Convert to base (10)

(a) $(101101)_2 \rightarrow (\quad)_{10}$

$$(1\times2^5)+(0\times2^4)+(1\times2^3)+(1\times2^2)+(0\times2^1)+(1\times2^0)$$
$$32+0+8+4+0+1$$
$$(45)_{10}$$

(b) $(567)_8 \rightarrow (\quad)_{10}$

$$(5\times8^2)+(6\times8^1)+(7\times8^0)$$
$$320+48+7$$
$$(375)_{10}$$

(c) $(AB1)_{16} \rightarrow (\quad)_{10}$

$$A\times16^2+B\times16^1+1\times16^0$$
$$10\times256+11\times16+1\times1$$
$$\cancel{1440}\ \ 2560+176+1$$
$$(2737)_{10}$$

(d) $(1010.101)_2$

$$1\times2^3+0\times2^2+1\times2^1+0\times2^0+1\times2^{-1}+0\times2^{-2}+1\times2^{-3}$$
$$8+0+2+0+0.5+0.\cancel{25}+0.125$$
$$(10.625)_{10}$$

(e) $(562.1)_8 \rightarrow (\ )_{10}$

$$5\times8^2 + 6\times8^1 + 2\times8^0 + 1\times8^{-1}$$
$$5\times64 + 6\times8 + 2\times1 + 0.125$$
$$320 + 48 + 2 + 0.125$$
$$(370.125)_{10}$$

(f) $(121.A)_{16} \rightarrow (\ )_{10}$

$$1\times16^2 + 2\times16^1 + 1\times16^0 + A\times16^{-1}$$
$$256\times1 + 2\times16 + 1 + 10\times0.0625$$
$$256+32+1+0.625$$
$$289.625$$

(g) $(277.542)_8 \rightarrow (\ )_{10}$

$$2\times8^2 + 7\times8^1 + 7\times8^0 + 5\times8^{-1} + 4\times8^{-2} + 2\times8^{-3}$$
$$2\times64 + 7\times8 + 7\times1 + 5\times0.125 + 4\times0.015625 + 0.001953125$$
$$128 + 56 + 7 + 0.625 + 0.0625 + 0.001953125$$
$$(191.689453125)_{10} \Leftarrow \left(191\tfrac{177}{256}\right)_{10}$$

(h) $(23.1)_5$

$$2\times5^1 + 3\times5^0 + 1\times5^{-1}$$
$$10 + 3 + 0.2$$
$$(13.2)_{10}$$

(2) Convert the following in binary (base 2).

(a) $(127)_8 \rightarrow (\ \ )_2$ Using 3-bit Method

001 010 111

$(001010111)_2 \Leftrightarrow (1010111)_2$

(b) $(77)_{10} \rightarrow 2$

2	77	
2	38	1
2	19	0
2	9	1
2	4	1
2	2	0
	1	0

$(1001101)_2$

(c) $(99)_{16} \rightarrow (\ \ )_2$

1001 1001 Using 4-bit Method.

$(10011001)_2$

(d) $(DA.3)_{16} \rightarrow (\ \ )_2$

1101 1010 0011

$(11011010.0011)_2$

(e)

$(12.5)_{10} \rightarrow (\quad)_2$

2	12
2	6 - 0
2	3 - 0
	1 - 1

$0.5 \times 2 = 1.\underline{0} \mid 1$

$(1100.1)_2$

(f) $(32.67)_8$

011 010 . 110 111

$(011010.110111)_2$

(g) $(43.2)_{16} \rightarrow (\quad)_2$

0100 0011 0010

$(01000011.0010)_2 \Leftarrow (01000011.001)_2$

(h) $(107.25)_{10} \rightarrow (\quad)_2$

2	107
2	53 - 1
2	26 - 1
2	13 - 0
2	6 - 1
2	3 - 0
	1 - 0

$0.25 \times 2 = 0.\underline{5} \mid 0$

$0.5 \times 2 = 1.\underline{0} \mid 1$

$(.01)_2$

$(1001011.01)_2$

(i) $(10111010)_2 + (1111101)_2$

$$\begin{array}{r} 10111010 \\ 1111101 \\ + \\ \hline 100110111 \end{array}$$

$(100110111)_2$

(j) $(101000101)_2 - (11111)_2$

$$\begin{array}{r} 101000101 \\ 11111 \\ - \\ \hline 100100110 \end{array}$$

(K)

(13) Convert all the following answers in base(8) octal.

