

52. We use Eq. 18-47 with  $f = 1200$  Hz and  $v = 329$  m/s.

(a) In this case,  $v_D = 65.8$  m/s and  $v_S = 29.9$  m/s, and we choose signs so that  $f'$  is larger than  $f$ :

$$f' = f \left( \frac{329 + 65.8}{329 - 29.9} \right) = 1584 \text{ Hz} .$$

(b) The wavelength is  $\lambda = v/f' = 0.208$  m.

(c) The wave (of frequency  $f'$ ) “emitted” by the moving reflector (now treated as a “source,” so  $v_S = 65.8$  m/s) is returned to the detector (now treated as a detector, so  $v_D = 29.9$  m/s) and registered as a new frequency  $f''$ :

$$f'' = f' \left( \frac{329 + 29.9}{329 - 65.8} \right) = 2160 \text{ Hz} .$$

(d) This has wavelength  $v/f'' = 0.152$  m.