total: 30 points

Homework 9.2

Exercises: 9, 10, 11, 12, 14, 15, 16, 23, 24, 31, 32
Problems: 1, 2, 3, 4

(2) **E.9 To raise its pitch, you could do:** Less mass, more tension, or less length.

(2) **E.10** A less taut (tense) string will result in a lower pitch

(2) **E.11** The copper wrap adds mass to the string to lower its pitch.

(2) **E.12** They usually are the thinnest strings (least mass) and/or the ones with the highest tension.

(2) **E.14** Helium has less density than air (lower speed of sound), this raises the pitch.

(2) **E.15** A piccolo's air columns are half the length of those in a flute, so they vibrate at twice the pitch or one octave higher.

(2) **E.16 The longer the tube (air column), the lower the pitch. Thus, the tuba has a much lower pitch than the trumpet**

(2) **E.23 In a standing wave, as in the vibrating violin string,** crests and troughs don't travel along the string. Instead, (in the fundamental mode) the center of the string is a stationary antinode, which becomes alternately a crest and a trough.

(2) **E.24** In a traveling wave, the crest moves along the string, just as the bump does along the kite string.

(2) **E.31** The surface (secondary oscillator) projects sound waves far better than strings alone.

(2) **E.32** The wooden structure is the secondary oscillator; that is, the surface that amplifies and projects the sound. Without it, the sound coming from just the strings would be very low.

(2) P.1 $f = 110\ Hz$, speed of sound $c = 343\ \frac{m}{s}$

$c = f \cdot \lambda$

$\rightarrow \lambda = c/f$

$\lambda = \frac{343\ m/s}{110\ Hz}$

$\lambda = 3.1\ m$

(could also use $c = 331\ m/s$ (at 0°C))

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(2) P.2 (see problem P.1): $\lambda = \frac{c}{f}$, $f = 1760\ Hz$

$\rightarrow \lambda = 0.19\ m$

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(2) P.3 $f = 264\ Hz$, $\lambda = 1.00\ m$

$c = f \cdot \lambda$

$c = 264\ Hz \cdot 1.00\ m$

$c = 264\ m/s$

(2) P.4 $f = 440\ Hz$, $\lambda = 0.725\ m$

$c = f \cdot \lambda$

$c = 319\ m/s$