Sit in Seat Number _____ Name _____

Rec. Sec. _____

PH2100 **Answer Sheet - Final** **Fall 2000**

Multiple Choice
(Circle your answer)

1. A B C D E

2. A B C D E

3. A B C D E

4. A B C D E F

5. A B C D E F

6. A B C D E F

7. A B C D E

8. A B C D E

9. A B C D E

10. A B C D E F

11. A B C D E

12. A B C D E F G

13. A B C D E F

Worked Problems

14. A) _____

B) _____

15. A) _____

B) _____

16. A) _____

B) _____

17. A) _____

B) _____

C) _____

18. _____

19. A) _____

B) _____

20. _____

Sub Total _____

Sub Total _____

Total Score _____

PH2100 FINAL Instructions

1. Put your name and recitation section number on your answer sheet.

2. An equation sheet is provided. You should *not* use one of your own and you should not use equations stored in your calculator.

3. If you need extra paper, pencils, or a calculator, contact your exam proctor.

4. Answers which are illegible or ambiguous will be graded as zero.

5. For numerical answers, supply your answer to three significant figures even if the data given has a different number of significant figures unless you are explicitly told to use a different number of significant figures.

6. There are 26 answers each worth 5 points giving a total possible on the exam of 130.

7. When you leave, turn in ONLY YOUR ANSWER SHEET. Keep the rest of the exam for reference and for review for the final.

Recitation Sections

Sect	Meets	Instructor
1	8 am	Leckenby
2	9 am	Leckenby
3	10 am	Daavettila
4	11 am	Agin
5	noon	Leckenby
6	1 pm	Agin
7	2 pm	Daavettila

Multiple Choice
Circle the letter corresponding to your answer on the answer sheet.

1. Given vectors $\vec{A} = 5.67\ \mathbf{i} - 3.12\ \mathbf{j}$ and $\vec{B} = 2.31\mathbf{i} + 1.76\ \mathbf{j}$ what is the magnitude of $\vec{A} + \vec{B}$ (to three significant digits)?

A) 6.62 B) 65.5 C) 8.09 D) 9.37 E) 7.61

2. Given vectors $\vec{A} = 5.30\ \mathbf{i} - 2.23\ \mathbf{j}$ and $\vec{B} = -2.28\ \mathbf{i} - 1.78\ \mathbf{j}$ what is $\vec{A} \bullet \vec{B}$ (to three significant digits)?

A) -12.1 **i** + 3.97 **j** B) 16.0 C) -8.11 D) 16.6 E) 0.00

3. Given a vector $\vec{A} = 6.52\ \mathbf{i} + 3.76\ \mathbf{j}$, which is at an angle of 30° with the x-axis, and a vector $\vec{B} = 3.37\ \mathbf{j}$, which is along the y-axis, what is the magnitude of $\vec{A} \times \vec{B}$ (to three significant digits)?

A) 10.6 B) 22.0 C) 13.9 D) 12.7 E) 25.4

4. A ball is thrown up with an initial speed v at an angle θ up from the horizontal. The initial vertical component of the velocity is

A) v cosθ B) v sinθ C) v tanθ D) v E) 0 F) -9.8 m/s^2

5. A ball is thrown up with an initial speed v at an angle θ up from the horizontal. The speed of the ball when it is at its peak height is, ignoring air resistance,

A) v cosθ B) v sinθ C) v tanθ D) v E) 0 F) -9.8 m/s^2

6. A mass M_1 is attached to a spring which has a spring constant k. When this mass-spring system oscillates, it oscillates with a frequency f_1. Now a second mass M_2 replaces M_1 and the frequency is now measured to be f_2. If $f_2/f_1 = 3$, then to three significant digits, M_2/M_1 =

A) 3.00 B) 0.333 C) 1.73 D) 0.577 E) 9.00 F) 0.111

7. Two particles with masses m_1 and m_2 ($m_1 \neq m_2$) are observed to have the same kinetic energy. Which one of the following statements must be true.

A) The particles have the same momentum.
B) The total momentum of the system of two particles is zero.
C) The particles have the same speed.
D) The particles are traveling in the same direction.
E) None of the above.

8. A wheel with a diameter of 0.198 m is rolling along a horizontal surface as shown. The center of mass velocity is measured to be 2.18 m/s to the right. How fast is the wheel rotating (about its center of mass)?

A) 11.0 rad/s B) 0.432 rad/s C) 0.216 rad/s
D) 22.0 rad/s E) 2.31 rad/s

9. An asteroid makes a circular orbit around the Sun with an orbital radius equal to 5 times the average radius of Earth's orbit. The Earth's orbit is very close to being circular and the Earth goes around the Sun once in a year (yr). The period of the asteroid's orbit will be closest to

A) 5 yr B) 25 yr C) 0.2 yr D) 11 yr E) 2.9 yr

10. A very long rope is stretched along the x-direction. A transverse sinusoidal wave on this rope is described by

$$y(x,t) = 9.0\sin(12x + 36t + 2.0)$$

where all distances are in meters and the time, *t*, is in seconds. What is the wave's speed?

