# UNIVERSITY OF SASKATCHEWAN
### Department of Physics and Engineering Physics

### Physics 115.3
### MIDTERM TEST – Alternative Siting

October 21, 2016                                                                 Time:  90 minutes


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


LECTURE SECTION (please check):

                    ❑    01      A. Zulkoskey

                    ❑    02      Dr. D. Janzen

                    ❑    03      B. Zulkoskey

                    ❑    04      Dr. S. Litt

                    ❑    97      Dr. A. Farahani

                    ❑    C15    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 <u>NOT</u> be returned.


*ONLY THE <u>THREE</u> PART B QUESTIONS THAT <u>YOU INDICATE</u> WILL BE MARKED*

*PLEASE <u>INDICATE</u> WHICH <u>THREE</u> 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 | |

## PART A

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

A1.    The length and width of a standard sheet of paper is measured, and the area is found by calculation to be 93.50 cm². The length has five significant figures in its measurement. The number of significant figures in the width measurement must be:

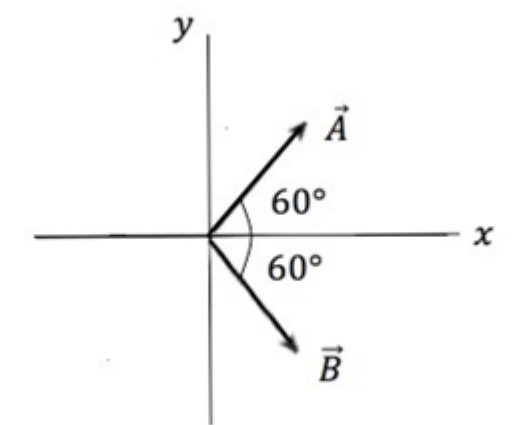    (A)  1         (B)  2         (C)  3         (D)  4         (E)  5

A2.    Given that the dimensions of $f$, $m$, and $k$ are as follows:

$$f\ :\ \frac{1}{[T]} \qquad m\ :\ [M] \qquad k\ :\ \frac{[M]}{[T]^2}$$

determine which one of the following equations is dimensionally correct.

    (A) $f = \dfrac{1}{2\pi}\dfrac{m}{k}$    (B) $f = 2\pi\dfrac{k}{m}$    (C) $f = \dfrac{1}{2\pi}\sqrt{\dfrac{m}{k}}$    (D) $f = 2\pi\sqrt{\dfrac{k}{m}}$    (E) $f = 2\pi\sqrt{mk}$

A3.    Vectors $\vec{A}$ and $\vec{B}$ have the same magnitude of 2.0 cm and make angles of 60.0° with the positive $x$ axis as shown in the diagram. What is the magnitude of the vector sum, $\vec{A} + \vec{B}$?



    (A) 2.0 cm        (B) 2.3 cm        (C) 3.0 cm        (D) 3.5 cm        (E) 4.0 cm

A4.    A racing car starts from rest and reaches a final speed $v$ in a time $t$. If the acceleration of the car is constant during this time, which one of the following statements must be true?

    (A)   The car travels a distance $v\,t$.
    (B)   The acceleration of the car is $v\,t$.
    (C)   The average speed of the car over the time interval $t$ is $v/2$.
    (D)   The velocity of the car remains constant.
    (E)   The velocity of the car increases exponentially.

A5.    A projectile is launched from Earth's surface at a certain initial velocity at an angle above the horizontal, reaching maximum height after time $t_{max}$. Another projectile is launched with the same initial velocity and angle from the surface of the Moon, where the acceleration of gravity is one-sixth that of Earth. Neglecting air resistance (on Earth) and variations in the acceleration of gravity with height, how long does it take the projectile on the Moon to reach its maximum height?

    (A) $t_{max}$        (B) $t_{max}/6$        (C) $6\,t_{max}$        (D) $\sqrt{6}\,t_{max}$        (E) $36\,t_{max}$

A6.    A ball is thrown vertically upward. Which one of the following statements best describes the acceleration of the ball at the instant it reaches maximum height? You may assume that the ball is in free-fall while it is in the air.

    (A) zero                                (B) magnitude $< g$, directed upward
    (C) magnitude $> g$, directed upward        (D) magnitude $< g$, directed downward
    (E) magnitude $= g$, directed downward

A7.    As a result of the coordinate system chosen to describe its motion, a car in straight line motion has a negative velocity and a positive acceleration. Which one of the following statements could possibly be correct for the motion of the car?

