10. Интегриращо и идеално диференциращо звено

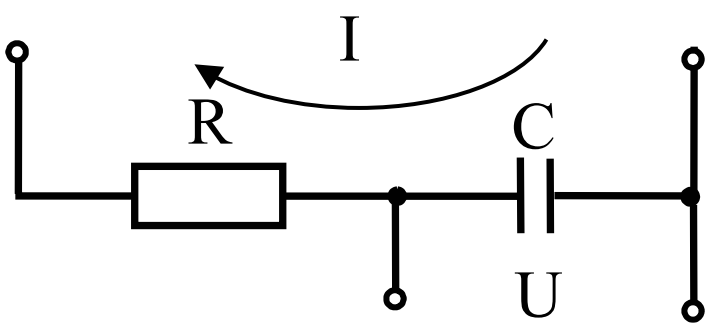
1. Интегриращо звено

ДУ: $\frac{dy(t)}{dt} = ku(t)$

ПФ: $pY(p) = kU(p), \qquad W(p) = \frac{Y(p)}{U(p)} = \frac{k}{p}$

(Други записи: $W(p) = \frac{k}{Tp}, \quad W(p) = \frac{1}{Tp}$)

Пример:



$$W(p) = \frac{U(p)}{I(p)} = \frac{\frac{1}{pC} I(p)}{I(p)} = \frac{1}{pC} = \frac{k}{p}$$

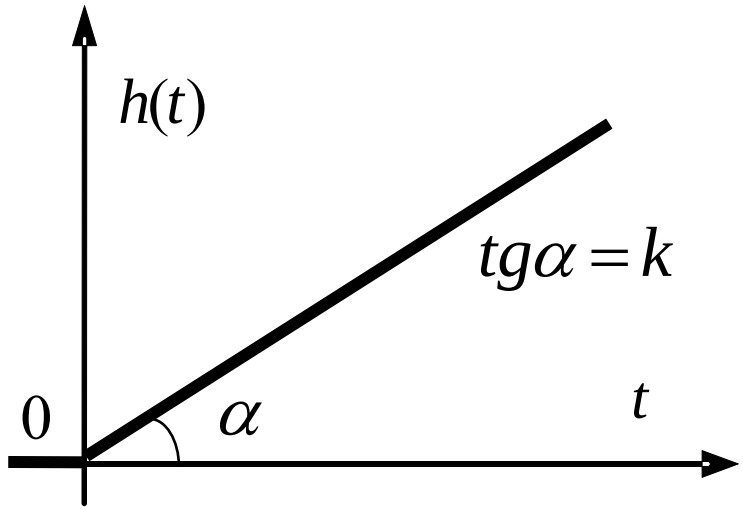
$$k = \frac{1}{C}$$

10. **Интегриращо** и идеално диференциращо звено

ПХ: $u(t) = 1(t), \quad \dfrac{dy(t)}{dt} = k.1(t)$

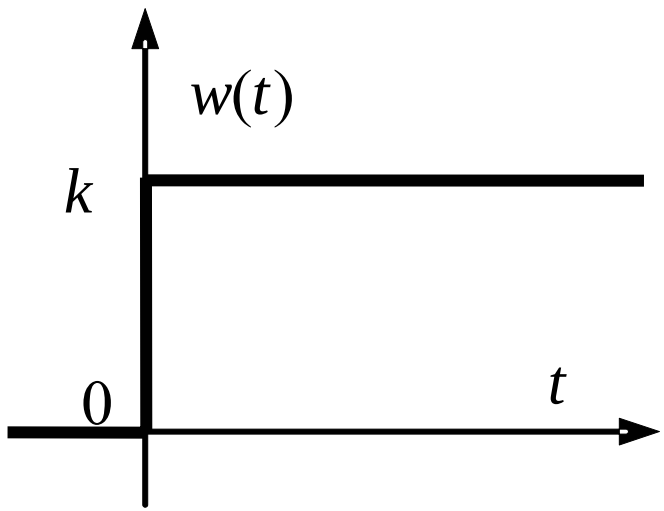
$dy = kdt, \quad \Rightarrow \quad y(t) = k\,t$

