PHYSICS 1111 Warmup 0 Name: <u>Fold and print name on back</u>

WarmUp Get to know your book and concepts to brush up on from Section 1.2

Reading Objectives for getting to know your book

- Locate the 9 tables in appendix C and familiarize yourself with this very useful tool.
- Notice that appendix D will be very helpful when connecting symbols with the name/definition of the concept that it stands for.
- Familiarize yourself with the layout of the information from each chapter: Introduction, then sections, then glossary, then section summaries.
- Familiarize yourself with the layout of questions/problems/exercises at the end of each chapter: Conceptual Questions followed by Problems and Exercises.
- Find the student solutions manual on the OpenStax website. Notice that some of the solutions are included, but not all.

1. Use table C1 in appendix C of your text to look up the value of the gravitational constant, ***G***.

2. Use table C6 in your book to look up how many kilometers are in 1 mile.

3. In the preface of the student solutions manual (page 12), what is stated as the worst thing you can do with the solutions manual?

4. Which appendix of the text includes the periodic table?

5. Consider Figure 1.20 in your text. What is shown in the picture?

Warmup Topic: **1 Dim Kinematics, Acceleration, Velocity, Kinematic Eqs.**

- Chapter 2 Sections 2.3, 2.4, 2.5
- Equations 2.5, 2.10, 2.28, 2.29, 2.35, 2.40, 2.46 [2.50 to 2.54]
- Note: equation 2.50 comes from the definition of average velocity and is valid regardless of whether the acceleration is constant or not (it [eq 2.50] should not be grouped with 2.51 to 2.54)
- Definitions of acceleration, velocity, displacement
- Kinematic equations for special case of constant acceleration
- Distinction among initial and final
- Distinction among initial velocity, final velocity, average velocity, change in velocity and speed (all using the symbol "v")

Online Resource: https://www.compadre.org/Physlets/mechanics/intro2.cfm
You may enter values of -20, -5, and 2 for each box. You may play with the graphs (right or left click and see)

1. A car accelerates uniformly from 20.0 m/s to 40.0 m/s in 5.00s. What is the acceleration during this interval (you must include correct units)?

   a=_____________

2. Give a definition of velocity (for one dimensional motion). Give both a verbal definition and a formula.

3. Give the four kinematic equations valid for **constant acceleration** as listed in class notes. I have started you out on each. Find them in class notes.

$v =$

$\bar{v} =$

$\Delta x =$

$v^2 =$

Warmup Topic: 1 Dim Kinematics, ball straight up, simple v vs t plot

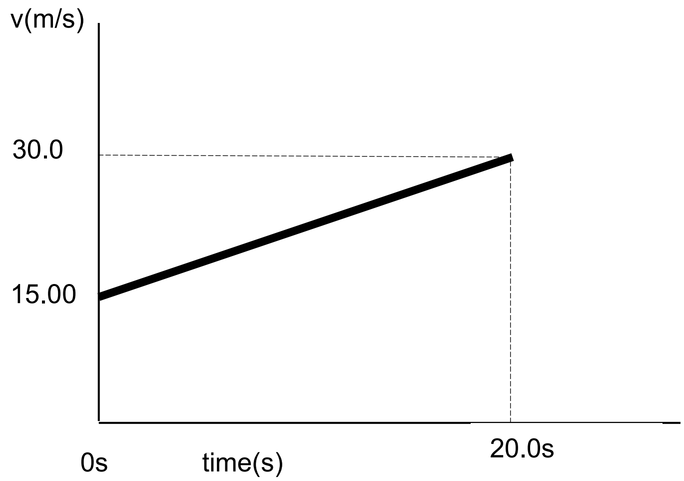
- Chapter 2 sections 2.7, 2.8
- Equations 2.75 to 2.77
- Example 2.14 and figure 2.42
- Example 2.17
- Fig 2.48 b
- Distinguish between acceleration and velocity
- Special application of free fall where acceleration = - g (what is g?)
- Analysis of v vs t plot with constant acceleration
    - Slope, area under, and average

1. A ball is thrown straight upward from the ground with an initial speed of 19.60m/s. When the ball reaches the peak height (at the peak)

   what is the velocity of the ball (at the peak)?____________________

   and what is the acceleration of the ball (at the peak)?_______________________

2 and 3. Refer to the v vs t plot below.



