AP Physics B: Harmonic Motion

Heavy Machinery

1a. ON b. No. $\vec{F} = kQq\left(\frac{1}{(D+x)^2} - \frac{1}{(D-x)^2}\right) \neq -M\vec{x}$ for any constant M.

2. $T = 2\pi\sqrt{\frac{m}{k}}$

A: Double k. $T_A = \frac{T_0}{\sqrt{2}}$ B: Double M. $T_B = \sqrt{2}\,T_0$ C: Triple M, Double k. $T_C = \sqrt{\frac{3}{2}}\,T_0$

D: T_D E: T_E

3a. $T = 2.4\,s = 2\pi\sqrt{\frac{m}{k}}$; $k = \frac{(2\pi)^2}{T^2}m = 5.2\ N/m$

b. $v_{max} = \omega A = \sqrt{\frac{k}{m}}(0.50m) = 1.3\ m/s$

c. $U_T = \frac{1}{2}kA^2 = 0.66\ J$

d. $\vec{v} = 1.3\cos(2.6t)$

e. $a_{max} = \frac{kx}{m} = 3.4\ m/s^2$

f. 1.8s, 4.2s

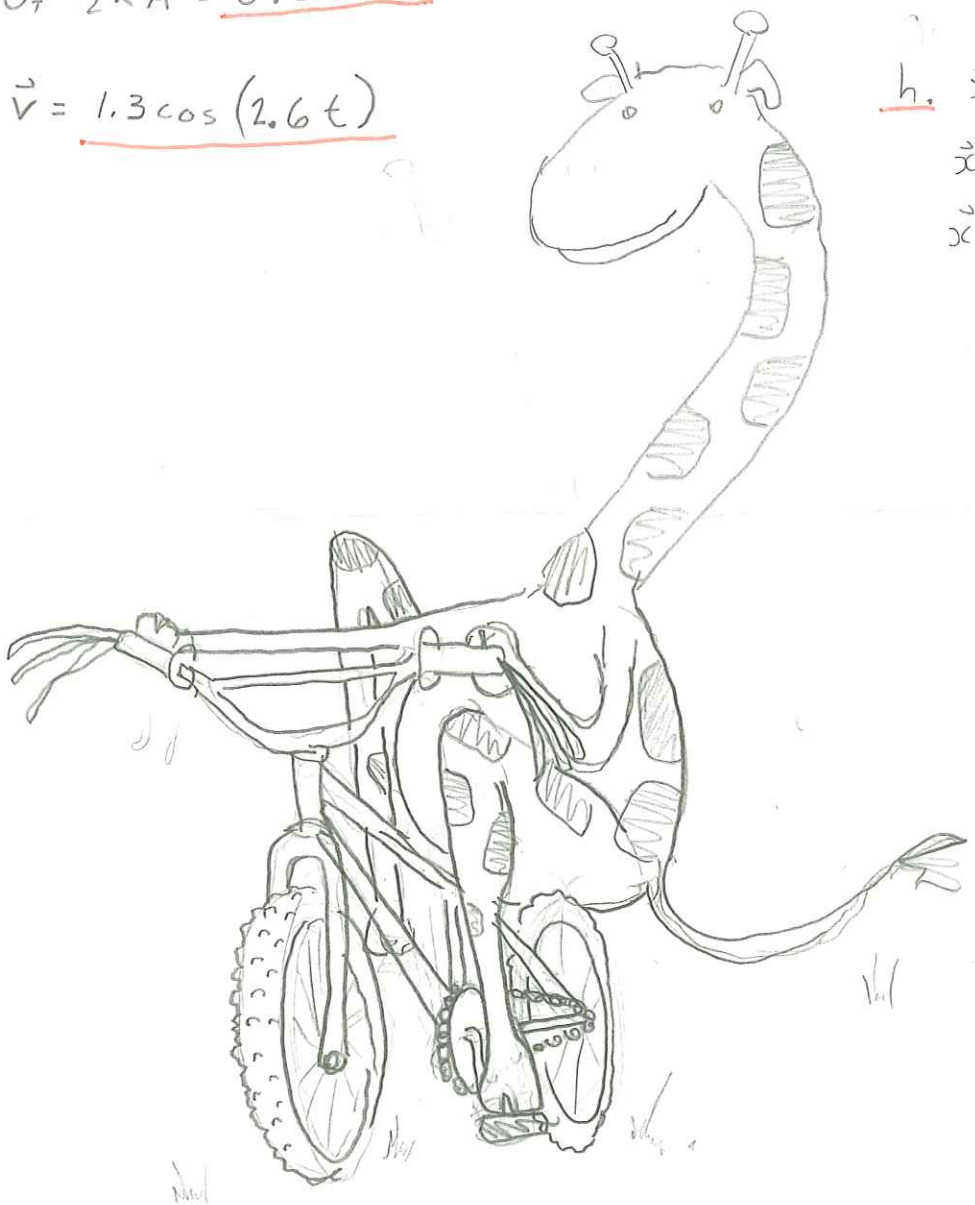
g. 0, 1.2s, 2.4s, 3.6s

h. $\vec{x} = A\sin(\omega t)$

$\vec{x} = 0.5\sin\left(\frac{2\pi}{T}t\right)$

$\vec{x} = 0.48\ m$

4.



