UNIVERSITY OF SASKATCHEWAN
Department of Physics and Engineering Physics

Physics 115.3
MIDTERM TEST – Alternative Sitting

October 2014 Time: 90 minutes

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

LECTURE SECTION (please check):

- ❑ 01 Dr. M. Bradley
- ❑ 02 Dr. R. Pywell
- ❑ 03 B. Zulkoskey
- ❑ C15 Dr. A. Farahani
- ❑ 97 Dr. A. Farahani

INSTRUCTIONS:

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 8 pages, including this cover page. **It is the responsibility of the student to check that the test paper is complete**.
3. Only a basic scientific calculator (e.g. Texas Instruments TI-30X series, Hewlett-Packard HP 10s or 30S) may be used. Graphing or programmable calculators, or calculators with communication capability are **not** allowed.
4. Enter your name and student number on the cover of the test paper and check the 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 NSID on the OMR sheet.
6. The test paper, the formula sheet and the OMR sheet must all be submitted.
7. The marked test paper will be returned. The formula sheet and the OMR sheet will NOT be returned.

ONLY THE THREE PART B QUESTIONS THAT YOU INDICATE WILL BE MARKED

PLEASE INDICATE WHICH THREE PART B QUESTIONS ARE TO BE MARKED

QUESTION NUMBER	TO BE MARKED	MAXIMUM MARKS	MARKS OBTAINED
A1-15	☑	15	
B1	❑	10	
B2	❑	10	
B3	❑	10	
B4	❑	10	
TOTAL		45	

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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. A computer data analysis program reports a result as $2.149\,613\,568 \times 10^2$, with an uncertainty of $\pm 3 \times 10^{-4}$. How many significant figures should be used when the answer is reported?

(A) two (B) five (C) seven (D) eight (E) nine

A2. In lab M36 you measured the mass of a steel ball and also determined its initial speed when it was fired from a spring-loaded gun. Suppose that the percentage error in the mass was 2% and the percentage error in the initial speed was calculated to be 4%. Which one of the following options is the correct value for the percentage error in the initial momentum of the ball?

(A) 2% (B) 4% (C) 6% (D) 8% (E) 0.5%

A3. Which one of the following options is **not** a valid unit for energy?

(A) Joule (B) Newton·metre (C) Watt·second (D) kilowatt·hour (E) $kg \cdot m^2/s^3$

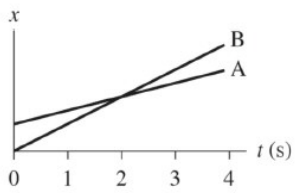
A4. An object is held outside an open window and released from rest. Air resistance can be neglected (the object is in free fall). Which one of the following statements correctly describes the motion of the object as it falls?

(A) The distance of the object from the release point increases linearly with time.
(B) The magnitude of the acceleration of the object increases linearly with time.
(C) The rate of change of the speed of the object increases linearly with time.
(D) The magnitude of the acceleration of the object decreases as it approaches the ground.
(E) The speed of the object increases linearly with time.

A5. A ball is thrown over level ground at an angle of θ above the horizontal. $0° < \theta < 90°$. Which one of the following statements is true when the ball is at maximum height?

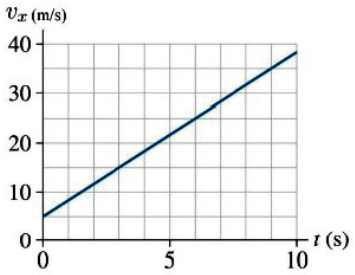
(A) Both the speed and acceleration of the ball are zero.
(B) The speed of the ball is zero, but the magnitude of the acceleration is not zero.
(C) The acceleration of the ball is zero, but the speed is not zero.
(D) The speed of the ball is not zero and the magnitude of the acceleration may or may not be zero, depending on the value of θ.
(E) Both the speed and the magnitude of the acceleration of the ball are not zero.

A6. Two objects, A and B, are moving along the x-axis. The graph shows their positions as a function of time. At what time(s) do the two objects have the same velocity?



(A) at $t = 0$ s (B) at $t = 2$ s (C) at $t = 4$ s
(D) Always (E) Never

A7. Which one of the following options is true for the magnitude of the displacement Δx between $t = 3.0$ s and $t = 6.0$ s for an object that is moving as described by the plot of v_x vs. t?



