UNIVERSITY OF SASKATCHEWAN
Department of Physics and Engineering Physics

Physics 115.3
<u>MIDTERM TEST</u> – Alternative Sitting

October 24, 2008   Time: 90 minutes

NAME: _____   STUDENT NO.: _____
      (Last)   **Please Print**   (Given)

LECTURE SECTION (please check):

❑ 01 B. Zulkoskey

❑ 02 Dr. C. Mitchell

❑ 03 Dr. A. Robinson

❑ C15 F. Dean

<u>INSTRUCTIONS:</u>

1. This is a closed book exam.

2. The test package includes a test paper (this document), a formula sheet, and an OMR sheet. The test paper consists of 7 pages. **It is the responsibility of the student to check that the test paper is complete**.

3. Only Hewlett-Packard hp 30S or Texas Instruments TI-30X series calculators may be used.

4. Enter your name and student number on the cover of the test paper and check to appropriate box for your lecture section. Also enter your student number in the top right-hand corner of each page of the test paper.

5. Enter your name and STUDENT NUMBER on the OMR sheet.

6. The test paper, the formula sheet and the OMR sheet must all be submitted.

7. The test paper will be returned. The formula sheet and the OMR sheet will <u>NOT</u> be returned.

PLEASE DO NOT WRITE ANYTHING ON THIS TABLE

| QUESTION NO.	MAXIMUM MARKS	MARKS OBTAINED
Part A	15	
B1	10	
B2	10	
B3	10	
TOTAL	45	

PART A

**FOR EACH OF THE FOLLOWING QUESTIONS IN PART A, ENTER THE MOST
APPROPRIATE RESPONSE ON THE OMR SHEET.**

A1.   Mars' biggest moon, Phobos, orbits Mars at a distance from the centre of Mars of
      approximately 9400 km. If this distance was increased by a factor of 2.5, by what factor would
      the gravitational force of Mars on Phobos change?

      (A) 0.16   (B) 2.5   (C) 6.2   (D) 0.40   (E) 0.30

A2.   The magnitude of the force F exerted by a spring that is stretched a distance x is given by the
      equation $F = kx$. Letting [M] represent the dimension of mass, [L] represent the dimension of
      length, and [T] represent the dimension of time, the constant k has the dimensions

      (A) [M] / [L]   (B) [M][L]   (C) $[M] / [T]^2$ (D) [L] / [T]   (E) $[M][L]^2 / [T]^2$

A3.   Vector $\vec{v}$ has a magnitude of 4.5 m/s and a direction 24° below the positive x-axis. Assume that
      the positive x-axis points to the right and the positive y-axis points upwards. What are the x and
      y components of $\vec{v}$?

      (A) $v_x = +4.1$ m/s, $v_y = -1.8$ m/s   (B) $v_x = +3.1$ m/s, $v_y = +2.2$ m/s
      (C) $v_x = +2.0$ m/s, $v_y = -3.7$ m/s   (D) $v_x = +2.0$ m/s, $v_y = -3.1$ m/s
      (E) $v_x = -1.8$ m/s, $v_y = -3.1$ m/s

A4.   Zero net force is applied to an object which is moving with a positive velocity in the x direction.
      Which one of the following statements is **true**?

      (A)   There are no forces applied to the object.
      (B)   The object's velocity remains constant.
      (C)   The object's velocity gradually decreases in magnitude.
      (D)   The object stops.
      (E)   The object will slow down if there is a frictional force acting on it.

A5.   An object is thrown vertically upward. Which one of the following statements is **false**?

      (A)   When the object is moving upwards, the velocity vector and the acceleration vector are in
            opposite directions.
      (B)   When the object is moving downwards, the velocity vector and the acceleration vector are
            in the same direction.
      (C)   At the top of the trajectory, the velocity vector is zero.
      (D)   At the top of the trajectory, the acceleration vector is zero.
      (E)   If the object returns to the position from which it was thrown, the displacement vector is
            zero.

A6.   Two children are standing at the edge of a cliff. One child throws a stone horizontally into the
      canyon. At the same time, the other child drops a stone over the edge. Neglecting air resistance,
      which one of the following statements is **true**?

