15nm
Cell height	1.71	1.4	0.768
No. of metal layers	6	10	5
Routing pitch	0.2	0.28	0.064
Cell height in routing tracks	NA	10.09	NA