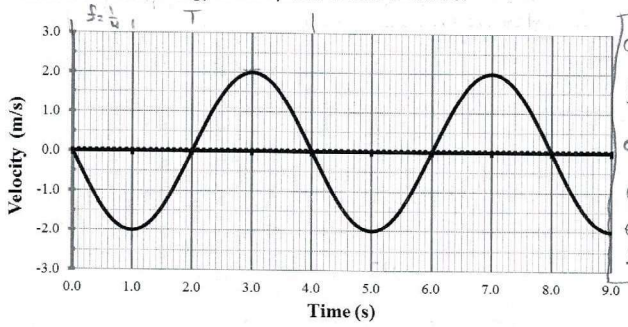
$U_{sp} = \frac{1}{2}kx^2$

2. ***~KJF2nd 14-48*** A 500 g mass is attached to a spring and oscillates on a smooth horizontal surface. Ignore friction and air resistance. The velocity-time graph for the oscillation is shown below.
   a) What is the period of the motion? *{4.0s}*
   b) What is the maximum speed of the mass?
   c) What is the maximum displacement (amplitude) of the motion? *{1.27 m}*
   d) What is the spring constant? *{1.23 N/m}*
   e) What is the maximum elastic potential energy (in J) of the mass-spring system? *{1.00 J}*
   f) What is the total energy of the system at time t = 3.50 s?



a) $T = 4.00\,s$
b) 2 m/s
c) 1.27 m
d) 1.23 N/m
e) 1.00 J
f) 1.00 J

$\omega = 2\pi f = \frac{2\pi}{4} = 1.570796327$

$V_{max} = A\omega \qquad A = \frac{2}{1.57} = 1.273239545$

$T = 2\pi\sqrt{\frac{m}{k}} \qquad \left(\frac{T}{2\pi}\right)^2 = \left(\sqrt{\frac{m}{k}}\right)^2 \qquad \left(\frac{T}{2\pi}\right)^2 M = \frac{M}{k}$

$a_{max} = A\omega^2 = 3.141592655 = A\left(\frac{k}{m}\right)$

$Ak = 1.570796328 \qquad k = 1.233700055$

A

$V(3.5) = -\omega A \sin(3.5\omega)$
$= 1.211015232$

$U_{sp_{max}} = \frac{1}{2}kA^2 = 1.000000001$

$x(3.5) = A\cos(3.5\omega)$
$= 0.903461903$

$\sum E_{t=3.5} = \frac{1}{2}MV^2 + \frac{1}{2}kx^2$

$= \frac{(0.5)(1.41)^2}{2} + \frac{(1.23)(0.903)^2}{2} = 1.000632365$