Practice Problems for Exam I 9/16/2004

CLOSED BOOK EXAM - ALL NOTES, BOOKS, ETC. ON FLOOR - CALCULATORS OK

Note: Each problem is worth 10 points.

Show all of your work on the sheet containing the problem. Draw diagrams as needed to explain your reasoning. If you need additional space, use the reverse side and put a note on the bottom of the page that material is on the back. DO NOT remove the staple.

For Grader Use Only

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Formulas

\[ x = x_o + v_o t + \frac{1}{2} a t^2 \]
\[ v = v_o + a t \]
\[ v^2 = v_o^2 + 2a(x - x_o) \]
\[ a_{circular} = \frac{v^2}{R} \]
\[ F_{net} = ma \]
\[ g_{earth} = 9.80 \text{m/} \text{sec}^2 \]
\[ \sin 30^\circ = 0.5 \]
\[ \sin 45^\circ = 0.707 \]
\[ \sin 60^\circ = 0.866 \]
Problem 1
What is the average velocity of an object whose position is given by 
\[ x = 6t - 5t^3 \] (in meters, \( t \) in seconds) in the time interval between \( t = 1s \) and \( t = 3s \)?

Problem 2
A 3.1 kg mass is swung in a vertical circle. It is fastened to a string 0.40 meters long. It moves with a speed of 6.0 meters/sec. What is the tension in the string (in N) when the mass is at the top of the circle?

Problem 3
A projectile of mass 350 kg is fired horizontally from the top of a building 40 m high. Neglecting air resistance, what is the magnitude of the acceleration in the horizontal direction (in \( m/sec^2 \))?

Problem 4
Two identical balls of mass 6.0 kg are projected off a cliff of height 20 meters. One is thrown horizontally with initial speed 3.0 meters/second, and the other is released from rest and falls vertically. Calculate the times at which each hits the ground.

Problem 5
A ball is thrown vertically upward. It is observed to come back to its starting point at a time \( t = 2.04 \) seconds later. What was its initial speed?
Problem 6
A force of 10 N is applied to a 5.0 kg box sitting on the floor. The direction of the force is downward at an angle of 60° with respect to the horizontal. Neglect friction between the box and the floor. Calculate the resulting horizontal acceleration of the box.

Problem 7
An object of mass 5 kg is hoisted by a rope and accelerates upward with an acceleration of $2 \, m/sec^2$. Calculate the tension in the rope.

Problem 8
Two blocks are connected by a rope which passes over a frictionless pulley mounted at the edge of a table. The first block ($m_1 = 5$ kg) sits on the table (which is frictionless); the second block ($m_2 = 10$ kg) hangs vertically alongside the table. Find the acceleration of the vertical block.

Problem 9
An object moves with initial velocity of 10 m/sec in a straight line. How long must it undergo a constant acceleration of $2.0 \, m/sec^2$ before its average velocity is equal to three times its initial velocity?

Problem 10
An intelligent being stands on the surface of a hypothetical planet. It drops a ball from a height of 1.0 meters and finds that it hits the surface after a time of 1.5 seconds. It also has access to a scale, where its weight is measured to be 160 N. What is its mass?