Exam 1  Phys 105  Section_____ Fall  2002

Name__________________________________   ID:

Closed book exam. Only the formula sheet (and anything you write on it) can be used. Calculators are allowed.
Use the scantron forms (pencil only!) for the multiple choice problems. Circle the answers on the examination sheet as well, and return it together with the scantron form. Use the back of these pages, or attach your own pages with solutions for problems which require calculations.

The multiple choice problems are 1 point each. Work out problems are 4 points each. Passing of the exam requires at least 50% of the maximum number of points.

Clearly print your last name and indicate your section number on both the scantron form and the examination sheet. Also, indicate your name and ID on each of the two sheets with work-out problems since they will be graded separately. Failure to do any of these will result in penalty of 2 points.

Problem 1. Consider an expression,
\[ a \frac{t^2}{2} \]
where \( a \) is acceleration and \( t \) is time. The dimension of this expression in the SI system of units is
A) m/s
B) m/s^2
C) m
D) km/s
E) (mi/h)/s

Problem 2. The surface area of Sun is about \( 6 \cdot 10^{12} \) km^2. This corresponds to
A) \( 6 \cdot 10^{12} \) m^2
B) \( 36 \cdot 10^{12} \) m^2
C) \( 6 \cdot 10^{18} \) m^2
D) \( 6 \cdot 10^6 \) m^2
E) \( 6 \cdot 10^9 \) m^2

Problem 3. Consider a two-dimensional system of coordinates with the \( x \) axis pointing right and the \( y \) axes pointing up as shown in the figure below. In vector component notation, \( \vec{a} = \hat{i} + \hat{j} \) and \( \vec{b} = \hat{i} - \hat{j} \). The sum of these vectors points
A) up
B) down
C) left
D) right
E) is zero (no direction)

Problem 4 . For the previous problem, the difference of the two vectors, \( \vec{a} - \vec{b} \), points
A) up
B) down
C) left
D) right
E) is zero (no direction)
Problem 5. A rock is dropped from a tall bridge with no initial velocity. Three seconds after the rock is dropped, the speed of the rock will be
   A) 44.1 m/s
   B) 29.4 m/s
   C) 9.8 m/s
   D) 19.3 m/s
   E) 33.2 m/s

Problem 6. A heavy object with mass \( m \) is dropped from a plane which is moving horizontally with a constant speed \( v \) at a height \( h \) above the ground. If one neglects air friction, the time for the object to hit the ground
   A) depends on \( v \) only
   B) depends on \( v \) and \( h \)
   C) depends on \( v \), \( h \) and \( m \)
   D) depends on \( h \) only
   E) depends on \( m \) only

Problem 7. For the same problem, calculate the horizontal distance which the object will travel before hitting the ground, if \( h = 490 \text{ m} \), \( v = 360 \text{ km/h} \) and \( m = 1000 \text{ kg} \)
   A) 100 m
   B) 1000 m
   C) 10000 m
   D) 3600 m
   E) 7200 m

Problem 8. A cart with an initial velocity of 8 m/s to the right experiences a constant acceleration of \( a = 2 \text{ m/s}^2 \) to the left. What is the cart's displacement after the first 6 s of its motion?
   A) 84 m
   B) 48 m
   C) 36 m
   D) 12 m
   E) 4 m

Problem 9. A butterfly moves with a speed of \( v = 12 \text{ m/s} \) The x-component of its velocity is 9 m/s. The angle between the direction of its motion and the x-axis must be:
   A) 30.0\(^\circ\)
   B) 41.40\(^\circ\)
   C) 48.2\(^\circ\)
   D) 53.0\(^\circ\)
   E) 58.6\(^\circ\)

Problem 10. A hockey puck sliding on a frozen lake comes to rest after traveling 200m. If its initial velocity is 10 m/s, what is the magnitude of its acceleration if that acceleration is assumed constant?
   A) 0.25 m/s\(^2\)
   B) 0.5 m/s\(^2\)
   C) 0.75 m/s\(^2\)
   D) 1.0 m/s\(^2\)
   E) 1.20 m/s\(^2\)
**Problem 11.** An archer shoots an arrow horizontally from a top of a tower. The tower wall is 78.4 m high and the arrow hits the ground a horizontal distance of 200 m from the wall. What is the final speed of the arrow just before it hits the ground?

A) 10.0 m/s  
B) 14.8 m/s  
C) 32.4 m/s  
D) 63.5 m/s  
E) 88.4 m/s
Work-out problems:

Write full solutions to the problems below. Answers without calculations will not be credited, even if correct. Clearly write the answers (with dimensions!) in the space provided. Grading will be reduced if the work is untidy or otherwise hard to read.

Work-out problem I. A car is driven south for a distance of 200 km, then west for 100 km, and then north for 50 km.

a) Draw a clear vector diagram for this motion, using the (x,y) system of coordinates with x pointing east and y pointing north. Indicate on the diagram the resulting total displacement vector.

b) Find components of the resulting displacement vector.

Ans.: x-component_______________ , y-component: _________________

c) Calculate the magnitude of the displacement. Ans. : _______________

d) If the speed of the car was 50 km/h on every segment of the drive, find the average velocity (magnitude and direction) during the trip.

Ans.: magnitude: _________________________ direction: ______________________
Work-out problem II: A stone is projected from zero level with an initial speed $v_0$ directed $35^\circ$ above the horizontal. Five seconds later it lands on a cliff 8 m high.

a) What is the magnitude of the initial velocity of the stone?

Ans.___________________

b) What is the horizontal and vertical component of its velocity and velocity magnitude just before the stone hits the cliff?

Ans.____________

c) How far from the release point horizontally does the stone hits the cliff?

Ans._______________