PHY 201 Quiz #1 Name _____

Score _____

Instructions:
1. Do all of your work on this sheet.
2. **Show all of your steps** in problems for full credit.
3. **Be clear and neat** in your work. Any illegible work, or scribbling in the margins, will not be graded.
4. Place you **answers in a box**. Do not forget **units**!
5. If you need more space, you may use the back of the page and write **On back** in the problem space.

1. **Multiple Guess (2 pts)** Find the answer which best fits the question and write it in the space provided.

a) The average and instantaneous speeds of an object are equal when the object
a. has constant velocity. b. has constant acceleration.
c. moves in a straight line. d. covers twice as much distance in each second. e. none of the above.

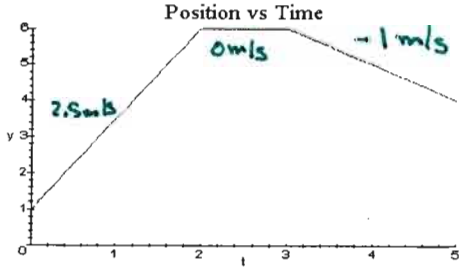
a

b) Which prefix represents one-thousandth?
a. kilo b. mega c. centi d micro e. milli.

e

2. **Definition/Principle (6 pts)**
a. List three of the kinematic equations for horizontal motion.

b. Someone makes a trip according to the graph below. For y in meters and t in seconds, find the average velocity over each segment of the trip. [Indicate all three on the graph.]



3. **Problems (12 pts)** .
a. Sound travels at a constant speed of 767 mph. How much time does it take for the sound of thunder to travel 1.00 km?

$t = \frac{d}{v} = \frac{1.00\,Km}{767\,\frac{mi}{h}} \cdot \frac{1}{1.6\,Km/mi} = .000815\,h$

$= 2.93\,s$

b. A cyclist moves at 14.0 m/s. To pass a second cyclist, the first one speeds up to 21.0 m/s with a constant acceleration of 1.2 m/s^2. During this acceleration, how far has the cyclist gone?

$x = \frac{v^2 - v_0^2}{2a} = \frac{21^2 - 14^2}{2.4} = 100\,m$

c. A person drops a stone from the roof of a building, 30.0 m above the ground.

i. How long does it take the stone to reach the ground?

$t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{60}{9.8}} = 2.47\,s.$

ii. What is its velocity right before hitting the ground?

$v = -\sqrt{2gh}$

$= -\sqrt{2(9.8)30} = -24.2\,m/s$

d. The position of a rolling ball is given by $x(t) = 3t^2 - 2t + 1$ m. Find

i. The average velocity from t = 0.0 s to 2.0 s.

$\bar{v} = \frac{x(2) - x(0)}{2} = 10\,m/s$

ii. The instantaneous velocity as a function of time.

$v(t) = 6t - 2\ m/s$

PHY 201 Quiz #2 **Name** _____

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1. **Multiple Guess (2 pts)** Find the answer which best fits the question and write it in the space provided.

a. Two objects are fired into the air shown in the figure below. Projectile 1 reaches the greater height, but projectile 2 has the greater range. Which one is in the air the longest?
a) Projectile 1, because it travels higher than projectile 2
b) Projectile 2, because it has the greater range.
c) Both projectiles spend the same amount of time in the air.
d) Projectile 2, because it has the smaller initial speed and, therefore, travels more slowly than projectile 1.

a

b. A plane traveling horizontally 10,000 m above the earth at 200 mph drops a package. Assuming no air resistance, the package lands _____ the plane.
a) in front of b) directly under c) behind d) none of the above

b

2. **Definition/Principle (5 pts)**

a. A particle travels along a circle of radius r at speed v.

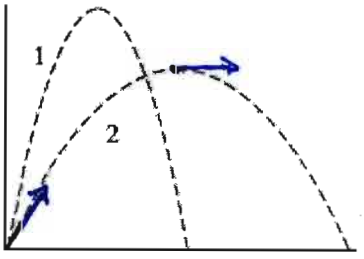
i. What is the magnitude and direction of the acceleration?

$a = \frac{v^2}{r}$, towards center

ii. What is the period of this motion?

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

b. Indicate on path 2 in the figure the initial velocity and the velocity at the top of the path.



