Some chapter 11 and 12 type problems....

1. A simple harmonic oscill ator has an amplitude of motion of 20 cm. Find a value of x for which the kinetic and potential energies are equal.

if $K=U$ and $U+K=E$

then $U=\frac{1}{2}E$ or $\frac{1}{2}kx^2=\frac{1}{4}kA^2$

so $x=A/\sqrt{2}=14.1\,cm$

2. Why must a pendulum clock have its amplitude kept constant if it is to keep time accurately?

Because its period is only independent of amplitude if its amplitude is small, even then only approximately. Period must be constant.

3. A mass executing simple harmonic motion on a spring with a spring constant of 50 N/m has an amplitude of motion of 30 cm. If its maximum speed is 1.5 m/s, the value of the mass is, in kg,

$E=\frac{1}{2}kA^2=\frac{1}{2}(50\,N/m)(0.30m)^2=2.25\,J$

$E\,also=\frac{1}{2}mv_{max}^2$ so $v_{max}=\sqrt{\frac{2E}{m}}$ or $m=\frac{2E}{v_{max}^2}$

~~$v_{max}=\sqrt{\frac{2(2.25J)}{m}}$~~ oops! $m=\frac{2(2.25J)}{(1.5m/s)^2}=2.22\,kg$

4. A pendulum has a certain period when it is oscillating on the surface of the earth. If we now put the pendulum in an elevator accelerating upwards, will its period increase or decrease?

Its apparent weight increases; that is, g is effectively bigger. Since the period is $T=2\pi\sqrt{\frac{\ell}{g}}$ the period decreases.

5. Find the intensity of a sound wave with a sound level of 125 dB.

$\beta=125=10\log_{10}(I/I_0)$, $12.5=\log_{10}(I/I_0)$

so $\frac{I}{I_0}=10^{12.5}=3.16\times10^{12}$ or $I=3.16\,W/m^2$ since $I_0=10^{-12}\,W/m^2$

6. If a source of sound moves away from us, will its intensity be lower than if it is stationary with respect to us?

No. Intensity is unaffected, Frequency is decreased.

7. A sound wave with a frequency of 440 Hz has what wavelength?

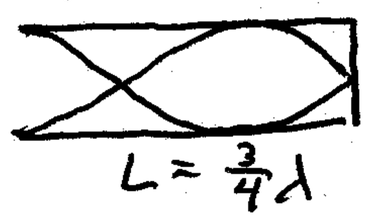
$v_{sound}=343\,m/s=\lambda f$

so $\lambda=\frac{343\,m/s}{440\,1/s}=78\,cm$

8. An organ pipe which is 75 cm long has one end closed and the other end open. What is the frequency of its second harmonic wave?

$L=\frac{3}{4}\lambda=\frac{3}{4}\frac{v_s}{f}$

so $f=\frac{3v_s}{4L}=\frac{3(343\,m/s)}{4(0.75m)}=343\,Hz$



A string which is 30 cm long and held motionless at both ends has a fundamental frequency of 45 Hz. What is the speed of the waves on the string? Are they longitudinal or transverse?

$L=\lambda/2=\frac{1}{2}\frac{v_s}{f}$ so $v_s=2fL$

$v_s=2(45\,Hz)(0.3m)=27\,m/s$

Transverse!