Tutorial (Introduction)

1 Frequency calculation

The frequency of a clock is calculated with:

$$f = \frac{1}{T}$$

Complete the following table (the first one has been completed):

	Frequency (Hz, kHz, MHz or GHz)	**Time (s, ms, µs or ns)**
1	1 kHz	1ms
2	1MHz	
3	1GHz	
4	50 MHz	
5		20 µs
6		200 ns

2 Data representation

1. Complete the following table (where the first entry has already been completed):

Binary	**Decimal**	**ASCII**	**Hexadecimal**	**Octal**
0b101010	42	*	0x2a	052
0b110110				
	61			
		e		
			0x49	

				0121

Check your answers using:

http://asecuritysite.com/calculators/datar

2 Bit shift

For the following determine the result with certain bit shifts. The first one has been completed:

Value	Shift left (1)	Shift right (1)
53 (00110101)	106 (01101010)	26 (00011010)
61 (00111101)		
37 (00100101)		

Check your answers using:

http://asecuritysite.com/calculators/shift

3 Boolean operations

For a Boolean equation of Z = A and B or not(C), determine the Truth Table (some of the table has already been completed):

A	B	C	A and B	not(C)	Z
0	0	0	0	1	1
0	0	1	0	0	0
0	1	0	0		
0	1	1	0		
1	0	0	0		
1	0	1	0		
1	1	0	1		
1	1	1	1		

Check your answer at: http://asecuritysite.com/calculators/bitops2

For a Boolean equation of Z = A or B and not(C), determine the Truth Table:

A	B	C	A or B	not(C)	Z
0	0	0	0	1	0
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

Check your answer at: http://asecuritysite.com/calculators/bitops2

For a Boolean equation of Z = (A xor B) and C, determine the Truth Table:

A	B	C	A xor B	C	Z
0	0	0	0	0	0
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

Check your answer at: http://asecuritysite.com/calculators/bitops2

4 Bitwise operations on integers

In this question, we have two binary values. Outline the results of the following bitwise operations (the first one has already been completed):

Value 1	Value 2	AND	OR	XOR
00110101	00110111	00110101	00110111	00000010
10110110	11001010			
00001111	11110000			
01010101	10101010			

00110011	10101010			

Check your answers using: http://asecuritysite.com/calculators/bitops

5 Bit masking

In this question, we have a binary values and a mask. Outline the result once the mask has been applied (the first one has already been completed):

Value 1	Mask	Result
00110101	0000 0001	0000 0001
00110101	0000 0010	
00110101	0000 0100	
00110101	0000 1000	
00110101	0000 01111	

Check your answers using: http://asecuritysite.com/calculators/bitmask

6 Matrix operations

For an add and subtract operation for matrices, we have the same dimensions and simply add or subtract them. For the following determine the addition and subtraction of the following:

(a) $A = \begin{bmatrix} 1 & 2 & 3 \end{bmatrix}$ $B = \begin{bmatrix} 3 & 4 & 5 \end{bmatrix}$

(b) $A = \begin{bmatrix} 4 & 2 & 3 \\ 6 & 2 & 2 \\ 4 & 3 & 1 \end{bmatrix}$ $B = \begin{bmatrix} 5 & 1 & 3 \\ 2 & 4 & 3 \\ 1 & 3 & 7 \end{bmatrix}$

Check your answers at:

http://asecuritysite.com/comms/matrix

For the following matrices, determine the multiplication and dot product:

(c) $A = \begin{bmatrix} 7 & 4 & 2 \end{bmatrix}$ $B = \begin{bmatrix} 9 & 1 & 3 \\ 6 & 4 & 2 \\ 4 & 3 & 7 \end{bmatrix}$

(d) $A = \begin{bmatrix} 6 & 6 & 1 \end{bmatrix}$ $B = \begin{bmatrix} 9 & 1 & 3 \\ 6 & 4 & 2 \\ 4 & 3 & 7 \end{bmatrix}$

(e) $A = \begin{bmatrix} 4 & 2 & 3 \\ 6 & 2 & 2 \\ 4 & 3 & 1 \end{bmatrix}$ $B = \begin{bmatrix} 5 & 1 & 3 \\ 2 & 4 & 3 \\ 1 & 3 & 7 \end{bmatrix}$

Check your answers at:

http://asecuritysite.com/comms/matrix

We can also represent matrices with square brackets to represent each row. Perform a multiplication and dot product for the following:

- [1,2,3] and [2,3,4].
- [5,7,8] and [[6,2,3],[1,3,5],[5,3,8]].
- [3,4,2] and [[1,4,5],[3,4,1],[5,2,1]].
- [7,3,1] and [[2,3,0],[3,4,1],[5,2,1]].
- [[1,5,2],[1,2,1],[3,2,5]] and [[1,5,0],[3,2,1],[3,2,1]].

