Pendulum

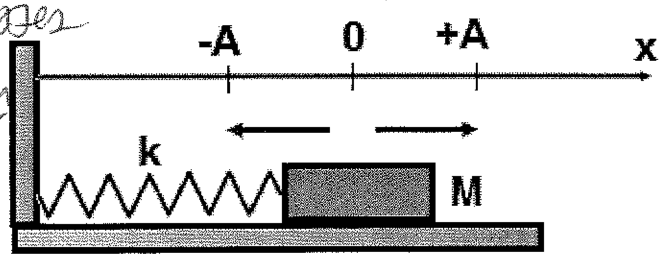
MC 7 13 14 15 16 17 FR 3

***Simple Harmonic Motion***
***Practice Problems***
*PSI AP Physics 1*

Name Solutions

Multiple Choice Questions

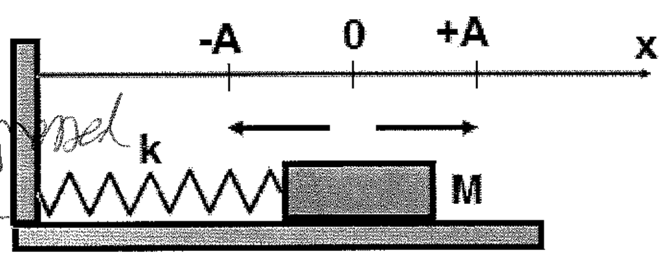
Vel = max as passes through equil. position @ X=0




1. A block with a mass M is attached to a spring with a spring constant k. The block undergoes SHM. Where is the block located when its velocity is a maximum in magnitude?

   A) x = 0 B) x = ±A C) x = +A/2 D) x = -A/2

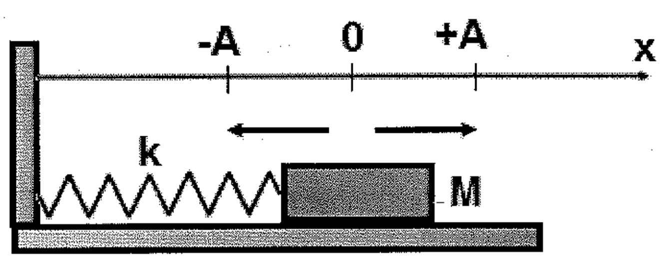
$PE_s$ = max when spring maximally compressed or maximally stretched @ ± A




2. A block with a mass M is attached to a spring with a spring constant k. The block undergoes SHM. Where is the block located when its potential energy is a maximum?

   A) x = 0 B) x = ±A C) x = +A/2 D) x = -A/2

Accel is minimum when F is minimum F=-kx is min @ X=0




3. A block with a mass M is attached to a spring with a spring constant k. The block undergoes SHM. Where is the block located when its acceleration is a minimum in magnitude?

   A) x = 0 B) x = ±A C) x = +A/2 D) x = -A/2

$T = 2\pi\sqrt{\frac{M}{K}}$ Period only depends on M and K not $A = X_{max}$

4. A mass-spring oscillating system undergoes SHM with a period T. What is the period of the system if the amplitude is doubled?

A) 2T B) 4T C) T D) T/2

Same M
Same K
→ Same T

5. A mass-spring oscillating system undergoes SHM with a period T when it is located on Earth. What is the period of the system when it is located on Moon?

A) 6T B) T/6 C) T D) $\sqrt{6}$ T

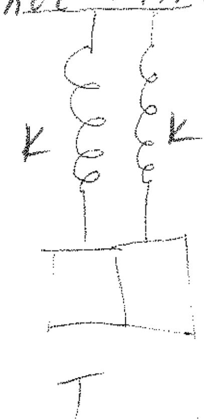
$T = 2\pi\sqrt{\frac{m}{k}}$ ∴ Same T

T of Spring-Mass is not dependent on g

6. A block with a mass M is attached to a vertical spring with a spring constant k. When the block is displaced from equilibrium and released its period is T. A second identical spring k is added to the first spring in parallel. What is the period of oscillations when the block is suspended from two springs?

A) 2T B) $\sqrt{2}$ T C) T D) $\frac{T}{\sqrt{2}}$

$K_{here} = K_1 + K_2$




$(K_1 + K_2)$

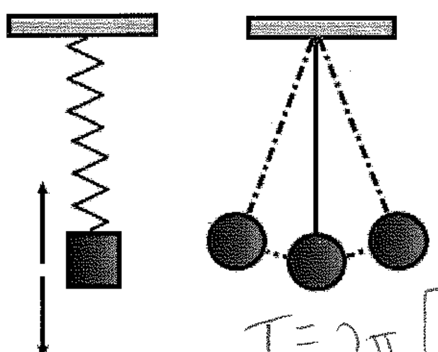
2K = K effective

$T_0 = 2\pi\sqrt{\frac{M}{K}}$

$T_N = 2\pi\sqrt{\frac{M}{2K}}$

$T_N = \frac{1}{\sqrt{2}}(T_0) = \frac{T_0}{\sqrt{2}}$

$T = 2\pi\sqrt{\frac{M}{K}}$



$T = 2\pi\sqrt{\frac{L}{g}}$

7. Two oscillating systems: spring-mass and simple pendulum undergo SHM with an identical period T. If the mass in each system is doubled which of the following is true about the new period?

| | Mass-spring | Simple pendulum |
|---|---|---|
| A) | $T$ | $\frac{T}{\sqrt{2}}$ |
| B) | $\frac{T}{\sqrt{2}}$ | $T$ |
| C) | $\sqrt{2}\,T$ | $T$ |
| D) | $T$ | $\sqrt{2}\,T$ |

T not Δed w/ Δ mass

$T = 2\pi\sqrt{\frac{L}{g}}$

$T_0 = 2\pi\sqrt{\frac{M}{K}}$

$T_N = 2\pi\sqrt{\frac{2m}{K}}$

$T_N = \sqrt{2}(T_0)$

$A \sin[B(x-c)] + D$ $\quad 2 = f$

$T = \frac{1}{2} = \frac{1}{f}$

8. An object undergoes SHM and position as a function of time is presented by the following formula: x= (0.1 m) Sin (4πt). What is the period of oscillations?

