Assignment

(1)

0	0
1	01
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001

(2)

a) 12

```
2 | 12   0
2 | 6    0
2 | 3    1
    1
```

1100

b)
```
2 | 20   0
2 | 10   0
2 | 5    1
2 | 2    0
    1
```

10100

c)
```
2 | 45   1
2 | 22   0
2 | 11   1
2 | 5    1
2 | 2    0
    1
```

d)
```
2 | 77   1
2 | 38   0
2 | 19   1
2 | 9    1
2 | 4    0
2 | 2    0
    1
```

1001101

e)
```
2 | 103  1
2 | 52   0
2 | 26   0
2 | 13   1
2 | 6    0
2 | 3    1
    1
```

```
2 | 102  1
2 | 5,6  0
2 | 8
```

2)

$$\begin{array}{r|ll}
2 & 1031 \\
2 & 515 & 1 \\
2 & 251 \\
2 & 125 & 1 \\
2 & 12 & 0 \\
2 & 6 & 0 \\
2 & 3 & 1 \\
& 1
\end{array}$$

1100111

$(9910)_{10} = (23266)_8$

③

$$\begin{array}{r|ll}
8 & 9,9,10 & — 6 \\
8 & 1238 & — 6 \\
8 & 154. & — 2 \\
8 & 19 & — 2 \\
8 & 2 & — 3
\end{array}$$

$(23.3226)_8$

④

(a) 1101 ⟶ 13

(b) 1110 ⟶ 14

(c) 1111 0101 ⟶ 245

(d) 0101 0101 ⟶ 85

(e) 1000 1111 ⟶ 143

⑤

(5)

(a) $(1101)_2 \Rightarrow$ 1101 $= (15)_8$

                      001   101

                        1   15

(b) $(\text{1111} \quad \text{1111} \cdot \text{1110})_2 =)$

$1 * 2^{11} + 1*2^{10} + 1*2^{9} + 1*2^{8} + 1 \times 2^{7} + 1 \times 2^{6} + 1 \times 2^{5} + 1 \times 2^{4} +$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad 1 \times 2^{3} + 1 \times 2^{2} + 1 \times 2^{1} + 2^{0}$

$2048 + 1024 + 512 + 256 + 128 + 64 + 32 + 16 + 8$

$+ 4 + 2 + 0$

$\qquad = (4094)_8$

(c) $(2 2 1 2 0 1)_3 \Rightarrow (\quad)_{10}$

$\quad 3^{6} \quad 3^{5} \quad 3^{4} \quad 3^{3} \quad 3^{2} \quad 3^{1} \quad 3^{0}$

$2187 \quad 729 \quad 243 \quad 81 \quad 27 \quad 9 \quad 3 \quad 1$

$\qquad\qquad 2 \quad 2 \quad 1 \quad 2 \quad 0 \quad 1$

$\qquad = (694)_{10}$

(e) $(2 3 1)_8 = (1001 1001)_2$

$\qquad 010 \quad 011 \quad 001$

(£) $(0 \times F00)_{16} \Rightarrow ( )_8$

1111 0000 0000

$= 2048 + 1024 + 512 + 256 = (7400)_8$

```
8 |3840
 8 |480 - 0
  8 | 60 - 0
   8 | 7 - 4
```

$(8^3 \times 7) + (8^2 \times 4) + (8^1 \times 0) + (8^0 \times 0) = (3840)_{10}$

```
16 |3840
 16 |240  0
  16 |15 - 0
```

$(3840)_{10} = (F00)_{16}$

(g) $0(\times DACC) =$

1001

1101   1010   1100   1110 $=$

```
12 |56014    - 28496
 12 |4667    - 100T
  12 |388 - 11b
   12 |32 - 4
      2 - 8
```

