

Solutions

2.1 C The outbound moving-source factor and return moving-observer factor multiply.

Compare the rejected options: $c/(c-u)$; $(c+u)/c$; $(c-u)/(c+u)$; 1. Use the stated model and conditions.

2.2 D The new fundamental is 60 Hz and allowed multiples are odd.

Compare the rejected options: 120,240,360 Hz; 120,360,600 Hz; 60,120,180 Hz; 240,480,720 Hz. Use the stated model and conditions.

2.3 1.2. $(330+30)/(330-30)=360/300=1.2$.

2.4 False. The one-closed spectrum has no even multiples of its new fundamental; that original line is absent.

3.1 The reflector receives $f(c+u)/c$ as a moving observer and re-emits toward the receiver as a moving source. Therefore $f_r = f(c+u)/(c-u)$. $r(c-u) = c+u$ gives $u = c(r-1)/(r+1)$. For $u \ll c$, $r \approx 1 + 2u/c$. Award two factors, product, inversion and limit. The equality with the moving-siren echo ratio does not make source and observer roles interchangeable.