   A) 2 s  B) 0.1 s  C) 0.5 s  D) 4 s

$B = 2\pi f$

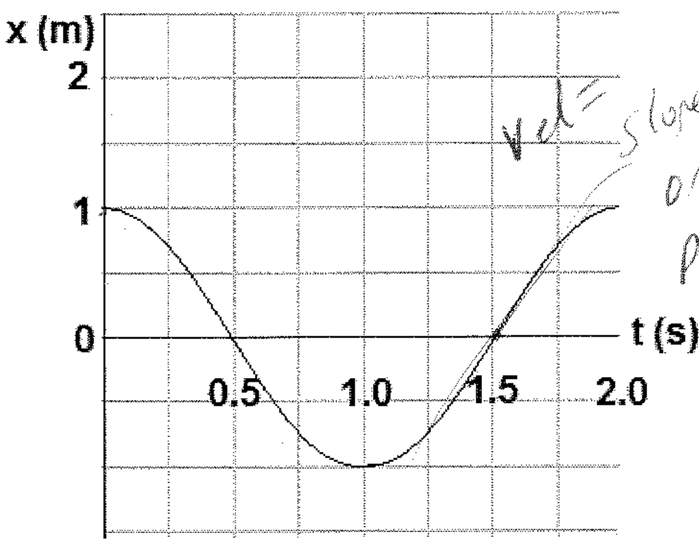
$4\pi = 2\pi f$

9. An object undergoes SHM and position as a function of time is presented by the following formula: x= (0.5 m) Cos (πt). What is the amplitude of oscillations?

   A) 2 m  B) 1 m  C) 0.5 m  D) 0.1 m

This is Amp

$.5 \cos \pi t$




slope $= \frac{\Delta x}{\Delta t} = +$

or - going through eq'B.

point V = max

a = 0

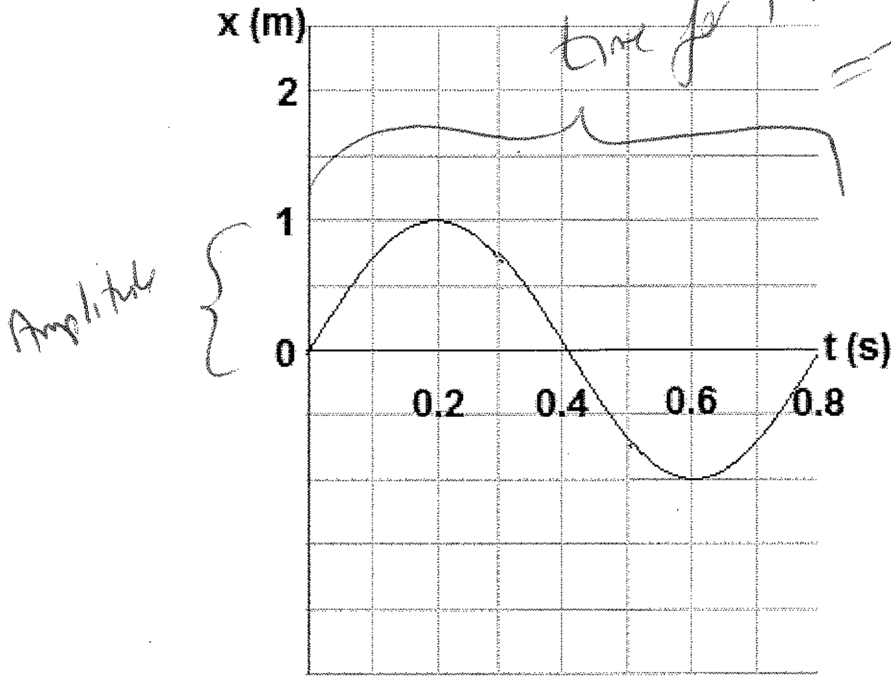
going to Stretched position (+X)

so V is +.

10. The position as a function of time of a mass-spring oscillating system is presented by the graph. Which of the following is true about velocity and acceleration at the time 1.5 s?

| Velocity | Acceleration |
|---|---|
| A) v >0 | a < 0 |
| B) v =0 | a > 0 |
| C) v < 0 | a = 0 |
| D) v >0 | a = 0 |

time for 1 complete cycle
= T




11. A particle undergoes SHM represented by the graph. Which of the following is true about the amplitude and period of oscillations?

| | Amplitude | Period |
|---|---|---|
| A) | 1 m | 0.8 s |
| B) | 1 m | 0.1 s |
| C) | 1 m | 0.4 s |
| D) | 2 m | 0.4 s |

A

T = .8 s

$X(t) = A \sin[B(t-C)] + D$ $C$ = Hz translation to Rt of sin wave

$B = 2\pi f = \frac{2\pi}{T}$

$T = 2$ sec

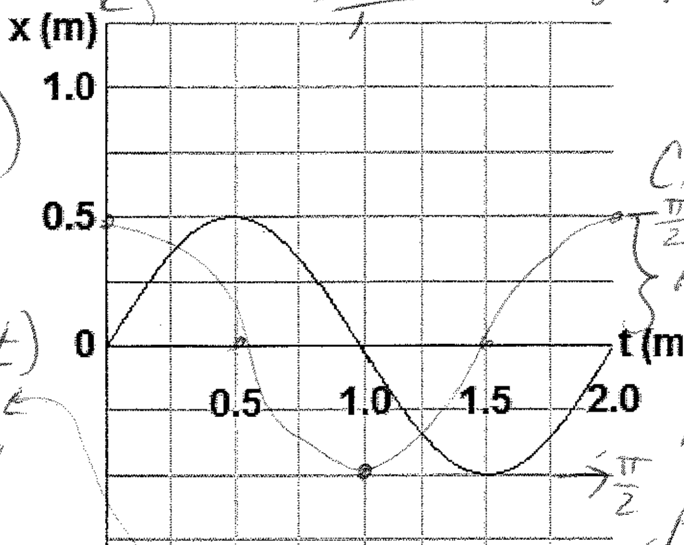
$D$ = vertical translation up (+) or down (−) of equilibrium.

From graph

$X(t) = .5 \sin\left(\frac{2\pi}{T} t\right)$

$= .5 \sin \frac{2\pi}{2} t$

$X(t) = .5 \sin(\pi t)$




CAN PLOT Shape of Velocity curve Knowing $V = V_{max}$ when going thru $X = 0$ AND $V = \frac{\Delta X}{\Delta t}$ slope of x

But doesn't give Amp of Vel Curve

How to find $V_{max}$ = Amp of Velocity graph

one way use circular motion

$V = \frac{2\pi r}{T}$

($r$ = string $X_{max}$)

$= \frac{2\pi(\frac{1}{2})}{2s} = \frac{\pi}{2}$

12. An object oscillates at the end of a spring. The position as a function of time is presented by the graph. Which of the following formulas represent the position and velocity of the object?

| Position | Velocity |
|---|---|
| A) x = (0.5) Sin(πt) | v = (0.5π) Sin(πt) |
| B) x = (0.5) Sin(πt) | v = (0.5π) Cos(πt) |
| C) x = (0.5) Cos(πt) | v = (0.5π) Sin(πt) |
| D) x = (0.5π) Sin(πt) | v = (0.5) Sin(πt) |

So need into

$V_{max} \cos 2\pi f t$

$V(t) = V_{max} \cos(\pi t)$

$V(t) = \frac{\pi}{2}(\cos \pi t)$

13. A simple pendulum oscillates with a period T. If the mass of the pendulum is doubled what is the new period of the pendulum?

