

Joe sets up a piano wire

$$\text{length } L = 1.5 \text{ m}$$

$$\text{mass } m = 5 \text{ gram} = 0.005 \text{ kg}$$

$$\text{tension } T = 290 \text{ N}$$

He whacks one end of the wire, creating waves with

$$\text{amplitude } A = 2 \text{ mm} = 0.002 \text{ m}$$

$$\text{frequency } f = 200 \text{ Hz}$$

The speed of waves moving down the wire is

$$v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{290 \text{ N}}{(0.005 \text{ kg}/1.5 \text{ m})}}$$

$$= 295.0 \text{ m/s}$$

The rate at which energy is transmitted down the wire is

$$\text{power } P = \frac{1}{2} (\mu v) (\omega^2 A^2)$$

$$= \frac{1}{2} \left(3.33 \times 10^{-3} \frac{\text{kg}}{\text{m}} \cdot 295.0 \frac{\text{m}}{\text{s}} \right) \left([2\pi \cdot 200 \text{ Hz}]^2 [0.002 \text{ m}]^2 \right)$$

$$= 3.10 \text{ W}$$

$$\uparrow$$
$$\omega = 2\pi \cdot f$$