1. A security company boasts of their tightknit security systems to its clients. Their systems run continuous security sweeps. The rate of their sweeps varies based on the client's subscription model. The premium model offers a sweep every **15ms** whereas the basic model runs the sweep every **40ms**. Their system is based on Arduino Uno platform running at **16MHz**.
   a) Compute the necessary timer counts to achieve the required delay for the premium and the basic model.
   b) If the system is using only a **16-bit timer** and if the available **prescalers are 8, 64, 256 and 1024**, compute the **maximum** possible time to be counted for the premium and the basic model with the help of this 16-bit timer.
2. Prepare the necessary registers associated with the 16-bit timer to achieve the necessary time counts calculated in Q1. Consider the timer to be running at normal mode.
   [**Hint:** TCCR1A and TCCR1B have to be initialized. The useful bits of TCCR1A are bit 0 and bit 1 which represent WGM10 and WGM11 respectively. Bits 0 to 4 are the useful bits from TCCR1B. Bits 3 and 4 represent WGM12 and WGM13 respectively. Bits 0 to 2 represent the clock select functions CS10, CS11, CS12 respectively. Consider WGM = 0 for normal mode of operation. The bits not mentioned here can be ignored/considered as 0]
3. The above-mentioned security company wants to increase the frequency of their security sweep while maintaining the same hardware. Considering the information given in Q1, compute the **minimum** possible time interval at which they can run their security sweeps.

CS12	**CS11**	**CS10**	**Prescaler**
0	1	0	8
0	1	1	64
1	0	0	256
1	1	1	1024

1. a) Premium Model

$TC = \left(\frac{R\,d}{T}\right) - 1$

$= (R\,d \times F) - 1$

$= (15\times10^{-3} \times 16\times10^{6}) - 1$

$= 23,9999$

Basic Model

$TC = (Rd \times F) - 1$

$= (40\times10^{-3} \times 16\times10^{6}) - 1$

$= 63,9999$

b) No prescalar Time Period = 62.5ns

Maximum time without P.S = $2^{16} \times 62.5\times10^{-9} = 4.096$ms

Maximum time with P.S of 8 = $2^{16} \times 62.5\times10^{-9} \times 8 = 32.768$ms

Maximum time with PS of 64 = $2^{16} \times 62.5\times10^{-9} \times 64 = 262.144$ms

Maximum time with P.S of 256 = $2^{16} \times 62.5\times10^{-9} \times 256 = 1.049$s

Maximum time with P.S of 1024 = $2^{16} \times 62.5\times10^{-9} \times 1024 = 4.194$s

2.

Premium Model

TCCR1A

Bit	7	6	5	4	3	2	1	0
							WGM11	WGM10
Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Value	0	0	0	0	0	0	0	0

TCCR1B

Bit	7	6	5	4	3	2	1	0
				WGM13	WGM12	CS12	CS11	CS10
Read/Write	R/W	R/W	R	R/W	R/W	R/W	R/W	R/W
Value				0	0	0	1	0

Basic model

TCCR1A

Bit	7	6	5	4	3	2	1	0
							WGM11	WGM10
Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Value.	0	0	0	0	0	0	0	0

TCCR1B

Bit	7	6	5	4	3	2	1	0
				WGM13	WGM12	CS12	CS11	CS10
Read/Write	R/W	R/W	R	R/W	R/W	R/W	R/W	R/W
Value.	0	0	0	0	0	0	1	1

3. For Premium Model (15ms):

With P.S = 8

Maximum possible time = 32.768ms

∴ Minimum time period = $\frac{1}{F} \times P.S$

$= \frac{1}{16\times10^{6}} \times 8$

$= 0.5\mu s$.

For Basic Model (40ms):

With P.S = 64.

Maximum possible time = 262.144ms

∴ Minimum time period = $\frac{1}{F} \times P.S$

$= \frac{1}{16\times10^{6}} \times 64$

$= 4\mu s$.