A) T/2   B) 2T   C) T   D) $\sqrt{2}$ T

$T_s = 2\pi\sqrt{\frac{m}{k}}$ mass spring

$T_p = 2\pi\sqrt{\frac{L}{g}}$ mass does not affect $T_p$

14. A simple pendulum oscillates with a period T. If the length of the pendulum is doubled what is the new period of the pendulum?

A) 2T   B) T   C) $\sqrt{2}$ T   D) $\frac{T}{\sqrt{2}}$

$T_o = 2\pi\sqrt{\frac{L_o}{g}}$

$T_N = 2\pi\sqrt{\frac{2L_o}{g}} = \sqrt{2}\left(2\pi\sqrt{\frac{L_o}{g}}\right)$

$T_N = \sqrt{2}\, T_o$

15. What is the length of a simple pendulum if it oscillates with a period of 2 s?

A) 2.0 m   B) 1.0 m   C) 0.5 m   D) 0.4 m

$T = 2\pi \frac{\sqrt{L}}{\sqrt{g}}$

$\frac{T}{2\pi} = \sqrt{\frac{L}{g}}$   $\frac{T^2}{4\pi^2} = \frac{L}{g} \Rightarrow L = \frac{g T^2}{4\pi^2} = \frac{10(4)}{4\pi^2} = \approx 1$

#12 How Also to find $V(t)$ if know $X(t) = 0.5 \sin(\pi t)$ mc #12

If know calculus easy $\frac{dx}{dt} = \left(\frac{d(.5 \sin \pi t)}{dt}\right)\left[\frac{d(\pi t)}{dt}\right]$

Chain Rule give

$V(t) = [.5 \cos \pi t](\pi)$

OR

$v(t) = \frac{\pi}{2} \cos \pi t$

We can also find it using Cons. of Energy

By graphs we know $V(t) = A \cos(\pi t)$

↑ need $A = V_{max}$

max ~~KE~~ = max PE

$\frac{1}{2} k X_{max}^2 = \frac{1}{2} m V_{max}^2$

$V_{max} = X_{max}\sqrt{\frac{K}{m}}$

We know for spring mass

$T = 2\pi\sqrt{\frac{m}{K}} \Rightarrow \frac{T}{2\pi} = \sqrt{\frac{m}{K}}$

Flipping $\sqrt{\frac{K}{m}} = \frac{2\pi}{T} = \frac{2\pi}{2}$ $T = 2$ sec here

$\sqrt{\frac{K}{m}} = \pi$ So $V_{max} = X_{max}(\pi)$

$X_{max} = \frac{1}{2}$

$V_{max} = .5\pi = A$

So $V(t) = A \cos \pi t$

$V(t) = \frac{1}{2}(\pi) \cos(\pi t)$

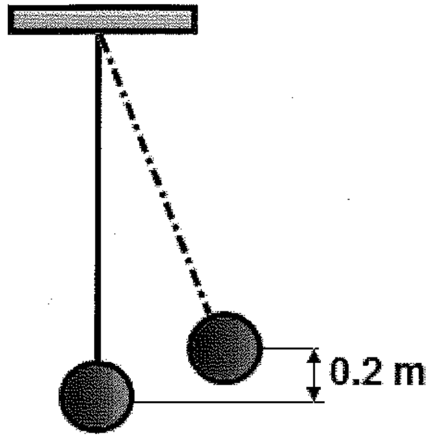
$PE_{max} = KE_{max}$ @ max vel all

So $mgh = \frac{1}{2}mv^2$  PE → converted to KE

$v = \sqrt{2gh}$

$= \sqrt{2(10)(.2)}$

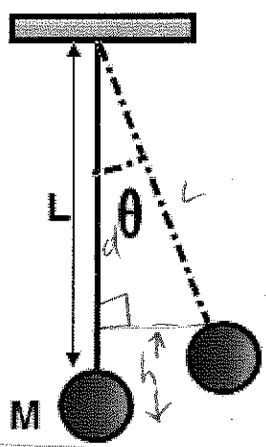
$v_{max} = \sqrt{4} = 2 m/s$




16. A simple pendulum consists of a mass M attached to a vertical string L. When the string is displaced to the right the ball moves up by a distance 0.2 m. When the ball is released from rest what is the maximum speed?

A) 1 m/s  B) 2 m/s  C) 3 m/s  D) 4 m/s

"yes"  NO  circled wrong answer!




$\cos\theta = \frac{d}{L}$

$d = L\cos\theta$

$h = L - d$

$= (L - L\cos\theta)$

$h = L(1-\cos\theta)$

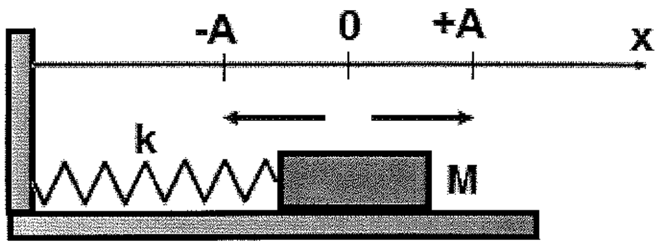
17. A simple pendulum consists of a mass M attached to a vertical string L. The string is displaced to the right by an angle Θ. When the pendulum is released from rest what is the speed of the ball at the lowest point?

A) 2 gL  B) $\sqrt{2gL}$  C) $\sqrt{2gL \cos\theta}$  D) $\sqrt{2gL(1-\cos\theta)}$

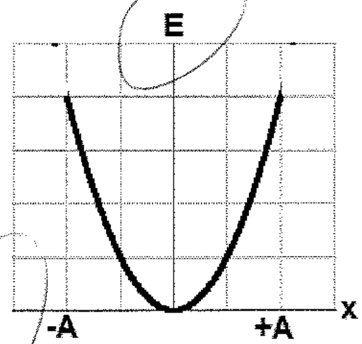
$\frac{1}{2}mv^2 = mgh$

$v = \sqrt{2gh}$  (h = ? see above)

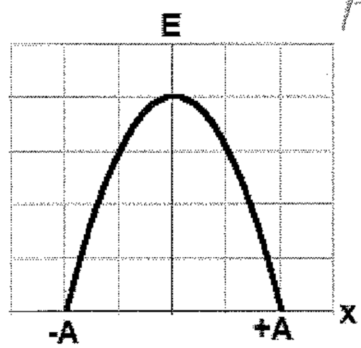
$v = \sqrt{2gL(1-\cos\theta)}$



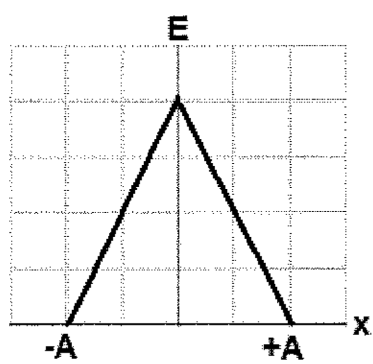

18. A block of mass M is attached to a horizontal spring k. The block undergoes SHM with amplitude of A. Which of the following graphs represents the elastic potential energy as a function of position x?