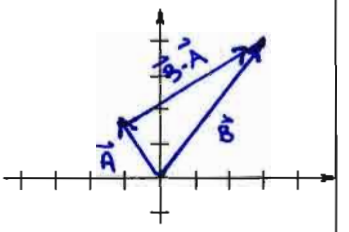
3. **Problems (13 pts)** .

a. Consider the vectors
A: Magnitude 2.0 m in a direction 120° from the positive x-axis,
B = 3.0 **i** + 4.0 **j** m.

i. Find the y-component of **A**.

$A_y = 2.0 \sin 120 = 1.7\text{ m}$

ii. Sketch **A**, **B** and **B** – **A**.



iii. Find the magnitude and direction of **A** + **B**.

$x: -1+3 = 2.0$
$y: 1.7+4.0 = 5.7$
$C = \sqrt{2^2+5.7^2} = \boxed{6.0\text{ m}}$
$\theta = \boxed{71°}$

b. Consider $\mathbf{r} = (5.1t^2 + 3.0t + 2.5)\mathbf{i} + (-6.2t + 1.7)\mathbf{j}$ in meters.

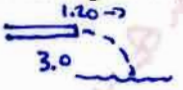
i. Find $\mathbf{r}_0$ and $\mathbf{v}_0$. $\vec{r}_0 = 2.5\hat{i} + 1.7\hat{j}$ m

$\vec{v}_0 = +3.0\hat{i} - 6.2\hat{j}$ m/s

ii. What is the acceleration?

$\vec{a} = 10.2\hat{i}\ \text{m/s}^2$

c. A diver runs horizontally with a speed of 1.20 m/s off a board that is 3.00 meters above the water. How far forward has the diver gone before hitting the water?



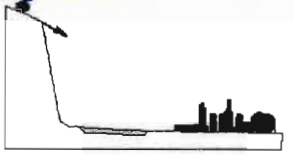
$x = v_0 t$
$t = \sqrt{\frac{2(3.0)}{g}} = .78$
$x = 1.2(.78) = \boxed{0.94\text{m}}$

Bonus

A large boulder rolls off a cliff with a speed of 50.0 m/s at an angle of 30° below the horizontal and at a point 400.0 m above the base of the. How long will the boulder be in the air?

$-400 = -25t - 4.9t^2$

$v_{0y} = 50\sin 30$ $\quad t = \frac{-25 \pm \sqrt{625 + 4(400)4.9}}{9.8} = 6.8\text{ s}$



There is a 200 m diameter pond with its edge 50 m from a point directly below the boulder. Will the boulder land in the pond?

$x = 6.8(43.3) = 294\text{m}$ No

PHY 201 Quiz #3 Name _____

Score _____

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1. **Multiple Guess (3 pts)** Find the answer which best fits the question and write it in the space provided.

a. As a general rule, friction
a) depends on the surface area. b) depends on the sliding speed. c) is proportional to the normal force. d) is greater for smoother surfaces. e) None of the above.

C

b. Cars moving on a properly banked track remain on the track because of
a) friction. b) Newton's Law of Inertia. c) the normal force. d) their mass.

C

c. A measure of inertia is
a) g b) apparent weight c) mass d) force e) none of these.

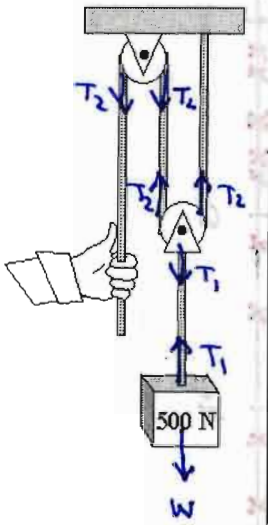
C

2. **Definition/Principle (5 pts)**

a. State Newton's Third Law of Motion.

Action-reaction

b. Draw all of the forces on the block and the massless pulleys and label appropriately, such as tension, weight, normal force.



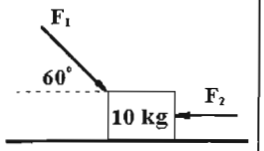
Bonus: What force is being exerted by the person to keep the block in equilibrium?

$T_2 = \frac{1}{2}T_1 = \frac{1}{2}W = \boxed{250\,N}$

3. **Problems (12 pts)**

a. Two forces act on a 10.0 kg block as shown below. The magnitudes of the forces are $F_1 = 30.0N$ and $F_2 = 20.0N$.

i. What is the horizontal acceleration of the block?



$ma = -20 + 30\cos 60$

$a = \boxed{0.500\ m/s^2}$

ii. What is the normal force?