2. What is the average velocity for the trip? The velocity is indicated by the solid sloped line on this plot?

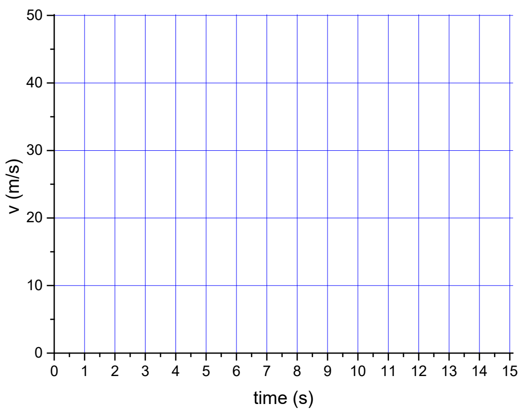
3. What is the constant acceleration during the 20.0s trip (in question 2)?

4. What is the distance traveled for the 20.0s trip?

Cooldown 1 dim kinematics

- Chapter 2 problem using one dimensional kinematics
- Graphical analysis---2 different constant accelerations
- v vs t plot   slope and area
- Displacement (distance, how far)
- Average speed
- Car on a ramp (like our lab, uses "g sin(θ))
    - Distance, speed, acceleration relations
    - Kinematic equations

1. A train conductor travels along and sees a truck parked on the tracks ahead. The train is travelling along the track at a constant 30.00m/s. It takes the train conductor 5.00s to react. The train punches the brakes and has an acceleration of $-3.00 m/s^2$.
    a. Sketch a plot of v vs. t below. Note that t=0 is when conductor first notices the truck ahead.



    b. How far does the train travel while stopping (from t=0 until stopped)?

    c. What is the average speed during the trip?

2. A car initially at rest rolls down a ramp with an acceleration of $4.90 m/s^2$. The car rolls for 30.00cm. (you can look ahead to lab notes to see what angle such a ramp is set to)
    a. How fast is the car going as it passes the 30.0cm mark?

    b. How much time did the car take to travel the 30.0cm?

3. The same car as in problem 2 is now rolled upward along the same ramp with an initial speed of 0.980m/s.
    a. How much time does it take the car to reach the peak position (turning point)?

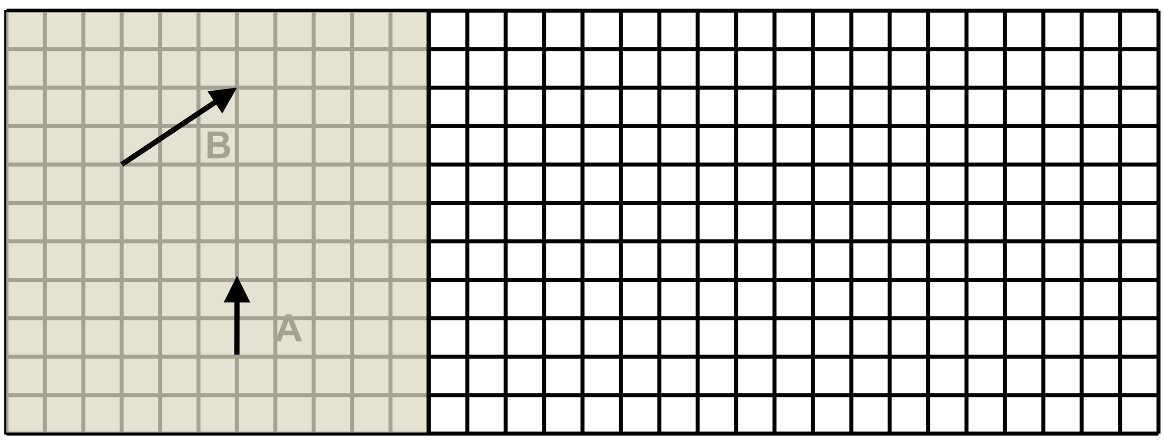
    b. What is the distance traveled by the car by the time it reaches the peak position?

    c. What is the average speed the car has during its trip upward to the turning point.

Warmup Topic: Vector Addition

- Chapter 3 sections 3.1 to 3.3
- Figure 3.17 to 3.19, 3.32
- Eqs 3.6, 3.7, 3.10, 3.11, 3.12, 3.13
- Example 3.3
- Graphical vector addition
- Analytical vector addition
- Resultant, Magnitude, Direction of vector.

1. In the figure below there are two vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$. Draw/sketch (on the grids somewhere outside the gray box) a vector $\vec{\mathbf{R}}$ that is the sum of the two, (i.e. $\vec{\mathbf{R}} = \vec{\mathbf{A}} + \vec{\mathbf{B}}$). Clearly label the resultant vector as $\vec{\mathbf{R}}$.



