HAWAI'I PACIFIC UNIVERSITY

PHYS 2050: SECOND PRACTICE EXAMINATION

SEMESTER: FALL 2018

Campus/Centre:	( ) Downtown campus (x) Loa Campus

Examination Day:	**N/A**	**Examination Date:**	**N/A**
Examination Time:	**N/A**	**Duration:**	**80 min**

Course Abbreviation & Number:	**PHYS 2050**
Course Title:	**General Physics I**

Name of Student: ______________________________

Student Number: ______________________________

INSTRUCTIONS TO CANDIDATES

1. This examination consists of 5 pages.
2. There are 8 conceptual and 8 quantitative questions in this examination. Answer ALL questions.
3. **All working must be shown.**
4. **Units must be shown.**
5. A list of selected formulae is provided below.

LIST OF SELECTED FORMULAE

Kinematics equations

$$v = \frac{dx}{dt}, \quad a = \frac{dv}{dt}$$

Center-of-mass

$$\vec{r} = \frac{1}{M}\sum_{i=1}^{N} \vec{r}_i m_i$$

Conservation of energy

$$W_{\text{ext}} = \Delta K_{\text{rot}} + \Delta K_{\text{trans}} + \sum \Delta U$$

Work

$$W = \int \vec{F} \cdot d\vec{s}$$

Newton's 2nd law

$$\sum \vec{F} = m\vec{a}$$

Centripetal acceleration

$$a_{rad} = \frac{v^2}{r}$$

Conservation of momentum

$$\vec{p}_i = \vec{p}_f, \quad m\vec{v}_i = m\vec{v}_f$$

Rotational kinematics

$$\omega = \frac{d\theta}{dt}, \quad \alpha = \frac{d\omega}{dt}$$

Kinetic energies

$$K_{\text{trans}} = \frac{1}{2}mv^2, \quad K_{\text{rot}} = \frac{1}{2}I\omega^2$$

Gravitational potential energy

$$\Delta U_g = mg(y - y_0)$$

Conservation of kinetic energy in an elastic collision

$$\vec{v}_{1f} + \vec{v}_{1i} = \vec{v}_{2f} + \vec{v}_{2i}$$

Spring potential energy for $x_{eq} = 0$

$$\Delta U_s = \frac{1}{2}k(x^2 - x_0^2)$$

Work-kinetic energy theorem

$$W_{\text{net}} = \Delta K$$

Momentum and impulse

$$\vec{p} = m\vec{v}, \quad \vec{J} = \int \vec{F}dt = \Delta\vec{p}$$

Volume density

$$\rho = \frac{dm}{dV}$$

Pressure

$$p = \frac{dF_\perp}{dA}$$

Simple fluid eqs.

$$p = p_0 + \rho gh, \quad A_1v_1 = A_2v_2, \quad \frac{dV}{dt} = Av, \quad \rho_1 + \rho g y_1 + \frac{1}{2}\rho v_1^2$$

Torque

$$\vec{\tau} = \vec{r} \times \vec{F}, \quad \Sigma\vec{\tau} = I\vec{\alpha}$$

Conservation of angular momentum

$$\vec{L}_i = \vec{L}_f, \quad I_i\omega_i = I_f\omega_f$$

Surface density

$$\sigma = \frac{dm}{dA}$$

Line density

$$\lambda = \frac{dm}{d\ell}$$

Moment-of-inertia

$$I = \sum m_i r_i^2, \quad I = \int r^2 dm$$

Traveling waves

$$y(x,t) = A\cos(kx - \omega t)$$

Wave speed

$$v = \lambda f = \frac{\omega}{k}, \quad v_{\text{string}} = \sqrt{\frac{F}{\mu}}, \quad v_{\text{sound}} = \sqrt{\frac{B}{\rho}}$$

Bernoulli's equation

$$\rho_1 + \rho g y_1 + \frac{1}{2}\rho v_1^2 = \rho_2 + \rho g y_2 + \frac{1}{2}\rho v_2^2$$