(при нулеви начални условия)



ТХ: $u(t) = \delta(t),$

$w(t) = \dfrac{dh(t)}{dt} = \dfrac{d}{dt}(kt) = k$



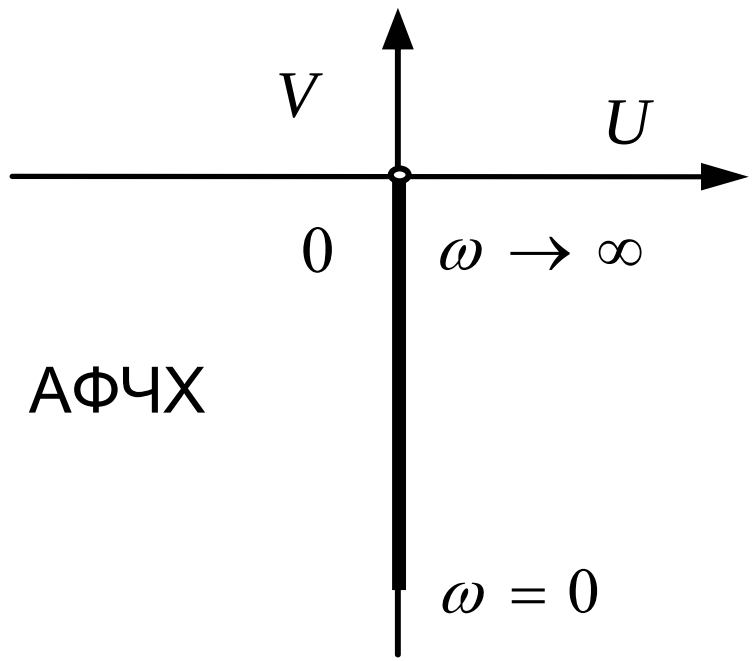
10. **Интегриращо** и идеално диференциращо звено

