(41) How many bits would be needed to represent $(15768)_{10}$ in binary format?

2	15768	
2	7884	0
2	3942	0
2	1971	0
2	985	1
2	492	1
2	246	0
2	123	0
2	61	1
2	30	1
2	15	0
2	7	1
2	3	1
2	1	1
	0	1

So if there is no sign then we need at least 14 bits to represent the number.

If there is a sign ~~bsat~~ bit then we need at least 15bits.

5.

	Hexadecimal	Decimal	Octal	Binary
a)	1CAC	7340	16254	1110010101100
b)	315	789	~~1425~~ 1425	~~11~~ 0001010101 11 000 10101
c)	~~281~~ 119	~~119~~ 281	431	100011001
	476	1142	2166	010001110110

a)

$(1CAC)_{16}$

$(0001\ 1100\ 1010\ 1100)_2$

$(1\ 6\ 2\ 5\ 4)_8$

Decimal : $1\times16^3 + 12\times16^2 + 10\times16^1 + 12\times16^0$

$= 7340$

	a
0	0
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001
(A)10	1010
(B)11	1011
(C)12	1100
(D)13	1101
(E)14	1110
(F)15	1111

b)

2	789
2	394 1
2	197 0
2	98 1
2	49 0
2	24 1
2	12 0
2	6 0
2	3 0
2	1 1
	0 1

$(0010001010 1)_2$

$(3\ 1\ 5)_{16}$

$(001\ 000\ 101\ 01)_2$

$(1\ 0\ 4\ 2\ 5)_8$

5/ c)

$(431)_8$

$(\underline{100}\ \underline{011}\ \underline{001})_2$

$(1\ \ 1\ \ 9)_{16}$

$(1\times16^2+1\times16+9\times16^0)_{10}$

$=(281)_{10}$

d)

$(\underline{010}\ \underline{001}\ \underline{110}\ \underline{110})_2$

$(2\ \ 1\ \ 6\ \ 6)_8$

$\underline{0100}\ \underline{0111}\ \underline{0110}$

$(4\ \ 7\ \ 6)_{16}$

$(\overset{11\ 10\ 9\ 8\ 7\ 6\ 5\ 4\ 3\ 2\ 1\ 0}{0\ 1\ 0\ 0\ 0\ 1\ 1\ 1\ 0\ 1\ 1\ 0})_2$

$=(1\times2^{10}+2^6+2^5+2^4+2^2+2^1+\cancel{2^0})_{10}$

$=\cancel{1143}\ =(1142)_{10}$

Q

a)

$(1346.6)_8$

$(1\ 011\ 100\ 110\ .\ 110)_2$

b)

$(0001\ 0111\ 1101\ .\ 1010)_2$

$(1\ 7\ D\ .\ A)_{16}$

c)

$(5703.4)_8$

$(101\ 111\ 000\ 011\ .\ 1000)_2$

$(B\ C\ 3\ .\ 8)_{16}$

d)

$(8AD.9)_{16}$

$(1000\ 1010\ 1101\ .\ 100100)_2$

$4\ 2\ 5\ 5\ .\ 4\ 4$

1/ Chapter 1 From Morris Mano's book

Problem

1-1

Decimal	base 3
0	0
1	1
2	2
3	10
4	11
5	12
6	20
7	21
8	22
9	100
10	101
11	102
12	110
13	111
14	112
15	120
16	121
17	122
18	200
19	201

Just to check

$3 \mid 19$
$3 \mid 6 \;\; 1$ ↑
$3 \mid 2 \;\; 0$
$0 \;\; 2$

as it is correct for the last value; the table must be correct.

1-2

a)

$$\begin{array}{r} {\scriptstyle 1} \\ (1230)_4 \\ +\;\; (23)_4 \\ \hline 1313 \end{array}$$

$4 \mid 5$
$4 \mid 1 \;\; 1$ ↑
$0 \;\; 1$

$$\begin{array}{r} {\scriptstyle 1\;1} \\ {\scriptstyle 2\;2} \\ (1230)_4 \\ (23)_4 \\ \hline 1010 \\ 3120\times \\ \hline (10221 0)_4 \end{array}$$

$4 \mid 4$
$1 \;\; 0$
$0 \;\; 1$

$4 \mid 6$
$4 \mid 1 \;\; 2$ ↑
$0 \;\; 1$

$4 \mid 8$
$4 \mid 2 \;\; 0$
$0 \;\; 2$

$4 \mid 9$
$4 \mid 2 \;\; 1$ ↑
$0 \;\; 2$

1-2

b)

$$\begin{array}{r} {\scriptstyle 1\,1\,1} \\ (135.4)_6 \\ (43.2)_6 \\ \hline (223.0)_6 \end{array}$$

