Physics 180A Name _____
Test 3 - 120 Points

You must complete six of the nine 10-point problems. You must completely cross off three 10-problems, thanks.
Place your answers in the answer box. Watch your units and sig figs.

1. Which of the following statements is true for an **inelastic collision**? (10 points)

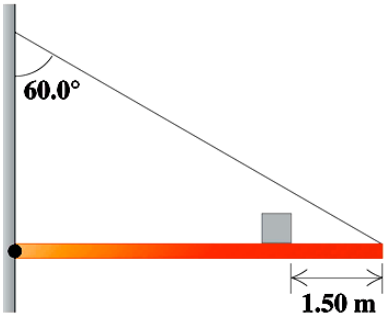
A. Both momentum and kinetic energy are conserved.
B. Momentum is conserved, but kinetic energy is not conserved.
C. Kinetic energy is conserved, but momentum is not conserved.
D. The amount of momentum lost by one object is the same as the amount gained by the other object.
E. The amount of kinetic energy lost by one object is the same as the amount gained by the other object.

2. On a highly polished, essentially frictionless lunch counter, a 0.500 kg submarine sandwich moving 3.00 m/s to the left collides with an 0.250 kg grilled cheese sandwich moving 1.20 m/s to the right. If the two sandwiches stick together, what is their final velocity? How much mechanical energy dissipates in the collision? Where did this energy go? (10 points)

3. A flywheel in a motor is spinning at 540 rpm when a power failure suddenly occurs. The flywheel has mass 40.0 kg and diameter 75.0 cm The power is off for 39.0 s and during this time the flywheel slows down uniformly due to friction in its axle bearings. During the time the power is off, the flywheel makes 210 complete revolutions. At what rate is the flywheel spinning when the power comes back on? How long after the beginning of the power failure would it have taken the flywheel to stop if the power had not come back on, and how many revolutions would the wheel have made during this time? (10 points)

4. An airplane propeller is rotating at 2200 rpm Compute the propeller's angular velocity in rad/s. How many seconds does it take for the propeller to turn through 48.0°? If the propeller were turning at 19.0 rad/, at how many rpm would it be turning? What is the period (in seconds) of this propeller? (10 points)

5. Draw a complete Freebody Diagram for the situation. (5 points)



5 points

What are the **Sums of the Forces**?

$$\Sigma F_x =$$

$$\Sigma F_y =$$

What are the **Sum of the Torques**?

$$\Sigma \tau =$$

6a. A mass of sunken lead is resting against the bottom in a glass of water. You take this lead, put it in a small boat of negligible mass, and float the boat in the water. Which of the following statements are true? (5 points)

A. The sunken lead displaces a volume of water equal to the lead's own volume.
B. The floating lead displaces a volume of water equal to the lead's own volume.
C. The sunken lead displaces a volume of water whose weight equals the lead's weight.
D. The floating lead displaces a volume of water whose weight equals the lead's weight.

b. Two equal-sized buckets are filled to the brim with water, but one of them has a piece of wood floating in it. Which bucket of water weighs more? (5 points)

a. The bucket with the wood.
b. The bucket without the wood.
c. They weigh the same amount.

7. In each of the objects what is the magnitude of the Force (if any) is needed to put the object into rotational equilibrium about the axis shown? Which of these objects are in translational equilibrium? (10 points)

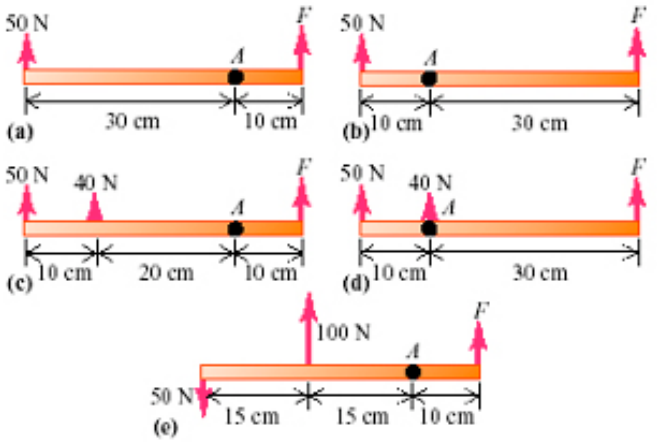
a.

b.

c.

d.

e.



8. A slab of ice floats on a freshwater lake. What minimum volume must the slab have for a 58.0 kg woman to be able to stand on it without getting her feet wet? (10 points)

9. Air streams horizontally past a small airplane's wings such that the speed is 78.0 m/s over the top surface and 57.0 m/s past the bottom surface. If the plane has a mass of 1520 kg and a wing area of 16.2 m^2 what is the magnitude of the net vertical force (including the effects of gravity) on the airplane? The density of the air is 1.20 kg/m^3. What is the direction of the net vertical force (including the effects of gravity) on the airplane? (10 points)

Do 2 of the following three DRS Problems

Physics 180A Chapter 8 Problem 68

A rifle bullet with mass 8.00 g strikes and embeds itself in a block with a mass of 0.992 kg that rests on a frictionless, horizontal surface and is attached to a coil spring. The impact compresses the spring 15.0 cm. Calibration of the spring shows that a force of 0.750 N is required to compress the spring 0.250 cm. (20 pts)

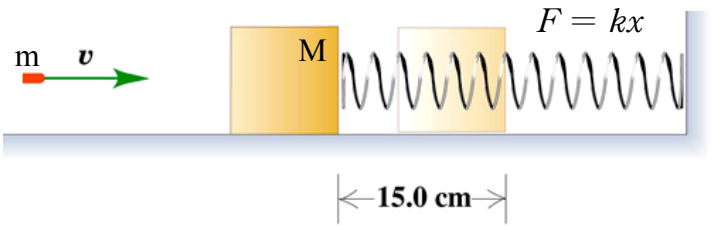
Momentum Before

mv_B

Ballistic Pendulum Problem

Momentum After

What kind of collision is this? (2 pts)



What is the value of the spring constant **k**? (2 pts)

Energy Before bullet enters block.