Wave parameters

$$k = \frac{2\pi}{\lambda}, \quad \omega = 2\pi f$$

Standing waves

$$f_n = \frac{nv}{2L} \quad (n = 1,2,3,\ldots)$$

Gravitation between 2 point masses

$$F_g = G\frac{m_1m_2}{r^2}, \quad U_g = -G\frac{m_1m_2}{r}$$

Harmonic motion

$$\omega_{\text{spring}} = \sqrt{\frac{k}{m}}, \quad \omega_{\text{pend}} = \sqrt{\frac{g}{\ell}}$$

Beat freq.

$$f_{\text{beat}} = f_a - f_b$$

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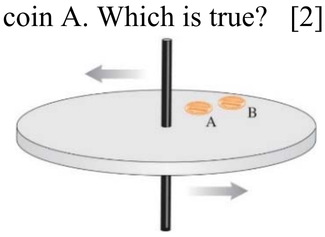
Conceptual Section (Circle the correct answer)

1. You are standing at rest on a skateboard. A friend throws a very heavy ball towards you. You can either catch or deflect the object back towards your friend. What should you do to minimize your speed? [2]
   A. Deflect the ball.
   B. Catch the ball.
   C. Your final speed on the skateboard will be the same regardless of catching or deflecting.

2. A small glider is coasting horizontally when suddenly a very heavy piece of cargo falls out of the bottom of the plane. You can neglect air resistance. Just after the cargo has fallen out [2]
   A. the cargo slows down but the plane does not change speed.
   B. the plane speeds up and the cargo slows down.
   C. the plane speeds up but the cargo does not change speed.
   D. neither the cargo nor the plane change speed.

3. Two coins rotate on a turntable. Coin B is twice as far from the axis of rotation as coin A. Which is true? [2]
   A. The speed of A is four times that of B.
   B. The speed of A is twice that of B.
   C. The speed of A is half that of B.
   D. The speed of A is the same as that of B.



4. If you double the pressure on the surface of a barrel of water, the buoyant force on a stone placed in that water will [2]
   A. not change.
   B. decrease, but not by one-half.
   C. increase, but not double.
   D. double.

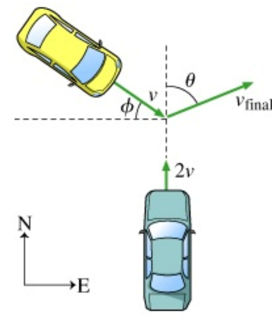
5. A certain planet has an escape speed v_e. If another planet has twice the size and twice the mass of the first planet, its escape speed will be [2]
   A. $2v_e$.
   B. $\sqrt{2}v_e$.
   C. v_e.
   D. $\frac{v_e}{2}$.

6. A restoring force of magnitude F acts on a system with a displacement of magnitude x. In which of the following cases will the system undergo simple harmonic motion? [2]
   A. $F \propto \sin x$
   B. $F \propto x$
   C. $F \propto x^2$
   D. $F \propto \frac{1}{x}$

7. If we double only the amplitude of a vibrating ideal mass-and-spring system, the mechanical energy of the system [2]
   A. increases by a factor of 2.
   B. increases by a factor of $\sqrt{2}$.
   C. increases by a factor of 4.
   D. does not change.

8. A wave pulse traveling to the right along a thin cord reaches a discontinuity where the rope becomes thicker and heavier. What is the orientation of the reflected and transmitted pulses? [2]
   A. Both pulses are inverted.
   B. The reflected pulse returns right side up while the transmitted pulse is inverted.
   C. Both pulses are right side up.
   D. The reflected pulse returns inverted while the transmitted pulse is right side up.

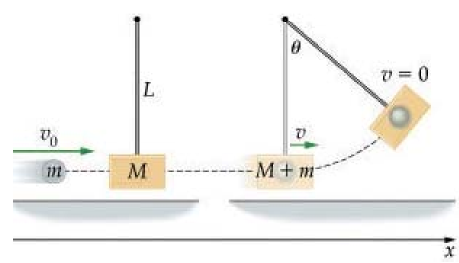
Quantitative Section



1. Two cars, both of mass $m = 2300$ kg, collide and stick together. Prior to the collision, one car had been traveling north at speed $2v$, while the second was traveling at speed v at an angle $\phi = 18.0°$ south of east. Let the speed $v = 42.0$ m/s. After the collision, the two-car system travels at speed v_{final} at an angle θ east of north.