2. Use the grid from problem 1 to determine the horizontal and vertical components of the resultant vector (R_x and R_y respectively). Consider each box to be 1.00m by 1.00m.

R_x=

R_y=

3. For the vector given in problems 1. and 2. find the magnitude and direction (angle) of the resultant vector.

4. A ball is thrown initially at 40.0m/s in a direction of 30º above the horizontal. What are the initial horizontal and vertical components of velocity? Use appropriate symbols and units.

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Warmup Topic: 2 Dim Motion Projectile

- Chapter 3 Section 3.4
- Equations 3.29 to 3.32 written for both “x” and “y”
- Example 3.4 and 3.5
- Note: What is the vertical acceleration? (for projectile motion….free fall)
- What is the horizontal acceleration? (for projectile motion….free fall)
- Velocity, acceleration at peak (this is 2 dimensional motion)

1. A ball is thrown initially at 20.0m/s in a direction of 60º above the horizontal. What are the initial horizontal and vertical components of velocity?

$V_{x\ init}$=	
$V_{y\ init}$=	

2. For the ball thrown in problem 1, **one of the four kinematic equations** is used to determine the time it takes for the ball to reach the peak. Write out the equation first (using symbols), and then plug in the numbers. DO NOT SOLVE— DO NO ALGEBRA

Kinematic equation:

Equation with numbers:

3. What is the velocity of the ball from problem 1 at the peak height (careful---it is not zero)?

4. What is the average vertical speed for the time interval from launch until the ball is at the peak?

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Warmup Topic: 2 Dim Motion Projectile

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- What is the horizontal acceleration? (for projectile motion….free fall)
- Velocity, acceleration at peak (this is 2 dimensional motion)

1 Spiderman releases his webbing and launches into the air moving at 50.0m/s at an angle of 40^{o} above the horizontal. He is trying to clear a wall that is 100 m ahead of him and a height of 60.0m.

a. What are the horizontal and vertical components of velocity?

b. Spidey is either going to clear the wall or fall short. At what time is Spiderman at the wall?

c. By how much does Spiderman (boy? Whichever spiderverse) make it over or miss clearing the wall?

d. What is the velocity vector of Spiderman as he passes (or hits) the wall? (magnitude and direction).

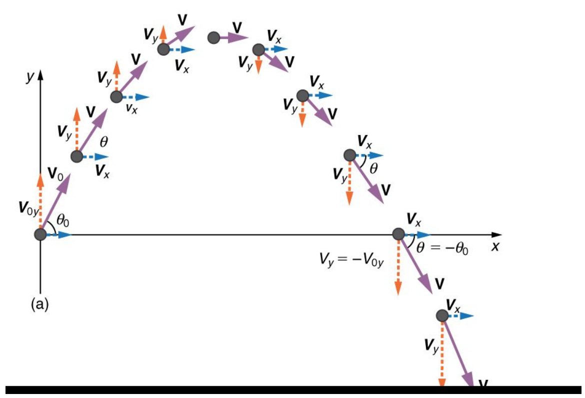
Name:___________________________________

Cooldown **Two dim projectile motion**

- Chapter 3 Section 3.4
- Equations 3.29 to 3.32 written for both “x” and “y”
- Example 3.4 and 3.5
- Note: What is the vertical acceleration? (for projectile motion….free fall)
- What is the horizontal acceleration? (for projectile motion….free fall)
- Velocity, acceleration at peak (this is 2 dimensional motion)
- Problem relates to lab—marble rolling off table

1. In a daring movie stunt, a 1966 Ford Thunderbird drives off a cliff launching horizontally at a launch speed of 50.0m/s. The cliff is 100.0m above the ground below.

   a. On the figure below, which “v” (circle) best describes what is happening at the time the care drives off the cliff?



   b. How long does it take for the car to reach the ground (assume all safety precautions are used- --somehow)?

   c. How far has the car landed from the edge of the cliff in the horizontal direction?

d. What is the vertical component of the cars velocity as it strikes the ground (not after)?

e. What is the velocity vector of the car as it strikes the ground?

