PHYS 172/spring2012-practice

Test/Quiz Number: 10

Your Name:

DO NOT OPEN YOUR EXAM UNTIL TOLD

Practice Exam I, Phys 172, Spring 2012

*1. Write your name on the line above and record it on your **scantron** form.*

*2. Record your two-digit Test/Quiz Number on your **scantron** form. The number is shown at the top of this page.*

*3. Record your PUID number in the respective field on your **scantron** form.*

Do not use other paper. Write on the back of this test if needed.

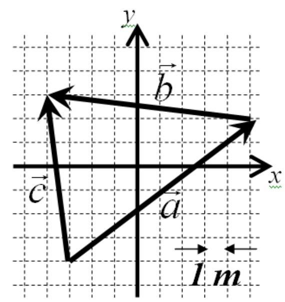
A page with major equations is provided at the back of this exam.

*Circle your answers here and on the **scantron** form. At the end of the exam, or if you finish earlier, please remain seated, raise your hand and a TA will come to you to collect your **scantron** form and this printout.*

Problems 1-3 use the same graph

Problem 1

What are the components of the vector $\vec{a}$?



A) <6, 8> m
B) <5, 2> m
C) <-3, 5> m
D) <8, 6> m
E) <-4, 2> m

Problem 2

What is the unit vector in the direction of the vector $\vec{a}$?

A) <0.8, 0.6>
B) <0.6, 0.8>
C) <1, 1>
D) <1, 0.75>
E) <0.93, 0.37>

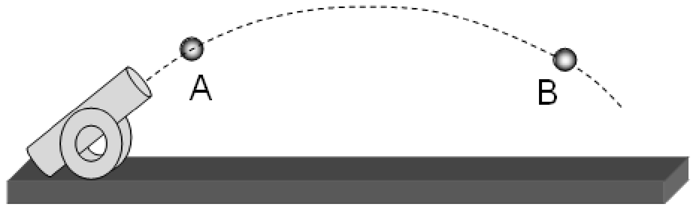
Problem 3

Which one of the following statements is true about vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$?

A) $\vec{a}+\vec{b}+\vec{c}=0$
B) $\vec{a}+\vec{c}=\vec{b}$
C) $\vec{a}=\vec{c}+\vec{b}$
D) $\vec{a}-\vec{b}=\vec{c}$
E) $\vec{a}+\vec{b}-\vec{c}=0$

Problem 4

A cannon ball is shot into air and flies along parabolic trajectory as shown in the picture below. Ignore air friction (drag) and account only for interactions between cannon, ball and the Earth (ignore other celestial bodies).



For the time interval when cannon ball flies from point A to B, examine the following statements:

1. The momentum of the cannon ball is conserved
2. The total momentum of the cannon and the ball is conserved
3. The total momentum of Earth, cannon and cannon ball is conserved
4. The total velocity of Earth and cannon is conserved
5. The velocity of the cannon ball is conserved

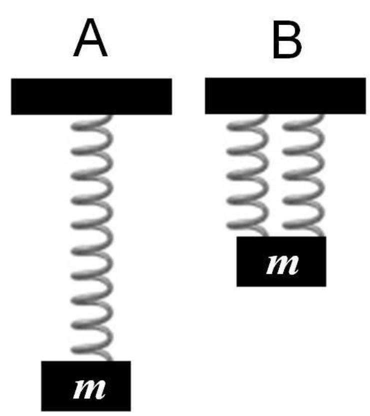
Which statements are correct?

A) Only 1 and 5
B) Only 3
C) Only 2
D) Only 3 and 4
E) Only 4

Problem 5

When you attach a mass *m* to a certain spring it stretches by 4 cm (Fig. A). You then cut that spring into two equal length pieces and attach the same mass *m* to two resulting springs as shown in Fig. B. How much does each of the springs stretch?

A) 8 cm
B) 2 cm
C) 1 cm
D) 16 cm
E) 4 cm



Problem 6

A falling rubber ball bounces off the floor. The velocity just before it hits the floor is <2.7,−5.2,0> m/s. Just after it hits the floor, the ball's velocity is <2.7,5.2,0> m/s. The ball's mass is 0.038 kg. The ball is in contact with the floor for only 1.8×10^{-3} seconds. What is the net force exerted on the ball during the time it is in contact with the floor? (Assume the net force is approximately constant.) Express your result as a vector.