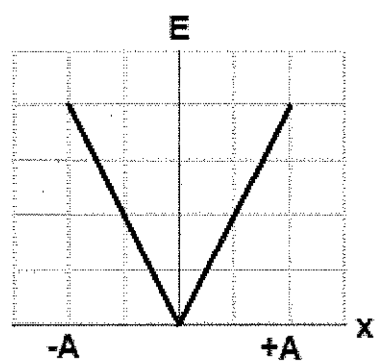

A)




B)




C)




D)

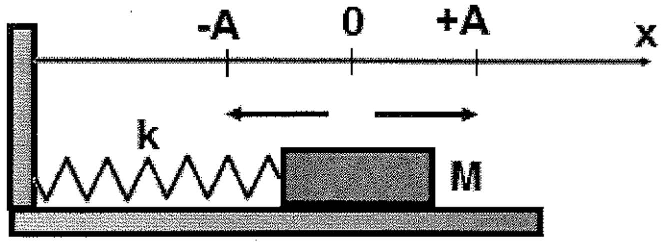
$PE_s = mTX$

@ $X_{max}$ ($\pm A$)

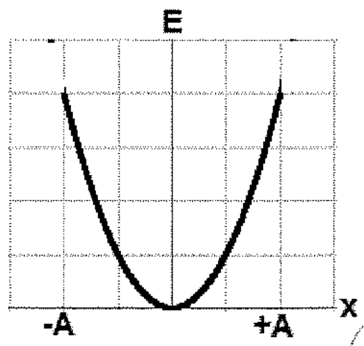
$= \frac{1}{2} k x^2$

This is an equation of a Parabola that opens up

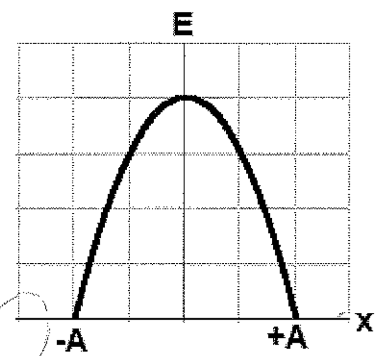
∴ A




19. A block of mass M is attached to a horizontal spring k. The block undergoes SHM with amplitude of A. Which of the following graphs represents the kinetic energy as a function of position x?



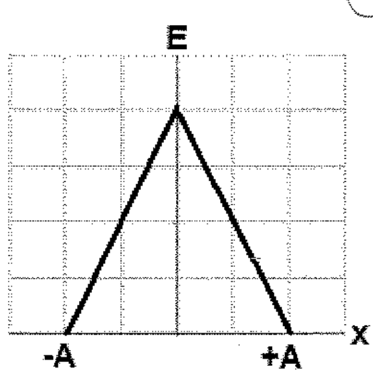

A)



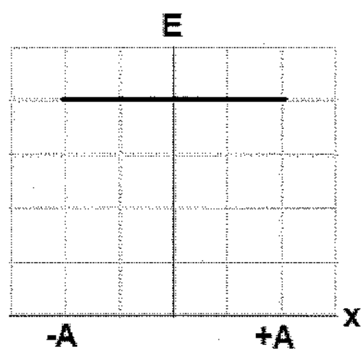

B)

max @ $x=0$

min $=0$ @ endpoints




C)




D)

$KE = \frac{1}{2}mv^2$

max @ $x=0$

then dec. to

zero @ endpoints $\pm A$.

so = B

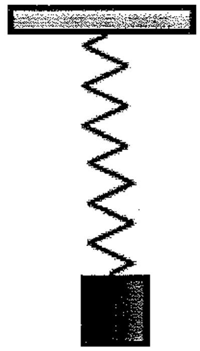
$T = 2\pi\sqrt{\frac{m}{k}}$

$= 2\pi\sqrt{\frac{.9}{10}} = .3(2\pi)$

$\frac{1}{2}T \Rightarrow$ question.

$t = \frac{1}{2}T = \frac{1}{2}(.3)(2\pi)$

$t = .3\pi\ s$



20. A 0.9 kg block is attached to an unstretched spring with a spring constant of 10 N/m. The block is released from rest. How long does it take for the block to return to its initial position?

A) 0.3π s  B) 0.5π s  C) 0.6π s  D) 0.9π s

Multi Correct Questions

Directions: For each of the following, two of the suggested answers will be correct. Select the best two choices to earn credit. No partial credit will be earned if only one correct choice is selected.

21. A student wishes to determine the spring constant of a spring in a mass-spring oscillating system. Which of the following pieces of equipment will provide the measured quantities needed for this calculation?

A) Meterstick  using meterstick and Balance $F = -kx$, $mg$

B) Balance

C) Stopwatch  - using Balance + Stopwatch measure mass time $t$  $t = 2\pi\sqrt{\frac{m}{k}}$  solve for $k$

D) Accelerometer

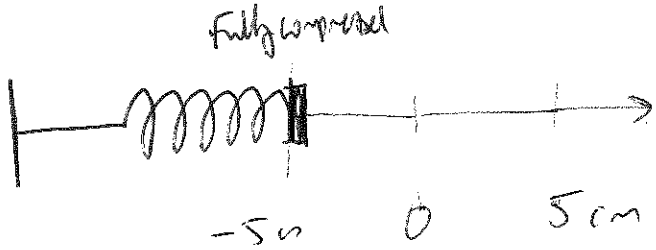
22. When an object in simple harmonic motion reaches its maximum displacement, which of the following statements are true?

