Exam 1 **Phys 105 – Sample Test** **Section_________**

Name___________________________________ **ID:** ______KEY___________________

Closed book exam - Calculators are allowed.

Only the official formula sheet downloaded from the course web page can be used. You are allowed to write notes on the back of the formula sheet.

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.

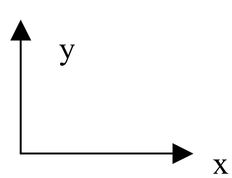
Problem 1. Consider an expression,

$$a\, t^2/2$$

where a is acceleration and t is time. The unit 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 the Sun is about $6 \times 10^{12}\ km^2$. This corresponds to
A) $6 \times 10^{15}\ m^2$
B) $36 \times 10^{12}\ m^2$
C) $6 \times 10^{18}\ m^2$
D) $6 \times 10^{6}\ m^2$
E) $6 \times 10^{9}\ m^2$

Problem 3. Consider a two-dimensional system of coordinates with the x-axis pointing right and the y-axis 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, $\vec{a} + \vec{b}$, points
A) up
B) down
C) left
D) right
E) is zero (no direction)



Problem 4. For the previous problem (*Problem 3*), 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, at the instant when the object hits the ground the plane will be

A) in front of the object
B) right above the object
C) depends on *v*
D) depends on *v* and *h*
F) depends on *v, h* and *m*

Problem 7. In the previous problem (*Problem 6*), 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 8. For the same problem *(Problem 6)*, calculate the horizontal distance which the object will travel before hitting the ground, if $h = 490$ m, $v = 360$ km/h and $m = 1000$ kg.

A) 100 m
B) 1000 m
C) 10000 m
D) 3600 m
E) 7200 m

Problem 9. A cart with an initial velocity of 8 m/s to the right experiences a constant acceleration of a = 2 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 10. A bird moves with a speed of v = 12 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) 30.0^0
B) 41.40^0
C) 48.2^0
D) 53.0^0
E) 58.6^0

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Problem 11. 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 12. A toy rocket, launched from the ground with zero initial velocity, rises vertically with an acceleration of 20 m/s^2 for 6.0 s until its motor stops. Disregarding any air resistance, what maximum height above the ground will rocket achieve?

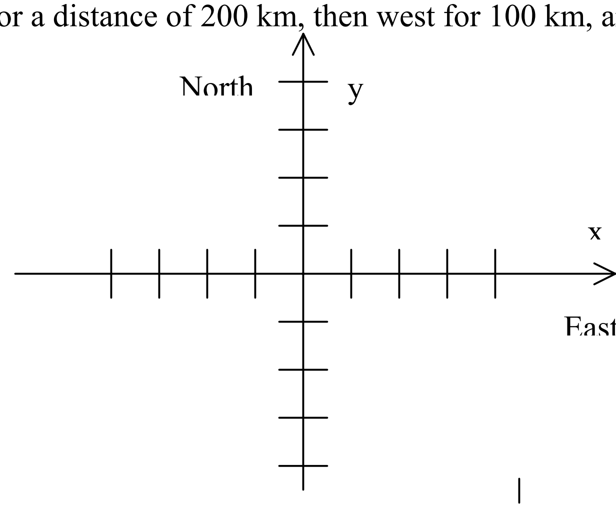
A) 1.1 km
B) 0.73 km
C) 1.9 km
D) 0.39 km
E) 1.5 km

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. *(The spacing between the marks on the axes is 50 km).*



b) Find components of the resulting displacement vector.

Ans.: x-component_____-100 km____________ , y-component: _______-150 km____________

c) Calculate the magnitude of the displacement. *Ans.* :_________180 km_______

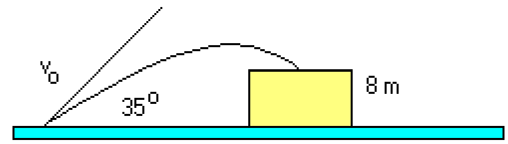
d) If the speed of the car was 50 km/h on every segment of the drive, find the average velocity (magnitude and direction) during the trip.

Ans.: magnitude: _____________26 km___________ direction: ___236.3° ccw or 123.7° cw_____

(Angle is measured from the positive x-direction. Indicate the angle on the graph whether it is clockwise or counter-clockwise from the positive x-axis)

Work-out problem II: A stone is projected from the ground level with an initial speed v_0 directed 35^0 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._______46____________ m/s.

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

Ans. Velocity: _____44_________ m/s.

Horizontal: _______38_______ m/s,

Vertical: ______-23___________ m/s.

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

Ans.______187_________ m.