(A) 60 m (B) 90 m (C) 150 m
(D) 160 m (E) 270 m

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A8. A small car collides with a large truck. Which one of the following statements is true?

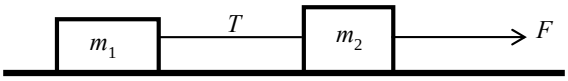
(A) The magnitude of the force that the truck exerts on the car is greater than the magnitude of the force that the car exerts on the truck.
(B) The magnitude of the force that the truck exerts on the car is smaller than the magnitude of the force that the car exerts on the truck.
(C) The forces that the two vehicles exert on each other are equal in magnitude.
(D) The relationship between the forces that the two vehicles exert on each other depends on the vehicles' masses.
(E) The relationship between the forces that the two vehicles exert on each other depends on the vehicles' initial speeds.

A9. A book, with mass m, is sliding on a horizontal table surface following a push that gave it an initial velocity v_o in the positive x direction. If the coefficient of kinetic friction between the book and the surface is μ_k, the acceleration of the book while it is sliding is

(A) $a_x = -\mu_k mg$ (B) $a_x = -\mu_k g$ (C) $a_x = -\dfrac{mg}{\mu_k}$

(D) $a_x = -\dfrac{g}{\mu_k}$ (E) $a_x = -\dfrac{\mu_k g}{m}$

A10. Two blocks, with masses m_1 and m_2, on a horizontal frictionless surface, are tied together with string and pulled by a constant horizontal force of magnitude F as shown. If we can ignore the mass of the string, how is the magnitude of the tension T in the string between the blocks related to F?

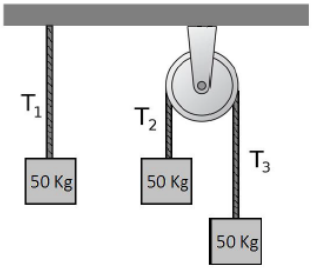


(A) $T = F$ (B) $T = \dfrac{m_2}{m_1 + m_2} F$ (C) $T = \dfrac{m_1}{m_1 + m_2} F$

(D) $T = \dfrac{m_2}{m_1} F$ (E) $T = \dfrac{m_1}{m_2} F$

A11. All three of the 50 kg blocks shown in the figure are at rest. Which one of the following options is the correct relationship between the magnitudes of the tension forces T_1, T_2, and T_3?

(A) $T_2 > T_3 > T_1$
(B) $T_3 > T_2 > T_1$
(C) $T_2 = T_3 > T_1$
(D) $T_2 = T_3 < T_1$
(E) $T_1 = T_2 = T_3$



A12. If particle 2 has a momentum whose magnitude is twice as large as that of particle 1, under what condition would the two particles have the same kinetic energy?

(A) $m_2 = 0$ (B) $m_2 = m_1$ (C) $m_2 = 2m_1$ (D) $m_2 = 4m_1$ (E) $m_1 = 0$

continued on page 4...

A13. Eugenie Bouchard receives a shot with the tennis ball (m = 60.0 g) travelling horizontally at 40.0 m/s and returns it in the opposite direction with a speed of 50.0 m/s. What is the magnitude of the impulse delivered to the ball by the racket?

(A) 0.6 kg·m/s (B) 2.4 kg·m/s (C) 3.0 kg·m/s (D) 5.4 kg·m/s (E) 7.5 kg·m/s

A14. A golf ball and a Ping-Pong ball are sliding with equal velocities over a horizontal frictionless surface. The golf ball has the greater kinetic energy because it has the greater mass. They encounter a frictionless hill and slow down as they slide up it. Which one of the following statements is correct?

(A) The golf ball slides to a greater height than the Ping-Pong ball since it has the greater kinetic energy.
(B) The Ping-Pong ball slides to a greater height than the golf ball since it has the smaller weight.
(C) The Ping-Pong ball slides to a greater height than the golf ball since the work done by gravity on it is less.
(D) Both the golf ball and the Ping-Pong ball slide to the same height since the result is independent of the mass.
(E) We do not have enough information to decide since the result will depend on the slope of the hill.

