**Given:** continuous-time signal $x(t) = 36 \cos(12\, t)$

1. What is the minimum sampling frequency to allow perfect restoration of the signal?

   First, determine the maximum continuous time (CT) frequency in the signal. This is cos(Ω t) in general, so for this signal the maximum (and only) frequency in the signal is:

   $$\Omega = 12 \text{ rads/sec}$$

   Recall the relationship between continuous time (CT) frequency in rads/sec $\Omega$ and CT frequency in Hz $f$ is:

   $$\Omega = 2\, \pi\, f$$

   so the maximum frequency in the signal in Hz is:

   $$f_{max} = 12/(2\pi) \text{ Hz} = 10/\pi \text{ Hz}$$

   This means that in every second there will be 10/π complete periods of the CT signal.

   The Sampling Theorem says to avoid aliasing the sampling frequency $f_s$ must be twice the highest frequency in the signal, so

   $$f_s = 2 \text{ (max freq in signal)} = \boxed{12/\pi \text{ Hz}}$$

2. What is the discrete frequency of x[n] if it is sampled from $x(t)$ at $f_s = 24/\pi$ samples/second?

   $f_s = 24/\pi$ samples/sec $\rightarrow T_s = \pi / 24$ sec/sample

   $x[n] = x(t = n\, T_s) = 36\, cos[12\, (n\, T_s)] = 36 \cos[\frac{\pi}{2} n]$

   $$\boxed{\omega = \frac{\pi}{2} \text{ samples/rad}}$$

3. What is the discrete frequency of x[n] if it is sampled from $x(t)$ at $f_s = 120/\pi$ samples/second?

   $f_s = 120/\pi$ samples/sec $\rightarrow T_s = \pi / 120$ sec/sample

   $x[n] = x(t = n\, T_s) = 36\, cos[12\, n\, T_s] = 36 \cos[\frac{\pi}{10} n]$

   $$\boxed{\omega = \frac{\pi}{10} \text{ samples/rad}}$$

   (note: same continuous time frequency, different discrete time frequency)

4. What is the discrete frequency of x[n] if it is sampled from $x(t)$ at $f_s = 6/\pi$ samples/second?

$f_s = 6/\pi$ samples/sec $\rightarrow T_s = \pi / 6$ sec/sample
$x[n] = x(t = n\,T_s) = 36\cos[12\,n\,T_s] = 36\cos[2\pi\,n]$
can subtract or add multiples of $2\pi$ without affecting discrete frequency so
$x[n] = 36\cos(0\,n) = 36$ (i.e. x[n] = [… 36 36 36 36 36 …] )

$\boxed{\omega = 0 \text{ samples/rad}}$

(note: aliasing has occurred and it now looks like a DC unchanging signal of 36)