Check for all these questions here:

http://asecuritysite.com/comms/matrix

Answers

Q6 (a):

Multiply:[[63 4 6] [42 16 4] [28 12 14]]

Dot product:[95 29 43]

Q6 (b):
Multiply: [[54 6 3] [36 24 2] [24 18 7]]

Dot product: [94 33 37]

Appendix

Char	Dec	Oct	Hex	Char	Dec	Oct	Hex	Char	Dec	Oct	Hex	Char	Dec	Oct	Hex
(nul)	0	0000	0x00	(sp)	32	0040	0x20	@	64	0100	0x40	`	96	0140	0x60
(soh)	1	0001	0x01	!	33	0041	0x21	A	65	0101	0x41	a	97	0141	0x61
(stx)	2	0002	0x02	"	34	0042	0x22	B	66	0102	0x42	b	98	0142	0x62
(etx)	3	0003	0x03	#	35	0043	0x23	C	67	0103	0x43	c	99	0143	0x63
(eot)	4	0004	0x04	$	36	0044	0x24	D	68	0104	0x44	d	100	0144	0x64
(enq)	5	0005	0x05	%	37	0045	0x25	E	69	0105	0x45	e	101	0145	0x65
(ack)	6	0006	0x06	&	38	0046	0x26	F	70	0106	0x46	f	102	0146	0x66
(bel)	7	0007	0x07	'	39	0047	0x27	G	71	0107	0x47	g	103	0147	0x67
(bs)	8	0010	0x08	(	40	0050	0x28	H	72	0110	0x48	h	104	0150	0x68
(ht)	9	0011	0x09	)	41	0051	0x29	I	73	0111	0x49	i	105	0151	0x69
(nl)	10	0012	0x0a	*	42	0052	0x2a	J	74	0112	0x4a	j	106	0152	0x6a
(vt)	11	0013	0x0b	+	43	0053	0x2b	K	75	0113	0x4b	k	107	0153	0x6b
(np)	12	0014	0x0c	,	44	0054	0x2c	L	76	0114	0x4c	l	108	0154	0x6c
(cr)	13	0015	0x0d	-	45	0055	0x2d	M	77	0115	0x4d	m	109	0155	0x6d
(so)	14	0016	0x0e	.	46	0056	0x2e	N	78	0116	0x4e	n	110	0156	0x6e
(si)	15	0017	0x0f	/	47	0057	0x2f	O	79	0117	0x4f	o	111	0157	0x6f
(dle)	16	0020	0x10	0	48	0060	0x30	P	80	0120	0x50	p	112	0160	0x70
(dc1)	17	0021	0x11	1	49	0061	0x31	Q	81	0121	0x51	q	113	0161	0x71
(dc2)	18	0022	0x12	2	50	0062	0x32	R	82	0122	0x52	r	114	0162	0x72
(dc3)	19	0023	0x13	3	51	0063	0x33	S	83	0123	0x53	s	115	0163	0x73
(dc4)	20	0024	0x14	4	52	0064	0x34	T	84	0124	0x54	t	116	0164	0x74
(nak)	21	0025	0x15	5	53	0065	0x35	U	85	0125	0x55	u	117	0165	0x75
(syn)	22	0026	0x16	6	54	0066	0x36	V	86	0126	0x56	v	118	0166	0x76
(etb)	23	0027	0x17	7	55	0067	0x37	W	87	0127	0x57	w	119	0167	0x77
(can)	24	0030	0x18	8	56	0070	0x38	X	88	0130	0x58	x	120	0170	0x78
(em)	25	0031	0x19	9	57	0071	0x39	Y	89	0131	0x59	y	121	0171	0x79
(sub)	26	0032	0x1a	:	58	0072	0x3a	Z	90	0132	0x5a	z	122	0172	0x7a
(esc)	27	0033	0x1b	;	59	0073	0x3b	[	91	0133	0x5b	{	123	0173	0x7b
(fs)	28	0034	0x1c	<	60	0074	0x3c	\	92	0134	0x5c	|	124	0174	0x7c
(gs)	29	0035	0x1d	=	61	0075	0x3d	]	93	0135	0x5d	}	125	0175	0x7d
(rs)	30	0036	0x1e	>	62	0076	0x3e	^	94	0136	0x5e	~	126	0176	0x7e
(us)	31	0037	0x1f	?	63	0077	0x3f	_	95	0137	0x5f	(del)			