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

After bullet enters block

Energy Before $\frac{1}{2}(m+M)v_A^2$

Energy After spring is compressed.

Conservation of Momentum (2 pts)

$mv_B =$

Conservation of Energy (2 pts)

$\frac{1}{2}(m+M)v_A^2 =$

Solve for the initial speed of the bullet then plug in given values? (4 pts)

Solve for the magnitude of the bullet-block velocity just after impact then plug in the given values? (4 pts)

How much energy was lost in this collision? (2 pts)

$KE_{before} =$

$PE_{spring} =$

Energy Lost

Where did the lost energy go? (2 pts)

Physics 180A Chapter 10 Problem 64

A basketball (which can be closely modeled as a **hollow spherical shell**) rolls down a mountainside into a valley and then up the opposite side, starting from rest at a height H_o above the bottom. In the figure, the rough part of the terrain prevents slipping while the smooth part has no friction. How high **h**, in terms of H_o, will the ball go up the other side? (20 pts)

What is the Energy of the ball at the top of this hill? (2 pts)

$PE_G =$

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

$KE_R =$

Rotational Dynamics

What is the Energy of the ball at the top of this hill? (2 pts)

What is the moment of Inertia for a **hollow sphere**?

$I =$

$a = r\alpha$

$v = r\omega$

What is the Energy of the ball at the bottom of the hill? (2 pts)

$PE_G =$

$KE_T =$

$KE_R = \frac{1}{2}I\omega^2$

On the diagram, draw the ball at the bottom of the hill and where it will stop. Indicate its velocity and height. (2 pts)

Conservation of Energy (5 pts)

Energy Before (Top of Hill) = Energy After (Bottom of Hill)

$PE_G + KE_T + KE_R =$ ____

____ $=$

Solve the equation above symbolically for the linear velocity at the bottom of the hill.

Conservation of Energy (5 pts)

Energy Before (Bottom of Hill) = Energy After (Top of Hill)

____ $= PE_G + KE_T + KE_R$

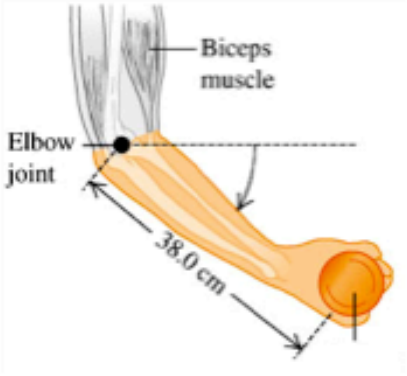
____ $=$

Using the linear velocity at the bottom of the hill, solve for the height **h** in terms of H_o.

Why didn't the ball go all the way up to H_o on the smooth hill? (2 pts)

Physics 180A Chapter 10 Problem 52

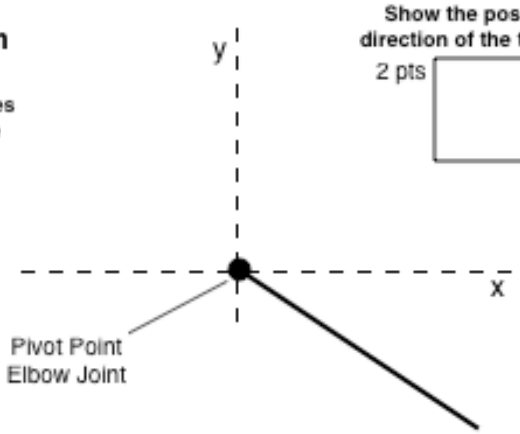
A 72.0 kg weight lifter is doing arm raises using a 7.50 kg weight in her hand. Her arm pivots around the elbow joint, starting 40.0° below the horizontal. Biometric measurements have shown that both forearms and the hands together account for 6.00 % of a person's weight. Since the upper arm is held vertically, the biceps muscle always acts vertically and is attached to the bones of the forearm 5.50 cm from the elbow joint. The center of mass of this person's forearm-hand combination is 16.0 cm from the elbow joint, along the bones of the forearm, and the weight is held 38.0 cm from the elbow joint. What force does the biceps muscle exert on the forearm? Find the magnitude and direction of the force that the elbow joint exerts on the forearm.



FreeBody Diagram

Draw the Freebody diagram include all forces and components of the forces and distances.

10 pts



Show the positive direction of the torque. 2 pts

What is the equation for Torque? 2 pts

Sum of Forces

$$\Sigma F_x = F_{Ex} = ma = 0$$

$$\Sigma F_y = -F_{Ey} + F_{BM} - F_{FA} - F_W = ma = 0$$

2 pts

Why are the Forces and Torques equal to zero? 2 pts

Provide the Torques in symbolic form, no numbers!

4 pts

$$\Sigma\tau =$$

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a. What force does the biceps muscle exert on the forearm?

Sum of Torques

Symbolically solve for the Force due to the Bicep Muscle

Symbolically

$$F_{BM} =$$

2 pts

Plug numbers in and solve numerically *Answer* 2 pts

$$F_{BM} = \quad =$$

b. Find the magnitude and direction of the force that the elbow joint exerts on the forearm.

Sum of Forces

$$F_{E_x} = 0$$ *no force in the x-direction*

$$-F_{Ey} + F_{BM} - F_{FA} - F_W = 0$$

Plug numbers in for elbow Force and solve numerically

2 pts

$$F_{Ey} =$$

Answer 2 pts