Opg 2.9

a)

$$x(t) = 2\sin(\omega_o t + 45^\circ) + \cos(\omega_o t) = x_1(t) + x_2(t)$$

$$x_1(t) = 2\sin(\omega_o t + 45^\circ) = 2\cos\left[90^\circ - (\omega_o t + 45^\circ)\right]$$

$$= 2\cos(45^\circ - \omega_o t) = 2\cos(\omega_o t - 45^\circ)$$

$$= 2 \cdot \mathrm{Re}\{e^{j(\omega_o t - \frac{\pi}{4})}\} = \mathrm{Re}\{2 \cdot e^{-j\frac{\pi}{4}} \cdot e^{j\omega_o}\}$$

$$X_1 = A_1 \cdot e^{j\phi_1} = 2 \cdot e^{-j\frac{\pi}{4}} = \sqrt{2} - j\sqrt{2}$$

$$x_2(t) = \cos(\omega_o t) = \mathrm{Re}\{e^{j\omega_o t}\}$$

$$X_2 = A_2 \cdot e^{j\phi_2} = 1 \cdot e^{j0} = 1 - j0$$

$$X = X_1 + X_2 = (\sqrt{2} - j\sqrt{2}) + (1 + j0) = (1 + \sqrt{2}) - j\sqrt{2}$$

$$= \sqrt{2\sqrt{2} + 5} \cdot e^{j\arctan(\sqrt{2}-2)} = 2.79793 \cdot e^{-j0.529903\,rad} \cong 2.8 \cdot e^{-j30.4^\circ}$$

$$\underline{x(t) = \mathrm{Re}\{e^{j\omega_o t}\} = 2.8\cos(\omega_o t - 30.4^\circ)}$$

b) $\omega_o = 5\pi$ $\quad x(t) \cong 2.8\cos(5\pi t - \frac{\pi}{6}) = 2.8\cos(2\pi\frac{5}{2}t - \frac{\pi}{6})$

$f_o = \frac{5}{2}$ $\quad \Rightarrow \quad T_o = \frac{1}{f_o} = \frac{2}{5} = 0.4$

Interval: $t \in [-1,2]$ Intervalbredde = 3

Antal perioder: $\frac{3}{0.4} = \underline{7{,}5}$

c) $x(t) = \mathrm{Re}\{e^{j\omega_o t}\}$

$$\bar{x} = X \cdot e^{j\omega_o t} = \underline{2.8 \cdot e^{-j0.53} \cdot e^{j\omega_o t}}$$

Fasevinklen kan også skrives: $\phi = -0.53 = -0.17\pi$

Opg. 2.9 fortsat

Beregning og plotning af komplexe tal i Mathlab ved hjælp af zprint og zvect. Disse to funktioner hører ikke med til selve Mathlab, men kommer fra DSP First.

```
x1=2^0.5-(2^0.5)*j;
x2=1+0j;
zprint([x1 x2 x1+x2])
```

```
Z =    X    +    jY    Magnitude   Phase    Ph/pi   Ph(deg)
     1.414     -1.414          2   -0.785   -0.250   -45.00
       1         0             1    0.000    0.000     0.00
     2.414     -1.414       2.798   -0.530   -0.169   -30.36
```

```
zvect([x1 x2 x1+x2])
```