$N = mg + F_1 \sin 60$

$= 98 + 30(.866) = \boxed{124\,N}$

b. A 80.0 kg person stands on a scale in an elevator. What is the apparent weight when the elevator is accelerating upward at 2.50 m/s^2?

$W = mg + ma = \boxed{984\,N}$

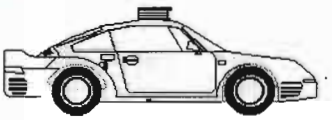
c. A student, in a hurry to go home after, leaves her book on top of the car. She drives around a flat curve with a 70 m radius. If the coefficient of static friction between the book and the car is 0.10, what is the maximum speed the car can have without the book sliding off?

$f_s = mv^2/r$

$\mu_s mg = mv^2/r \Rightarrow v = \sqrt{\mu_s r g}$

$= \sqrt{(0.1)70(98)}$

$= \boxed{8.3\,m/s}$



d. A 1700 kg car is parked on a road that rises 15° above the horizontal.

i. What is the magnitude of the static frictional force exerted on the tires by the road?

$f_s = mg\sin\theta = \boxed{4300\,N}$

ii. What is the coefficient of static friction?

$N = mg\cos\theta = 16090N$

$\mu_s = f_s/N = \boxed{0.268}$

PHY 201 Quiz #4 **Name** _____

Score _____

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1. **Multiple Guess (3 pts)** Find the answer which best fits the question and write it in the space provided.

a. All of the following are units of energy except
a) joules; b) horsepower; c) kilowatt-hours; d) ergs; e) none of these.

b

b. A force $\mathbf{F} = 3.0\mathbf{i} - 4.0\mathbf{j}$ N is applied to a body undergoing a displacement of $\mathbf{d} = -2.0\mathbf{i} + 1.0\mathbf{j}$ m. The work done is
a) 10.0 J. b) 2.0 J. c) -10.0 J d) 11.0 J e) None of these.

C

c. The amount of work required to stop a horizontally moving object is equal to the
a) velocity of the object; b) mass times acceleration of the object; c) the weight of the object; d) the initial kinetic energy of the object; e) none of these.

d

2. **Definition/Principle (3 pts)**

a. What is the Work-Energy Theorem?

$W = \Delta K$

b. Give a specific example of a nonconservative force.

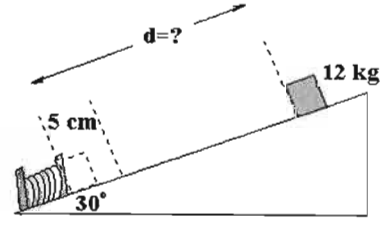
friction

Bonus: A 12.0 kg block slides down the incline shown and compresses a spring 5.0 cm as it comes to rest. If the spring constant is 100.0 N/m, what distance d did the block travel?

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

$2\frac{500(.05)^2}{12(9.8)} = d$

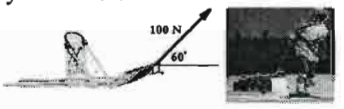
$d = 21\text{cm}$



3. **Problems (14 pts)**

a. A person pulls a toboggan 35.0 m along the snow with a rope directed at 60° above the snow. The rope's tension is 100.0 N. How much work is done on the by the tension force?

$W = 100(35)\cos 60$
$= 1750\text{ J}$

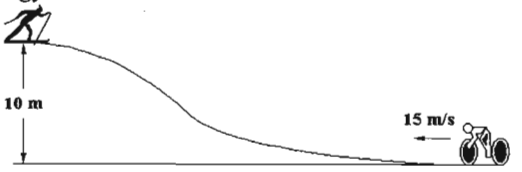


b. In screeching to a halt, a car leaves skid marks that are 65 m long. The coefficient of friction between the tires and the road is $\mu = 0.71$. Use the Work-Energy Theorem to find the speed of the car before the brakes were applied.

$W = \Delta K$

$-\mu_k mgd = -\frac{1}{2}mv^2 \Rightarrow v = \sqrt{2\mu_k gd} = 30\text{ m/s}$

c. Use energy methods and assume a frictionless incline:



i. How fast will the skier be moving at the bottom of the hill?

$v = \sqrt{2gh} = 14\text{ m/s}$

ii. Can the cyclist coast to the top of the hill? If so, how fast will she be moving? If not, then how high will she get?

Yes $\frac{1}{2}mv^2 = \frac{1}{2}mv_0^2 - mgh$

$v = \sqrt{v_0^2 - 2gh} = 5.4\text{ m/s}$

d. A motor lifts a 500.0 kg elevator at a constant speed through a distance of 20.0 m in a time of 30.0 seconds. What is the average power expended by the motor?