(a) $(83)_{10} \rightarrow (\ )_8$

$$\begin{array}{r|l} 8 & 83 \\ \hline 8 & 10 - 3 \\ \hline & 1 - 2 \end{array}$$

$(123)_8$

(b) $(1011011)_2 \rightarrow (\ )_8$

~~101 110 100~~

~~$(564)_8$~~

$\boxed{\cancel{1011011}}$

$\underline{00}\,\underline{1}\,\underline{011}\,\underline{011}$

$(133)_8$

(c) $(101101.11)_2 \rightarrow (\ )_8$

$\underline{00}\,\underline{10}\ \underline{111}\ \underline{01} \cdot 11\underline{0}$

$(13\cancel{5}\cdot 6)_8$

$0.11 \times 8 = 8.8 \quad 0.88 \mid 0$

$0.88 \times 8 = 70.4 \quad \mid 6$

$0.4 \times 8 = 3.2$

$0.2 \times 8 = 1.6$

$0.6 \times 8 = 4.8$

$0.8 = 6.4$

0.11

(d) $(AB)_{16} \rightarrow (\quad)_8$

$8 \,|\, AB$ ~~crossed out~~

Hexa → Binary → octal

$$AB \rightarrow (1010\ 1011)_2$$

$$\underline{010}\,\underline{101}\,\underline{011}$$

$$(253)_8$$

(e) $(A1F2.C)_{16} \rightarrow (\quad)_8$

$$\underline{00}1010\ 0001\ 1111\ 0010 \cdot 1100\ \underline{00}$$

$$(120762.60)_8$$

(f) $(675)_8 + (771)_8 \rightarrow (\quad)_8$

$$\begin{array}{r} 675 \\ 771 \\ \hline 1666 \end{array}$$

$675 + 771$

$110\ 111\ 101 + 111\ 111\ 001$

$$\begin{array}{r} 110\ 111\ 101 \\ 111\ 111\ 001 \\ \hline 1\,110\,110\,110 \end{array}$$

$(1666)_8$

$(1666)_8$

(g) $53_{10} - 53_{8}$

$8 \mid 13 \;\; 1 - 2$

$8 \mid 13 \;\; 1 - 5$

$5\times 8^1 + 3\times 8^0$

$40 + 3$

$(53)_{10} - (43)_{10}$

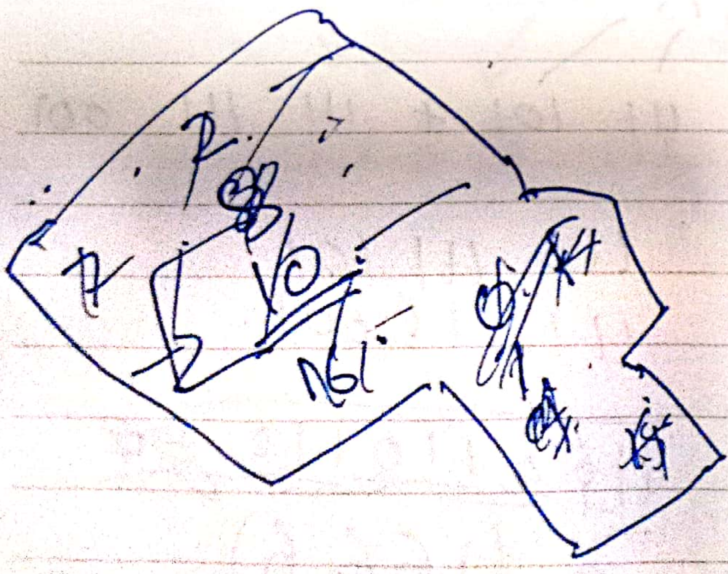
$\leftarrow (10)_{10}$

$(15)_8$

(h) $(1025)_8 - (773)_8$

001 000 010 101 − 111 111 011

  001 000 010 101
− 111 111 011
―――――――――――
011 000



(i) $2345_8 - 1234_8 + 7_8 - 512_8 + 62_8$

010 011 100 101
001 010 011 100 −
+
111
~~000 101 001 010~~ −
~~000 000 110 010~~ +

001 001 011 001
111 +

001 001 100 000
000 101 001 010 −

?

