a)
$$\overset{4\,3\,2\,1\,0}{1\,1\,1\,0\,0}_{(2)} \longrightarrow (\quad)_{(10)}$$

$$1\,1\,1\,0\,0_{(2)} = 1 \cdot 2^4 + 1 \cdot 2^3 + 1 \cdot 2^2$$
$$= 16 + 8 + 4$$
$$= \boxed{28_{(10)}}$$

b)
$$3D_{(16)} \longrightarrow (\quad)_{(10)}$$

$$3D_{(16)} = 3 \cdot 16^1 + \overset{D}{\boxed{13}} \cdot 16^0$$
$$= 48 + 13$$
$$= \boxed{61_{(10)}}$$

c)
$$\{231_{(6)} \longrightarrow (\quad)_{(4)}$$

① $231_{(6)} \longrightarrow (\quad)_{10}$

$$231_{(6)} = 2 \cdot 6^2 + 3 \cdot 6^1 + 1 \cdot 6^0$$
$$= 72 + 18 + 1$$
$$= 91_{(10)}$$

② $\{91_{(10)} \longrightarrow (\quad)_{(4)}$

$$91 : 4 = 22, \quad \text{rest } 3 \uparrow$$
$$22 : 4 = 5, \quad \text{rest } 2$$
$$5 : 4 = 1, \quad \text{rest } 1$$
$$1 : 4 = 0, \quad \text{rest } 1$$

$$\Longrightarrow \boxed{1123_{(4)}}$$

d)
$$(32 - 17)_{(8)}$$

① $32_{(8)} = 3 \cdot 8^1 + 2 \cdot 8^0 = 26_{(10)}$
$17_{(8)} = 1 \cdot 8^1 + 7 \cdot 8^0 = 15_{(10)}$

$$(26 - 15)_{(10)} = 11_{(10)}$$

② $11_{(10)} = \boxed{13_{(8)}}$

$11 : 8 = 1, \quad 3 \text{ rest} \uparrow$
$1 : 8 = 0, \quad 1 \text{ rest}$

(4) Calcul. $47^{109} \pmod{113}$

1) $47^2 \pmod{113} = 2209 \pmod{113} = \underline{89}$

2) $47^4 \pmod{113} = 89^2 \pmod{113} = 7921 \pmod{113} = \underline{55}$

3) $\{47^8\} \pmod{113} = 55^2 \pmod{113} = 3025 \pmod{113} = \underline{15}$

4) $\{47\}^{16} \pmod{113} = 15^2 \pmod{113} = 225 \pmod{113} = \underline{5}$

5) $\{47\}^{32} \pmod{113} = 5^2 \pmod{113} = \underline{25}$

6) $\{47\}^{64} \pmod{113} = 25^2 \pmod{113} = 625 \pmod{113} = \underline{56}$

Prop. additiv. mod.
$$(a \cdot b) \pmod{n} = ((a \bmod n)(b \bmod n)) \bmod n$$

Th. Euler: $a^{\varphi(p)} \overset{\neq p-1}{\equiv} 1 \pmod{p}$ $(a, p) = 1$

$$47^{109} = 47^{64} \cdot 47^{32} \cdot 47^8 \cdot 47^4 \cdot 47^1$$

$$47^{109} \pmod{113} = (56 \cdot 25 \cdot 15 \cdot 55 \cdot 47) \pmod{113}$$

$$= (156 \bmod) \boxed{76}$$