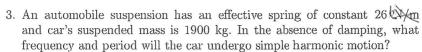
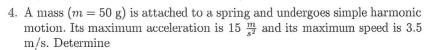
## 0.2 Physics for Smart Systems, 2nd week

- 1. A violin string playing the note A oscillates at 440 Hz. What is its oscillation period?
- 2. Write expressions for simple harmonic motion:
  - (a) with amplitude 10 cm, frequency 5.0 Hz and maximum displacement at t=0.
  - (b) with amplitude 2.5 cm, angular frequency 5.0 1/s and maximum velocity at t=0.





- (a) angular frequency,
- (b) spring constant,
- (a) amplitude.
- 5. Show that if  $y(t) = D\cos(\omega t + \phi)$ , where  $\omega$  is a constant, then

$$y''(t) + \omega^2 y(t) = 0.$$

This means that  $y(t) = D\cos(\omega t + \phi)$  is a solution to the differential equation (Simple Harmonic Motion).

6. In a mass-spring system  $m=400~{\rm g}$  and  $k=7.888~{\rm N/m}$ . It will oscillate according to Simple Harmonic Motion given by

$$y(t) = A\sin(\omega t + \theta).$$

- (a) What is the period?
- (b) Find the constants A and  $\theta$ , if the maximum displacement is 5 cm and the mass passes through y=0 at time t=0 in the positive direction.
- (c) Find the constants A and  $\theta$ , if the maximum displacement is 5 cm and the mass passes through y=0 at time t=0 in the negative direction.
- 7. Consider the Simple Harmonic Motion

$$y''(t) + \omega^2 y(t) = 0.$$

Let m=1.0 kg and k=4.0 N/m. Therefore  $\omega=2.0$  rad/s. The general solution is  $y(t)=A\sin(\omega t+\theta)$ . Find the constants A and  $\theta$ , if

(a) 
$$y(0) = 0$$
 and  $v(0) = y'(0) = 2$ .

(b) 
$$y(0) = 1$$
 and  $v(0) = y'(0) = 0$ .

What does the initial conditions in (a) and (b) mean physically?