$\overline{P} = \frac{W}{t} = \frac{500(9.8)20}{30} = 3300\text{ W}$

e. Let the force exerted on a body be given as $F(x) = 2x - 3$ N. Determine the work done by this force to move the body from $x = 1.0$ m to $x = 3$ m.

$W = \int_1^3 (2x-3)\,dx$

$= x^2 - 3x\Big|_1^3 = +2\text{ J}$

PHY 201 Quiz #5 Name _____

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1. **Multiple Guess (3 pts)** Find the answer which best fits the question and write it in the space provided.

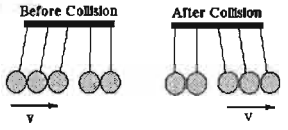
a. Impulse is equal to
a) $F\Delta x$. b) change in kinetic energy.
c) the change in momentum. d) $\frac{dp}{dt}$. C

b. The momentum of a system of objects is conserved if
a) the force acting on the system is conservative;
b) there is an unbalanced external force acting on the system;
c) there are no net external forces acting on the system;
d) the mechanical energy is conserved. C

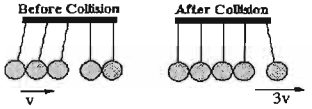
c. The center of mass of which of the following objects would not lie within the body itself?
a) baseball b) solid brick c) Frisbee d) paperback book C

2. **Definition/Principle (3 pts)**
A popular toy exhibiting elastic collisions is shown below. There are five identical masses suspended from a supporting bar. Let three balls enter with a speed v. Based on conservation principles, determine which of the following two scenarios is most likely. [Explain your answer for full credit!]

A. A



B.



energy not conserved.

Bonus: At one end of a train car is a crate of oranges. A monkey tosses each orange 15 m/s to the opposite end of the car, where it hits the wall and falls straight down to the floor. Describe the position and velocity of the car after the monkey has thrown the oranges?

Position: moves to other side so com is fixed

Velocity: 0

---

3. **Problems (14 pts)** .

a. A top tennis player serves a 0.060 kg tennis ball horizontally at 65.0 m/s during a serve.

i. If the contact time with the racket is 0.030 s, then what is the average force on the ball?

$$F = \frac{\Delta p}{\Delta t} = \frac{.06(65)}{.03} = \boxed{130\text{ N}}$$

ii. If the ball rebounds horizontally from a wall at 50.0 m/s, what is the impulse delivered by the wall?

$$J = \Delta p = (50+65)(.06) = \boxed{6.9\text{ Ns}}$$

b. A 5.00 g pellet strikes a 200.0 g block of wood that is free to move and sticks to it. What was the original speed of the pellet if the block's speed is 3.00 m/s after impact?

$$mv = (m+M)V$$

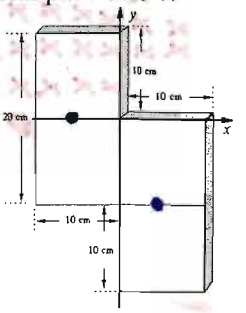
$$v = \frac{205}{5}(3) = \boxed{123\text{ m/s}}$$

c. (3 pts) Find the center of mass of the uniform plate below.

$x_{com} = 0$

$y_{com} = \frac{m(0-10)}{2m} = -5\text{cm}$

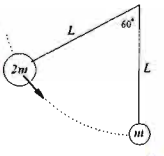
$\boxed{(0,-5)\text{ cm}}$



d. An 1100 kg van is stopped at a light. It is hit directly by a 750 kg car traveling with velocity 2.50 m/s.. Assuming the van is in neutral and the collision is elastic, what is the final velocity of the van after the collision?

$$v_{2f} = \frac{2m_1}{m_1+m_2}v_{1i} = \frac{2(750)}{1850}2.5 = \boxed{2.0\text{ m/s}}$$

e. (3 pts) A ball of mass $2m$ on a string ($L = 45$ cm) swings down and strikes a similar ball of mass m as shown. How high does the small mass rise after the collision? Assume the collision is elastic or inelastic. State which you used: _____



1. $v_1 = \sqrt{gL}$
2. $v_2 = \frac{2(2m)}{3m}v_1$
3. $h = \frac{v_2^2}{2g} = \left(\frac{4}{3}\right)^2\frac{L}{2} = \boxed{40\text{cm}}$ Elastic

or 2. $v_2 = \frac{2}{3}v_1$ or

3. $h = \left(\frac{2}{3}\right)^2\frac{L}{2} = \boxed{10\text{cm}}$ Inelastic.

