

7.13) A GENERAL (REAL) WAVE HAS TIME DEPENDENCE WRITTEN AS

$$\psi(t) = a \cos \omega t + b \sin \omega t \text{ OR } \psi(t) = A \sin(\omega t + \phi)$$

a) SHOW THESE ARE EQUIVALENT.

b) SHOW THAT CHANGING THE ORIGIN OF TIME CAN ELIMINATE ϕ

a) USING THE ANGLE SUM IDENTITY

$$\psi(t) = A \sin(\omega t + \phi) = A(\sin \omega t \cos \phi + \cos \omega t \sin \phi)$$

SINCE ϕ IS A CONSTANT $\cos \phi$ AND $\sin \phi$ ARE CONSTANTS SO RE-NAME THEM:

$$\text{LET } a = A \sin \phi \quad b = A \cos \phi$$

THEN $\boxed{\psi(t) = a \cos \omega t + b \sin \omega t}$ (QED!)

b) LET $\omega t' = \omega t + \phi \Rightarrow t' = t + \frac{\phi}{\omega}$

THEN $\psi(t) = A \sin(\omega t + \phi) = A \sin(\omega t')$

DRAW A SINE WAVE TO SEE WHAT THIS DOES

LET $\phi = \frac{\pi}{4}$, AT $t=0$, $\psi(t) = A \sin(\phi)$