ЧПФ: $$W(j\omega) = \frac{k}{j\omega} \cdot \frac{j}{j} = -j\frac{k}{\omega}$$

РЧФ: $$U(\omega) = \mathrm{Re}\,W(j\omega) = 0$$

ИЧФ: $$V(\omega) = \mathrm{Im}\,W(j\omega) = -\frac{k}{\omega}$$

ω	0	∞
U	0	0
V	$-\infty$	0

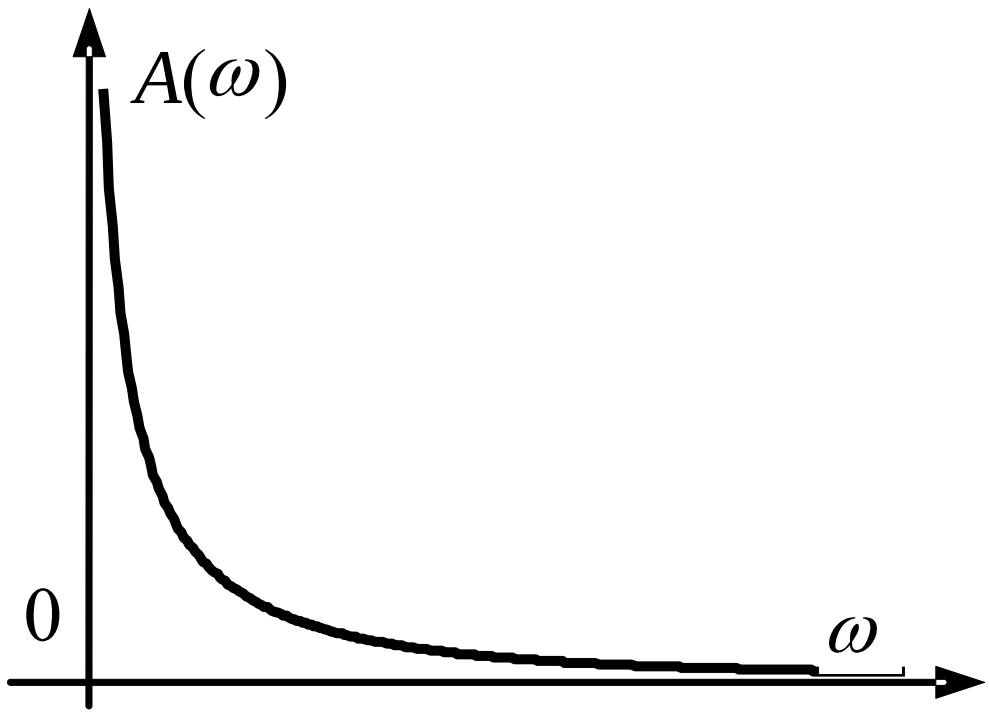


АФЧХ

10. **Интегриращо** и идеално диференциращо звено

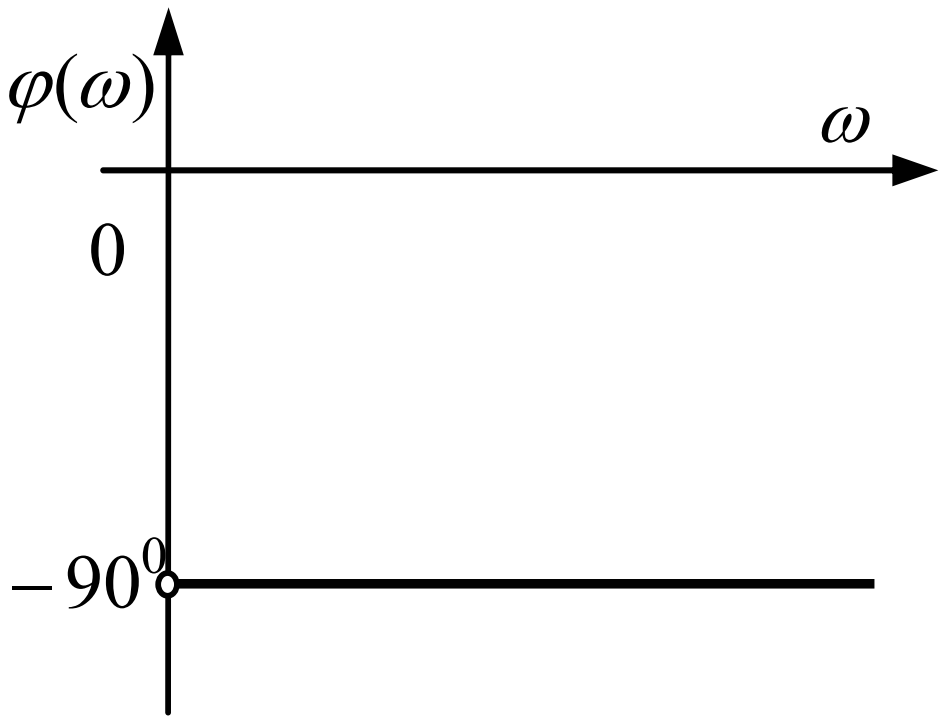
АЧХ: $$A(\omega) = \sqrt{U^2(\omega) + V^2(\omega)} = \sqrt{0^2 + \left(\frac{-k}{\omega}\right)^2} = \frac{k}{\omega}$$

ω	0	∞
A	∞	0



10. **Интегриращо** и идеално диференциращо звено

ФЧХ: $$\varphi(\omega) = \operatorname{arctg}\frac{V(\omega)}{U(\omega)} = \operatorname{arctg}\frac{\frac{-k}{\omega}}{0} = -\frac{\pi}{2}$$

