Practice Problems
For Chapter 18

The problems and solutions that follow were designed by students. Although I have checked them, there are very possibly a few errors here and there. If you notice a mistake and turn in a typed correction, you will receive two extra homework points. You may also write new homework problems to add to any chapter and receive between 2 and 5 homework points per problem (see syllabus for details.) Please note: since these problems were written by students, the teacher takes no responsibility for errors – in other words, if there is a mistake and you make the same mistake on a test, you will not get credit for that mistake.

In the problems below, I have highlighted what I feel are the best problems to study prior to tests. The other problems are all ok, but they tend to be very easy problems or repeats of homework problems with slight variations. You may want to start with a few of the regular problems as warm up and then move on to the highlighted problems.

Chapter 18 Practice Problems

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1. Write the formula to find the position of an object in SHM if its amplitude is 2.5m and it takes 7.3 secs to do 4 cycles. It starts at 1m.

John Stevenson ‘07

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2 If an object’s period is .54 secs in SHM, what is its angular frequency?

John Stevenson ‘07

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3. Find an object’s max distance, max velocity, max acceleration, and max force in SHM if its period is 7 secs, and its mass is 27 kg.

John Stevenson ‘07

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4. What is the period of a pendulum that has a length of 18m and has a 200 kg mass attached to it? What if it had a 1000kg mass attached to it? What is the percent increase? Why is this so? What if the 200kg was at a higher altitude ($g=9.65m/sec^2$)? What difference would this make?

John Stevenson ‘07

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5. How long is the pendulum of a grandfather clock that has a second hand whose xmax=5 centimeters and every second it completes a cycle? What assumptions must be made to complete this problem?

Catherine Burke ‘07

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6. a) Draw a graph of this simple harmonic motion equation:

$$X(t)=2\cos(5t+.3125)$$

b) Rename the graph with X as a sin function of t.
c) What is the maximum position of the object?
d) What is the phase shift?
e) What is the angular velocity?

Emily Whitcher ‘07

7. A little girl is swinging on the giant swing at Old San Francisco Steak House. The period of her swing is 5 seconds. How far would the center of mass have to rise up to decrease the period of her swing to 4.5 seconds?

Emily Whitcher '07

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8. A young boy afraid of the water brings a rubber duck in the tub for security. The mother washing her son notices that the rubber toy undergoes simple harmonic motion. If the altitude of the waves in the bath are 2 cm and if it takes 5 seconds to complete a full cycle, and if the phase angle is 1.2 radians then what is the equation for the osculation? What is the position when t=10 seconds?

Iana Gaidarski '07

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9 If the equation for an object in SHM is 12 cm cos(13.2t+3.1). What is the…

a) angular freq?
b) frequency in hertz?
c) Period?
d) Altitude?
e) The position at 2 seconds?
f) The maxium acceleration?

Iana Gaidarski '07

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10. A whack-a-mole undergoes simple harmonic motion, moving a total distance of .6 meters (the peak is at .15 meters). If it takes .8 seconds for a mole to pop up and return to safety, what is the maximum speed of the mole and at what point does it reach this speed?

John Wheeler (class of 2008)

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11. Using the equation q(t) = 5cos(7t + 4.2), find the point at which q = 0. Then explain why this problem is a trick question.

John Wheeler (class of 2008)

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12. A pendulum undergoes simple harmonic motion, moving 30cm each direction from a center point. If this pendulum completed four cycles a second and is at a position of 3cm when t is equal to 0, what is the equation for the oscillator?

John Wheeler (class of 2008)

13. After a very bad pass during an otherwise pleasant day at the wharf, Timmy fails to recover a football from the ocean. If Timmy can only come back to the dock at five o'clock in the afternoon, how many days much he wait until the ball will be at the proper height at five o'clock sharp? at eight o'clock that night the ball is six meters below the nearest dock, the tide runs a full cycle in 11 hrs and 47 min, and the lowest tide will bring the ball to a level six meters below the dock (the highest tide will bring it level to the dock)?

