PHYS 101: General Physics 1 **KOÇ UNIVERSITY** **Fall Semestre 2010**

College of Sciences

Section 1 **Quiz 12** **06 January 2011**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: SOLUTION **Student ID:** **Signature:**

A sinusoidal sound wave has the speed **v** and wave length **λ**. The sound wave travels in the positive x- direction and at (t=0 , x=0) it has maximum upward displacement of **A** . Write the corresponding displacement y(x,t) and pessure p(x,t) wave equations in terms of (**v**, **λ** ,A) describing the same wave. (Take the bulk modulus of the medium as **B**.)

$y(x,t) = A\cos(kx - \omega t)$ → positive $\hat{x}$ direction

$k = \frac{2\pi}{\lambda}$, $\lambda f = v$

$\omega = 2\pi f = 2\pi \cdot \frac{v}{\lambda}$

(I) $y(x,t) = A\cos\left[\frac{2\pi}{\lambda}(x - vt)\right]$ ✓

(II) $p(x,t) = -B\frac{\partial y}{\partial x} = -BA\left(-\sin\left[\frac{2\pi}{\lambda}(x-vt)\right]\right)\cdot\frac{2\pi}{\lambda}$

$= \frac{2\pi}{\lambda} BA \sin\left[\frac{2\pi}{\lambda}(x-vt)\right]$ ✓

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Section 2 **Quiz 12** **06 January 2011**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: SOLUTION **Student ID:** **Signature:**

The pressure in a traveling sound wave is given by the equation

$$P = (1.5Pa)\sin\pi[(1.00m^{-1})x - (330s^{-1})t]$$

Find; a) the pressure amplitude, b) the frequency, c) the wavelength and d) the speed of the wave.

(a) $p(x,t) = BAk \sin(kx - \omega t)$

$$BAk = 1.5\,Pa$$

$$A = \frac{1.5\,Pa}{Bk} = \frac{1.5}{\pi B} \simeq \frac{1}{2B}$$

(b) $\omega = 2\pi f = 330\pi$ $\quad f = 165\ Hz$

(c) $\lambda = \frac{2\pi}{k}$ $\quad , k = \pi$ $\quad , \lambda = 2\ m$

(d) $v = \lambda f = 115.2 = 330\ m/s$

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Section 3 **Quiz 12** **06 January 2011**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: SOLUTION **Student ID:** **Signature:**

Calculate the length of an organ pipe that is open at one end and closed at the other if its fundamental frequency is to be 9 times that of a pipe that is 7 m. long and open at both ends.

both Open / $f_n = \frac{nv}{2L} = \frac{nv}{2.7}$

one end open / $f_n' = \frac{nv}{4L} = 9 f_n = 9 \cdot \frac{nv}{14} = \frac{nv}{4L}$

$L = \frac{14}{4.9} = \frac{14}{36} = \frac{7}{18}$ m

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Section 4 **Quiz 12** **06 January 2011**

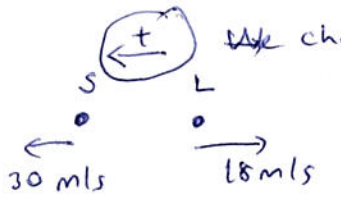
Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: SOLUTION **Student ID:** **Signature:**

A railroad train is traveling at 30 m/s in still air.The frequency of the note emitted by the train whistle is 200 Hz. What frequency is heard by a passenger on a train moving in the opposite direction to the first at 18 m/s and moving away from the first? (Listener and source are moving away from each other!) The speed of sound is 340 m/s.

$$f_L = \left(\frac{v + v_L}{v + v_S} \right) f_S$$

$v = 340$ m/s



choose + direction from listener to the source

$$f_L = \left(\frac{340 + 18}{340 + 30} \right) \cdot 200 \text{ Hz}$$

$$= (0.87)(200) \text{ Hz}.$$

$$f_L < f_S$$

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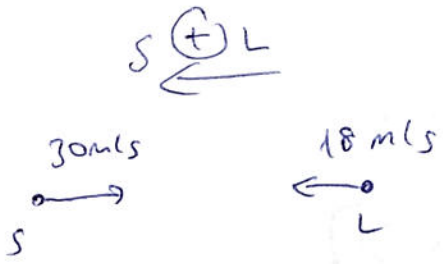
Section 5 **Quiz 12** **06 January 2011**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: SOLUTION **Student ID:** **Signature:**

A railroad train is traveling at 30 m/s in still air.The frequency of the note emitted by the train whistle is 200 Hz. What frequency is heard by a passenger on a train moving in the opposite direction to the first at 18 m/s and approaching the first? (Listener and source are approaching each other!) The speed of sound is 340 m/s.



$v = 340$ m/s

$$f_L = \left(\frac{v + v_L}{v + v_S} \right) f_S$$

$$= \left(\frac{v + 18}{v - 30} \right) f_S = \left(\frac{340 + 18}{340 - 30} \right) 200 \text{ Hz}.$$

$$= (1.15)(200) \text{ Hz}.$$

$f_L > f_S$