A) The acceleration of the object is zero.  NO MAX @ max displacement  Acc $F = -kx = mA$  $A = -\frac{kx}{m}$

B) The kinetic energy is at a maximum.
No $\emptyset$ since $v = 0$

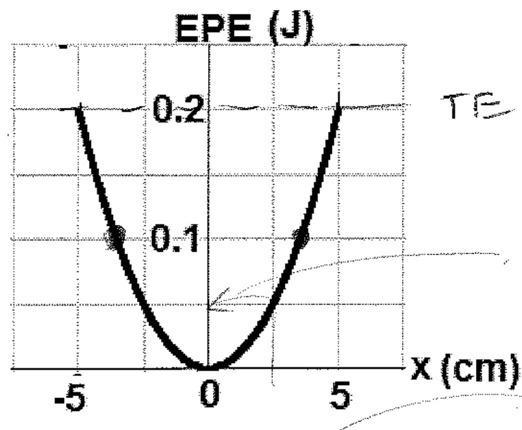
C) The velocity of the object is zero.
yes!

D) The potential energy is at a maximum.
yes




Free Response Problems

1. A 0.4 kg object is attached to a horizontal spring undergoes SHM with the total energy of 0.2 J. The potential energy as a function of position presented by the graph below:




KE = PE
KE + KE = TE
2KE = TE
$KE = \frac{TE}{2}$

This is PEs
KE + PE = TE
KE = TE − PE
KE = .2 − .05J
= .15J

a. What is the amplitude of oscillations? 5 cm = .05 m

b. What is the spring constant? $160 \frac{N}{m} = k$

c. What is the kinetic energy of the system at point x = 2.5 cm? .15J

$\frac{1}{2}k(\Delta x)^2 = \frac{1}{2}(160\frac{N}{m})(0.025m)^2 = .05J$

d. Indicate point or points where the kinetic energy equals the potential energy of the system. When $KE = \frac{1}{2}TE$ ! See dots on curve

e. What is the maximum speed of the object? $1\frac{m}{s}$

$\cancel{X_{max}} = \sqrt{\frac{2(0.2)}{k}}$

e) Then ME = KE

$\frac{1}{2}kX_{max}^2 = 0.2J$

$\frac{1}{2}k(.05m)^2 = .2J$

$k(.05)^2 = .4$

$k = \frac{.4}{(.05)^2} = 160 N/m$

TE

$.2J = \frac{1}{2}mv_{max}^2$

$.4 = mv_{max}^2$

$\sqrt{\frac{.4}{m}} = v_{max} = \sqrt{\frac{.4}{.4}} = 1\frac{m}{s}$

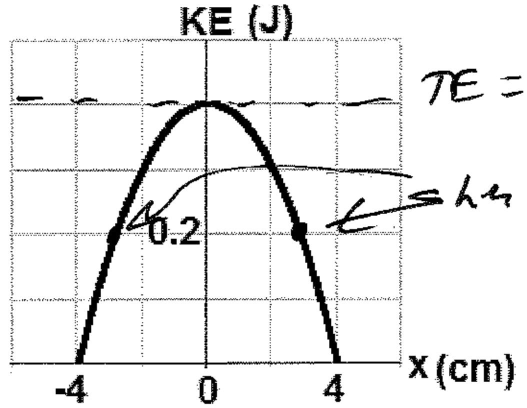
2. A 0.2 kg object is attached to a horizontal spring undergoes SHM with the total energy of 0.4 J. The kinetic energy as a function of position presented by the graph below:

@ max speed

TE all $KE = \frac{1}{2} m V_{max}^2$

$\sqrt{\frac{2(TE)}{m}} = V_{max}$

$\sqrt{\frac{2(.4J)}{.2kg}} = \sqrt{4} = 2\frac{m}{s}$




$TE = 0.4J$

when $KE = \frac{1}{2} TE$

$PE = \frac{1}{2} TE$

a. What is the maximum displacement from equilibrium? $4cm = .04m$

b. What is the maximum speed of the object? ~~.9~~ → 2m/s

c. What is the spring constant?

d. Indicate point or points where the kinetic energy equals the potential energy of the system. where $KE = \frac{1}{2} TE$

e. What is the potential energy of the system at point x = 2 cm?

↳ $\frac{1}{2} k \Delta x^2 = \frac{1}{2} 500\frac{N}{m} (.02)^2$

$PE = .1 J$

AT max excursion

TE all $PE_s$

$TE = \frac{1}{2} k X_{max}^2$

$\frac{2TE}{X_{max}^2} = k = \frac{2(0.4J)}{(.04m)^2}$ = $500\frac{N}{m} = k$

e) $(m_1+m_2) \rightarrow v_{ix} = 1.9\,m/s$

$\uparrow$ .7m $\downarrow$

$t = \sqrt{\frac{-2y_i}{a_y}} = \sqrt{\frac{-2(.7m)}{-9.8\frac{m}{s^2}}} = .38\,sec$

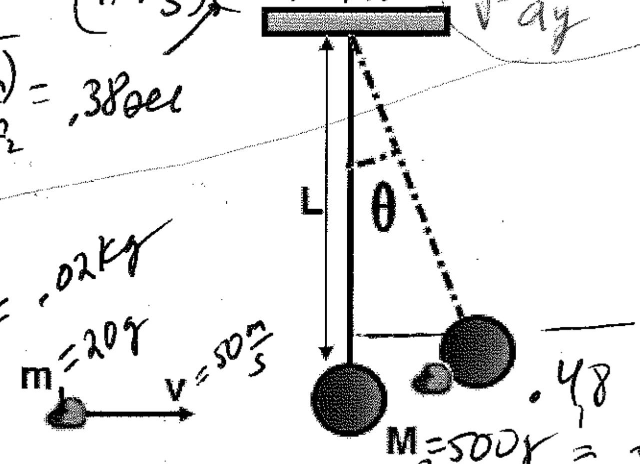
$v\Delta t = \Delta x$

$(1.9\frac{m}{s})(.38s) = .72m$

$y_f = y_i + v_{iy}^{\,0} t + \frac{1}{2}a_y t^2$

$0 = y_i + \frac{1}{2}a_y t^2$

$\sqrt{\frac{-2y_i}{a_y}} = t$




Some of these Answers do not match solutions. If you see errors please let me know! thanks

3. A 20 g piece of clay moving at a speed of 50 m/s strikes a 500 g pendulum bob at rest. The length of a string is 0.8 m. After the collision the clay-bob system starts to oscillate as a simple pendulum.

   a. What is the speed of the clay-bob system after the collision?

   b. What is the maximum angular displacement of the pendulum?

   c. What is the period of the clay-bob oscillating system? $T = 2\pi\sqrt{\frac{L}{g}} = 2\pi\sqrt{\frac{.8m}{9.8}}$ $T = 1.8\,sec$

   all KE at start → max Energy

   d. What is the total energy of the oscillating system? .945

   $\frac{1}{2}(m_1+m_2)v_i^2 = \frac{1}{2}(.02 + .5)kg(1.9\frac{m}{s})^2 = .945$

   The pendulum bob makes one complete oscillation and the string breaks at the lowest point.