John Wheeler (class of 2008)

Chapter 18 – Solutions

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1. Work:
T=7.3/4=1.825 v=4/7.3= .547945 w=2pi(.54) w=3.44
X(t)=xmaxcos(wt+phaseangle)
1=2.5cos(3.44(0)+phase)
.4=cos(phase)
phase=1.15 rad
Answer: x(t)=2.5mcos(3.44rad/sec+1.15rad)

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2. Work:
T=.54
2pi/T=w
Answer: w=11.63 rad/ sec

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3. Work:
W=2pi/7
W=.89
V=wx
V=.89(15)
Answer: V=13.46 rad/sec
$A=w^2x$
$A=.89^2(15)$
Answer: $a=11.8815$ *rad/sec*^{2}
F=ma
F=27(11.8)
Answer: F=320.8005 N

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4. Work:
$T^2=2pi^2L/G$
Answer: T=8.51 secs
Answer: 1000 vs. 200= no difference b/c mass is not in formula
$T^2=4pi^2 18/9.65$
Answer: T=8.58 secs; a longer period

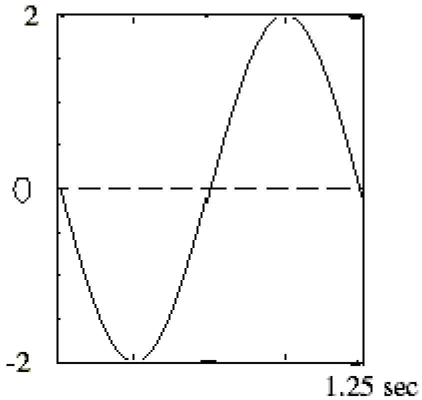
5.
Answer:
T=1/1
T=1

Tsquared=4(pi squared)(L)/g
1=4(pi squared)(L)/9.8

9.8/(4)(pi squared)=L
L=.25 meters

For the equation to work, the length must be large compared to the angle.

6.
ω=5
T=2π/ω
T=2π/5
T=1.25 seconds
ϕ=1/4 cycle



b) Rename the graph with X as a sin function of t.

X(t)=-2sin(5t)

c) What is the maximum position of the object? **2**

d) What is the phase shift? **.3125 seconds**

e) What is the angular velocity? **5 rad/sec**

7.
T=2π√(L/9.8)
5=2π√(L/9.8)
(5/2π)^2=L/9.8
9.8 * (5/2π)^2=L
9.8 * (4.5/2π)^2 = ?
6.2m=L
?=5.02m

`It would have to rise 1.18m.`

8.

5 sec= T

1/5= v

= W

a) x (t) = 2 cm cos (1.26t+1.2)

b) x (10)= 2 cos (1.26 (10) + 1.2

= .66cm

9.

a) 13.2 seconds

b) 13.2/2∏ = 20. 7 hertz

c) 1/20.7= .048 seconds

d) 12 cm

e) 12 cm cos (13.2 (2) +3.1) = -4.05 cm

f) $a= -w^2 \Delta x$

$=-(13.2)^2 (12) = -2090.88 \ m/s^2$

10.
1/(.8) rev/s = 7.85 r/s
X_{max} = .15m
V_{max}= WX_{max} = 1.18 m/s
It occurs at X_{max} which is .15m

11.
Cosine is equal to zero at **both** 90 and 270 degrees
7t + 4.2 = 90

T = 12.26
7t + 4.2 = 270
T = 37.97
Though the problem asks for "the point" at which q = 0, it actually wants both

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12.
$x(t) = (30cm) \cos((2)(4)\pi t + \theta)$
$3 = (30) \cos((8)\pi(0) + \theta)$
$.1 = \cos(\theta)$
$\theta = 84.26$
$x(t) = 30\cos(8\pi t + 84.26)$

13.
11 hrs and 48 min = 708 min
8 p.m. + 11hrs 48 min = 7:48 a.m. (this is when it first will reach the proper height, day1)
This will be 24 min earlier each day, so
12 – 5 = 7 + 7:48 = 888 min needed until 5 p.m.
888 / 24 = 37 days!