(h) $(2B)16 \Rightarrow 8$

0010   1011 $=$

```
8 |43    3    = 53.
 8 | 5
```

(7)

a) $(5610) \Rightarrow 10$

$(1010111101010)_2$

b) $(5610) \Rightarrow (21200210)_3$

c) $(5610)_{10} \Rightarrow (12752)_8$

d) $(5610)_{10} \Rightarrow (15ca)_{16}$

e) $(22110)_{10} \Rightarrow (1010110010111110)_2$

f) $(22110)_{10} \Rightarrow (1010022220)_3$

g) $(22110)_{10} \Rightarrow (53136)_8$

i) $(22110)_{10} \Rightarrow (53136)_4$

j) $(22110)_{10} \Rightarrow (565e)_{16}$

2 | 5610
2 | 2805 1
2 | 1402 0
2 | 701 1
2 | 350 0
2 | 175 1
2 | 87 1
2 | 43 1
2 | 21 1
2 | 10 0
2 | 5 1
2 | 2 0
2 | 1

Assignment

(6)

(a) 9+12

$$1001 \rightarrow 9$$
$$1100 \rightarrow 12$$
$$\overline{10101}$$

(b) 40+31

$$101000 \rightarrow 40$$
$$011111 \rightarrow 31$$
$$\overline{1000111}$$

(c) 1110 + 0101

$$1110 \rightarrow 14$$
$$0101 \rightarrow 5$$
$$\overline{10011}$$

(d) 1111 0101 + 0111 1100

$$1111\,0101$$
$$0111\,1100$$
$$\overline{10111\,0001}$$

$$1111\,0101 \rightarrow 245$$
$$0111\,1100 \rightarrow 124$$
$$\overline{10111\,0001} \rightarrow 369.$$

(e) 1100 0111 + 0101 1110

$$1100\,0011 \rightarrow 195$$
$$0101\,1110 \rightarrow 94$$
$$\overline{1001\,00001} \rightarrow 289$$

9)

(a) 8-3

```
    111
  0 1 1 0 → 8
+ 1 0 0 0 → -8
  0 0 1 1 → 3
  ─────────
  0 1 0 1 → 5
```

(b) 17-11

```
      1 1 1
    0 1 1 0
  0 1 0 0 0 1 → 17
  0 0 1 0 1 1 → 11
  ──────────────
  0 0 0 1 1 0 → 6.
```

(c) 23-7

```
      0 1 1
      0 1 1 0
  0 0 1 1 0 0 1 → 25
    0 0 0 1 1 1 → 7
  ──────────────
    0 1 0 0 1 0 → 18
```

(d) 86-31

```
    0 1 0        1 1 1 0 1
  0 1 0 1   0 1 1 0 1 0 → 86
  0 0 0 1   1 1 1 1 → 31
  ──────────────────
  0 0 1 0 1 1 1 1
```

```
  0 1 0 1 0 1 0 0 1 0
  0 1 0 1   0 1 1 0 1 0
  0 0 0 1 1 1 1 1
  ──────────────
  0 0 1 1 0 1 1 1
```

```
  0 1 1 0 1 1 0 1
  0 1 0 1   0 1 1 0 1 0
  0 0 0 1   1 1 1 1
  ──────────────
  0 0 1 1 0 1 1 1
```

(e) 1101 0001 - 0100 0111

$$1101\ 0001 \rightarrow 209$$

(with carries marked above: 0 1 1 10 over the bits)

$$0100\ 0111 \rightarrow 71$$
$$\overline{1000\ 1010} \rightarrow 138$$

(10) Multiplication

(a) 12×3

```
      1100
    × 0011
   ────────
    1 11 0 0
    1 10 0 ×
   0 0 0 0 × ×
0· 0 0 0 × × ×
──────────────
  0 1 0 0 1 0 0  → 36·
```

(b) 20 × 5

```
    0 1 0 1 0 0
        0 1 0 1
   ──────────────
    0 1 0 1 0 0
   0 0 0 0 0 0 ×
  0 1 0 1 0 0 × ×
0 0 0 0 0 0 × × ×
──────────────────
0 0 1 1 0 0 1 0 0
```

1
64
32
4
108

11
128
64
8
200

```
2│1 0 0 0
  │5 1 0 0   2
  │2 5 1     2
  │1 2 1     2
  │ 8 0      2
  │ 4 0      2
  │ 2 0      2
  │ 1
```
00 01

```
2│1 0 0 0
  │5 0 0    2
  │2 5 1    2
  │1 2 0    2
  │ 6 0     2
  │ 3 1     2
  │ 1
```