    (A)   The car is moving in the negative direction with increasing speed.
    (B)   The car is moving in the positive direction with increasing speed.
    (C)   The car is moving in the positive direction with decreasing speed.
    (D)   The car is moving in the negative direction with decreasing speed.
    (E)   The car is moving in the negative direction with constant speed.

A8.    Two monkeys of equal mass are holding onto a single vine of negligible mass that hangs vertically from a tree branch, with one monkey a few metres higher than the other. If the tension in the vine above the upper monkey is 400 N, what is the tension in the vine between the two monkeys?

    (A) 100 N         (B) 200 N         (C) 300 N         (D) 400 N         (E) 800 N

A9.    Consider the figure below. What is the magnitude of the resultant force exerted by the two cables supporting the traffic light?
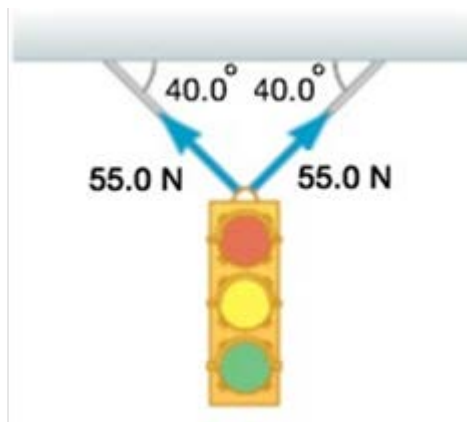


    (A) 70.7 N        (B) 84.3 N        (C) 92.3 N        (D) 115 N        (E) 131 N

A10.    A block of mass $m$ is held in equilibrium on a frictionless incline of angle $\theta$ by a horizontal force $\vec{F}$ applied in the direction shown in the figure. What is the magnitude of $\vec{F}$ required to hold the book in equilibrium?
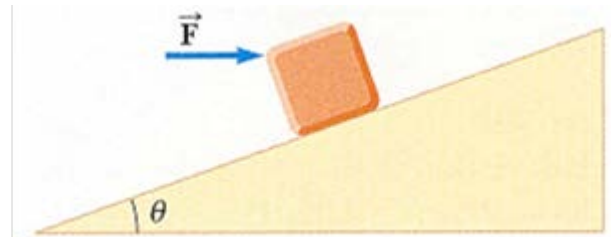


    (A) $mg$        (B) $mg \sin \theta$        (C) $mg \cos \theta$        (D) $mg \tan \theta$        (E) $mg \cot \theta$

A11.    Imagine a spherical planet with eight times the mass of the Earth and exactly twice the radius. What would be the acceleration due to gravity near the surface of this planet?

    (A) 2.45 m/s$^2$      (B) 4.90 m/s$^2$      (C) 9.80 m/s$^2$      (D) 12.6 m/s$^2$      (E) 19.6 m/s$^2$

A12.    If the net work done on a particle is zero, which one of the following statements **must** be true?

    (A)   The velocity of the particle is decreased.
    (B)   The velocity of the particle must be zero.
    (C)   The speed of the particle is unchanged.
    (D)   The velocity of the particle is unchanged.
    (E)   More information is required to answer the question.

A13.    Two particles of different mass start from rest. The same net force acts on each of them as they move over equal distances. How do their final kinetic energies compare?

   (A)    The particle of larger mass has more kinetic energy.
   (B)    The particle of smaller mas has more kinetic energy.
   (C)    The particle of larger mass has less kinetic energy initially, but as its momentum increases its kinetic energy becomes greater than the less-massive particle's kinetic energy.
   (D)    The particles have equal kinetic energies.
   (E)    Not enough information is given to answer this question.


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, unless they are moving perpendicular to each other.
   (E)    No, never.


A15.    A block of mass $m$ is dropped from rest from the fourth floor of an office building, subsequently hitting the sidewalk at speed $v$. From what floor should the mass be dropped to double that impact speed? (The ground floor is "floor zero". The first floor is one floor above ground level.)

   (A)    The sixth floor
   (B)    The eighth floor
   (C)    The tenth floor
   (D)    The twelfth floor
   (E)    The sixteenth floor


## PART B

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

**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.**

**<u>SHOW AND EXPLAIN YOUR WORK</u> – 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.  While leaning out of a window 12.5 m above the ground, you throw a ball vertically-upward
with an initial speed of 25.0 m/s.  You may assume that the ball is in free-fall while in the air.

