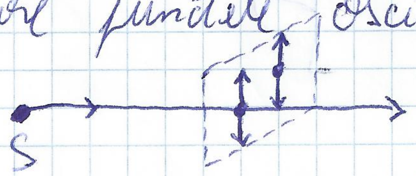
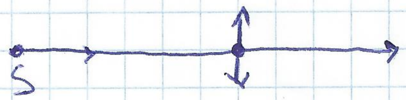
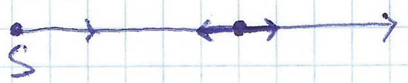
12. Prezentați subiectul: Unda plană. Unda plană monocromatică.

O undă se numește undă plană dacă există plane perpendiculare pe direcția de propagare a undei în care punctele oscilează în fază.

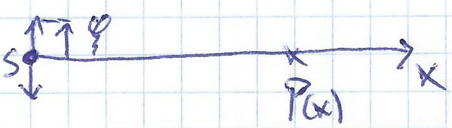



undă transversală

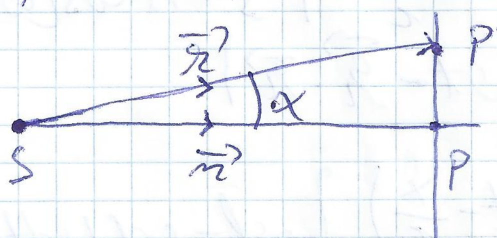



undă longitudinală




$\xi(0,t)$ reprezintă elongația

$$\xi(x,t)=\xi(0,t-\frac{x}{c})=f(t-\frac{x}{c})$$




$|n|=1$

$$\xi_P(x,t)=f(t-\frac{x}{c}) \qquad \xi_{P'}(\vec{r},t)=f(t-\frac{\vec{r}\cdot\vec{n}}{c})=$$

$$=f(t-\frac{|\vec{r}|\cos\alpha}{c})$$

$$\xi(0,t)=A\cos\omega t$$

$$\xi(x,t)=A\cos[\omega(t-\frac{x}{c})]=A\cos[\frac{2\pi}{T}(t-\frac{x}{c})]=$$

$$\left.\begin{aligned}&=A\cos(\frac{2\pi t}{T}-\frac{2\pi x}{T\cdot c})\\ &\lambda=T\cdot c\end{aligned}\right\} \Rightarrow \xi(x,t)=A\cos(\frac{2\pi t}{T}-\frac{2\pi x}{\lambda})$$

$$\xi(x,t+T)=A\cos\{\omega[(t+T)-\frac{x}{c}]\}=$$

$$\cancel{=A\cos(\omega(t-\frac{x}{c}))}=A\cos(\omega t+2\pi-\frac{\omega x}{c})=$$

$$= A\cos\left(\omega t - \frac{\omega x}{c}\right) = A\cos\left[\omega\left(t - \frac{x}{c}\right)\right] =$$

$$\xi(x,t) \Rightarrow \xi(x, t+T) = \xi(x,t)$$

$$\xi(x+\Lambda, t) = A\cos\left[\omega\left(t - \frac{x+\Lambda}{c}\right)\right] = A\cos\left[\omega\left(t - \frac{x}{c}\right)\right]$$

$$\left.\frac{\omega\Lambda}{c} = 2\pi \Rightarrow \Lambda = \frac{2\pi c}{\omega} = T\cdot c = \lambda\right\} \Rightarrow$$

$$\Rightarrow \xi(x,t) = \xi(x+\Lambda, t)$$

$$\vec{k} = \frac{2\pi}{\lambda}\vec{n}$$

$$\xi(\vec{r},t) = f\left(t - \frac{\vec{r}\cdot\vec{n}}{c}\right)$$

$$\xi(x,t) = A\cos\left[\omega\left(t - \frac{x}{c}\right)\right]$$

$$\xi(\vec{r},t) = A\cos\left[\omega\left(t - \frac{\vec{r}\cdot\vec{n}}{c}\right)\right] = A\cos\left[\omega t - \vec{r}\cdot\frac{2\pi\vec{n}}{\lambda}\right] = A\cos(\omega t - \vec{k}\cdot\vec{r})$$

$$\left.\begin{array}{l}\varphi = \omega t - \vec{k}\cdot\vec{r} = \omega\left(t - \frac{x}{c}\right) \\ \quad x = x+dx \qquad t = t+dt\end{array}\right\} \Rightarrow \varphi = \omega(t+dt) - \frac{\omega(x+dx)}{c}$$

$$\omega\left(t - \frac{x}{c}\right) = \omega\left(t + dt - \frac{x+dx}{c}\right) \Rightarrow \omega dt - \frac{\omega dx}{c} = 0 \Rightarrow$$

$$\Rightarrow dt - \frac{dx}{c} = 0 \Rightarrow c = \frac{dx}{dt} = v_f$$

$$\xi = A\cos(\omega t - \vec{k}\cdot\vec{r}) \Rightarrow = R_e\left[A e^{i(\omega t - \vec{k}\cdot\vec{r})}\right]$$