   (a) Find the speed v_{final} of the joined cars after the collision. [4]

   (b) What is the angle θ made by the velocity vector of the two cars after the collision? [3]



2. In a ballistic pendulum an object of mass $m = 0.070$ kg is fired with an initial speed $v_0 = 52.0$ m/s at a pendulum bob. The bob has a mass $M = 1.35$ kg, which is suspended by a massless rod of length $L = 0.650$ m. After the collision, the pendulum and object stick together and swing to a maximum angular displacement θ as shown.

   (a) Find the speed of the combined masses immediately after the collision. [4]

   (b) Find the maximum height of the combined bullet + block relative to the block's initial hanging position. [3]

   (c) Find the maximum angle made by the bullet + block relative to their position at the time of the collision. [2]

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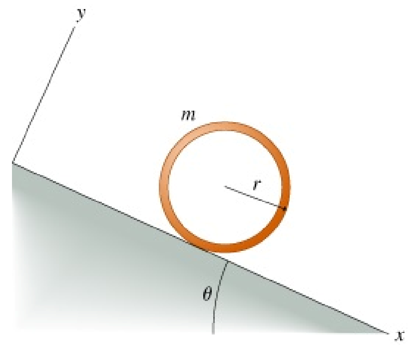
3. A circular hoop ($I_{\text{hoop}} = mR^2$) of mass $m = 5.00$ kg, radius $r = 2.00$ m, and infinitesimal thickness rolls without slipping down a ramp inclined at an angle $\theta = 32.0°$ with the horizontal.



(a) Draw a free body diagram of the hoop. [1]

(b) Determine the magnitude of the hoop's acceleration down the ramp. [4]

(c) Determine the force of static friction on the hoop. [3]

4. A person stands, hands at his side, on a platform rotating at a rate of 7.0 rad/s. If he raises his arms to a horizontal position, then his rate of rotation decreases to 5.0 rad/s. Consider this a closed system, where angular momentum is conserved.

(a) By what factor has his moment-of-inertia changed? [2]

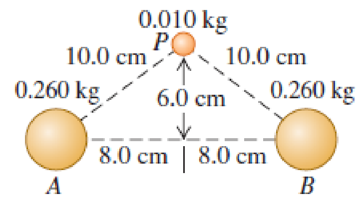
(b) By what factor has his rotational kinetic energy changed, $\frac{K_{\text{after}}}{K_{\text{before}}}$? [2]

5. Water is flowing in a circular pipe with a varying cross-sectional area, and at all points the water completely fills the pipe.

(a) At one point in the pipe the radius is 0.215 m. What is the speed of the water at this point if water is flowing into this pipe at a steady rate of 1.95 m^3/s? [3]

(b) At a second point in the pipe the water speed is 4.40 m/s . What is the radius of the pipe at this point? [3]

6. Two uniform spheres, each of mass 0.260 kg, are fixed at points A and B. Find the magnitude and direction of the initial acceleration of a uniform sphere with mass 0.010 kg if released from rest at point P and acted on only by forces of gravitational attraction of the spheres at A and B. [Gravitational constant, $G = 6.67\times10^{-11}$ N m^2/kg^2] [4]



7. A 1.50 kg mass on a spring has displacement as a function of time given by the equation

$$x(t) = (7.40\text{ cm})\cos[(4.16\text{ rad/s})t - 2.42\text{ rad}]$$

(a) Determine the time for one complete vibration. [2]

(b) Find the force constant of the spring. [2]

(c) Determine the maximum speed of the mass. [2]

(d) Determine the maximum force on the mass. [2]

8. A guitar string is vibrating in its fundamental mode, with nodes at each end. The length of the segment of the string that is free to vibrate is 0.382 m . The maximum transverse acceleration of a point at the middle of the segment is 8300 m/s^2 and the maximum transverse velocity is 3.30 m/s.

(a) What is the amplitude of the standing wave? [4]

(b) What is the wave speed for the transverse traveling waves on this string? [4]

END OF EXAMINATION