PHY 201 Quiz #6 **Name** _____

Score _____

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1. **Multiple Guess (3 pts)** Find the answer which best fits the question and write it in the space provided.

a. On which of the following is the moment of inertia of an object not dependent? The
a) axis of rotation. b) object shape. c) distribution of mass. d) velocity. e) none of these. **d**

b. The units of torque are
a) N/m. b) N-m/s. c) N-m. d) J. e) none of these. **c**

c. A hoop, a solid cylinder and a sphere of equal radii are placed at the top of an incline. They are released at the same time. Which one reaches the bottom last?
a) hoop. b) cylinder. c) sphere. d) One cannot tell. **a**

2. **Definition/Principle (4 pts)**

Fill in the exact missing analogous quantities:

Physical concept	**Rotational**	**Translational**
Displacement	θ	x.
Centripetal Acceleration	$\omega^2 r$	v^2/r
Inertia	I	m .
Newton's Second Law	$\tau = I\alpha$	$F = ma$.
Work	$W = \int \tau d\theta$	$W = \int F\,dx$.

Bonus: A pen of length 34.5 cm stands vertically on a desk. It falls from this vertical position. Assuming the end on the desk does not slip, determine the speed of the other end just before it hits the desk surface. Assume the pen is a uniform rod.

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

$mg\frac{L}{2} = \frac{1}{2}\left(\frac{1}{3}mL^2\right)\left(\frac{v}{L}\right)^2$

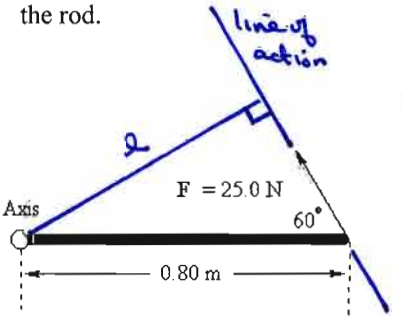
$v = \sqrt{3gL} = \boxed{3.2\ m/s}$

3. **Problems (13 pts)** .

a. A merry-go-round rotates from rest with an angular acceleration of 1.50 rad/s^2. How long does it take to rotate through 2.00 rev?

$\theta = \frac{1}{2}\alpha t^2 \Rightarrow t = \sqrt{\frac{2(2)(2\pi)}{1.5}} = \boxed{4.09\ s}$

b. In the figure below draw and label the line of action and moment arm. Determine the torque produced by the force on the rod.



$\tau = Fr\sin\phi$

$= \boxed{17.3\ Nm}$

c. The angular position of a point on a wheel of radius 3.0 cm and mass 5.0 kg is given by $\theta = 2.0 - 3.0t + 4.0t^2$ rad.

i. Find the angular velocity at $t = 2.0$ s.

$\omega = -3.0 + 8.0t = \boxed{13.0\ rad/s}$

ii. What is the tangential velocity at $t = 2.0$ s?

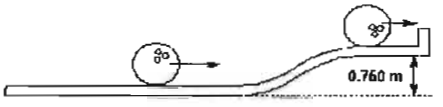
$v = \omega r = \boxed{39\ cm/s}$

iii. If the wheel is in the shape of a solid disk, then what torque is needed to maintain its constant angular acceleration?

$\tau = I\alpha = \frac{1}{2}MR^2\alpha$

$= \frac{1}{2}(5.0)(.03)^2 8 = \boxed{.018\ Nm}$

d. A bowling ball, moving with a speed of 3.50 m/s, encounters a 0.760 m vertical rise on the way to the ball rack. Assuming that the mass is distributed uniformly and the ball rolls without slipping, find the translational speed of the ball at the top of the rise.



$\frac{7}{10}mv_0^2 = \frac{7}{10}mv^2 + mgh$

$v = \sqrt{v_0^2 - \frac{10}{7}gh} = \boxed{1.27\ m/s}$

PHY 201 Quiz #7 Name _____

Score _____

Instructions:
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2. **Show all of your steps** in problems for full credit.
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4. Place your **answers in a box**. Do not forget **units**!
5. If you need more space, you may use the back of the page and write **On back** in the problem space.