   e. What is the maximum horizontal distance of the bob when it strikes the floor 0.7 m below?

a) $m_1 v_{1i} + m_2 \cancel{v_{2i}}^{\,0} = (m_1+m_2)v_f$

$v_f = \frac{m_1 v_{1i}}{(m_1+m_2)} = \frac{(.020\,kg)(50\,m/s)}{(.020\,kg + 0.5\,kg)} = 1.9\,m/s$ to Rt

$v_f$ After collision = $v_{max}$ for pendulum = $v_{max}$

O

.7m

b) $\frac{1}{2}(m_1 + m_2)v_{max}^2 = (m_1 + m_2)gh$

$KE_{max} = PE_{max}$

$h = \frac{v_{max}^2}{2g} = \frac{(1.9\,m/s)^2}{2(9.81\frac{m}{s^2})} = .18m$

(L−h)

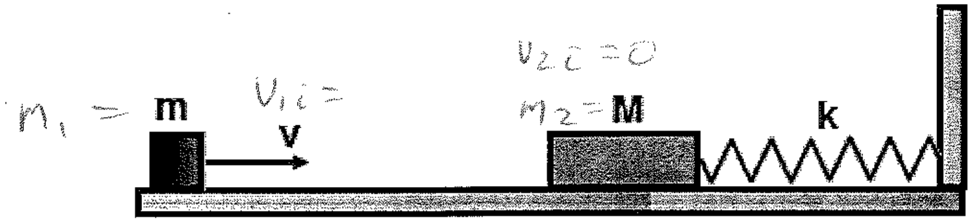
(L−.18) θ L

h = .18

L = .8

$\cos\theta = \left(\frac{L - .18}{L}\right)$

$\theta = \cos^{-1}\left(\frac{.8 - .18}{.8}\right) = 39.2°$




4. A small block moving with a constant speed v collides inelastically with a block M attached to one end of a spring k. The other end of the spring is connected to a stationary wall. Ignore friction between the blocks and the surface.

   a. What is the speed of the system of two blocks after the collision?

   b. What is amplitude of oscillations of the system of two blocks?

   c. What is the period of oscillations?

   d. What is the total energy of the oscillating system?

a) $m_1 V_{1i} + \cancel{m_2 V_{2i}} = (m_1 + m_2) V_f \qquad V_f = \frac{m_1 V_{1i}}{m_1 + m_2}$

speed after collision.

b) All KE will then be converted to PE,

$$\cancel{\tfrac{1}{2}} m v_{max}^2 = \cancel{\tfrac{1}{2}} k x^2$$

$$\sqrt{(m+M)\left(\frac{mV}{m+M}\right)^2} = \sqrt{k X_{max}^2}$$

$$\frac{mV}{\sqrt{m+M}} = \sqrt{k}\, X_{max}$$

c) $T = 2\pi\sqrt{\frac{m_T}{k}}$

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

$$\text{Amp} = X_{max} = \frac{mv}{\sqrt{k(m+M)}}$$

d) TE is all $KE_i$

$$\tfrac{1}{2}(m_1+M)V_i^2 = \tfrac{1}{2}(m+M)\left(\frac{mV_i}{m+M}\right)^2 = TE$$

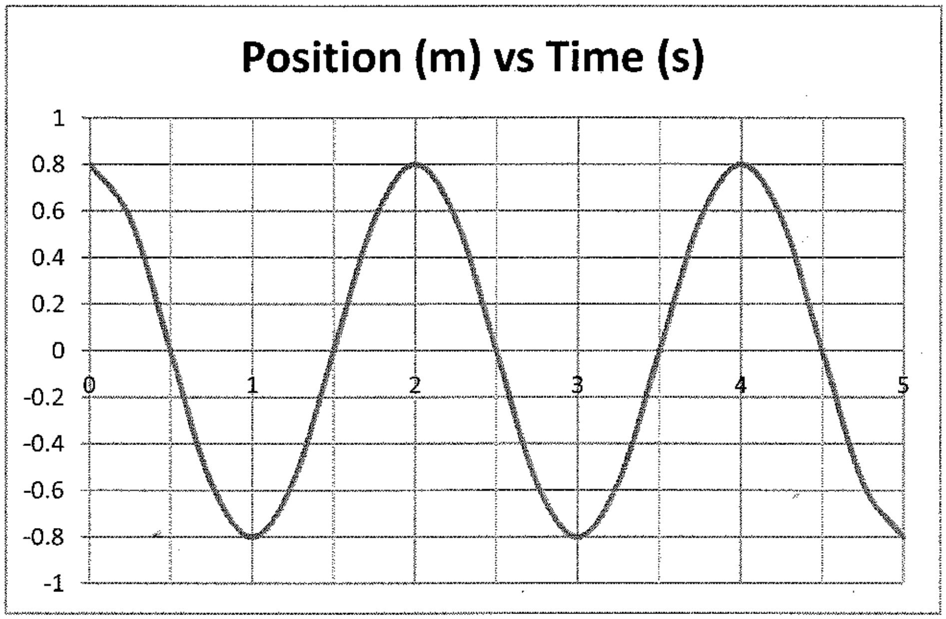
$$= \frac{1}{2}\left(\frac{m^2V^2}{m+M}\right)$$

$B = 2\pi f \quad f = \frac{1}{T} \quad y(t) = A\sin[B(t - C_{sin})] + D$

Qualitative/Quantitative Questions

or $y(t) = A\sin[B(t - C_{cos})] + D$

5. A student sets a 0.25 kg object into simple harmonic motion on a horizontal frictionless surface. The graphs for position and velocity as functions of time are shown below.