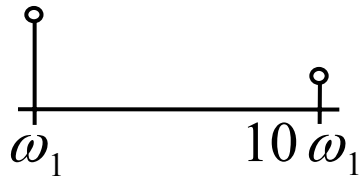


*10. **Интегриращо** и идеално диференциращо звено*

ЛАЧХ: $$L(\omega) = 20\lg A(\omega) = 20\lg\frac{k}{\omega} = 20\lg k - 20\lg\omega$$

$$\text{т}(\omega = 1; L = 20\lg k), \quad \frac{\Delta L}{\Delta\omega} = ?$$

Нека $\Delta\omega = 1\,\text{dec}$



$$L(\omega_1) = 20\lg k - 20\lg\omega_1$$

$$L(10\omega_1) = 20\lg k - 20\lg 10\omega_1$$

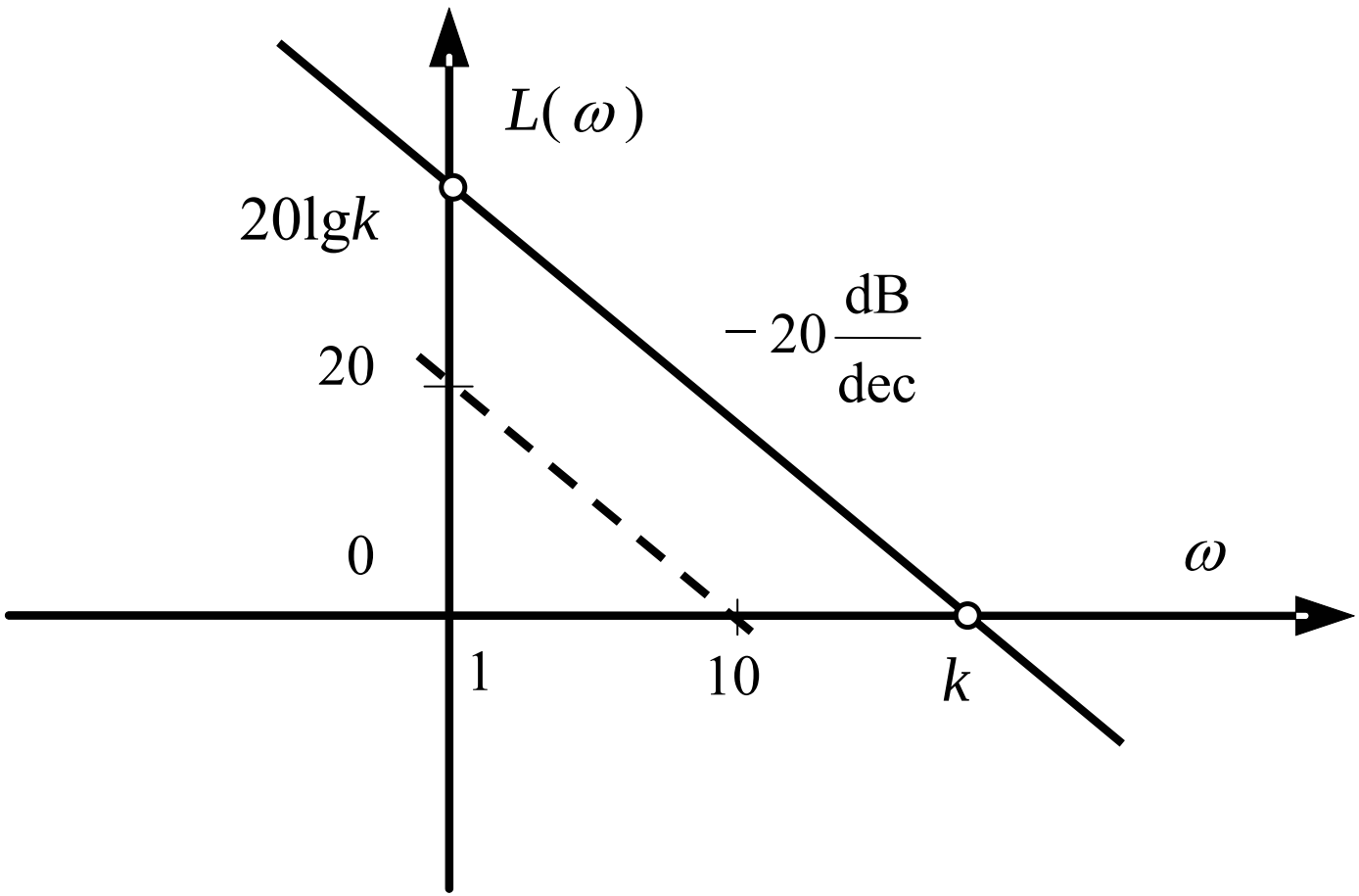
$$\Delta L = L(10\omega_1) - L(\omega_1) =$$