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1. **Multiple Guess (4 pts)** Find the answer which best fits the question and write it in the space provided.

a. When one stretches liquorice, the strain is given by
a) the change in length per original length. b) the applied force per unit area. c) the restoring force. d) none of these.

a

b. An ice skater spins on frictionless ice with her arms extended. She pulls her arms in toward her body. Angular momentum is conserved. So, as the moment of inertia is reduced, her angular velocity increases and she spins faster. Compared to the initial rotational kinetic energy, her final rotational kinetic energy is
a) the same. b) larger, because her angular speed is larger.
c) smaller, because her moment of inertial is smaller.

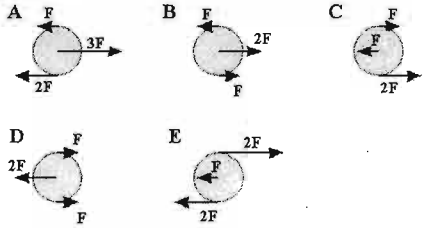
b

c. When the distance between two masses is cut in half and one of the masses is doubled, the gravitational force between them is _____ the original force.
a) half b) the same as b) twice c) four times d) eight times
e) None of these.

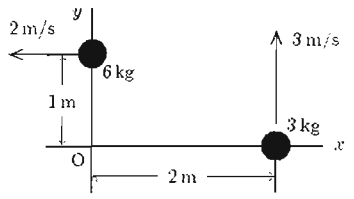
d

d. The drawing shows a top view of several hockey pucks and three forces that act on each one. Which one of the five pucks is in equilibrium?

d



2. **Angular Momentum (3 pts)**
Two objects are moving in the *x*-*y* plane. Find the magnitude of their total angular momentum about the origin.



$l = rp\sin 90 = rmv$

$L = r_1 m_1 v_1 + r_2 m_2 v_2$

$= 12 + 18 = \boxed{30\ \text{kg m}^2/\text{s}}$

Bonus: Let $\mathbf{r} = 3\mathbf{i} - 5\mathbf{j}$ m and $\mathbf{p} = 2\mathbf{i} + 4\mathbf{k}$ kg m/s. Compute $\mathbf{r} \times \mathbf{p}$.

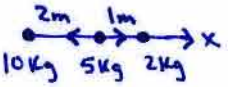
$\vec{r} \times \vec{p} = (3i - 5j)(2i + 4k) = \boxed{-20\hat{i} - 12\hat{j} + 10\hat{k}\ \text{kg m}^2/\text{s}}$

What nuclear material was used in the Nagasaki bomb?

plutonium

3. **Problems (13 pts)** .

a. Three masses lie on a line: 10.0 kg at $x = 0.0$ m; 5.0 kg at $x = 2.0$ m and, 2.0 kg at $x = 3.0$ m. Find the gravitational force on the 5.0 kg mass. [$G = 6.67 \times 10^{-11}$ Nm^2/kg^2]



$F = -G\frac{m_1 m_2}{r_1^2} - G\frac{m_2 m_3}{r_2^2}$

$= -G\frac{50}{4} + G\frac{10}{1} = -2.5G = \boxed{-1.7 \times 10^{-10}\ \text{N}}$

b. The moon's mass and radius are about 1/100$^{\text{th}}$ and 1/4$^{\text{th}}$ those of the Earth, respectively. If a person weighs 600 N on the Earth, then what do they weigh on the moon?

$g_{moon} = \frac{GM_m}{R_m^2} = \frac{GM_E}{R_E^2}\frac{\frac{1}{100}}{(1/4)^2} = \frac{16}{100}g$

$W_{moon} = mg_{moon} = \frac{16}{100}W_E = 16 \cdot 6 = \boxed{96\ \text{N}}$

c. After a fall, a 95 kg rock climber finds himself dangling from the end of a rope that had been 15 m long and 9.6 mm in diameter, but which has stretched by 2.8 cm. Determine Young's modulus for the rope.

$E = \frac{FL}{A\Delta L} = \frac{95(9.8)15}{\pi(.0048)^2(.028)} = \boxed{6.89 \times 10^9\ \text{N/m}^2}$

d. An airport baggage carousel rotates with angular speed of 0.20 rad/s. The moment of inertia of the carousel is 1500 kg m^2. Ten pieces of baggage with an average mass of 15 kg each drop vertically onto the carousel and come to rest 2.0 m from the axis of rotation. Assuming no net external torque acts on the system, what is the final speed of the carousel and baggage?

