

UNIVERSITY OF SASKATCHEWAN
Department of Physics and Engineering Physics

Physics 115.3
ALTERNATIVE MIDTERM TEST

October 2015

Time: 90 minutes

NAME: _____
(Last) **Please Print** (Given)

STUDENT NO.: _____


LECTURE SECTION (please check):

- 01 Dr. M. Ghezelbash
- 02 Dr. D. Janzen
- 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



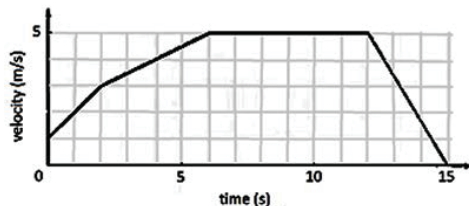
QUESTION NUMBER	TO BE MARKED	MAXIMUM MARKS	MARKS OBTAINED
A1-15	<input checked="" type="checkbox"/>	15	
B1	<input type="checkbox"/>	10	
B2	<input type="checkbox"/>	10	
B3	<input type="checkbox"/>	10	
B4	<input type="checkbox"/>	10	
TOTAL		45	

continued on page 2...

PART A

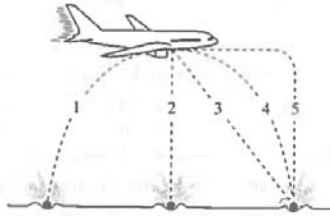
FOR EACH OF THE FOLLOWING QUESTIONS IN PART A, ENTER THE MOST APPROPRIATE RESPONSE ON THE OMR SHEET.

- A1. Which one of the following options correctly expresses the result for b when $b = (4.905 \text{ m/s}^2)(2.10 \text{ s})^2$?
- (A) 21.6 m/s (B) 21.6 m (C) 21.63 m (D) 21.63 m/s (E) 22 m/s
- A2. Newton's law of universal gravitation is represented by $F = G \frac{Mm}{r^2}$, where F is the gravitational force, M and m are masses, and r is a distance. What are the SI units of the proportionality constant G ?
- (A) $\text{m}^3 \text{kg}^{-1} \text{s}^{-2}$ (B) $\text{m}^2 \text{kg}^{-1} \text{s}^{-2}$ (C) $\text{m}^3 \text{kg}^{-1} \text{s}^{-3}$ (D) $\text{m}^2 \text{kg}^{-1} \text{s}^{-3}$ (E) $\text{m}^2 \text{kg}^{-2} \text{s}^{-2}$
- A3. Based on its apparent size, you estimate that a hot air balloon is a distance ℓ from your eyes. You also estimate that when looking directly at the distant balloon, your line of sight is at an angle of θ above the horizontal. Which one of the following expressions is correct for the altitude of the balloon above your eyes?
- (A) $\ell \tan \theta$ (B) $\frac{\ell}{\tan \theta}$ (C) $\ell \sin \theta$ (D) $\ell \cos \theta$ (E) $\frac{\ell}{\cos \theta}$
- A4. In which one of the following scenarios does an object in straight-line motion have a positive acceleration?
- (A) Object moving in positive direction at constant speed.
(B) Object moving in negative direction at constant speed.
(C) Object moving in positive direction with decreasing speed.
(D) Object moving in negative direction with decreasing speed.
(E) Object moving in negative direction with increasing speed.
- A5. A ball is thrown over level ground at an angle of 60° above the horizontal with an initial speed of v_0 . Which one of the following statements is **TRUE** when the ball is at maximum height?
- (A) Both the velocity and acceleration of the ball are zero.
(B) The speed of the ball is v_0 and its acceleration is g downward.
(C) The speed of the ball is $\frac{1}{2} v_0$ and its acceleration is g downward.
(D) The speed of the ball is zero and its acceleration is g downward.
(E) The speed of the ball is $\frac{1}{2} v_0$ and its acceleration is zero.
- A6. The graph below shows the velocity versus time for an object moving in one dimension. What is the object's average acceleration between $t = 0 \text{ s}$ and $t = 6 \text{ s}$?