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Warmup **start forces**

- Sections 4.1-4.5
- Newton's laws
- Free body diagram(s) (figures throughout chapter) (Fig. 4.15)
- Weight, Normal force
- See example 4.5 but get rid of friction

1. Consider the cart you used in lab sitting on a ramp. Tilt the ramp at 30^o from the horizontal. The carts have a mass of 0.500kg. What is the acceleration of the mass on the ramp (you know this from your lab) and what is the net force on the cart (remember how net force and acceleration are related)

2. In problem 1 sketch a free body diagram of the forces acting on the cart.

3. What is the weight (magnitude of force due to gravity) acting on the cart in problem 1?

4. What is the normal force acting on the cart?

Name:_____________________________

Warmup Ramp simple

- Example 4.5
- Newton's 2^{nd} law (Isaac not Professor)
- Apply 2^{nd} law, Weight, determine acceleration

1. A 50.00kg box sits on a frictionless ramp. The ramp is at an angle of 20.0^{o} above horizontal. Sketch a free body force diagram for the box.

2. In problem 1 give the magnitude of each of the forces.

3. give the magnitude and direction of acceleration

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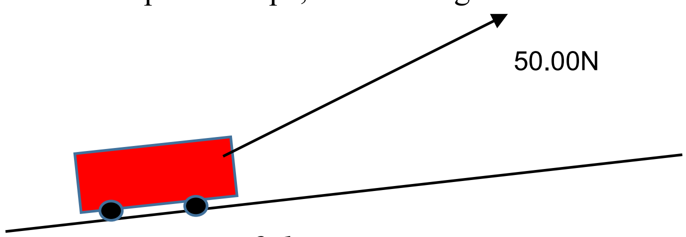
Cooldown **Wagon on a ramp**

- Ch. 4 Newton's laws
- Vector addition, free body diagram
- Weight, normal, pulling forces

You pull on the handle of a 30.00kg loaded Radio Flyer red wagon with a pulling force of 50.00N. This causes the wagon to accelerate. You are pulling the wagon on a hill with a 10° upward slope, and the wagon handle is at an angle of 30° **above the ramp**.



a) Draw a ***careful*** **free body force diagram** indicating (with labels) all the forces acting on the wagon. There are 3 forces (F_{pull}, and the other two being gravitational force and normal)

b) What is the weight of the loaded wagon?

c) What is the acceleration perpendicular (normal) to the ramp?

d) Using an x axis pointing up along the ramp, fill in a vector addition table for the three forces. After you have a table you may write out the x and y component of Newton's 2^{nd} law.

e) What is the magnitude of acceleration of the wagon, and is it up or down the ramp (remember that the "x" axis should be along the ramp)?

f) What is the normal force acting on the wagon? (it is not equal to the weight)

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Warmup Forces Elevator Example

- Example 4.9
- Figure 4.24 b
- Forces in one dimension
- Acceleration non-zero
- Apparent Weight (bad term for force due to scale)

1. You are carrying a bag full of biology books, giving you total weight (you and the books) of 980N while standing on a scale in an elevator at rest. Later, when the elevator is moving upward at a constant velocity the reading on the scale has: (circle best answer)

   Increased

   Decreased

   Remained the same

2. While the elevator was increasing speed from rest to the constant velocity in part 1, the reading on the scale:

   Increased

   Decreased

   Remained the same

3. The cable breaks, and you find yourself in desperate trouble. What is the reading on the scale while in free fall? Use Newton's 2^{nd} law explicitly to show your result.

4. Along comes assistance, your friendly neighborhood spiderman grabs the cable and pulls up with the greatest force he can. You (being completely unfazed by events) note the reading on the scale is now 735N. What is the acceleration of the elevator?

Warmup Friction

- Section 5.1
- Eqs. 5.2,3, 4
- Free Body Force diagram
- Newton's 2^{nd} law

1. Your car sits on a level road surface. You push on the car which was accidentally left in park. Sketch a free body diagram indicating all the forces acting on the car (use appropriate symbols for all).

2. Given a 1.00kg sitting **at rest** on a level table with coefficient of friction equal to 0.500, with no additional forces pushing horizontally, what is the static frictional force acting on the mass?

3. In question 2, you now apply a horizontal force of 4.00N to the mass. What is the acceleration?

4. The coefficient of friction given in question 2 was “static”. How hard do you need to push on the object to just make it accelerate?

5. Continuing with the object in question 2, are you able to determine the acceleration of the object if you push twice as hard as you found in question 4? Explain why or why not?