      (A)   The thrown stone hits the ground first.
      (B)   The dropped stone hits the ground first.
      (C)   Both stones hit the ground at the same time.
      (D)   Which stone hits first depends on the speed of the thrown stone.
      (E)   Which stone hits first depends on the height of the cliff above the canyon floor.

A7.   A man who weighs 600 N is sitting in a chair with his feet on the floor and arms resting on the
      armrests. The chair weighs 100 N. Each armrest exerts an upward force of 25 N on his arms and
      the seat exerts an upward force on him of 500 N. What force does the floor exert on his feet?

      (A) 75 N upward   (B) 500 N upward   (C) 525 N upward
      (D) 50 N upward   (E) 0 N

A8.   Which one of the following statements concerning the velocity versus time graph below is **false**?

v_x (m/s)
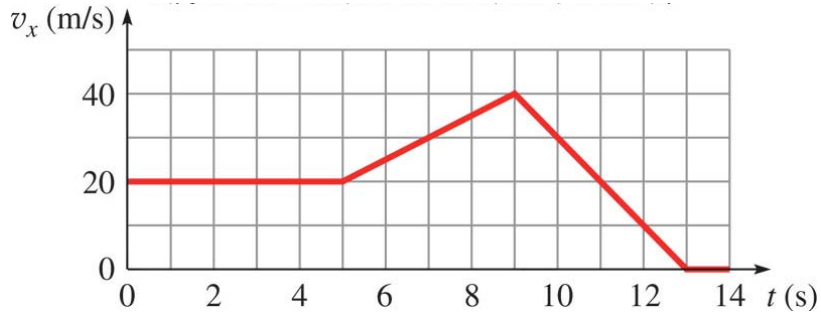
(A)   In the time interval from 0 to 5 seconds, the velocity is constant.
(B)   The position at time $t = 0$ s and the position at time $t = 14$ s must be identical.
(C)   The acceleration is positive in the time interval 5 to 9 seconds.
(D)   The position vectors at t = 13 seconds and t = 14 seconds are the same.
(E)   The acceleration is negative in the time interval 9 to 13 seconds.

A9.   An object moves along a circular path with an increasing speed. The total acceleration of the object is directed

(A)   radially inward.
(B)   radially outward.
(C)   with a component radially inward and a component along the direction of the velocity.
(D)   with a component radially inward and a component opposite to the direction of the velocity.
(E)   with a component radially outward and a component along the direction of the velocity.

A10. Consider a frictionless dart gun that uses an ideal spring to propel the dart. The mass of the dart is m, the spring constant is k and the spring is compressed a distance x when the gun is loaded. When the gun is held horizontally and fired, the speed of the dart when it leaves the barrel of the gun is given by:

(A) $\dfrac{kx}{m}$ (B) $2\dfrac{kx}{m}$ (C) $\dfrac{kx}{2m}$ (D) $x\sqrt{\dfrac{k}{m}}$ (E) $x\sqrt{\dfrac{2k}{m}}$

A11. Consider a spaceship in deep space, where the force of gravity is negligible. Which one of the following phrases best completes the sentence, "The spaceship's engines must be fired…"

(A)   all the time in order to keep moving.
(B)   **only** when the spaceship changes direction.
(C)   **only** when the spaceship changes speed.
(D)   **only** when the spaceship increases its speed.
(E)   whenever the spaceship speeds up, slows down, or changes direction.

A12. A student is riding her motorcycle in a straight line. The initial position is –125 m and the initial velocity is –35.0 km/h. Her final velocity is 0 km/h and final position is –173 m. Which one of the following statements is **false**?

(A)   Her average velocity is negative.
(B)   Her displacement is negative.
(C)   Her average acceleration is negative.
(D)   She is slowing down.
(E)   The distance travelled is 48 m.