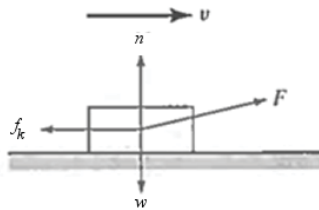
- (A) 3.0 m/s^2 (B) 1.5 m/s^2 (C) 0.83 m/s^2 (D) 0.67 m/s^2 (E) 0.50 m/s^2

- A7. A bowling ball accidentally falls out of the cargo bay of an airliner as it flies in a horizontal direction. As observed by a person standing on the ground and viewing the plane as in the figure below, which of the paths 1-5 would the bowling ball most closely follow after leaving the airplane?



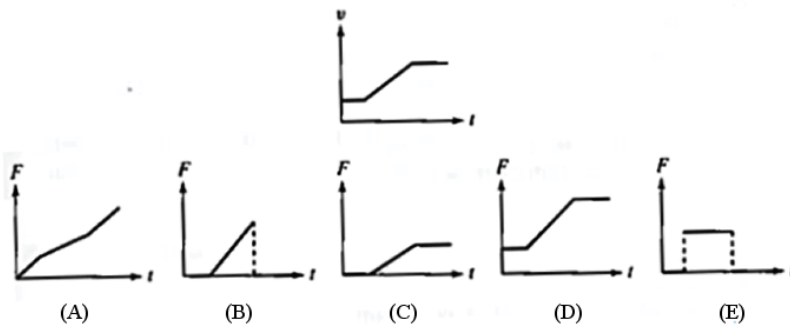
- (A) 1 (B) 2 (C) 3 (D) 4 (E) 5

- A8. A person pulls a block across a rough horizontal surface at a constant speed by applying a force F . The arrows in the diagram below correctly indicate the directions, but not necessarily the magnitudes, of the various forces on the block. Which one of the following relations among the force magnitudes w , f_k , n , and F must be true?



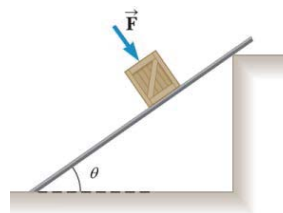
- (A) $F = f_k$ and $n = w$ (B) $F = f_k$ and $n > w$ (C) $F = f_k$ and $n < w$
 (D) $F > f_k$ and $n < w$ (E) $F > f_k$ and $n = w$

- A9. The velocity of an object as a function of time is shown in the graph directly below. Which one of the force versus time graphs best represents the net force vs. time relationship for this object?



- A10. Three identical 6.0-kg cubes are placed on a horizontal surface in contact with one another. The cubes are lined up from left to right and a 36-N force is applied to the left side of the left cube, causing all three cubes to accelerate to the right. If the cubes are each subject to a frictional force of 6.0 N, what is the magnitude of the force exerted on the middle cube by the left cube?
- (A) 12 N (B) 24 N (C) 36 N (D) 30 N (E) 6.0 N

- A11. A crate of mass m is on a ramp that is inclined at an angle θ as shown in the diagram. The coefficient of static friction between the crate and the ramp is μ_s . A force of magnitude F is applied to the crate perpendicular to the ramp. Which one of the following expressions is correct for the minimum value of F that is required to prevent the crate from sliding down the ramp?



- (A) $\frac{mg(\sin \theta - \mu_s \cos \theta)}{\mu_s}$ (B) $\frac{mg(\sin \theta + \mu_s \cos \theta)}{\mu_s}$ (C) $\frac{mg(\cos \theta - \mu_s \sin \theta)}{\mu_s}$
 (D) $\frac{mg(\cos \theta + \mu_s \sin \theta)}{\mu_s}$ (E) $\frac{mg(\tan \theta - \mu_s \cot \theta)}{\mu_s}$
- A12. The work required to accelerate an object on a frictionless surface from a speed v to a speed $2v$ is
 (A) twice the work required to accelerate the object from $v = 0$ to v .
 (B) three times the work required to accelerate the object from $v = 0$ to v .
 (C) four times the work required to accelerate the object from $2v$ to $3v$.
 (D) not known without knowledge of the acceleration.
 (E) equal to the work required to accelerate the object from $v = 0$ to v .
- A13. Three projectiles with different masses are launched from the top of a building each at different angles of elevation. Each particle has the same initial kinetic energy. Which particle has the greatest speed just as it impacts with the ground?
 (A) The projectile launched at the highest angle of elevation has the greatest speed.
 (B) The projectile launched at the lowest angle of elevation has the greatest speed.
 (C) The projectile with the highest mass has the greatest speed.
 (D) The projectile with the lowest mass has the greatest speed.
 (E) They all have the same speed on impact with the ground.
- A14. If two particles have equal kinetic energies, are their momenta equal?
 (A) Yes, always.
 (B) Yes, as long as their masses are equal.
 (C) Yes, if both their masses and directions of motion are the same.
 (D) No, never.
 (E) No, unless they are moving perpendicular to each other.
- A15. Water flows over a section of Niagara Falls at a rate of 1.20×10^6 kg/s and falls 50.0 m. How much power is available at the bottom of the waterfall? (Ignore any frictional effects.)
 (A) 588 MW (B) 294 MW (C) 147 MW (D) 60.0 MW (E) 74.0 MW