6 | 22 → 6 | 3 → 0 3 → 6 | 0 → 0 1

6 | 16 → 6 | 2 → 0 2 → 6 | 0 → 0 1

6 | 9 → 6 | 1 → 0 1 → 6 | 0 → 0 1

6 | 8 → 6 | 1 → 0 1 → 6 | 0 → 0 1

$$\begin{array}{r} {\scriptstyle 2\,3\,2} \\ {\scriptstyle 1\,2\,2} \\ {\scriptstyle 1\,1\,1} \\ (135.4)_6 \\ (43.2)_6 \\ \hline 3152 \\ 4550\times \\ 10244\times\times \\ \hline (11214.52)_6 \end{array}$$

6 | 17 → 6 | 2 → 0 2 → 6 | 5 → 0 5

6 | 12 → 6 | 2 → 0 2 → 6 | 0 → 0 2

6 | 11 → 6 | 1 → 0 1 → 6 | 5 → 0 5

6 | 7 → 6 | 1 → 0 1 → 6 | 1 → 0 1

c)

$$\begin{array}{r} (367)_8 \\ (715)_8 \\ \hline (1304)_8 \end{array}$$

$$\begin{array}{r} (367)_8 \\ \times(715)_8 \\ \hline {\scriptstyle 1\,1} \\ 2323 \\ 367\times \\ 3301\times\times \\ \hline (336313)_8 \end{array}$$

8 | 9 → 8 | 1 → 0 1 → 8 | 1 → 0 1

8 | 11 → 8 | 1 → 0 1 → 8 | 1 → 0 1

d)

$$\begin{array}{r} {\scriptstyle 1\,1} \\ (296)_{12} \\ (57)_{12} \\ \hline (331)_{12} \end{array}$$

12 | 13 → 12 | 1 → 0 1 → 12 | 1 → 0 1

12 | 15 → 12 | 1 → 0 1 → 12 | 3 → 0 3

$$\begin{array}{r} {\scriptstyle 3\,2} \\ {\scriptstyle 5\,3} \\ (296)_{12} \\ \times(57)_{12} \\ \hline 1766 \\ 1196\times \\ \hline (13506)_{12} \end{array}$$

12 | 42 → 12 | 3 → 0 3 → 12 | 6 → 0 6

12 | 17 → 12 | 1 → 0 1 → 12 | 5 → 0 5

12 | 45 → 12 | 3 → 0 3 → 12 | 9 → 0 9

12 | 30 → 12 | 2 → 0 2 → 12 | 6 → 0 6

12 | 19 → 12 | 1 → 0 1 → 12 | 7 → 0 7

12 | 66 → 12 | 5 → 0 5 → 12 | 6 → 0 6

1-3

$(250.5)_{10}$

3	250
3	83 1
3	27 2
3	9 0
3	3 0
3	1 0
	0 1

↑

$$\begin{array}{r} .5 \\ \times 3 \\ \hline 1 \mid .5 \\ \times 3 \\ \hline 1 \mid .5 \\ \times 3 \\ \hline 1 \mid .5 \end{array}$$

$= (100021.11111\ldots)_3$ (Approx)

4	250
4	62 2
4	15 2
4	3 3
	0 3

↑

$$\begin{array}{r} 0.5 \\ \times 4 \\ \hline 2 \mid 0 \end{array}$$

$= (3322.2)_4$

7	250
7	35 5
7	5 0
	0 5

↑

$$\begin{array}{r} 0.5 \\ \times 7 \\ \hline 3 \mid .5 \\ \times 7 \\ \hline 3 \mid .5 \\ \times 7 \\ \hline 3 \mid 5 \end{array}$$

↓

~~$= (505)$~~ $= (505.33333)_7$ (Approx)

1-3

8	250	
8	31	2
8	3	7 ↑
	0	3

$$0.5 \times 8 = 4.0$$

$$= (372.4)_8$$

16	250	
16	15	10 ↑
	0	15

$$0.5 \times 16 = 8.0$$

$$= (FA.8)_{16}$$

1-4

$$(12.0625)_{10} = (1100.0001)_2$$

2	12	
2	6	0
2	3	0 ↑
2	1	1
	0	1

$$0.0625 \times 2 = 0.125$$
$$0.125 \times 2 = 0.25$$
$$0.25 \times 2 = 0.5$$
$$0.5 \times 2 = 1.0$$