(a)  Calculate the maximum height that the ball reaches, relative to the window.  (*3 marks*)

(b)  Calculate the speed of the ball just before it hits the ground.  (*3 marks*)

(c)  Calculate the time that the ball was in the air (from just after release until just before hitting
the ground).  (*4 marks*)

B2.  A children's playground is located on top of a building. The playground is 6.00 m above street
level, and is surrounded by a 1.00 m high wall that makes the sides of the building 7.00 m high. A
person walking by the building finds a ball on the street and kicks it back to the children on the
playground. The person kicks the ball a horizontal distance $d$ = 24.0 m away from the building at
an angle $\theta$ = 53.0° above the horizontal. It takes the ball 2.20 s to cover the distance $d$ (and reach a
point vertically above the front edge of the wall).
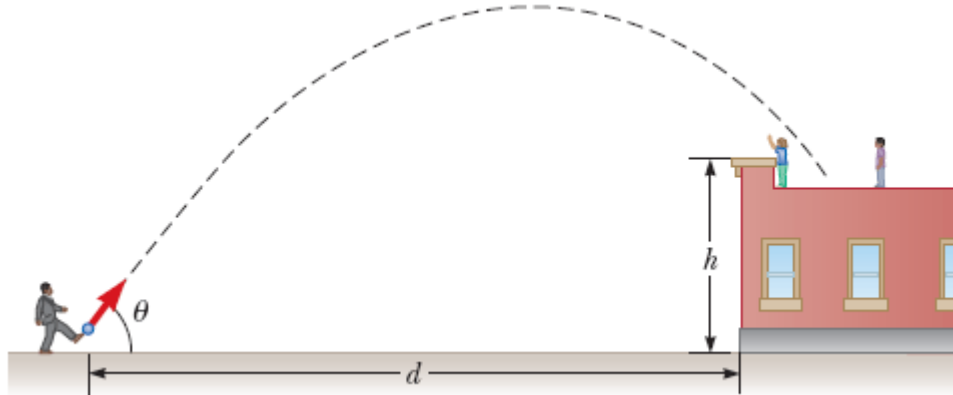


(a)  Calculate the speed with which the ball was launched.  (*3 marks*)

(b)  Calculate the vertical distance by which the ball clears the 7.00 m-high wall.  If you did not
obtain an answer for (a), use a value of 19.0 m/s.  (*4 marks*)

(c)  Calculate the total time that the ball is in the air.  (*3 marks*)

B3.  Two objects with masses of $m_1 = 3.00$ kg and $m_2 = 5.00$ kg are connected by a light string that passes over a frictionless pulley as shown in the figure.
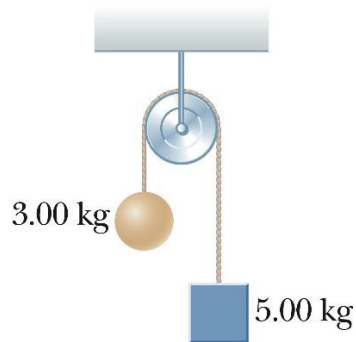


(a)  Draw the free-body diagrams for each of the masses and show the coordinate system. (*3 marks*)

(b)  Calculate the magnitude of the tension in the string. (*4 marks*)

(c)  Calculate the magnitude of the acceleration of each mass. If you did not obtain an answer for (b), use a value of 37.5 N. (*3 marks*)

B4.  A truck travels uphill with constant velocity on a highway with a 7.00° slope. A 50.0-kg package
     sits on the floor of the back of the truck and does not slide, due to a static frictional force.

(a)   Draw a free-body diagram for the package and show the coordinate system.  (*2 marks*)

(b)   During an interval in which the truck travels 341 m, calculate the net work done on the
      package.  (*2 marks*)

(c)   During an interval in which the truck travels 341 m, calculate the work done on the package
      by the force of gravity.   (*2 marks*)

(d)   During an interval in which the truck travels 341 m, calculate the work done on the package
      by the normal force.   (*2 marks*)

(e)   During an interval in which the truck travels 341 m, calculate the work done on the package
      by the static frictional force.   (*2 marks*)

*END OF EXAMINATION*