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.

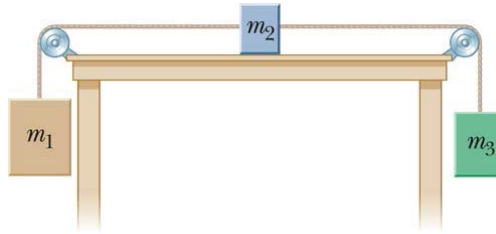
B1. At Fenway Park in Boston there is a wall (the Green Monster) that is 11.3 m high. The wall is 94.5 m from home plate. Suppose that a batter hits a baseball at home plate such that it is at an initial height of 80.0 cm above the ground and has an initial velocity of 48.9 m/s at an angle of 55.0° above the horizontal.

(a) Calculate the time for the ball to travel from home plate to the wall. (3 marks)

(b) Calculate the height of the ball above the ground when it reaches the wall. If you did not obtain an answer for (a), use a value of 3.30 s. (4 marks)

(c) Calculate the speed of the ball when it reaches the wall. If you did not obtain an answer for (a), use a value of 3.30 s. (3 marks)

- B2. Three objects are connected by two cords as shown in the figure below. The coefficient of kinetic friction between the block of mass m_2 and the table is 0.350. The objects have masses of $m_1 = 4.00$ kg, $m_2 = 1.00$ kg, and $m_3 = 2.00$ kg. The pulleys are frictionless.



- (a) On the diagram above, draw the forces acting on each object. (3 marks)
 (b) Determine the acceleration of each object, including its direction. (3 marks)

$a_1 =$ $a_2 =$ $a_3 =$

- (c) Determine the tensions in the two cords. If you did not obtain answers for (b), use a value of 2.30 m/s^2 for the magnitude of the acceleration of each object. (2 marks)

$T_{\text{left}} =$ $T_{\text{right}} =$

- (d) If the tabletop were smooth (frictionless), would the tensions increase, decrease, or remain the same? (2 marks)

T_{left} will ... T_{right} will ...

B3. A 7.80-g bullet moving at 575 m/s penetrates a solid wood wall and eventually comes to rest in the wall. Assume that the bullet moves horizontally in the wall.

- (a) Calculate the work done by the frictional force of the wall on the bullet in stopping the bullet. (4 marks)

- (b) Assuming the frictional force of the wall on the bullet is constant, and given that the elapsed time between the moment the bullet enters the wall and the moment it stops moving is 1.91×10^{-4} s, calculate the distance that the bullet penetrates the wall. (3 marks)

- (c) Calculate the magnitude of the frictional force of the wall on the bullet. If you did not obtain an answer for (a), use a value of -1.25×10^3 J and if you did not obtain an answer for (b), use a value of 0.0500 m. (3 marks)

- B4. A 65.0-kg adult throws a 0.100-kg snowball forward with a ground speed of 30.0 m/s. A child, with a mass of 30.0 kg, catches the snowball. Both the adult and the child are on skates. The adult is initially moving forward with a speed of 2.50 m/s, and the child is initially at rest. Calculate the velocities of the adult and child after the snowball is exchanged. You may ignore any change in the speed or trajectory of the snowball as it travels from the adult to the child. Disregard the friction between the skates and the ice. (10 marks).

$v_{\text{adult}} =$

$v_{\text{child}} =$