

test 2
CH16

10-18-13

11

(45) Doppler effect; beats

See 8-30-13

note.

start (44) practice for test 2

2 parts Example 16.8

(A) what frequency does
warehouse receive?

(B) what frequency does cop
hear from reflected
waves (off warehouse)?

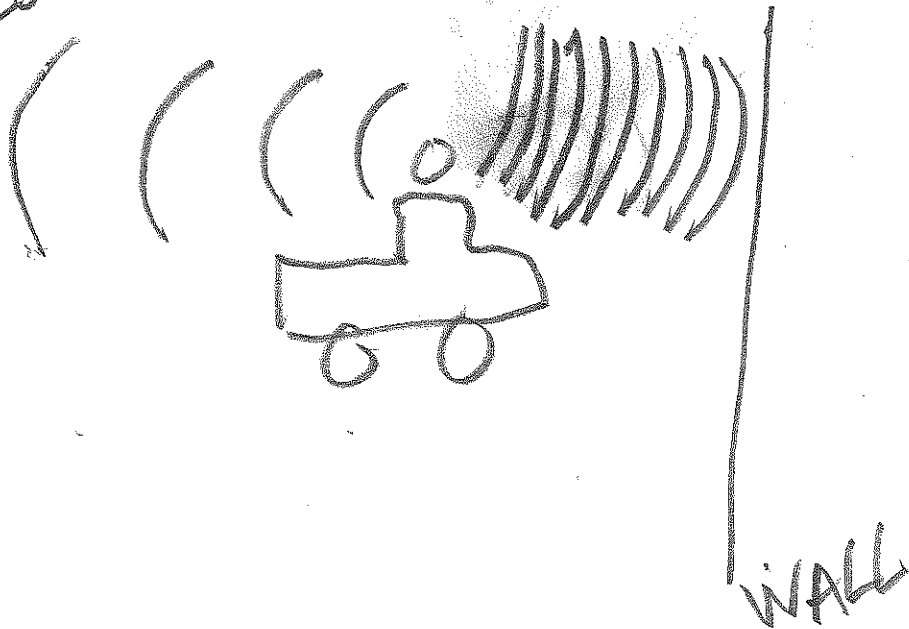
example 16.18

(2)

(A)

LOW f

HIGH f



formula = $f_{\text{Doppler}} = f \cdot \left(\frac{v}{v \pm v_s} \right)$

MOVING SOURCE
of SOUND.

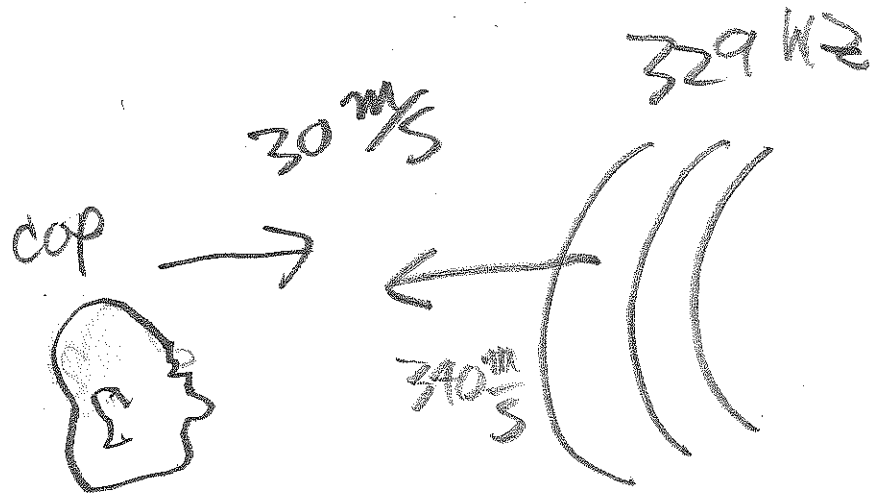
+ SOURCE MOVES
AWAY

- SOURCE MOVES
TOWARD

$$f_{\text{wall}} = (300 \text{ Hz}) \left(\frac{340}{340 - 30} \right) \quad (3)$$

$$= 329 \text{ Hz}$$

(B)