Warmup circular motion Phys1111 Fall 2019 Dr. Colbert
Ch. 6 Section 2 (partly)
Ch. 6 Section 3
Centripetal Acceleration Equation 6.17
Centripetal Force (**Really Net Force**)
Equations 6.23 and 6.24

1. In section 6.3 of your text. What is the first full sentence of the 2nd paragraph in the section? What one THREE letter word is critical in that sentence?

2. A 100 kg student sits in a roller coaster car making an inside loop with 20.0m radius at a speed of 30.0m/s. Sketch a free body force diagram for this situation when the student is at the top of the loop?

3. In problem 2, what is the net force acting on the student? (both magnitude and direction)

Name:_________________

Section 6.5
Equations 6.40, 6.41, 6.42, 6.43
Equations 6.52, 6.54
Equation 6.61
Universal Law of Gravitation, Centripetal force.

NOTE: WHEN I GIVE GRAVITATION PROBLEMS-----I WILL GIVE PLANET MASSES IN UNITS OF "EARTH MASSES" AND DISTANCES IN UNITS OF "EARTH RADII".

1. You (a typical 75.0kg physics student) are pushed out of the airlock (from the Heart of Gold spaceship) at a distance of 3.00Earth radii from a planet with twice the mass of the Earth. What is the gravitational acceleration at your location? Also give the gravitational force acting on you? (YOU SHOULD NOT NEED "G" "M_{EARTH}" or "R_{Earth}" to do this.

2. If you are lucky in problem 1 you might be well preserved if you have the right speed and direction to maintain a circular orbit. What speed is required (for conditions of problem 1)? You will need to know the radius of the Earth which is ~6400km.

3. For problem 2, assuming you achieve orbit, what is the centripetal acceleration and centripetal force acting on you (two answers)?

Name:________________

Warmup 14 PHYS1111 Work/Energy Name:_____________
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- Equation 7.1 Definition of Work done by a ***particular force F***
- Equation 7.11 **Net** Work causes a change in Kinetic Energy
    - This statement leads to other more useful conservation of energy statements
- Equation 7.13 Definition of Kinetic Energy KE
- Gravitational Potential Energy $\Delta PE = mg\Delta y$ up defined as positive
    - We often say "mgh"
    - EQUATIONS 7.34 AND 7.35 SHOULD NOT BE WRITTTEN THIS WAY. THERE SHOULD BE SUBSICRIPTS INDICATING INITIAL OR FINAL HEIGHT, AND INITIAL OR FINAL SPEED. THERE SHOULD ALSO BE ZERO'S FOR THE OTHER TERMS.
    - 7.35 THIS WAY. "KINETIC ENERGY AT ONE TIME CAME FROM THE POTENTIAL ENERGY AT ANOTHER TIME".
- Mechanical Energy is Kinetic plus Potentials (KE+PE). In many problems this is the Total Energy (E or E_{tot})

1. A 1.00kg object is lifted at a constant velocity by from ground to a height of 10.00m? The object was then placed at rest on a window ledge at that height. How much work was done to lift the object?

2. What is the gravitational potential energy of the object at the 10.00m height?

3. The object falls off the ledge and passes by you looking out your window at a height of 3.00m?
    a. What is the total mechanical energy of the object as it passes 3.00m?
    b. What is the gravitational potential energy as the object passes 3.00m?
    c. What is the Kinetic energy as the object passes 3.00m?
    d. What is the speed of the object as it passes 3.00m?

Warmup Momentum Phys1111 Fall2019 Dr. Colbert

- Eq 8.1---Definition of momentum
- Equation 8.7 NEWTON'S SECOND LAW RESTATED
- The sentence below equation 8.17---definition of "IMPULSE"
- 8.31 Conservation of Momentum (same as 8.33 and 8.34)
- Inelastic Collision -Example 8.5

  Note that in "PERFECTLY INELASTIC" collisions the objects stick together
  If objects stick together that means the final velocity is the same for each object

1. Define both impulse and also momentum.

2. You are sitting still in deep space (perfectly still) in your space suit enjoying your view. You are wearing a space suit making your total mass 100.00kg. You notice another astronaut headed your way at a speed of 10.00m/s (this is either Matt Damon or Sandra Bullock—your preference). The other astronaut has the same mass as you. You successfully catch the other astronaut rescuing them from oblivion.

   i) What is the other astronaut's magnitude of momentum prior to your catching them?

   ii) What is the combined momentum of you and the other astronaut after you catch them?

3. While conservation of momentum is universally correct, it is primarily used in physics to describe what type of physics events (one word here)?