0 0 1 0 0 1 1

1 0 0 1 0 0

0 0 1 0 0 1 1

© 0111 x 0010

$$
\begin{array}{r}
0\,1\,1\,1 \to 7 \\
\times\ 0\,0\,1\,0 \to 2 \\
\hline
0\,0\,0\,0 \\
0\,1\,1\,1\ x \\
0\,0\,0\,0\ x\ x \\
0\,0\,0\,0\ x\ x\ x \\
\hline
0\,0\,0\,1\,1\,1\,0 \to 14
\end{array}
$$

ⓓ 0110 0111 x 101

$$
\begin{array}{r}
0\,1\,1\,0\ 0\,1\,1\,1 \to 103 \\
1\,0\,1 \to 5 \\
\hline
1\,0\,1\,1\,0\,0\,1\,1\,1 \\
0\,0\,0\,0\,0\,0\,0\,0\,x \\
0\,1\,1\,0\,0\,1\,1\,1\,x\,x \\
\hline
1\,0\,0\,0\,0\,0\,0\,1\,1\,1 \to 515
\end{array}
$$

ⓔ 1010 1010 x 0101

$$
\begin{array}{r}
1\,0\,1\,0\ 1\,0\,1\,0 \to 170 \\
0\,1\,0\,1 \to 5 \\
\hline
1\,1\,0\,1\,0\ 1\,0\,1\,0 \\
0\,0\,0\,0\,0\ 0\,0\,0\,x \\
1\,0\,1\,0\,1\,0\ 1\,0\,x\,x \\
0\,0\,0\,0\,0\,0\,0\ 0\,x\,x\,x \\
\hline
0\,1\,1\,0\,1\,0\,1\,0\,0\,1\,0 \to 850
\end{array}
$$

① Division

(a) 15/2.

$$10 < 11$$
$$10 < 11$$

$$10\,)\,\overset{2}{1}1\,\overset{.5}{1}11\,(\,\overset{.1\,1\,1}{}\,$$
```
      10
      ─────
      0 1 1
      0 1 0 ↓
      ─────
      0 1 1
        1 0
      ─────
        0 1
```

$$2\,)\,15\,(2$$
```
     14
   ─────
     1
```

(b.) 45/5

$$101\,)\,1011\,01\,(\,\overset{3\ 2\ 2\ 1\ 20}{1001}$$
```
      1011 ↓
      ──────
      000101
         101
      ──────
           0
```

$$101 \le 101$$

$$5\,)\,45\,(9$$
```
     45
   ─────
     0
```

(c) 121/14

$$1110\,)\,0111\,1\,001\,(\,1001$$
```
      1110 ↓
      ──────
      000 110 1
          1110
        ──────
          1111
            14
```

$$1110\,)\,01111\,001\,(\,11$$
```
       1110 ↓
      ───────
       1001 ↓
       1110
      ───────
```

$$1110 < 1111$$
$$1110 < 1101$$

$$1000$$
$$14 < 15$$
$$112$$

$$14\,)\,121\,(8$$
```
      112
    ─────
      9
```

$$1110 \ne 0111$$
$$1110 < 1001 \quad 32 + 2 + 1$$
$$1110 < 1.0011$$

(c) 121/14   8   14   4+2+1=7

```
                                      8+2          1110  >  0111
1110) 0111 1001 (01000'                 16              17
      0000  ↓                          1110 < 1111
      ─────                              8+4+2+1
      0111)                            1110 < 1111
      1110  ↓
      ─────                              -14      8+1
      0001 001                          1110 > 1001
          0000
      ─────────
           1001
```

(d)   1101   0100 / 101

```
    5            212        42
   0 1
101) 1101 0100 (101010'
     101 ↓   ↓
     ───────
     0011 0 0
       101  ↓ ↓
       ───
       001 0 0
       101
       ─────
       0010 0'
         101
       ─────
       0010
         000
       ─────
          010
```

```
 5      6
101  <  110
101  <  110
101  <  110
 5        2
101  >  010
```

```
5 ) 212 (42·
    20
    ───
    12
    10
    ───
     2⦸
```

(e)   1010   1010 / 0111

```
    7
     0 0 0 0 170                  24
0111) 1010 1010 (110000
      0111 ↓
      ─────
      00111
       0111
      ─────
      0000 010
         0000
      ─────────
          10  →2
```

```
 7
0111  <  1010
0111  ≤  0111
0111  >  0010
```