000 100 011 110
~~000 000~~ 110 010 +

000 101 010 000
0 111

0

(j) $(10101)_2 + (9A3)_{16}$

~~1010h~~ + 1001 1010 0011

1 0101

1001 1011 1000

$\underline{100}\ \underline{110}\ \underline{111}\ \underline{000}$

4 6 7 0

$(4670)_8$

(k) $(164)_8 + (65)_8 - (152)_8$

164 } 001 110 100

65 } 000 110 101 +

010 101 001

52 101 010 −

001 111 111

$\underline{001}\ \underline{111}\ \underline{111}$

1 7 7

$(177)_8$

4- Convert the following into base (16) Hexa

(a) $(1010\ 111)_2 \rightarrow (\ \ )_{16}$

$\cancel{1010\ 111\,0}$ → 10, 14 → $\cancel{(AE)_{16}}$

$\underline{0101}\ \underline{0111}$

5 7

$(57)_{16}$

~~(b) 146.13_8~~

146 . 13

~~001 100 110 . 001 011~~

0 ~~0011001100001011 0~~

~~66~~

(b) $(146.13)_8 \rightarrow (\ \ )_{16}$

000 $\underline{001\ 100}$ $\underline{110\ .\ 001}$ $\underline{011\ 00}$

0 6 6 . 2 C

$(66.2C)_{16}$

Scanned with CamScanner

(c)

$(11001.01101)_2 \rightarrow (\ )_{16}$

$\underline{0001}\ \underline{1001}.\underline{0110}\ \underline{1000}$

$(19.68)_{16}$

(d) $(124.5625)_{10} \rightarrow (\ )_{16}$

16 | 124
7 - 12

$0.5625 \times 16 = 9.0000$

$(7C.9)_{16}$

(e) $(AB.CD)_{16} + E5.2F_{16}$

A B C D
1010 1011.1100 1101
E
1110 0101.0010 1111

+

0001 1001 0000.1111 1100
1 9 0 F C

$(190.FC)_{16}$

$(190.Fc)_{16}$

(f) $C5.A2_{16} - A7.B3_{16}$

$$
\begin{array}{r}
1100\ 0100 . 1010\ 0010 \\
-\ 1010\ 0111 . 1011\ 0011 \\
\hline
0001\ 1101 . 1110\ 1111 \\
1\ \ D\ .\ E\ \ F
\end{array}
$$

$(1D.EF)_{16}$

(g) $53_{10} - 50_8 \rightarrow (\quad)_{16}$

Wrong Question.

16 | 53
3 – 5

50
101 000

35 – 40

0011 0101
– 0100 0000
0010101

$(53)_{10}$

2	53
2	26 – 1
2	13 – 0
2	6 – 1
2	3 – 0
	1 – 1

$(50)_8$
101 000

110101
– 101000
0011010 0
38

$937_{16} + 3725_8$

1001 0011 0111 + 011 111 010 101

$$
\begin{array}{r}
1001\,0011 . 0111 \\
+\ 0111\,1101 . 0101 \\
\hline
000\,1\,0001\,0000 . 1100 \\
1\ \ 1\ \ 0\ \ C
\end{array}
$$

$(110.C)_{16}$

(h) $(100.01)_{16} - (142.3)_{10}$

0001 0000 0000 . 0000 0001
1000 1110 . 0100 1100

3.

$16 \,|\, 142.3$

8 – 14

8E.4C

0.3×16 = 4.8
0.8 = 12.8

0 1111 1101

0.3×2 = 0.6 | 0
0.6×2 = 1.2 | 1
0.2×2 = 0.4 | 0
0.4×2 = 0.8 | 0
0.8×2 = 1.6 | 1
0.6× = 1.2 = 1

0100 1100

2	142
2	71 – 0
2	35 – 1
2	17 – 1
2	8 – 1
2	4 – 0
2	2 – 0
	1 – 0

0001 0000 0000 . 0000 0001
1000 1110 . 0100 1100

–

~~0000~~ 01110001 1011 0101
7 1 . B 5

$(71.B5)_{16}$

8 – 5 = 3
1000
0101
0011

(i) $30.4_8 - 111.1101_2$

011 000 . 100 0
111 . 1101

–

00 010000 . 1011
1 0 . B

$(10.B)_{16}$

(j) $83A7F4.5D_{16} + B5B63.3E_{16} \rightarrow (\ )_{16}$

1000 0011 1010 0111 1111 0100 . 0101 1101
1011 0101 1011 0110 0011 . 0011 1110

+

1000 1111 0000 0011 0101 0111 . 1001 1011
8 F 0 3 5 7 . 9 B

$(8F0357.9B)_{16}$

(k) $[1234_8 - (716_8 + 104_8)] + 256_{16}$

~~000~~

111 001 100
+ 001 000 100

1000 010010

~~001~~ 010 011 100
1 000 010010

−

0000 1000 1010

0010 0101 0110

+

0010 1110 0000

2E0

$(2E0)_{16}$

Main answer
For $(2E1)_{16}$

Q.5 Using 8-bit register, Convert the following decimal number to binary and find 1's and 2's complement.

