DISCUSSION # 24

# TRAVELING WAVES

A TRAVELING WAVE IS A DISTURBANCE WHICH TRANSPORTS ENERGY THROUGH AN ELASTIC MEDIUM (OR IN THE CASE OF ELECTROMAGNETISM, THROUGH A VACUUM). ONLY ENERGY IS TRANSPORTED FROM ONE PLACE TO ANOTHER. THERE IS NO BULK MOTION OF THE MATERIAL FROM PLACE TO PLACE.

## DESCRIPTION

A GOOD GENERAL DESCRIPTION OF A TRAVELING WAVE:

$$y(x,t) = A\sin(\omega t \mp kx)$$

$y(x=0, t=0) = 0$ ← SIN

$y(x=0, t=0) = A$ ← COS

$-$ $\Rightarrow$ PROPAGATES IN $+x$ DIRECTION

$+$ $\Rightarrow$ PROPAGATES IN $-x$ DIRECTION

$\omega t \mp kx \equiv$ "PHASE ANGLE" IN RADIANS

IMPORTANT RELATIONSHIPS

$$f = \frac{1}{T} \qquad \omega = 2\pi f \qquad k \equiv \frac{2\pi}{\lambda} \qquad \boxed{v = \lambda f}$$

$$v = \lambda f = \frac{\lambda}{2\pi} \cdot 2\pi f = \boxed{\frac{\omega}{k} = v}$$

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$v \equiv$ WAVE PROPAGATION SPEED m/s

$\omega \equiv$ ANGULAR FREQUENCY RAD/S

$f \equiv$ FREQUENCY $s^{-1}$ OR Hz

$k \equiv$ WAVE NUMBER $m^{-1}$

$T \equiv$ PERIOD s

FOR A TRANSVERSE WAVE ON A STRING

$$v = \sqrt{\frac{T}{\mu}}$$

$T \equiv$ TENSION FORCE APPLIED TO STRING

$$\mu \equiv \frac{\text{STRING MASS}}{\text{STRING LENGTH}} = \frac{m}{L}$$

$\mu \equiv$ GREEK "MU", "LINEAR MASS DENSITY"

FOR Sound, PROPAGATING IN A SOLID

$$v = \sqrt{\frac{Y}{\rho}}$$

$Y \equiv$ Young's Modulus

$\rho \equiv$ Volume mass Density

Sound is A Longitudinal WAVE WHERE The displacement $\psi$ is Parallel to the Direction OF PROPAGATION.