A15. A small bomb with a total mass of 10 kg is moving toward the North with a speed of 4 m/s. It explodes into three fragments. After the explosion it is observed that a 5 kg fragment is moving toward the East, while a 4 kg fragment is moving toward the West. What is the velocity of the third 1 kg fragment?

(A) Zero.
(B) 4 m/s North.
(C) 40 m/s North.
(D) 40 m/s South.
(E) It is impossible to determine since we are not given the speeds of the other two fragments.

PART B

ANSWER THREE OF THE PART B QUESTIONS ON THE FOLLOWING PAGES AND INDICATE ON THE COVER PAGE WHICH THREE PART B QUESTIONS ARE TO BE MARKED.

FOR EACH OF YOUR CHOSEN PART B QUESTIONS ON THE FOLLOWING PAGES, 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.

SHOW AND EXPLAIN YOUR WORK – NO CREDIT WILL BE GIVEN FOR ANSWERS ONLY.

EQUATIONS NOT PROVIDED ON THE FORMULAE SHEET MUST BE DERIVED.

USE THE BACK OF THE PREVIOUS PAGE FOR YOUR ROUGH WORK.

continued on page 5...

B1. A baseball is deflected straight up after striking the bat, which is held by the hitter at a height of 1.40 m above the ground. The ball travels vertically for 4.00 s before reaching its maximum height.

(a) Calculate the initial velocity of the ball when it loses contact with the bat. (*3 marks*)

(b) Calculate the maximum height above the ground reached by the ball. If you did not obtain an answer for (a), use a value of 40.0 m/s. (*4 marks*)

(c) Calculate the speed of the ball just before it hits the ground. If you did not obtain an answer for (b), use a value of 80.0 m. (*3 marks*)

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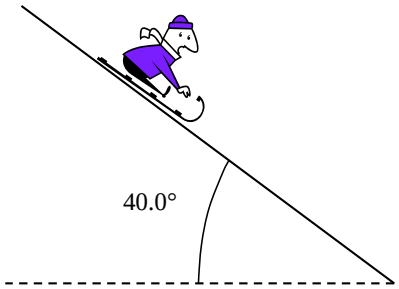
B2. A man on a sled slides down a snow-covered slope which makes a constant angle of 40.0° with the horizontal. As he slides, his speed increases. It is found that the magnitude of his acceleration down the slope is 5.30 m/s^2.

(a) On the diagram provided below, draw a labelled free body diagram showing all the forces on the sled as it slides (Consider the man and sled as one object.) (*3 marks*)



(b) Calculate the coefficient of kinetic friction between the sled and the snow. (*7 marks*)

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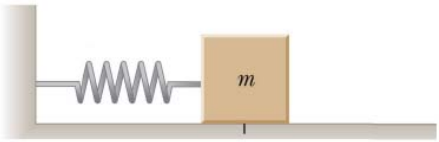
B3. A 0.500-kg wood block on a horizontal table is firmly attached to a very light horizontal spring (k = 181 N/m) as shown. It is noted that the block-spring system, when initially compressed 5.00 cm and released, stretches to a distance of 2.50 cm beyond the equilibrium point before stopping and moving back.



(a) Calculate the magnitude of the force of kinetic friction between the block and the table. (*5 marks*)

(b) Calculate the speed of the block when it first passes the equilibrium position. If you did not obtain an answer for (a), use a value of 2.00 N. (*5 marks*)

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B4. A railroad car (mass $m = 1.80 \times 10^4$ kg), initially moving at 4.21 m/s, collides with a group of three joined railroad cars (each of the same mass as the single car). The group of three cars is initially travelling at 2.15 m/s in the direction opposite to that of the single car. After the collision all four cars are joined together.

(a) Calculate the magnitude of the momentum of the four coupled cars after the collision. (*3 marks*)

(b) Calculate the speed of the four coupled cars after the collision. If you did not obtain an answer for (a), use a value of 4.00×10^4 kg·m/s. (*3 marks*)

(c) Calculate the kinetic energy that is lost in the collision. If you did not obtain an answer for (b), use a value of 0.500 m/s. (*4 marks*)

END OF EXAMINATION