$L_i = L_f \Rightarrow 1500(.20) = (1500 + 150(2)^2)\omega_f$

$L = I\omega$

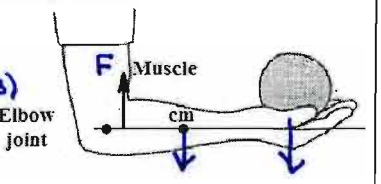
$\omega_f = \frac{300}{2100} = \boxed{0.14\ \text{rad/s}}$

e. A person holds a 150 N ball with the forearm horizontal. The elbow is 0.030 m from the flexor muscle and 0.330 m from the ball. The center of mass of the forearm is 0.090 m from the elbow. If the forearm weighs 25.0 N, find the force exerted by the flexor muscle.

$\Sigma\tau = 0$

$F(.03) = 25(.09) + 150(.33)$

$F = \boxed{1725\ \text{N}}$



PHY 201 Quiz #8 Name _____

Score _____

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4. Place your **answers in a box**. Do not forget **units**!
5. If you need more space, you may use the back of the page and write **On back** in the problem space.

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1. **Multiple Guess (3 pts)** Find the answer which best fits the question and write it in the space provided.

a. The units of torque are
a) N/m. b) Nm. c) Nm/s. d) J. e) none of these.

b

b. An ice skater spins on frictionless ice with her arms extended. She pulls her arms in toward her body. Angular momentum is conserved. So, as the moment of inertia is reduced, her angular velocity increases and she spins faster. Compared to the initial rotational kinetic energy, her final rotational kinetic energy is
a) the same b) smaller, because her moment of inertial is smaller. c) larger, because her angular speed is larger.

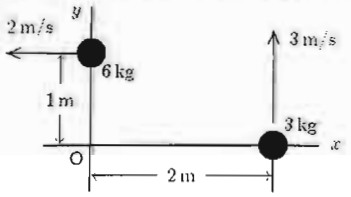
c

c. When the distance between two masses is cut in half and one of the masses is doubled, the gravitational force between them is _____ the original force.
a) half b) the same as b) twice c) four times d) eight times
e) None of these.

d

2. **Angular Momentum (4 pts)**

a. Two objects are moving in the x-y plane. Find the magnitude of their total angular momentum about the origin.



18+12 = 30 kgm²/s

b. An airport baggage carousel rotates with angular speed of 0.20 rad/s. The moment of inertia of the carousel is 1500 kg m^2. Ten pieces of baggage with an average mass of 15 kg each drop vertically onto the carousel and come to rest 2.0 m from the axis of rotation. Assuming no net external torque acts on the system, what is the final speed of the carousel and baggage?

.14 rad/s

3. **Problems (13 pts)** .

a. The angular position of a point on a wheel of radius 3.0 cm and mass 5.0 kg is given by $\theta = 2.0 - 3.0t + 4.0t^2$ rad. If the wheel is in the shape of a solid disk, then what torque is needed to maintain its constant angular acceleration?

.018 Nm

b. Three masses lie on a line: 10.0 kg at $x = 0.0$ m; 5.0 kg at $x = 2.0$ m and, 2.0 kg at $x = 3.0$ m. Find the gravitational force on the 5.0 kg mass. [$G = 6.67 \times 10^{-11}$ Nm^2/kg^2]

-1.67×10^{-10} N

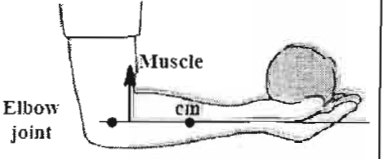
c. A bowling ball, moving with a speed of 3.50 m/s, encounters a 0.760 m vertical rise on the way to the ball rack. Assuming that the mass is distributed uniformly and the ball rolls without slipping, find the translational speed of the ball at the top of the rise.

1.27 m/s

d. The moon's mass and radius are about 1/100th and 1/4th those of the Earth, respectively. If a person weighs 600 N on the Earth, then what do they weigh on the moon?

96 N

e. A person holds a 150 N ball with the forearm horizontal. The elbow is 0.030 m from the flexor muscle and 0.330 m from the ball. The center of mass of the forearm is 0.090 m from the elbow. If the forearm weighs 25.0 N, find the force exerted by the flexor muscle.