$$= 20\lg k - 20\lg 10\omega_1 - 20\lg k + 20\lg\omega_1 =$$

$$= -20\lg 10 = -20\,\text{dB}$$

10. **Интегриращо** и идеално диференциращо звено

ЛАЧХ: $\dfrac{\Delta L}{\Delta \omega} = -20\dfrac{\text{dB}}{\text{dec}};$ $\omega = 1,\ L(1) = 20\lg k$



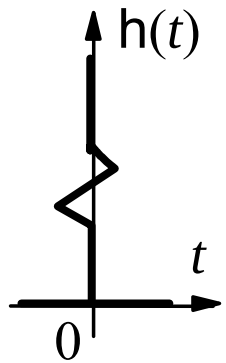
2. Идеално диференциращо звено

ДУ: $$y(t) = k\frac{du(t)}{dt}$$

ПФ: $$Y(p) = kpU(p), \qquad W(p) = \frac{Y(p)}{U(p)} = kp$$

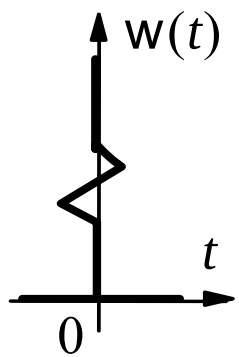
ПХ: $$u(t) = 1(t)$$

$$h(t) = k\frac{d1(t)}{dt} = k\delta(t)$$



ТХ: $$u(t) = \delta(t)$$

$$w(t) = k\frac{d\delta(t)}{dt} = k\dot{\delta}(t)$$



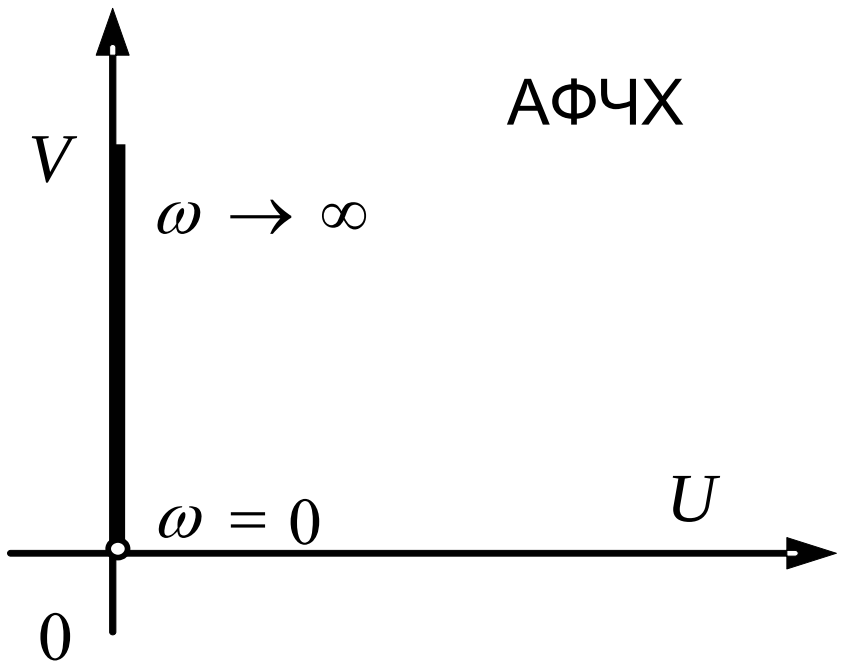
*10. Интегриращо и **идеално диференциращо** звено*

