Practice Problems
For Chapter 15

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 15 Practice Problems

1.) Find the centripetal force of a 25 kg object making 79 revs in 60 secs around a circle with a radius of 10m.

John Stevenson '07

2.) Find the centripetal acceleration of a object that rotates at 13 revs/sec on a circle with a radius of 15 cm.

John Stevenson '07

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3. Charlie is swinging his keychain (1 kg) around on the end of his .75 m long lanyard. He notices it makes 85 revolutions in one minutes. What is the centripetal force of the keys?

Fontaine Foxworth '07

4.) An amateur designs a carrousel for a theme park. If the bolt holding the horse can withstand 580 000 newtons. What is the maximum velocity tangential and time that the ride can move without falling apart? The radius of the ride is 8 meteter and the mass of a horse and child is 100kg.

Iana Gaidarski '07

5.) If Pocahontas swings from a vine from a cliff, making a semi-circular path of radius 30 m. She is self conscientious about her small figure so refuses to tell us her mass. If we know that she jumped from the cliff when the vine was horizontal, and we know that the tension was 1490 newtons at the bottom. What is her mass?

Iana Gaidarski '07

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6. If a 10 kg bowling ball makes 20 revolutions per minute in a circular path with radius 10 m, what is the centripetal force?

John Wheeler (class of 2008)

7.) The front wheel of a tricycle rotates at 30 revolutions per second (yeah, its that fast). If the wheel has a diameter of 30 cm, what is the centripetal acceleration of a point on the edge of the wheel?

John Wheeler (class of 2008)

8.) A Frisbee with a circumference of 50 cm is balanced on the tip of a fire poker and is spinning at a rate of 15 rev/sec. What is the centripetal acceleration of a point on the fringe of the Frisbee?

John Wheeler (class of 2008)

9.) A half-kilogram marble races around on the edge of a plate with an area of 1.5 sqr. meters. In order to have a centripetal force of 100 Newtons, how many revolutions per second must the marble be making?

John Wheeler (class of 2008)

10.) A tennis ball (.2kg) is spinning around in midair. Somehow it is spinning in a circle of radius four meters perfectly parallel to the ground. Unbeknownst to the tennis ball, a tiny invisible thread is attached to the ball and is running through a pvc pipe in the center of the circular path. At the end of the string, a pair of shoes filled with sand (4 kg) is hanging towards the ground. How fast must the ball be swinging in order to keep the system in equilibrium (as in the shoes stationary in mid-air)?

John Wheeler (class of 2008)

11.) Using a clever new contraption, Drew attempts to fly. Attaching a long, hollow pole to a backpack, Drew ties a string to the bottom end of the pole and runs it through until it extends one meter past the end of the pole. Attaching a weight to the end of the pole and attaching a motor that will swing the weight in a circular motion at 5 revolutions per second, how high must the weight of the mass be in order to lift the 45 kg Drew and his 15kg contraption off the ground?

John Wheeler (class of 2008)

12.) A random student decides to spin a ball on a string around his head (for funsies). The ball has a mass of 12kg and it makes 46 revolutions in 90 seconds. The circle he creates has a radius of 5 meters. What is:

a.) The centripetal force?

b.) The centrifugal force on the object?

13.) Even as a 4 year-old child, Mr. Laba spent many a time observing the world around him, studying the physics of everything. One day, while in a stroller, baby Laba begins to think about the stroller wheel. If the wheel has a radius of 15cm and it rotates at 12 rev/sec, what is the centripetal acceleration of a point on the edge of the wheel?

14.) Another random student saw the first random student spinning a ball above his head and decided to join the fun. This student's ball had a mass of 3kg and made 25 revolutions in 30 seconds. The circle made by the spinning ball had a radius of 2 meters. What is:

a.) The centripetal force?

b.) The centrifugal force on the object?

15.)

. a. A warlord calls his knight on horseback to participate in an epic battle. If he is charging into battle swinging an extremely long 10 kg steel mace over his head, and the chain is rotating 1.5 meters from the handle at 3 revolutions every 1.5 seconds, what is the centripetal force?

b. As the knight starts to make his epic charge across the battlefield, he begins swinging his mace to the side like a Ferris wheel. Using the information provided, what is the minimum ω that the knight needs to swing the mace in a complete circle?