1-4

$(10^4)_{10} = (1000)_{10} = (1111101000)_2$

2	1000
2	500 0
2	250 0
2	125 0
2	62 1
2	31 0
2	15 1
2	7 1
2	3 1
2	1 1
	0 1

$(673.23)_{10} = (1010100001.00111)_2$ (Approx)

2	673	
2	336	1
2	168	0
2	84	0
2	42	0
2	21	0
2	10	1
2	5	0
2	2	1
2	1	0
	0	1

0.23
× 2
0.46
× 2
0.92
× 2
1.84
× 2
1.68
× 2
1.36
× 2
0.72

1-4

2	1998
2	999 0
2	499 1
2	249 1
2	124 1
2	62 0
2	31 0
2	15 1
2	7 1
2	3 1
2	1 1
	0 1

$(1998)_{10} = (11111001110)_2$

1-5

$(10.10001)_2 = (1\times2^{1} + 1\times2^{-1} + 1\times2^{-5})_{10}$

$= 2.53125$

$10\,1110.0101 = 2^{5} + 2^{3} + 2^{2} + 2^{1} + 2^{-2} + 2^{-4}$

$= 46.3125$

$1110101.110 = 2^{6} + 2^{5} + 2^{4} + 2^{2} + 2^{0} + 2^{-1} + 2^{-2}$

$= 117.75$

$1101101.111 = 2^{6} + 2^{5} + 2^{3} + 2^{2} + 2^{0} + 2^{-1} + 2^{-2} + 2^{-3}$

$= 109.875$

1-6

a) $(225.225)_{10} = (E1.399)_{16\,(Approx)} = (11100001.00111001)_{2\,(Approx)}$

$= (341.162)_{8\,(Approx)}$

~~2 | 225~~ ~~2×16^{2}~~

16 | 225
16 | 14 1
0 14

.225
×16
3. 6
×16
9.6
×16
9.6
×16
9.6
×16
9.6

E1.39

(0111 0000 1.0011 1001 0)$_2$

(3 4 1 . 1 6 2)$_8$

b)

(011 010 111 . 110)$_2$

(3 2 7 . 6)$_8$

(11010111.1100)$_2$

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

$= (13 \times 16^{1} + 7 \times 16^{0} + 12 \times 16^{-1})_{10}$

$= (215.75)_{10}$

c)

$(623.77)_8$

$(\underline{110}\ \underline{010}\ \underline{011}\ .\ \underline{111}\ \underline{111100})_2$

$(1\ 9\ 3\ .\ F\ C)_{16}$

$= (6\times16^2 + 9\times16^1 + 3\times16^0 + 15\times16^{-1} + 12\times16^{-2})_{10}$

$= (659.984375)_{10}$

d)

$(2AC5.D)_{16}$

$(\underline{0010}\ \underline{1010}\ \underline{1100}\ \underline{0101}\ .\ \underline{1101})_2$

$(2\ 5\ 3\ 0\ 5\ .\ 6\ 4)_8$

$(\overset{3}{2}\ \overset{2}{A}\ \overset{1}{C}\ \overset{0}{5}\ .\ \overset{-1}{D})$

$= (2\times16^3 + 10\times16^2 + 12\times16^1 + 5\times16^0 + 13\times16^{-1})_{10}$

$= (10949.8125)_{10}$

1-7

a) $(1001001.011)_2$

$= (2^6 + 2^3 + 2^0 + 2^{-2} + 2^{-3})_{10} = (73.375)_{10}$

b) $(12121)_3$

$= (1\times3^4 + 2\times3^3 + 1\times3^2 + 2\times3^1 + 1\times3^0)_{10} = (151)_{10}$

c) $(1032.2)_4$

$= (1\times4^3 + 3\times4^1 + 2\times4^0 + 2\times4^{-1})_{10} = (78.5)_{10}$

d) $(4310)_5$

$= (4\times5^3 + 3\times5^2 + 1\times5^1)_{10} = (580)_{10}$

e) $(0.342)_6$

$= (3\times6^{-1} + 4\times6^{-2} + 2\times6^{-3})_{10} = (0.620370371)_{10}$ (Approx)

f) $(50)_7$

$= (5\times7^1)_{10} = (35)_{10}$

g) $(8.3)_9$

$= (8\times9^0 + 3\times9^{-1})_{10} = (72.33333)_{10}$ (Approx)

h) $(198)_{12}$

$= 1\times12^2 + 9\times12^1 + 8\times12^0 = (260)_{10}$