UNIVERSITY OF SASKATCHEWAN
Department of Physics and Engineering Physics

Physics 111.6
MIDTERM TEST #1

October 12, 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 10 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 mathematical relationship between three physical quantities is given by $a = \frac{b^2}{c}$. If the dimension of b is $\frac{[L]}{[T]}$ and the dimension of c is [L], which one of the following choices is the dimension of a?

(A) [L] (B) $\frac{[L]}{[T]}$ (C) $\frac{[L]^2}{[T]^2}$ (D) $\frac{[L]}{[T]^2}$ (E) [T]

A2. Luke Autbeloe is a human cannonball artist. When he is shot out of a cannon, he leaves the end of the cannon with a speed v at an angle θ above the horizontal. If the horizontal and vertical components of his velocity are v_x and v_y, respectively, which one of the following expressions is correct?

(A) $v = \sqrt{v_x^2 + v_y^2}$ (B) $\sin\theta = \frac{v_x}{v_y}$ (C) $\cos\theta = \frac{v_y}{v}$

(D) $\tan\theta = \frac{v_y}{v_x}$ (E) $\sin\theta = \frac{v}{v_y}$

A3. Which one of the following is the longest length?

(A) 10^0 meters (B) 10^4 millimeters (C) 10^7 nanometers
(D) 10^2 centimeters (E) 10^5 micrometers

A4. Two vectors **A** and **B** are added together to form a vector **C**. The relationship between the magnitudes of the vectors is given by $A + B = C$. Which one of the following statements concerning these vectors is true?

(A) **A** and **B** must be displacements.
(B) **A** and **B** must have equal lengths.
(C) **A** and **B** must point in opposite directions.
(D) **A** and **B** must point in the same direction.
(E) **A** and **B** must be at right angles to each other.

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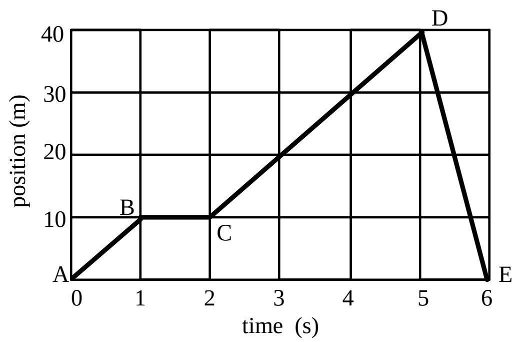
A5. A brick is dropped from rest and a rock is thrown horizontally. Both objects are released from the top of a vertical cliff at the same instant. Compare the time it takes each object to reach the level ground at the base of the cliff. Neglect any effects due to air resistance.

(A) The brick reaches the ground first.
(B) The rock reaches the ground first.
(C) Which object reaches the ground first depends on the speed with which the rock is thrown. If the rock is thrown faster than a certain value the brick will reach the ground first.
(D) Which object reaches the ground first depends on the speed with which the rock is thrown. If the rock is thrown faster than a certain value the rock will reach the ground first.
(E) Both objects reach the ground at the same time.

A6. An object is moving along a straight line. The graph shows the object's position from the starting point as a function of time.



In which segments(s) of the graph does the object have the greatest **speed**?

(A) AB (B) CD (C) AB and CD
(D) BC (E) DE

A7. A football is kicked at an angle θ with respect to the horizontal. Which one of the following statements best describes the *acceleration* of the football during this event if air resistance is neglected?

(A) The acceleration is zero at all times.
(B) The acceleration is 9.80 m/s^2 downward at all times.
(C) The acceleration is zero when the football has reached the highest point in its trajectory.
(D) The acceleration is directed upward as the football rises, and it is directed downward as the football falls.
(E) The acceleration starts at 9.80 m/s^2 upward and the magnitude decreases to some constant lower value as the ball approaches the ground.

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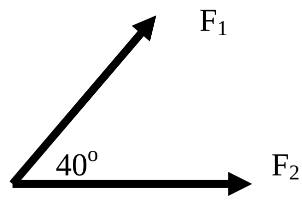
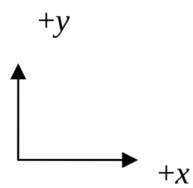
A8. Forces F_1 and F_2 act on an object, with force F_2 acting in the positive *x* direction. From the free body diagram shown, which is the correct expression for the net force in the *x* direction?