A) 4.0 m/s B) 0.25 m/s C) 3.0 m/s D) 6.0 m/s E) 324 m/s F) 108 m/s

11. The tension in the rope in problem 10 is now doubled. The new wave speed (compared to the previous wave speed and to three digits) is now

A) 0.500 times the previous value B) 0.707 times the previous value

C) the same value as in problem 10 D) 1.41 times the previous value

E) 2.00 times the previous value.

12. A point source produces a (spherical) sound wave which, when measured 2.00 m from the source, has an intensity of 60 dB. The intensity 4.00 m from the source is closest to

A) 15 dB B) 30 dB C) 54 dB D) 57 dB E) 63 dB F) 66 dB G) 120 dB

13. Which one of the following describes a transverse sinusoidal wave with amplitude, A, wavelength, λ, frequency, f, and which is traveling toward +x ?

A) $y(x,t) = A \sin(x - \lambda ft)$ B) $y(x,t) = A \cos(x/\lambda - ft)$

C) $y(x,t) = A \cos(x + \lambda ft)$ D) $y(x,t) = A \sin(x/\lambda + ft)$

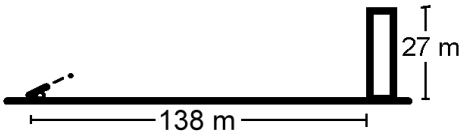
E) $y(x,t) = A \sin(2\pi(x/\lambda + ft))$ F) $y(x,t) = A \cos(2\pi(x/\lambda - ft))$

Problems

Write your answer in the appropriate space on the answer sheet. Include units, directions for vector quantities, and use three significant figures for numerical answers unless specified otherwise.

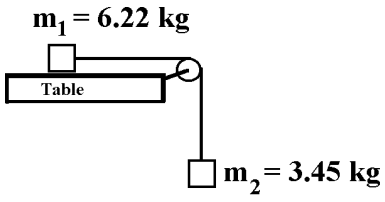
14. A canon shoots a canon ball with mass 5.00 kg toward a castle. The ball has an initial velocity of 50.2 m/s at an angle θ up from the horizontal. The castle is 27.0 m high and is 138 m from the canon. The canon ball reaches the castle 3.00 s after it is fired. (Ignore the height of the canon, and note that the figure is not to scale).

A) What is the speed of the ball when it is 8.00 m above the ground?



B) At what height does the ball hit the castle? (Hint: it *does* hit the castle!)

15. Two masses are connected by a (massless) string over a (massless, frictionless) pulley, as shown below, with one mass on a horizontal table and the other hanging vertically. Initially the masses are at rest.



A) Assuming the masses start to move and the coefficient of kinetic friction for m_1 on the table is 0.234, what is the tension in the string?

B) If the coefficient of static friction is large enough, then the masses will stay at rest and will never move. What is the smallest value the coefficient of static friction can have so that the masses stay at rest?

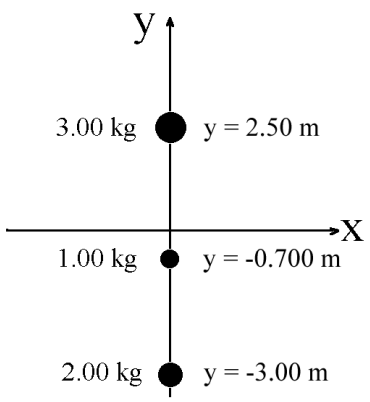
16. A block of mass, m = 5.36 kg, initially at rest is pushed along a frictionless horizontal table by a force, F. After the mass has traveled to a position 4.30 m from its starting point, which takes 3.00 s, the speed of the mass is 5.00 m/s. (Hint: do not assume F is constant.)

A) How much work was done by the force F on the block?

B) What is the magnitude of the average acceleration of the block?

17. Three small masses are connected by rigid rods of negligible mass and are along the y-axis as shown.

A) Where is the center of mass for this system?



B) What is the moment of inertia for this system for rotations about the x-axis?

C) If this system now begins to rotate about the x-axis so that the 3 kg mass is (initially) moving into the page, and the 1 and 2 kg masses are moving out of the page, what is the direction of the angular momentum of the system? (Describe your answer using **i**, **j**, **k** notation. The z-axis is coming out of the page toward you).

18. The potential energy associated with a particular (conservative) force is given by

$$U(x) = 4.30\,x^2 - 5.70\,y + 6.90$$

where U is in Joules and x and y are in meters. What is the force, **F**, at x = 2.00 m, y = 3.00 m?

19. The fundamental standing wave on a 20.0 m long string with tension, T, has a frequency of 3.75 Hz. The string is fixed at both ends and has a mass per unit length of 7.00×10^{-3} kg/m .

A) What is the next higher frequency that could cause a standing wave on this string?

B) What is the tension, T, in the string?

20. The horns on two trains have identical frequencies of 220 Hz. When one train is at rest (at a station) and the other is moving towards it, both trains sound their horns. The conductor on the train which is at rest hears a beat frequency of 2.50 Hz. What is the speed of the other train? (The speed of sound in air at the time is 341 m/s).