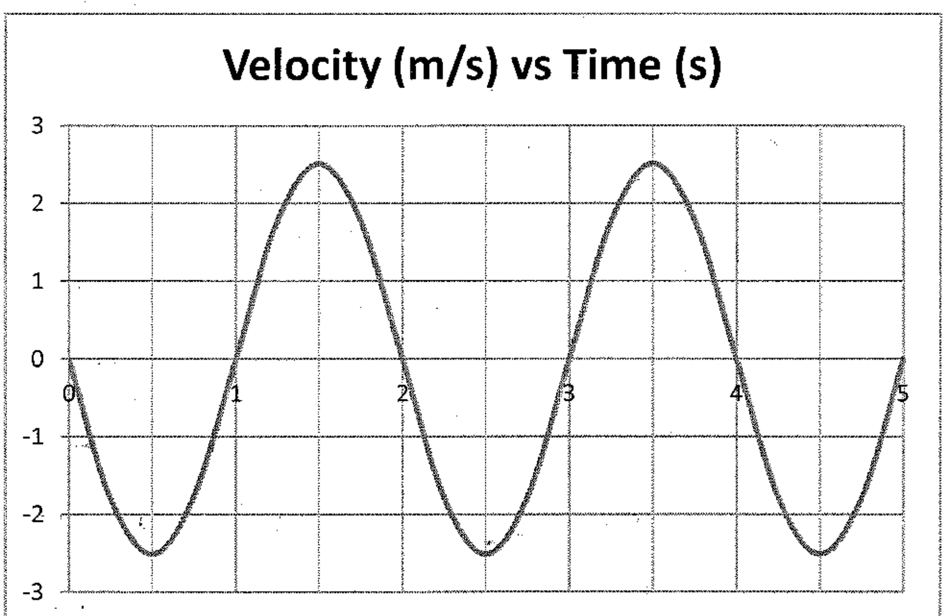



$y(t)$

$.8\cos(\pi t)$

or

$.8\sin[\pi(t - 1.5)]$




Could look at it as a flipped sin wave or a shifted sin wave

$V(t) = -2.5\sin(\pi t)$

$B = \frac{2\pi}{T} = \frac{2\pi}{2} = \pi$

or $V(t) = 2.5\sin[\pi(t - 1)]$

$KE_m = \frac{1}{2} m V_{max}^2$

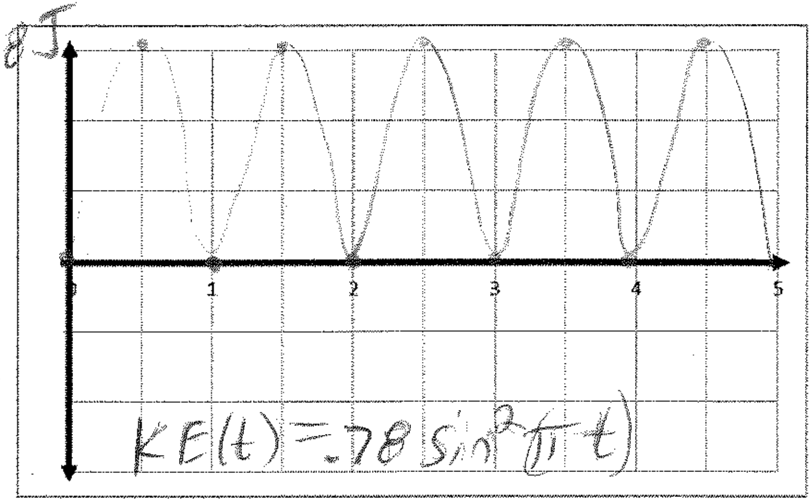
$= \frac{1}{2}\left(\frac{1}{4}\right)(2.5)^2 = \frac{2.5^2}{8} = .78\,J$

On the axes below, sketch a) the kinetic energy of the object, b) the potential energy, and c) the acceleration as functions of time. Make sure to label any intercepts, asymptotes, maxima or minima.

.78 J

KE

$= PE_{max}$




a)

$KE = \frac{1}{2} m V^2$

lowest when $V = 0$

Never Neg

$= \frac{1}{2}\left(\frac{1}{4}\right)(-2.5 \sin \pi t)^2$

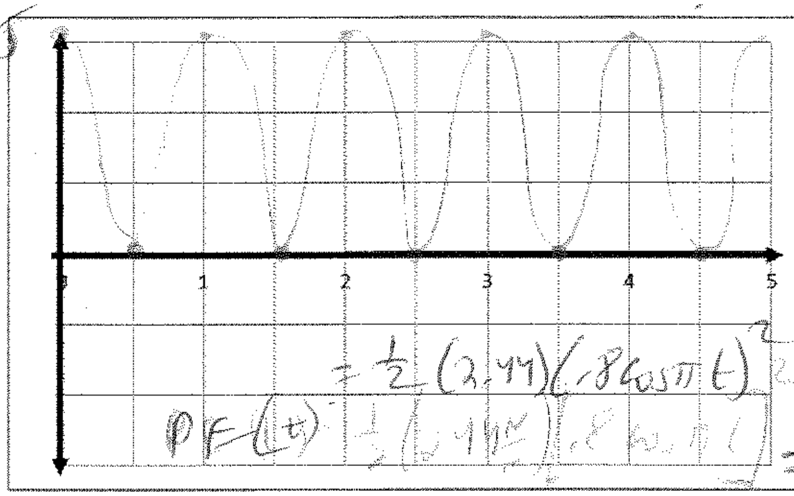
$= \frac{1}{8}(6.25 \sin^2(\pi t))$

when $V = 0$ → $KE = 0$

when $V = max$ $KE = max$

.78 J

PE




b)

$= .78 \cos^2 \pi t$

or

$PE_{max} = \frac{1}{2} K X_{max}^2$

when $X = 0$ $PE = 0$

$\frac{1}{2} K X_{max}^2$ so $E_m = KE_m$

$= \frac{1}{2}(2.44\frac{N}{m})(.8m)^2$

$\approx .77\,J$

Same as $KE_{max}$

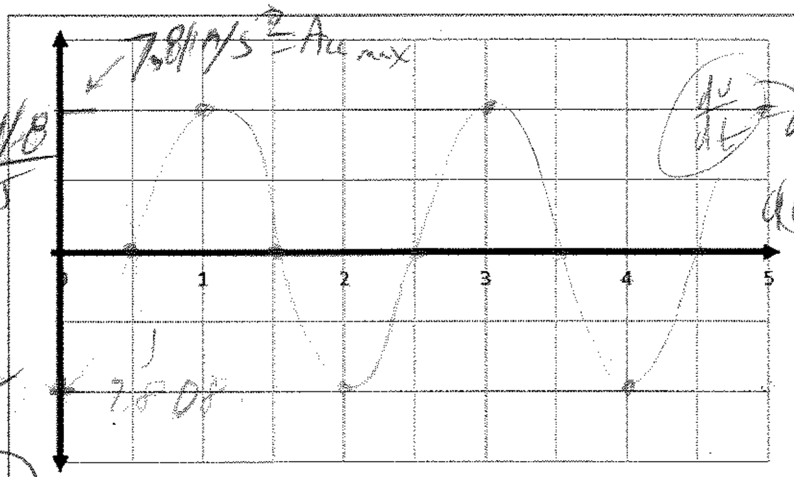
One way to find Amplitude

$F = -KX = mA$

$-KX_{max} = m A_{max}$

$-\frac{K X_{max}}{m} = A_{max} = 2.44/.8 \over .25$

ACC




c)

Calculation (not needed)

