

Answer on Question #74870 Physics / Other

An ambulance siren has frequency $f_0 = 250$ Hz. The ambulance is headed towards an accident site with a speed of 90 km/h. Two police officers on separate motor cycles head for the same accident site: one (first) follows the ambulance with a speed of $u = 80$ km/h and the other (second) approaches the accident site from the other direction with a speed of $v = 80$ km/h. What frequency does ambulance siren has for each of the police officers? Take the speed of sound equal to $c = 340$ m/s.

Solution:

The relative velocity

(For officer that follows the ambulance) $\Delta v_1 = u - v = 80 - 90 = -10 \frac{\text{km}}{\text{h}} = -2.8 \frac{\text{m}}{\text{s}}$

(For officer that moves towards the ambulance) $\Delta v_2 = u + v = 80 + 90 = 170 \frac{\text{km}}{\text{h}} = 47.2 \frac{\text{m}}{\text{s}}$

Doppler Effect states

$$f = f_0 \left(1 + \frac{\Delta v}{c} \right)$$

Thus

$$f_1 = f_0 \left(1 + \frac{\Delta v_1}{c} \right) = 250 \left(1 - \frac{2.8}{340} \right) = 248 \text{ Hz}$$

$$f_2 = f_0 \left(1 + \frac{\Delta v_2}{c} \right) = 250 \left(1 + \frac{47.2}{340} \right) = 285 \text{ Hz}$$

Answers:

First officer: $f_1 = 285$ Hz

Second officer: $f_2 = 248$ Hz

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