(A) $\sum F_x = F_1 \sin 40^o + F_2$

(B) $\sum F_x = F_1 \cos 40^o + F_2$

(C) $\sum F_x = F_1 + F_2 \cos 40^o$

(D) $\sum F_x = F_1 + F_2 \sin 40^o$

(E) $\sum F_x = F_1 \sin 40^o + F_2 \cos 40^o$

A9. The weight of a person is measured on a scale in an elevator. Which one of the following statements is **NOT** correct?

(A) If the elevator is stationary, the weight measured is the true weight.
(B) If the elevator is accelerating downwards, the weight measured is less than the true weight.
(C) If the elevator is accelerating upwards, the weight measured is greater than the true weight
(D) If the elevator is falling freely, then the weight measured is zero.
(E) If the elevator is moving upwards with constant velocity, then the weight measured is greater than the true weight.

A10. A block of mass *m* slides down a frictionless ramp inclined at an angle θ with the horizontal. The magnitude of the reaction force exerted on the block by the ramp is

(A) $g \sin \theta$.
(B) $mg \sin \theta$.
(C) $g \cos \theta$.
(D) $mg \cos \theta$.
(E) zero because the ramp is frictionless.

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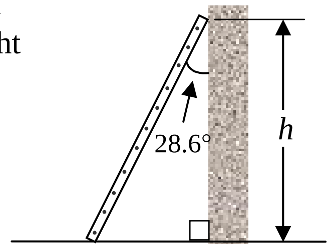
PART B

FOR EACH OF THE FOLLOWING PROBLEMS, WORK OUT THE SOLUTION IN THE SPACE PROVIDED AND ENTER YOUR ANSWERS ON PAGE 7.

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

B1. A 3.05-m ladder leans against a wall and makes an angle with the wall of 28.6° as shown in the drawing. Calculate the height *h* above the ground where the ladder makes contact with the wall.



B2. If Vince Carter makes a vertical leap of 1.29 m, calculate his speed when he leaves the ground.

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B3. Two vertical posts are positioned parallel to each other and 1.25 m apart. A squirrel leaps from the bottom of one post to a spot on the second post that is 1.15 m above the ground. He then leaps to a spot on the first post that is 1.95 m above the ground. Finally the squirrel jumps to a spot on the second post that is 2.75 m above the ground. Calculate the magnitude of the squirrel's displacement as measured from the bottom of the first post.

B4. A sled is being pulled along a road at a constant velocity by a cable attached to a moving vehicle. The cable is parallel to the ground. The mass of the sled is 95.6 kg and the coefficient of kinetic friction between the sled and the road is 0.835. Calculate the tension in the cable.

continued on page 7...

B5. Jupiter has a mass of 1.90×10^{27} kg and a radius of 6.99×10^{7} m. Calculate the acceleration due to gravity of an object at the surface of Jupiter.

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 8...

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. Otto Emissions is driving his car along a straight road. His car has an initial velocity of 24.7 m/s and accelerates at 2.16 m/s^2 for 5.13 s. Otto's car then maintains a constant velocity for 9.33 s. Otto then decelerates his car at 5.67 m/s^2 until it stops.

(a) Calculate the velocity of Otto's car at the end of the 5.13 s time interval.

(b) Calculate the displacement of Otto's car during the first 12.5 seconds of its motion.

(c) From the moment Otto's car starts to decelerate, calculate the time until it comes to rest.

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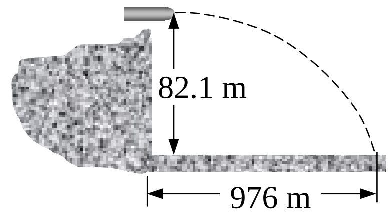
C2. A shell is fired with a horizontal velocity from the top of an 82.1-m high cliff. The shell strikes the level ground 976 m from the base of the cliff. The drawing is not to scale. Ignore any effects due to air resistance.



(a). Calculate the time, from when it was fired, for the shell to hit the ground.

(b). Calculate the magnitude of the initial velocity of the shell.

(c). Calculate the magnitude of the velocity of the shell as it hits the ground.

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C3. A car is travelling at an initial velocity of v_o when the driver sees an obstruction in the road ahead and brakes suddenly, locking the wheels, causing the car to slide.

(a) On the following diagram, clearly show all the external forces acting on the car while it is sliding along the road surface.

(b) Derive an equation for x, the distance travelled before the car comes to a halt, in terms of the initial velocity, v_o, the coefficient of kinetic friction between the tires and the road, μ_k, and the magnitude of the acceleration due to gravity, g.

$x =$

END OF EXAMINATION