अ

$$
0111) \overline{101010} (11000
$$

0111

00111

0111

00000 10

0000

0010 →2

0111 < 1010

0111 ≤ 0011

अ 0111 > 0010

ਰ) 170 (14

14

30

28

2

Assignment

(a) 34·34

$0·34 \times 2 = 0·68$ 0

$0·68 \times 2 = 1·36$ 1

$0·36 \times 2 = 0·72$ 0

$0·72 \times 2 = 1·44$ 1

$0·44 \times 2 = 0·88$ 0

$0·88 \times 2 = 1·76$ 1

$0·76 \times 2 = 1·52$ 1

$0·52 \times 2 = 1·04$ 1

$0·04 \times 2 = 0·08$ 0

1 0 0 0 1 0 · 0 1 0 1 0 1 1 1 0

(b) 123 · 125

$0·125 \times 2 = 0·25$ 0

$0·25 \times 2 = 0·50$ 0

$0·5 \times 2 = 1·0$ 1

2	125	1
2	62	0
2	31	1
2	15	1
2	7	1
2	3	1
	1	

1 1 1 1 1 0 1 . 0 0 1

(c) 10·16

$0·16 \times 2 = 0·32$ 0

$0·32 \times 2 = 0·64$ 0

$0·64 \times 2 = 1·28$ 1

$0·28 \times 2 = 0·56$ 0

$0·56 \times 2 = 1·12$ 1

$0·12 \times 2 = 0·24$ 0

$0·24 \times 2 = 0·48$ 0

$0·48 \times 2 = 0·96$ 0

$0·96 \times 2 = 1·92$ 1

$0·92 \times 2 = 1·84$ 1

$0·84 \times 2 = 1·68$ 1

$0·68 \times 2 = 1·36$ 1

$0·36 \times 2 = 0·72$ 0

$0·72 \times 2 = 1·44$ 1

1010 . 0010 1000 1101

(13)

The largest positive no. In decimal

1111 1111 1111

By applying 2's complement code.

$$\begin{array}{ccc} 1111 & 1111 & 1111 \\ 0000 & 0000 & 0000 \\ & & +1 \\ \hline 0000 & 0000 & 000\,1 \end{array}$$

$2's \longrightarrow 1's + 1$

(14) C O D E 1 4 H S 2022?

C = 100 · 0100 0011

D = 0100 11 11

D = 0100 0100

E = 0100 0101

1 = 0010 11 11

7 = 0101 0100

H. = 01 00 1000

S = 0101 0011

1' = 0010 00 00

2 = 0011 0000

0 = 0011 0000

2 = 0011 0010

2 = 0011 0010

complete sequence of 8 bit patterns.

(15)   11111 => 35

35 is biggest binary of 5 bits.

(16)   In hex 2BfC + 54A7

2 BfC   19 = 13

+ 54A7   26 = 1A

8 0A3   16 = 10

(17)   • hex Number ABC7 to Binary.

a = 1010
b = 1011
C = 1100
7 = 0111

1010 1011 1100   0111

(18) $ACt4 - B3F$:

614
$ACt\ 4$
$-\ \ \underline{B3F}$
$\ \ \ \underline{4135}$

(19) (a) $0.1001 = 1/2 + 1/16 = 9/16$

(b) $1.0011 = 1 + 1/8 + 1/16 = 13/8$

(c) $1.1111 = 1 + 1/2 + 1/4 + 1/8 + 1/16 = 3/1$

(20) expan q $11/17$ is 0.64
~~this~~ find Binary expan. q $11/17$.

$0.647 \times 2 = 1.294$ 1
$0.294 \times 2 = 0.498$ 0
$0.498 \times 2 = 0.996$ 0
$0.996 \times 2 = 1.992$ 1

$\therefore \left(11/17 = \left(1001 \ldots \right) \right)_2$

(21) Decimal expasin $3/11$ is 0.2727 . then
find. $3/11$

$0.2727 \times 2 = 0.5454$ 0
$0.5454 \times 2 = 1.0908$ 1
$0.908 \times 2 = 0.1616$ 0
$0.1616 \times 2 = 0.3632$ 0

$\therefore \left(3/13 = \left(0100 \ldots \right) \right)_2$