UNIVERSITY OF SASKATCHEWAN

Department of Physics and Engineering Physics

Physics 111.6
MIDTERM TEST #2

November 16, 2006 Time: 90 minutes

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

LECTURE SECTION (please check):

- ❑ 01 Dr. K. McWilliams
- ❑ 02 B. Zulkoskey
- ❑ 03 Dr. A. Robinson
- ❑ C15 F. Dean

INSTRUCTIONS:

1. You should have a test paper, a formula sheet, and an OMR sheet. The test paper consists of 9 pages. **It is the responsibility of the student to check that the test paper is complete**.
2. Enter your name and STUDENT NUMBER on the OMR sheet.
3. The test paper, the formula sheet and the OMR sheet must all be submitted.
4. The test paper will be returned. The formula sheet and the OMR sheet will NOT be returned.

PLEASE DO NOT WRITE ANYTHING ON THIS TABLE

QUESTION NO.	MAXIMUM MARKS	MARKS OBTAINED
Part A	10	
Part B	10	
C1	5	
C2	5	
C3	5	
TOTAL	35	

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PART A

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

A1. The speed of a satellite of mass m, orbiting the Earth in a stable circular orbit of radius R, is v. The speed of a satellite of mass $2m$, in a stable circular orbit of radius $4R$, is

(A) $\frac{1}{4}v$ (B) $\frac{1}{2}v$ (C) v (D) $2v$ (E) $4v$

A2. Which one of the following statements is **false**?

(A) A force is conservative if the change in the associated potential energy is independent of the path taken.
(B) A force is conservative if the change in the associated potential energy is zero around a closed loop.
(C) A force is non-conservative if the work done by the force depends on the length of the path.
(D) Friction is a non-conservative force.
(E) The sum of the conservative and non-conservative forces acting on an object must always be zero.

A3. Which one of the following statements is **false**?

(A) The average power can be defined as the work done divided by the time taken to do that work.
(B) The average power can be defined as the change in energy divided by the time in which the energy changes.
(C) The average power for the situation of an object acted upon by a constant force $\vec{\mathbf{F}}$ and travelling with an average speed v can be defined as the product of the magnitude of $\vec{\mathbf{F}}$ and the average speed.
(D) The SI unit of power is the Joule.
(E) The Joule has dimensions of $[M]\,[L]^2\,[T]^{-2}$.

A4. Which one of the following statements concerning momentum is **true**?

(A) Momentum is a force.
(B) Momentum is a scalar quantity.
(C) The SI unit of momentum is $kg{\cdot}m^2/s$.
(D) The momentum of an object is always positive.
(E) Momentum and impulse are measured in the same units.

A5. A particle at rest explodes into two pieces. Which one of the following statements concerning the pieces after the explosion is **true**?

(A) They both are stationary after the explosion.
(B) They must move in opposite directions.
(C) They must have equal masses.
(D) They must have equal velocities.
(E) Nothing can be said without knowing the nature of the explosion.

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A6. Two wheels are connected by a chain. The radius of one wheel is three times larger than that of the other wheel. When the smaller wheel is rotating with an angular velocity ω, the angular velocity of the larger wheel is

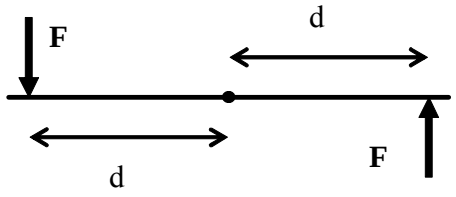
(A) 9ω (B) $\omega/9$ (C) ω (D) $\omega/3$ (E) 3ω

A7. Two points are located on a rigid wheel that is rotating with *decreasing* angular velocity about a fixed axis. Point A is located on the rim of the wheel and point B is halfway between the rim and the axis. Which one of the following statements concerning this situation is **true**?

(A) Both points have the same centripetal acceleration.
(B) Both points have the same tangential acceleration.
(C) At any instant, the angular velocity at point A is greater than at point B.
(D) Both points have the same angular acceleration.
(E) Each second, point A turns through a greater angle than point B.

A8. A revolving door is common in office buildings. What is the magnitude of the torque exerted on a revolving door of mass M if two people push on opposite sides of the door, each with a force F at a distance d from the axis of the door? Each person pushes on the door in a direction perpendicular to the door. (The diagram is a top view of the door.)

(A) Fd
(B) $2Fd/M$
(C) $2Fd$
(D) $(Fd)/2$
(E) zero



A9. Which one of the flowing statements concerning a rigid body in equilibrium is **false**?

(A) The sum of the external torques must equal zero.
(B) The sum of the external forces must equal the sum of the external torques.
(C) The sum of the external forces must equal zero.
(D) The object must have a zero linear acceleration.
(E) The object must have a zero angular acceleration.

A10. Consider a thin rod, mass M and length L. If the moment of inertia when it rotates about an axis which is perpendicular to the rod and passes through the centre is I, what is the new moment of inertia, in terms of I, when the rotation axis is still perpendicular to the rod but now passes through one end?

(A) $2\times I$ (B) $4\times I$ (C) $12\times I$ (D) $\frac{I}{3}$ (E) $\frac{I}{4}$

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PART B

FOR EACH OF THE FOLLOWING PROBLEMS, WORK OUT THE SOLUTION IN THE SPACE PROVIDED AND ENTER YOUR ANSWERS ON PAGE 6.

ONLY THE ANSWERS WILL BE MARKED. THE SOLUTIONS WILL NOT BE MARKED.

B1. A car travelling at constant speed around a circular track of radius 2.61×10^3 m requires 356 s to go around the track once. Calculate the magnitude of the centripetal acceleration of the car.