5. $a_{max} = \frac{v_{max}^2}{A} \Rightarrow A = \frac{v_{max}^2}{a} = \frac{(1.2\ m/s)^2}{2.1\ m/s^2} = 0.6857142857\ m$

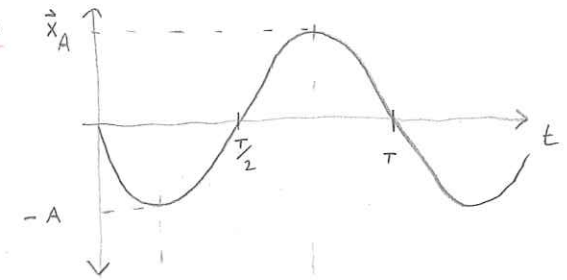
a. $a_{max} = \frac{kA}{m} \Rightarrow k = \frac{a_{max}\, m}{A} = \frac{2.1\ m/s^2\,(0.650\ kg)}{0.6857\ldots} = 1.990625$

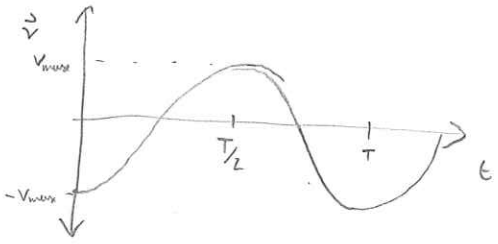
$k = 2.0\ N/m$

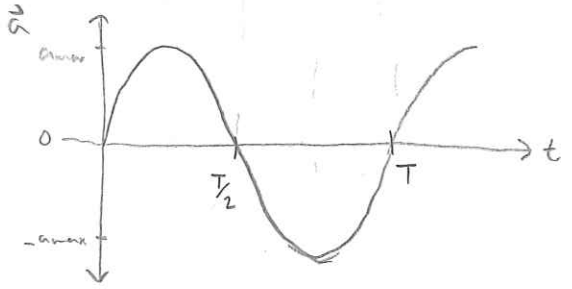
b. $A = 0.69\ m$

c. $v_{max} = \frac{2\pi A}{T} = 2\pi A f \Rightarrow f = \frac{v_{max}}{2\pi A} = 0.27852\ldots = 0.28\ Hz$

d.







6. $E = K + U = \frac{1}{2}mv^2 + U_s = \frac{1}{2}(0.444\ kg)(3.20\ m/s)^2 + 1.80\ J = 4.07328\ J$ ← THIS IS TOTAL ENERGY AND IT IS CONSTANT!

a. $U_{max} = \frac{1}{2}kA^2 = 4.07328\ J \Rightarrow A = \sqrt{\frac{2U_{max}}{k}} = 0.07628\ldots$ 7.6 cm

b. $T = 2\pi\sqrt{\frac{m}{k}} = 0.35384\ldots$ 0.35 s

c.