$V(t) = -2.5 \sin \pi t$

$\frac{dv}{dt}$ $a(t) = \pi(-2.5 \cos \pi t)$

$a(t) = -2.5\pi \cos(\pi t)$

$a = 0$ when $X = 0$

when $X = max$ $a =$ biggest in opp direction

or

max KE = max PE

$\frac{1}{2} m V_m^2 = \frac{1}{2} K X_{max}^2$

Finding K

$K = \frac{m V_{max}^2}{X_{max}^2} = \frac{m(2.5\frac{m}{s})^2}{(.8m)^2} = \frac{.25(2.5)^2}{(.8m)^2} = 2.44\frac{N}{m}$

Key ideas $f = \frac{\#\text{ cycle}}{\text{sec}}$

$$\omega = 2\pi f = \frac{\Delta\theta}{\Delta t} = \text{Angular freq in } \frac{\text{Radians}}{\text{sec}}$$

so can often use $\omega = \frac{\theta}{t}$

for example

$$\cos\theta = \cos\omega t = \cos 2\pi f t =$$

$$x(t) = A\cos\left(\frac{2\pi}{T}t\right)$$

for velocity

$$v(t) = -V\sin\theta$$

$$= -V\sin\omega t$$

$$V_{max} = \frac{2\pi r}{T} = \frac{2\pi A}{T} \qquad r = \text{excursion}$$

So $v(t) = A\left(\frac{2\pi}{T}\right)\sin\left(\frac{2\pi t}{T}\right)$

for accel

$$a(t) = -a_{max}\cos\theta$$

$$= -a_{max}\cos\omega t$$

$$a = \frac{v^2}{r} = \left(\frac{2\pi r}{T}\right)^2 \cdot \frac{1}{r} = \frac{2^2\pi^2 r^{\cancel{2}}}{T^2 \cancel{r}} \qquad A = X_{max}$$

$$a = \frac{4\pi^2 A}{T^2}$$

so $a(t) = -\frac{4\pi^2}{T^2}A\cos\left(\frac{2\pi}{T}t\right)$

6. A student needs to determine whether the relationship between the restoring force and the amount stretched of a rubber band is the same as an ideal spring.

   a) Describe a procedure that the student could use to collect the necessary data. Make sure to include all equipment needed and values to be measured as well as how the student would analyze that data.

   Assume that the student has determined that the rubber band does indeed act like an ideal spring and has calculated its spring constant.

   b) The student is now given an object with an unknown mass and is asked to use the rubber band to find the mass of the object. Describe a procedure using the ideas you learned in the SHM chapter as well as the object, rubber band, and any other equipment that the student could use to determine the mass of the object.

See typed solution w/ Answers in Packet

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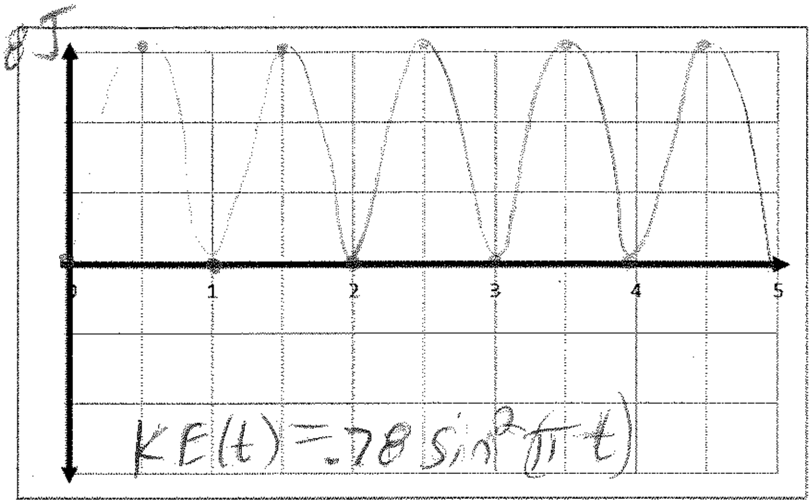
KE

$.78 J$




a)

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when $V = 0$ $KE = 0$

when $V = max$ $KE = max$

$= PE_{max}$

PE

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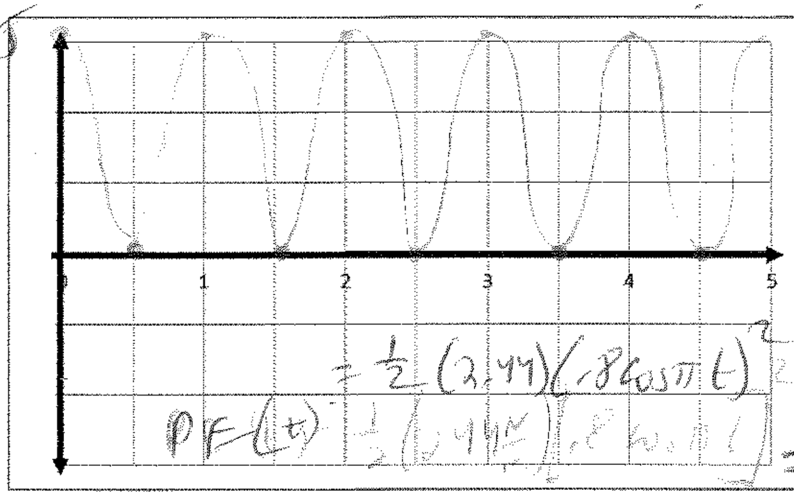


b)

or

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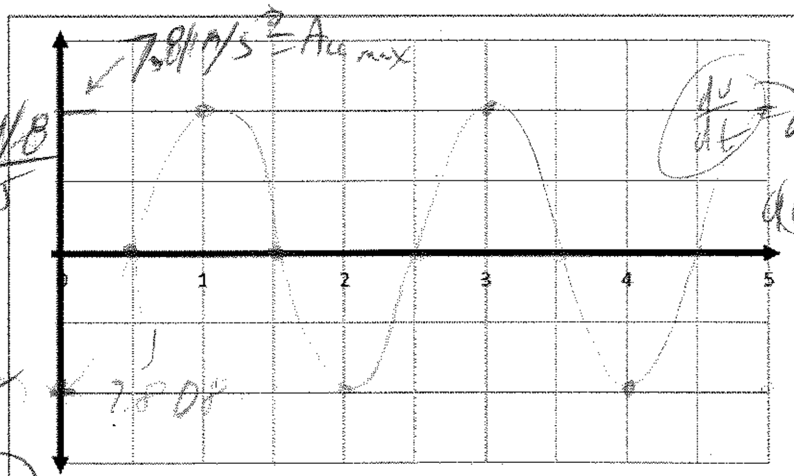
ACC

$-2.5\pi$

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