Matthew Porter (class of 2010)

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16. A jet is flying at 250 m/s and needs to make a U-turn because it missed it's runway. If the acceleration must stay under 40 m/s^2, what is the minimum time that the plane can take to make the u-turn?

Bethany Berg (class of 2011)

Chapter 15 Solutions

1.) Work:

$Fc=mv^2/r$

$Vt=deltatheta/deltaT*r$

$Vt=2pi*79/60*10$

$Vt=82.728606$ m/sec

$Fc=25*82^2/10$

Answer: $Fc=17110.05585$ N

2.) *Work:*

$Ac=v^2/r$

$Vt=deltatheta/deltaT*r$

$Vt=2pi*13*.15$

$Vt=12.25$ m/sec

$12.25^2/.15=ac$

$ac= 1000.777$ m/sec^2

3.)

85 rev/min = 8.9 rad/s = w

V = wr = (8.9)(.75) = 6.68 m/s

Fc = mv^2/r = (1)$(6.68)^2$/.75 = **59.4 N**

4.) Ef r =mac

Bolt=$(m\ v\ t^2)$ /r

580 000= (100) (Vt^2) / (8)

Vt= 215. 4 m/s

5.) EF r= ma c

T- mg =$(Vt^2\ m)/r$

$\Delta T=0$

Tb=Ta

Mgh=.5 mvθ

Masses cancel out

Square root (30* 9.8* 2)=V

24.25 =V t

Go to previous equation: T- mg =(Vt ^{2} m)/r

1490-m(9.8)= (588m) /30

44700-294m=588m

44700=882m

<u>50.68kg=mass</u>

6.) $F_c = mv^2/r$

$F_c = m(w)^2r$
$F_c = m(rev/time)^2r$
$F_c = (10)(20/60)^2 (10)$
$F_c = 11.11$ N

7.) r = .5d = 15 cm
$a_c = v^2/r$
$a_c = (w)^2r$
$a_c = (rev/time)^2r$
$a_c = (30)^2(0.15)$
$a_c = 135$ m/sec^2

8.) radius = .50 / (2)(3.14)
$a_c = v^2/ .0796$
$a_c = (w)^2 (.0796)$
$a_c = (rev/time)^2 (.0796)$
$a_c = (15)^2(.0796)$
$a_c = 17.91$ m/sec^2

9.) $F_c = mv^2/r$
$100N = (.5)(w)^2r$
R = Sqr. root(1.5 / 3.14)
$100N = (.5)(rev/sec)^2(.69)$
Rev/sec = 17.03

10.) Force of Shoes = (4)(9.8)

F = 39.2 N
$F_c = mv^2/r$
$39.2 = (.2)(v^2)/(4)$
V = 28 r/s

11.) Force of Drew and Backpack = (9.8)(60)
F = 588
$F_c = mv^2/r$
$588 = (m)(10)(10)/1$
M = 5.88 kg
(On a side note, is this possible?)

12.) A.) $F_c = mv^2/r = m\omega^2 r = m(rev/time)^2 r$
$[(12kg)(46)^2(2\pi)^2(5)]/(90)^2$
=618.79N

b.) F_{cent}=618.79N outward

13.) $a_c = v^2/r = \omega^2 r$

$(24\pi)^2(.15) = 852.73 m/s^2$

14.) A.) $F_c = mv^2/r = m\omega^2 r = m(rev/time)^2 r$
$[(3kg)(25)^2(2\pi)^2(2)]/(30)^2$
=164.49N
b.) F_{cent}=164.49N outward

15.)

a. 2 revolutions per second is approximately 12.6 radians per second

$Fc = m\omega^2 r$

$Fc = 10(12.6)^2(1.5)$

Fc = 2381.4 N

b. $mg = m\omega^2 r$

$10(9.8) = 10(1.5)\omega$

$98 = 15\omega$

$\omega = 6.53$ radians per second

16.

$A_c = v_t^2/r$
$40 = 250^2/r$
$r = 1562.5$ meters

arc length $= \pi r$
arc length $= 3.14\ (1562.5)$
arc length $= 4908.73$ meters

time = distance/velocity
time = 4908/250
time = 19.6 seconds
