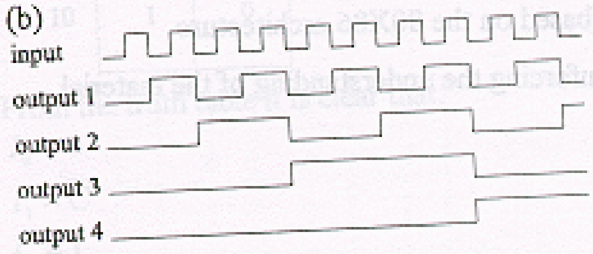
13.1

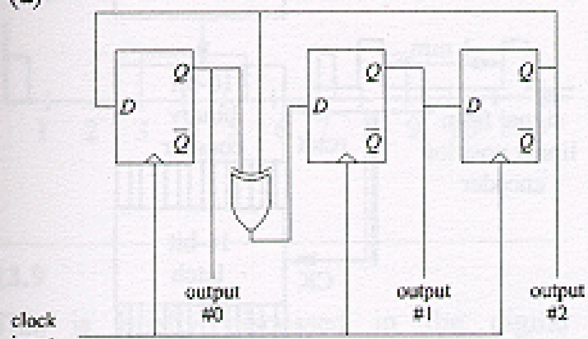
(a) The device is called a MOD-16 ripple counter. It can count clock pulses from 0 to (2^4-1). The outputs divide the frequency by 2^1, 2^2, 2^3, and 2^4 respectively. Therefore, you can use this circuit as a divide by N counter, where N is 2, 4, 8 and 16.

(b)

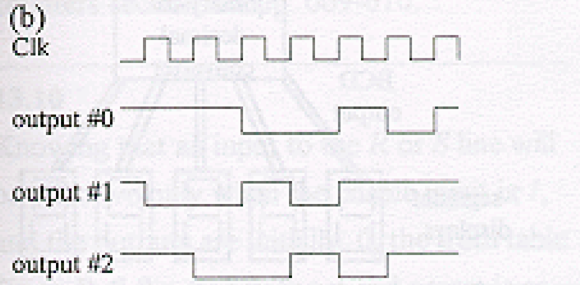


13.4

(a)

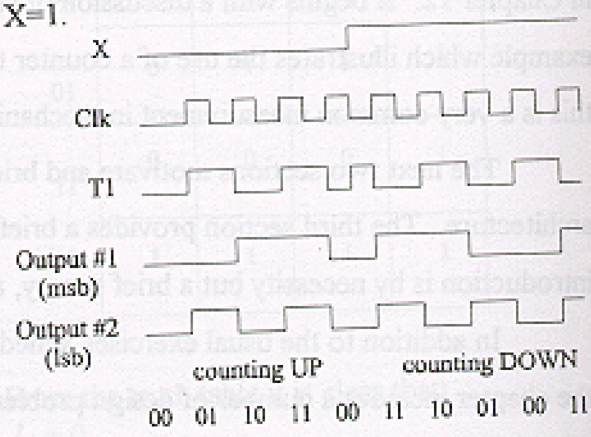


(b)



13.3

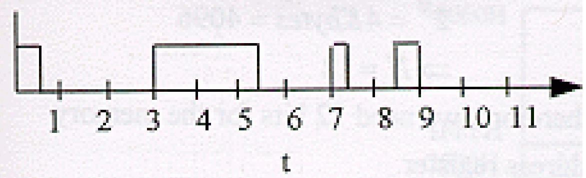
The basic operation of the circuit is to count up when X=0, and to count down when X=1.



Clock	X	Output #2	T_1	Output #1
↑	0	0	0	No change
↑	1	1	0	No change
↑	0	1	1	toggle
↑	1	0	1	toggle

13.8

Output



13.17

640K bytes = 640×1024 = 655,360 bytes

(a) $655360 \times \frac{1 word}{2 bytes} = 327680 words$

(b) $655360 bytes \times \frac{2 nibbles}{1 byte} = 1310720 nibbles$

(c) $655360 bytes \times \frac{8 bits}{1 byte} = 5242880 bits$

(d) $1 Mbyte = 1024 Kbytes$

$\therefore$ we need $1024 - 640 = 384 Kbytes$

or $384 \times 8 = 3072 Kbits$

or $\frac{3072}{256} = 12$ of the 256Kbit chips.

Cost = $12 \times \$0.20 = \$2.40$

13.19

(a) We need

$$2^N = 4 Kbytes = 4096$$

$$\Rightarrow N = 12$$

Therefore, we need 12 bits for the memory address register.

(b) The data register must be at least as large as each word in memory. Therefore, the data register must be 16 bits in length.

13.18

a) n(n-1)

b) 2n

13.22

$$\frac{8 tracks}{cm} \times 2 cm = 16 tracks$$

$$16 tracks \times 200 \frac{bits}{cm} = 3200 \frac{bits}{cm}$$

$$3200 \frac{bits}{cm} \times \frac{1 byte}{8 bits} = 400 \frac{bytes}{cm}$$

$$400 \frac{bytes}{cm} \times 25 \frac{cm}{s} = 10000 \frac{bytes}{s}$$