A) $\langle 0, 219.6, 0 \rangle\ N$
B) $\langle 0, 219.2, 0 \rangle\ N$
C) $\langle 0, 219.9, 0 \rangle\ N$
D) $\langle 0, -0.37, 0 \rangle\ N$
E) $\langle 0, 0, 0 \rangle\ N$

Problem 7

An electron is accelerated to a speed 0.9999*c* (four 9's), where $c=3\times10^{8}$ m/s is the speed of light. What is the momentum of this electron? Mass of an electron is 9×10^{-31} kg.

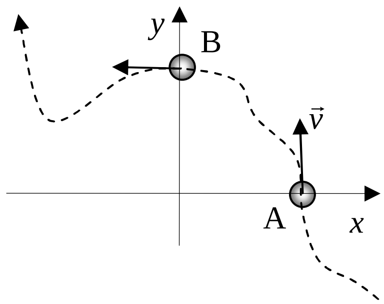
A) 2.7×10^{-22} kg·m/s
B) 3.8×10^{-24} kg·m/s
C) 3.8×10^{-20} kg·m/s
D) 1.9×10^{-20} kg·m/s
E) 1.6×10^{-21} kg·m/s

Problem 8

If an object moves at constant velocity, you can irrefutably conclude that:

A) The object certainly does not interact with anything in the universe
B) The object may be interacting with other objects in the universe, but the net interaction is zero
C) The net interaction with other objects in universe may be not zero, but it is constant in time
D) The object does not obey laws of physics
E) There is no gravity acting on that object

Problem 9
An object of mass 2 kg moves at a constant speed 0.5 m/s along a path as shown.



What is the magnitude of the momentum change $|\Delta\vec{p}|$ when the object travels from point A to point B?

A) 0 kg·m/s
B) 1 kg·m/s
C) 0.5 kg·m/s
D) 2 kg·m/s
E) 1.41 kg·m/s

Problem 10
A 70 kg guy sliding freely (no friction) on horizontal icy surface with velocity <-10,0,0> m/s catches a 160g puck flying at speed <40,20,2> m/s. What is the velocity of the guy after he catches the puck? (Note that the guy still moves along horizontal surface of the ice)

A) <9.9, 0.046, 0.0046> m/s
B) <9.9, 0.046, 0> m/s
C) <-640, 3.2, 0.32> m/s
D) <-9.58, 0.003, 0.001> m/s
E) <-9.58, 0.003, 0> m/s

Problem 11
A planet with mass 10^{24} kg and a star with mass 10^{30} kg are located at coordinates <1,1,2> $\cdot 10^8$ km and <1,2,3> $\cdot 10^8$ km, respectively. Find the gravitational force acting on the planet due to the star.

A) $1.67 \cdot 10^{21}$ <0,1,0> N
B) $1.67 \cdot 10^{21}$ <0,-0.71,-0.71> N
C) $1.67 \cdot 10^{21}$ <0,0.71,0.71> N
D) $1.67 \cdot 10^{21}$ <0.71,0,-0.71> N
E) None of the above answers is within 10% of the correct result.

PHYS 172 - Spring 2010
<u>Hand-Graded part of *Practice* Exam 1</u>:

Mark your recitation time with an X

	Tu	W	Th	F
8.30				
9:30				
10:30				
11:30				
12:30				
1:30				
2:30				
3:30				
4:30				

Name (Print):________________________________

Signature:___________________________________

PUID:______________________________________

When you use a fundamental principle you must explain clearly what physical system you are applying it to and which objects in the system's surroundings are interacting significantly with it.

Problem 1 (20 points)

You see your 10 kg bag sitting at rest on the floor at the airport baggage claim, and you rush over to grab it. You jerk the bag off the ground by pulling on it with a constant force of 130 N, at an angle of 70° above horizontal, for 0.1 seconds. The force of your pull is in the x-y plane (where the x-axis is parallel with the ground, and the y-axis points straight up in the air).

We want to know the velocity of the bag at the end of this 0.1 second period of tugging, and also the total distance through which the bag moved.

1.1. Define the system you're using in this problem.

1.2. List the external <u>objects</u> that interact significantly with the system. Make a carefully labeled diagram showing their interaction with the system. List an object that doesn't interact significantly with the system.

1.3. Use the momentum principle to find the velocity of the bag at the end of the 0.1 second period of time. Show all steps, include units, and circle the final answer. (*Note: You're not being asked for the speed of the box.)*

1.4. Through what total distance did the bag move during the 0.1 second period of time? Show all steps, include units, and circle the final answer.