(a) 15_{10}

00001111 ↓ invert all the bit 0 to 1 and 1 to 0

1111 0000 1's complement

+1 add 1 to make 2's complement

1111 0001

b) 53_{10}

~~0101 0011~~ 0011 0101

~~1010 1100~~ +1 1's compliment → 1100 1010

1010 1101 2's compliment → 1100 1011

(c) 115_{10} → 73_{16}

0111 0011

1000 1100 → 1's

1000 1101 → 2's

d) 95_{10} → 5E

0101 1110

1's → 1010 0001

2's → 1010 0010

(6) Using two's complement in 8-bit registers, Show how the computer would evaluate:

(a) $0001\ 1101_2 - 0001\ 0101_2$

~~0001 1101 + (-0001 0101)~~

~~1110 1010~~

~~0001 1101~~
~~1110 1010~~

~~1 0000 0111~~

0001 1101
0001 0101

0000 1000

$(0000\ 1000)_2$

(b) 0011 1101 − 0001 0111

~~0011 1101~~
~~0001 0111~~

~~0010 0010~~

~~1010~~

0011 1101
0001 0111

$(0010\ 0110)_2$

(c) 0111 1100 − 0111 0101

0111 1100
0111 0101

$(0000\ 1010)_2$

(d) $11_{10} - 25_{10}$

~~000~~ $11 + (-25)$

$\downarrow$ 00001011

$+$ ~~11111111~~

~~100001010~~

$\downarrow$ 00011001

11100110 1's

+1 +1 2's

~~11111111~~

11100111

00001011

11100111

11110010

(e) $-11 - 25$

00001011

11110100

+1

(11110101) +

00011001

11100110

+1

(11100111)

11110101

$+$ 11100111

100011100

$(00011100)_2$

(f) $25_{10} - 11_{10}$

$25 + (-11)$

00011001

~~00011001~~

~~+ 00001011~~

~~(00100100)~~

100001110

00001011

11110100

+

11110101

00011001

100001110

(—)

~~(g) $32_{10} - 13_{10}$~~

~~$+(-13)$~~

~~00010000~~

~~00001101~~

~~+1 11110010~~

~~11110011~~

~~11110011~~

~~00010000~~

~~100000011~~

USA

12 ~~9000~~ 20000

2500 1500 3000

5000 1500 75000

~~USA~~ USA 5000

1500 4500- 5000

1500

7500 10000

10000

Programming

Math

H.S 4.5

(g) $32_{10} - 13_{10} \rightarrow 32 + (-13)$

$32 \rightarrow 00100000 \Rightarrow 13 \rightarrow 00001101$

11110010 1's

+1

$-13 \rightarrow$ 11110011 2's

00100000

11110011

100010011

extra bit, MSB

$\Rightarrow (00010011)_2$ Ans.

$(+19)_{10}$

(h) $(-10)_{10} - (5)_{10}$

$(-10) + (-5)$

	00001010	00000101	
1's	11110101	11111010	1's
	+1	+1	
2's	11110110	11111011	2's

11110110

11111011 +

c/ 111110001

extra bit, MSB

0000 1110

1

0000 1111 =

Q.7 Using 16 bit

	S	E	M
bits	1	6	9

(a)(i) $(12.75)_{10}$

$\Downarrow$

$\Rightarrow (1100.11)_2$

$\Rightarrow 1.10011 \times 2^3$ So exponent is $\Rightarrow 3$

$\Rightarrow$ 10011 Mentisa is $\Rightarrow$ 10011

$\Rightarrow$ 1001100000 Completed Mentisa.

$\Rightarrow$ Bias $= 2^{(n-1)} - 1$ n = number of bits assigned for expont.

$= 2^{(6-1)} - 1$

$= 2^5 - 1$

$\Rightarrow$ Bias $= 31$

Exponent $= 3 + 31$

$= 34$

$= (100010)_2$

Sign = 0

0	100010	1011 00000 ~~010101010~~

0 100010 101100000

Rough-work

Reverse process

Sign = 0

E = 34 - 31

n = 3

.1011 00000

~~101 100000~~

~~5.5 + 1 = 6.5~~

6.

(iii) $(-6.03125)_{10}$

$(110.00001)_2$

$1.10,00001$

1.1000001×10^2

Mentisa = 100000100

power = 2

E = Power + Bias $\quad 2^{n-1} - 1 = 31$

Exponent = ~~2~~ + 31

Exponent = 33

= ~~100101~~ $(100001)_2$

Sign = 1

$\boxed{1\ 100001 \cdot 100000100}$

---

iv $(8.625)_{10} \Rightarrow (1000.101)_2$

1.000101×10^3

added three extra zeros to complete 9 bits of Mentisa.