ЧПФ: $W(j\omega) = jk\omega = U(\omega) + jV(\omega)$

РЧФ: $U(\omega) = 0$

ИЧФ: $V(\omega) = k\omega$

ω	0	∞
U	0	0
V	0	∞

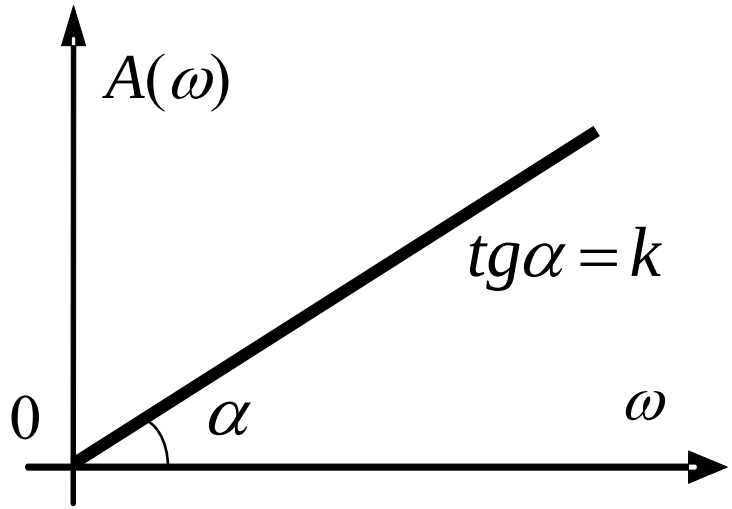


*10. Интегриращо и **идеално диференциращо** звено*

АЧХ:

$$A(\omega) = \sqrt{U^2(\omega) + V^2(\omega)} =$$

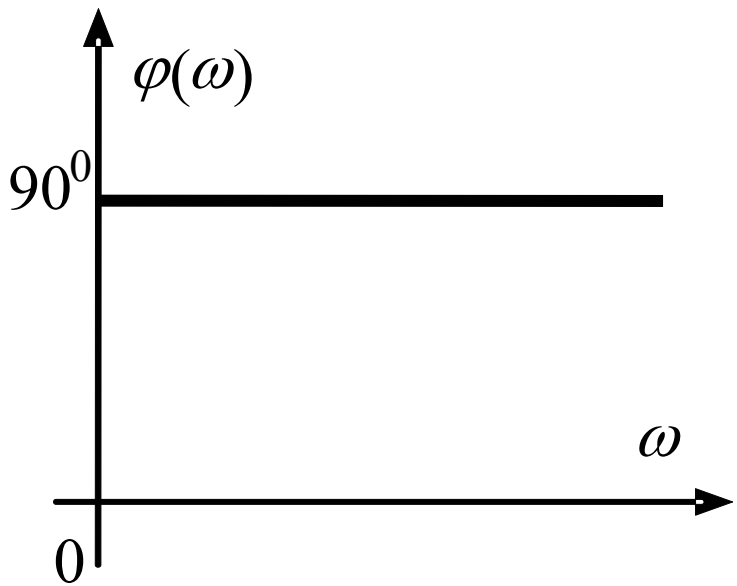
$$= \sqrt{0^2 + (k\omega)^2} = k\omega$$



ФЧХ:

$$\varphi(\omega) = \text{arctg}\frac{V(\omega)}{U(\omega)} =$$

$$= \text{arctg}\frac{k\omega}{0} = \frac{\pi}{2}$$

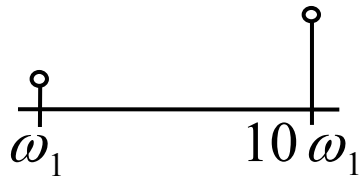


*10. Интегриращо и **идеално диференциращо** звено*

ЛАЧХ: $L(\omega) = 20\lg A(\omega) = 20\lg k\omega = 20\lg k + 20\lg \omega$

$\text{т}(\omega = 1; L = 20\lg k), \quad \dfrac{\Delta L}{\Delta \omega} = ?$

Нека $\Delta\omega = 1\,\text{dec}$



$$L(\omega_1) = 20\lg k + 20\lg \omega_1$$

$$L(10\omega_1) = 20\lg k + 20\lg 10\omega_1$$

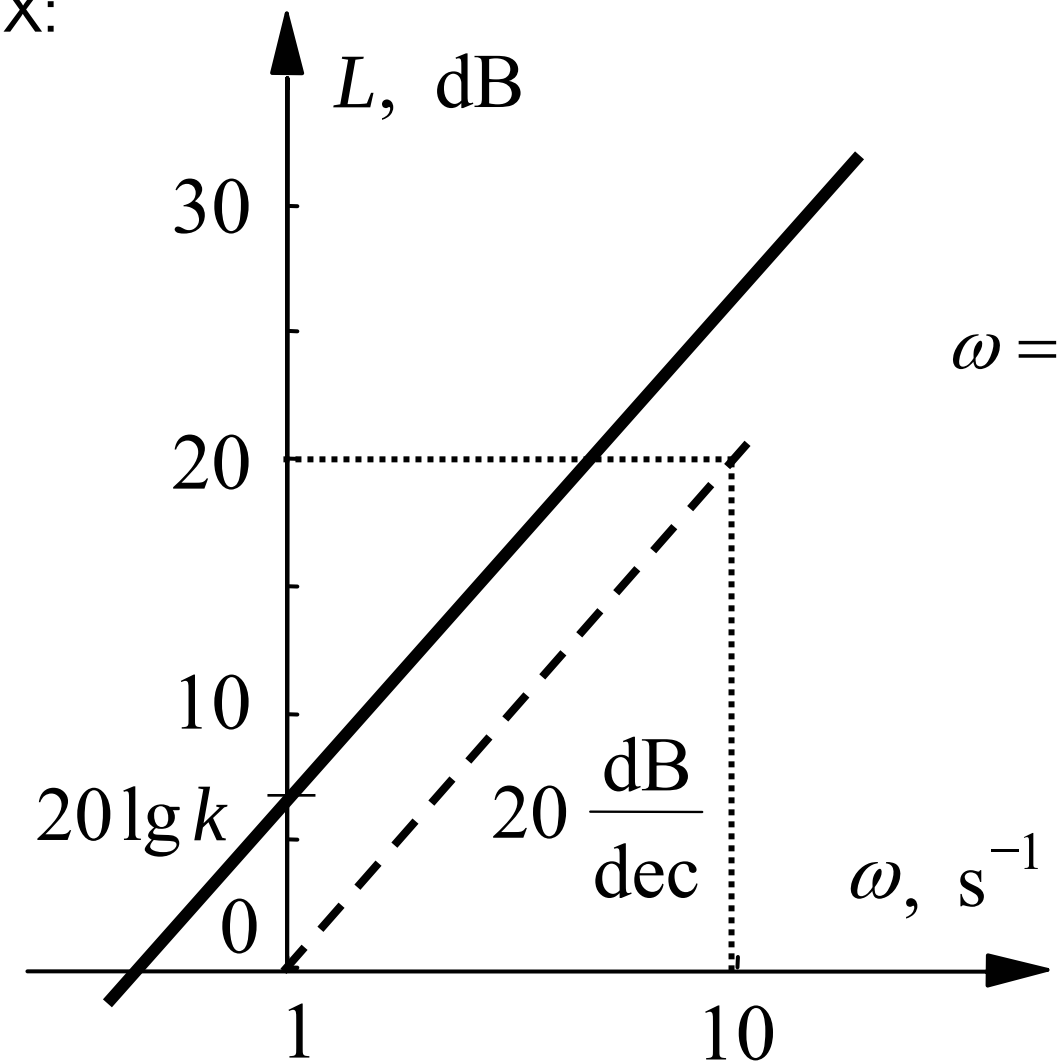
$$\Delta L = L(10\omega_1) - L(\omega_1) =$$

$$= 20\lg k + 20\lg 10\omega_1 - 20\lg k - 20\lg \omega_1 =$$

$$= 20\lg 10 = 20\,\text{dB}$$

*10. Интегриращо и **идеално диференциращо** звено*

ЛАЧХ:



$$\frac{\Delta L}{\Delta \omega} = 20\,\frac{\text{dB}}{\text{dec}};$$

$$\omega = 1, \quad L(1) = 20\lg k$$