B2. A fireworks rocket of mass 0.200 kg is launched from rest and is moving with a speed of 62.4 m/s when it is at a height of 37.3 m. Calculate the work done by the non-conservative force of the propellant acting on the rocket. Neglect air resistance and assume that the mass of the rocket is constant.

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B3. A wooden block of mass 0.215 kg is at rest on a flat, frictionless surface. When a bullet of mass 0.00416 kg is fired horizontally into the block, the block and embedded bullet move off with a speed of 8.29 m/s. Calculate the speed of the bullet before it hits the block.

B4. A pulley turning at 13.1 rad/s has a radius of 5.67×10^{-2} m. As it turns, a string is wound onto its rim. What length of string will be wrapped onto the pulley in 11.3 seconds? (Assume that the thickness of the string is negligible.)

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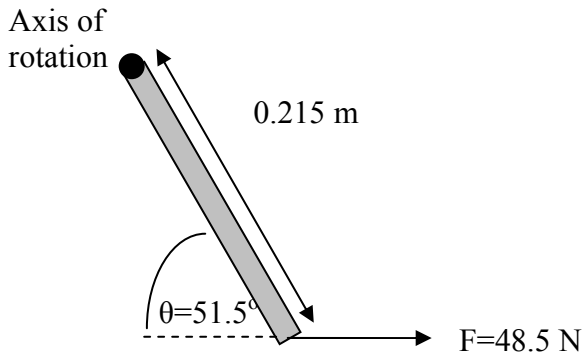
B5. A force of 48.5N is applied at an angle of 51.5^o to a wrench of length 0.215 m. Calculate the torque applied with respect to the shown axis of rotation.



ANSWERS FOR PART B

ENTER THE ANSWERS FOR THE PART B PROBLEMS IN THE BOXES BELOW.

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

ONLY THE ANSWERS WILL BE MARKED. THE SOLUTIONS WILL NOT BE MARKED.

B1 [ ]

B2 [ ]

B3 [ ]

B4 [ ]

B5 [ ]

continued on page 7...

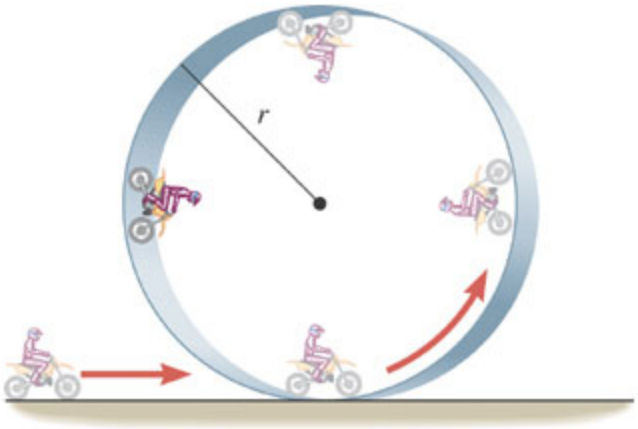
PART C

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, SHOW AND EXPLAIN YOUR WORK. EQUATIONS NOT PROVIDED ON THE FORMULA SHEET MUST BE DERIVED.

C1. A motorcycle stunt rider drives around a vertical circular track.



(a) Draw a free body diagram of the forces on the cycle at the top of the loop.

(b) Derive an expression for the minimum safe speed, v_{min}, in terms of the radius, r, and the acceleration due to gravity, g, in order for the cycle to avoid falling off at the top of the loop.

v_{min} =

(c) Calculate the minimum safe speed in km/hour for a loop of radius 4.00 m.

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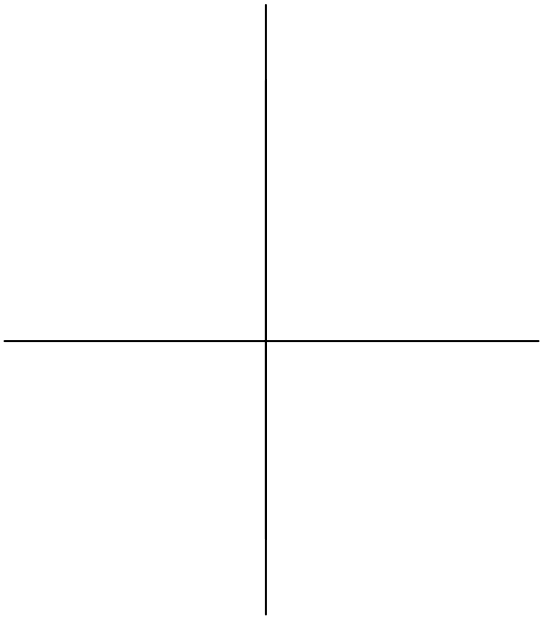
C2. In yet another experiment gone wrong, a rocket car built by Dr. Olaf Whatanut exploded into three pieces. Before the explosion, the rocket car was at rest. After the explosion piece 1 (mass of 95.5 kg) was observed heading exactly 45.0º North of West at 225 km/h, and piece 2 (mass of 50.2 kg) was observed heading exactly 45.0 º North of East at 333 km/h. Piece 3 has a mass of m_3 = 256 kg. Calculate the final velocity of piece 3. Express the direction as an angle with respect to East. (All the pieces are moving in a horizontal plane, and you may neglect friction).

magnitude:	
direction:	



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C3. A CD has a mass of 1.70×10^{-2} kg and a diameter of 1.20×10^{-1} m. It accelerates from rest to an angular velocity of 20.5 rad/s in 0.785 s. Assuming that the CD is a uniform solid disk, determine the net torque acting on it while it is accelerating.

END OF EXAMINATION