$\Rightarrow$ Mentisa = 000101000

power = 3

Bias = $2^{6-1} - 1 = 31$

$\Rightarrow$ Expont = $31 + 3 \Rightarrow 34 \Rightarrow 100010$

Sign = 0

$(\underbrace{0}_{S}\ \underbrace{100010}_{E}\ \underbrace{000101000}_{M})$ Ans.

(iv) $\left(\frac{5}{16}\right)_{10}$

$(0.3125)_{10} \Rightarrow 0.0101$

Mantisa = 010100000

Power = 0

Exponent = P + Bias

$\Rightarrow E = 0 + 31 = 31$

Sign = 0

Exponent $\Rightarrow$ 011111

$(\underset{S}{0}\ \underset{E}{011111}\ \underset{M}{010100000})_2$ Ans.

(b) Binary to decimal Using 16 bits

(i) $(1100\ 1011\ 1000\ 0000)_2$

Sign = 1 $\Rightarrow$ negtive

$\Rightarrow$ Exponent = 100 101
= 37

$\Rightarrow$ Bias = ~~37~~ 31

n = E − Bias

n = 37 − 31

$\Rightarrow$ n = 6

Mantisa = 11000 0000
= 0.75

Formula = where n = E − B

$(S) \times (1 + M) \times 2^n$

$-1 \times (1 \times 0.75) \times 2^6$

$-1 \times 1.75 \times 64$

$(-112)_{10}$ Ans

(ii) $(0100\ 1111\ 0111\ 0101)_2$

sign = 0 (+ve)

E = 100111 = 39

$n = \underset{E}{39} - \underset{B}{31} = 8$

M = .101 11 0101 $\Rightarrow$ (0.728515625)

Formula = $S \times (1 + M) \times 2^n$ where n = E − B

$= (+1) \times (1 + 0.728515625) \times 2^8$

= +442.5

(iii) 0011 1101 0111 0101

Sign = 0

E = Exponent = 011110 = 30

n = E − Bias

n = 30 − 31

n = −1

Mentisa = 0.10 1110101 = 0.728515625

~~Formula = (S) × (1 + M) × 2^n~~

$= \cancel{1 \times (1 + 0.373) \times 2^{-1}}$

$= \cancel{1 \times (1.373) \times 2^{-1}}$

$= \cancel{0.6865}$

0.728515625

$S \times (1 + M) \times 2^{n}$

$1 \times (1 + 0.728515625) \times 2^{-1}$

$= \dfrac{1.728515625}{2}$

$= 885/1024$

Scanned with CamScanner

Q.8 Using 32 bit → 8 bits for expont

$n = 8$

$Bias = (2^{n-1}) - 1$

$= (2^{8-1}) - 1$

$= 127$

23 bits for Mentisa

(i) 27.75

11011.11

1.101111×10^4

23

Mentisa = 101111 00000000000000000

Power = 4

Expont = n + Bias = 4 + 127

= 131

$= (10000011)_2$

Sign = 0

(0 1000 0011 1011 1100 0000 0000 0000 000)

$\underbrace{0}_{S}\ \underbrace{1000\ 0011}_{E}\ \underbrace{1011\ 1100\ 0000\ 0000\ 0000\ 000}_{M}$

Ans.

(ii) −37.875 S = 1

100101.111

1.00101111×10^5 Power = 5

Exponet = n + Bias ⇒ 5 + 127 ⇒ 132

= 10000100

Mentisa = 00101111 0000 0000 0000 000

(1 10000100 00101111 0000 0000 0000 000)

$\underbrace{1}_{S}\ \underbrace{10000100}_{E}\ \underbrace{0010\ 1111\ 0000\ 0000\ 0000\ 000}_{M}$

Ans.

(a) 1 10000010 1111 0110 0000 0000 0000 000

Sign = 1 (-ve)

E = 130

n = E - B

n = 130 - 127

n = 3

0.1111 0110 0000 0000 0000 000

$\Rightarrow (0.9609375)_{10}$

$S \times (1+M) \times (2)^{n}$

$-1 \times (1+0.9609375) \times (2)^{3}$

-15.6875 Ans.

(b)

$(C2100000)_{16}$

1 000 0010 0001 0000 0000 0000 0000 0000

S

S = 1 (-ve)

E = 1000 00100 $\Rightarrow$ 132

n = E - Bias = 132 - 127 = 5 $\Rightarrow$ n = 5

Mantissa = 0.001 0000 0000 0000 0000 0000

$\Rightarrow (0.125)_{10}$

$= S \times (1+M) \times (2)^{n}$

$= -1 \times (1+0.125) \times (2)^{5}$

$= -1 \times 1.125 \times 1$

$\Rightarrow -36$