A13.   Consider the rotating CD shown in the figure.
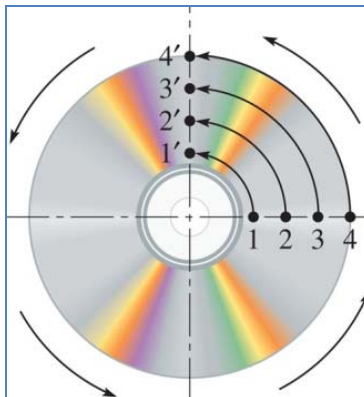
Which one of the following statements is **false**?

(A)   The angular speeds of the points 1, 2, 3 and 4 are equal.
(B)   The linear speed is proportional to the distance from the centre of rotation.
(C)   The linear speed is greater nearer the centre of rotation.
(D)   The angular displacement of point 1 moving to point 1′ is $+\dfrac{\pi}{2}$ radians.
(E)   An acceptable unit for the angular velocity is rad/s.

A14.   Which one of the following statements is **false**?

(A)   Energy stored as potential energy by a conservative force during displacement can be recovered as kinetic energy.
(B)   A force is conservative if the work done by the force is independent of the path taken.
(C)   Gravity is a conservative force.
(D)   Friction is a conservative force.
(E)   If a system is acted upon only by conservative forces, then the total mechanical energy of the system is constant.

A15.   A wheel is rolling without slipping. It has radius r and a period of rotation of T. What is the linear speed v, of the wheel?

(A) $v = \dfrac{r}{T}$ (B) $v = \dfrac{2\pi r}{T}$ (C) $v = \dfrac{2\pi}{rT}$ (D) $v = \dfrac{T}{2\pi r}$ (E) $v = \dfrac{r}{2\pi T}$

PART B

IN EACH OF THE FOLLOWING QUESTIONS, GIVE THE COMPLETE SOLUTION AND ENTER THE FINAL ANSWER IN THE BOX PROVIDED.

THE ANSWERS MUST CONTAIN THREE SIGNIFICANT FIGURES AND THE UNITS MUST BE GIVEN.

NO CREDIT WILL BE GIVEN FOR ANSWERS ONLY, <u>SHOW AND EXPLAIN YOUR WORK</u>.

EQUATIONS NOT PROVIDED ON THE FORMULA SHEET MUST BE DERIVED.

B1. A suitcase is being dragged across the horizontal floor by pulling on its strap. The suitcase has a mass of 22.5 kg and the strap can be approximated as an ideal rope. The strap is at an angle of 36.5° above the horizontal. The coefficient of kinetic friction between the suitcase and the floor is 0.267 and the coefficient of static friction between the suitcase and the floor is 0.342. *Remember to include a free body diagram and choice of coordinates for each of the following parts.*

    (a) The tension in the strap is 128 N. Calculate the acceleration of the suitcase.

    (b) The person dragging the suitcase stops, and the suitcase comes to rest. Calculate the minimum tension in the strap required to start the suitcase moving again. The strap is at an angle of 36.5° above the horizontal.

B2.   The performance figures for a sports car are quoted as 0 to 100 km/h in 6.00 seconds. You may assume that the final speed is known to 3 significant figures. The mass of the sports car is 1.45×10^3 kg.

   (a)   Assuming that the acceleration is constant throughout this time interval, calculate the magnitude of the acceleration of the car in m/s^2.

   (b)   Calculate the magnitude of the net force acting on the car.

   (c)   A rope is now attached from the sports car to a Smart car of mass 476 kg. The rope is taut when the two cars are stationary. The rope will break if the tension is greater than 2.00×10^3 N. Neglecting friction, calculate the maximum possible acceleration of the sports car so that the rope does not break.

   (d)   Should the driver of the sports car be concerned that the rope might break? Explain your reasoning.

B3. A 75.0 kg skier starts from rest and slides down a 41.5 m long slope, which is inclined at 25.0° to the horizontal. The slope is not frictionless, and the final velocity of the skier is 12.5 m/s. You may neglect air resistance.

(a) Draw a free body diagram of the forces on the skier.

(b) Calculate the work done on the skier by gravity as she skis from the top to the bottom of the slope.

(c) Calculate the work done on the skier by friction as she skis from the top to the bottom of the slope.

(d) Calculate the magnitude of the friction force acting on the skier, assuming it is constant.

END OF EXAMINATION