1725 N

PHY 201 Quiz #8 Name _____

Score

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1. **Multiple Guess (4 pts)** Find the answer which best fits the question and write it in the space provided.

a. If an object displaces an amount of liquid of greater weight than its own, the object will
a) sink b) float c) remain in equilibrium for any submerged position. **b**

b. Bernouli's equation is derived using conservation of
a) mass. b) momentum. c) energy. d) pressure. **c**

c. In simple harmonic motion the acceleration is
a) proportional to the displacement. b) never greater than g.
c) inversely proportional to the displacement. d) constant
e) greatest when the velocity is greatest. **a**

d. If the length of a simple pendulum is doubled, then its period
a) doubles. b) halves. c) is less by a factor of $\sqrt{2}$.
d) is greater by a factor of $\sqrt{2}$. e. remains the same. **d**

2. **Definition/Principle (4 pts)**

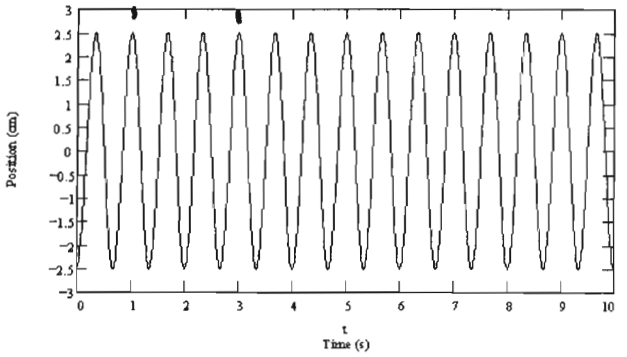
a. Give Bernoulli's equation exactly.

$p + \frac{1}{2}\rho v^2 + \rho g y = \text{const.}$

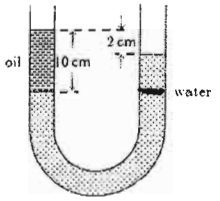
b. For the graph below of position (cm) vs time (s), give the

i. Amplitude. 2.5 cm

ii. Frequency of oscillation. $T = 2/3 \Rightarrow 1.5\,Hz$



Bonus: Determine the density of the oil in the U-tube.



$P_o = P_w$

$\rho_o g h_o = \rho_w g h_w$

$\rho_o = \frac{h_w}{h_o}\rho_w = 800\ kg/m^3$

3. **Problems (12 pts)** Do only 6 problems

a. What is the pressure on a diver 10 m below the surface of a lake at sea level? (Give the answer in atmospheres.)

$P = P_o + \rho g h = 1 + .98 = 1.98\ atm$

b. The dimensions of a wooden raft (density = 150 kg/m^3) are 3.0m × 3.0m × 1.0m. What maximum load can it carry in seawater (density = 1020 kg/m^3)?

$W + \rho_r V_r g = \rho_w V_w g$

$W = (\rho_w - \rho_r) V g = 870(9)9.8$

$= 7.67 \times 10^4\ N$ or $7800\ kg$

c. Water flows through a garden hose at 11 cm/s. The circular hose has a radius of 1.5 cm and the hose nozzle has a radius of 0.25 cm. What is the water speed in the nozzle?

$A_1 v_1 = A_2 v_2$

$v_2 = \frac{1.5^2}{(.25)^2} v_1 = 396\ cm/s$

d. A motorist uses a hydraulic lift to raise a 1.5×10^3 kg car. If the area of the input piston is 2.0×10^{-3} m^2 and the output plunger has an area of 5.0×10^{-2} m^2, then what input force in needed to lift the car?

$F_1 = F_2 \frac{A_1}{A_2} = 1.5\times10^3 \frac{2\times10^{-3}}{5\times10^{-2}} 9.8 = 588\ N$

e. An oscillator consists of a block of mass 0.500 kg connected to a spring. When set into oscillation with amplitude of 35.0 cm, it is observed to repeat its motion every 0.500 s. Find the spring's

i) frequency of oscillation. 2.0 Hz

ii) maximum speed. $v_{max} = 2\pi f x_m$ 4.4 m/s

iii) spring constant. $K = m\omega^2 = 4\pi^2 f^2 m$ 79 N/m

f. Water flows through a horizontal tapered pipe. At the wide end its speed is 4.0m/s. The difference in pressure between the ends is 4.5×10^3 Pa. Find the speed of the water at the narrow end.

$\Delta p = P_2 - P_1 = \frac{1}{2}\rho v_1^2 - \frac{1}{2}\rho v_2^2$

$v_1 = \sqrt{v_2^2 + 2(4.5\times10^3)/10^3} = \sqrt{4^2+3^2} = 5.0\ m/s$

or 2.65 m/s

g. A simple pendulum has a length of one meter. What is its period of oscillation?

$T = 2\pi\sqrt{\frac{L}{g}} = 2\pi/\sqrt{9.8} = 2.0\ s$