Problem 2 (10 points)

As you are walking down a hallway in the Physics building you overhear two students discussing a Phys 172 problem in which two boxes are being moved across a loading dock. The smaller of the two boxes is on top of the larger one. As a worker pushes on the larger box, both boxes move together with increasing speed across the level, polished concrete floor.

One student says “The worker must be exerting a force on the top box, otherwise its motion would not be changing and it would be left behind as the bottom box moves.” The other student responds “No, the worker isn’t exerting any significant force on the top box because he isn’t in contact with it. The motion of the top box does change though, so, it must be interacting significantly with some other object in its surroundings.”

Starting from fundamental principles, how do you explain the changing motion of the top box in this situation? What objects in its surroundings is the top box interacting significantly with?

Equation sheet for Exam I, PHYS 172, Spring 2012

$$\vec{v}_{avg} = \frac{\Delta\vec{r}}{\Delta t} \equiv \frac{\vec{r}_f - \vec{r}_i}{t_f - t_i} \qquad \vec{v} = \lim_{\Delta t \to 0} \frac{\Delta\vec{r}}{\Delta t} \equiv \frac{d\vec{r}}{dt} \qquad \vec{r}_f = \vec{r}_i + \vec{v}_{avg}\left(t_f - t_i\right)$$

$$r_f = r_i + \frac{v_i + v_f}{2}\left(t_f - t_i\right)$$

$$\vec{p} = \gamma m\vec{v} \qquad \gamma = \frac{1}{\sqrt{1 - \left(\frac{|\vec{v}|}{c}\right)^2}} \qquad \vec{v} = \frac{\vec{p}/m}{\sqrt{1 + \left(\frac{|\vec{p}|}{mc}\right)^2}}$$

$$\Delta\vec{p} = \vec{F}_{net}\Delta t \qquad \vec{p}_f = \vec{p}_i + \vec{F}_{net}\Delta t \qquad \frac{d\vec{p}}{dt} = \vec{F}_{net} \qquad \Delta\vec{p}_{system} + \Delta\vec{p}_{surrounding} = \vec{0}$$

$$\frac{d\vec{p}}{dt} = \frac{d|\vec{p}|}{dt}\hat{p} + |\vec{p}|\frac{d\hat{p}}{dt} \qquad \left(\frac{d\vec{p}}{dt}\right)_{\perp} = p\frac{v}{R} = F_{\perp} \qquad \left(\frac{d\vec{p}}{dt}\right)_{\parallel} = \frac{dp}{dt} = F_{\parallel}$$

$$\left|\vec{F}_{spring}\right| = k_S|s| \qquad \frac{F_T}{A} = Y\frac{\Delta L}{L} \qquad k_s = \frac{A}{L}Y \qquad k_{interatomic} = Yd$$

$$\vec{F}_{grav\ \mathrm{on\,2\,by\,1}} = -G\frac{m_2 m_1}{\left|\vec{r}_{2-1}\right|^2}\hat{r}_{2-1} \qquad \vec{F}_{\mathrm{elec\ on\,2\,by\,1}} = \frac{1}{4\pi\varepsilon_0}\frac{q_2 q_1}{\left|\vec{r}_{2-1}\right|^2}\hat{r}_{2-1}$$

$$\Delta x \Delta p_x \ge h$$

$$\ddot{x}(t) = -\frac{k}{m}x(t) \qquad x = A\cos(\omega t) \qquad \omega = \sqrt{\frac{k_s}{m}} \qquad T = \frac{2\pi}{\omega} \qquad f = \frac{1}{T}$$

Constants:

$G = 6.7\times10^{-11}\ \frac{\mathrm{N\times m^2}}{\mathrm{kg^2}}$ $\qquad \frac{1}{4\pi\varepsilon_0} = 9\times10^{9}\ \frac{\mathrm{N\times m^2}}{\mathrm{C^2}}$ $\qquad h = 6.6\times10^{-34}$ kg·m²/s

$c = 3\times10^{8}$ m/s $\qquad g = 9.8$ N/kg $\qquad N_A = 6\times10^{23}$ mol^{-1}

Geometry:

$\pi = 3.14$

Circle: *circumference* = $2\pi r$, *area* = πr^2

Sphere: *area* = $4\pi r^2$, *volume* = $(4/3)\pi r^3$