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Warmup Momentum and Energy
Perfectly Inelastic Collision: PHYS1111 Fall 2019 Dr. Colbert

1. In a quick-draw contest, wearing full protective gear, you fire a Potato gun at your lab partner (don’t do this for real). Your lab partner also wearing perfectly frictionless roller skates. The potato weighs 1.00 kg and is moving 25.0m/s when it strikes your 49.0 kg lab partner who is initially at rest. The potato sticks to your lab partner, who is now rolling along.

   a) What is the initial momentum of the potato?

   b) What is the momentum of your lab partner/potato immediately after the collision?

   c) What is the speed of the potato/person immediately after the collision?

   d) What is the kinetic energy of the potato immediately before the collision?

   e) What is the kinetic energy of the potato-person immediately after the collision?

f) What is the ratio of the kinetic energy before to kinetic energy after (this is simply dividing)

g) Was energy conserved during this collision—explain your answer (briefly)?

h) In part f, what characteristics of this experiment/event determine the ratio that you get for the end result?

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Warmup Angular Kinematics Phys1111 Fall 2019 Dr. Colbert

- I am covering chapters 9 and 10 as one unit-Rotation
- First-Sections 10.1 and 10.2 on rotational kinematics (think of this like kinematic equations for one dimensional motion)
- Table 10.2 ---**should also have equation 10.20 in it.**
- Know symbols, names and definitions for each quantity
- Know arc length and distance around a circle—also see table 10.1
-

1. Give the symbols used for angular displacement, angular speed (or velocity), and angular acceleration.

2. Given a circle with radius 0.100m, what is the angle around the edge of a quarter circle, and what is the distance around a quarter circle (what units should you use for angle)?

3. List the five kinematic rotational equations (similar to our linear kinematics) for constant angular acceleration (see my bullet points above bold and underlined statement).

4. Your bicycle wheel has a radius of 0.300m and an initial angular speed of 10.00Radians/s. The bicycle comes to rest in 1.00s.
   a. How much angle does the wheel travel through in this time?
   b. How far does the bicycle travel?
   c. What is the average angular speed?
   d. What is the angular acceleration?

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Warmup 18 Torque and moment of inertia Phys1111 Fall2019 Dr. Colbert

- Eqs 9.3, 9.4, 9.5 definitions of torque and lever arms
- Fig 9.26 (remember CG and CM effectively mean the same thing)
- EQ 10.43 (this is like F(net)=ma---similar)
- Figure 10.12 (what is most like your arm?)
- EQ 10.60 and conservation of energy (like we did in lab).

1. You hold your arm (0.75m long) straight out and level. Your arm is uniform and weighs 5.00kg. What is the torque applied by gravity on your arm (think about where the force is applied)?

2. Your shoulder muscles holding up your arm in problem 1 get tired and completely collapse. Your arm starts falling from the initial position (rotating about an axis at one end---your arm does not fall off your shoulder). What is the angular acceleration your arm has **initially** (the angular acceleration is not constant)?

3. What is the moment of inertia of your arm?

4. As your arm falls, gravitational potential energy (OF WHAT POINT) gets converted to rotational kinetic energy. What is the angular speed of the arm as it swings through the vertical position? (YOU MUST USE ENERGY CONSERVATION FOR THIS).

Name:_________________

Warmup 19 Springs 1 Phys1111 Fall 2019 Dr. Colbert

- Equilibrium Position
- Energy 16.33, 34, 35
- Speed vs position 16.39 (I call big X—Amplitude, A)
- Time period 16.56

A 0.500kg mass on a spring is released at a distance of 10.0cm from the equilibrium position.The spring constant is 50.0N/m.

1 What is the maximum speed of the mass?

b) As the mass moves through 4.00cm position, what is the total energy of the system?

c) What is the time period for one full oscillation of this system?

d) What is the speed of the mass as it passes the position in part b?

Name:_________________

Warmup 20 Springs 2 Phys1111 Dr. Colbert

- Time period 16.56
- Motion of mass on spring
  - x(t) v(t) a(t)
    - Equations 16.20, 21, 22---
    - I use 'A" for amplitude rather than big "X".
-

A 0.2500kg mass is pulled 20.00cm from equilibrium while on a spring with spring constant 1.00N/m. The mass is released from rest at t=0 from the maximum displacement (20.00cm).

1 What is the time period for the oscillation?

2 Where is the mass located at 0.500s?

3 How fast is the mass moving at the time given in part b?

4 What is the acceleration of the mass at the time given in part b?

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