If the end of the string is free to slide along a rod, then the boundary conditions change: now

1: y position of incident wave = y pos of reflected wave

2: y velocity " " " = y vel " " "

We know incident wave is

$$y_i(x,t) = A\sin(kx-\omega t)$$

and reflected wave must be some combination of

$$y_r(x,t) = C\sin(kx+\omega t) + E\cos(kx-\omega t)$$

So, at boundary, where $x=0$

$$y_i(0,t) = y_r(0,t)$$

$$A\sin(-\omega t) = C\sin(\omega t) + E\cos(\omega t)$$

$$-A\sin(\omega t) = C\sin(\omega t) + E\cos(\omega t)$$

Once again, we can separate the sine and cosine terms

$$-A\sin(\omega t) = C\sin(\omega t) \Rightarrow \boxed{A = -C}$$

$$E\cos(\omega t) = 0 \Rightarrow \boxed{E = 0}$$

Note that in this case, the amplitude of the reflected wave is <u>opposite</u> in sign to incident wave.