DERIVE DOPPLER SHIFT

effective speed of sound for cop:

$$= (30 + 340) \frac{\text{m}}{\text{s}}$$

$$= 370 \frac{\text{m}}{\text{s}}$$

$$f_{\text{Doppler (cop)}} = \frac{\text{speed}}{\lambda'} = \frac{370 \frac{\text{m}}{\text{s}}}{\lambda'}$$

FIND λ'

(4)

$$\lambda' = \lambda_0 \left(\frac{v \pm v_s}{v} \right)$$

see 8-30-13 notes

use - for wall

$$\lambda' = \lambda_0 \left(\frac{v - v_s}{v} \right)$$

$$= \left(\frac{340 \frac{m}{s}}{300 s^{-1}} \right) \left(\frac{340 \frac{m}{s} - 30 \frac{m}{s}}{340 \frac{m}{s}} \right)$$

$$= (1.133)(0.9117)$$

$$= 1.0329$$

(5)

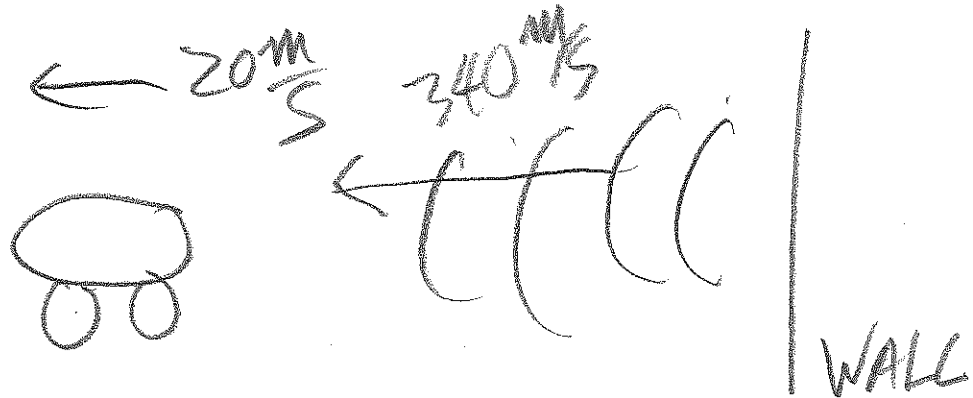
$f_{\text{DOPPLER(COP)}}$

$$= \frac{376 \text{ m/s}}{1.0329}$$

$$= 364 \text{ Hz}$$

444

PHYSICS OLYMPIAD



$$\begin{aligned}
 f_{WALL} &= (300) \left(\frac{v}{v + v_s} \right) \\
 &= (300) \left(\frac{340}{340 + 20} \right) \\
 &= (300) \cdot \left(\frac{340}{360} \right) \\
 &= 283 \text{ Hz}
 \end{aligned}$$

NOTE:
 $v_{20} = (340 - 20) \frac{m}{s}$
 relative speed of
 sound for
 car

$$f_{car} = \frac{\text{speed (effective)}}{\lambda''} = \frac{320 \frac{m}{s}}{\lambda''}$$

$$\lambda' = \lambda \left(\frac{v + v_s}{v} \right)$$

$$= (1.133) \left(\frac{340 + 20}{340} \right)$$

$$= (1.133) (1.0588)$$

$$= 1.1996 \text{ m}$$

$$f_{\text{cop}} = \frac{320 \text{ m/s}}{1.1996 \text{ m}} =$$

$$\Rightarrow 267 \text{ Hz} < 300 \text{ Hz}$$

$$\Rightarrow 267 \text{ Hz} < 283 \text{ Hz} < 300 \text{ Hz}$$