Faculty of Science - Cairo University
Department of Physics

General Physics (PTP 101)
Date: 13 Jan. 2011
Time allowed: 2 hours
Total marks

Answer on Four (4) Questions Only:

Question (1)
1. Write down the kinematic equations of one-dimensional motion under constant acceleration.

2. A stone is thrown from the top of a building with an initial velocity of 20.0 m/s straight upward, at an initial height of 50.0 m above the ground. The stone just misses the edge of the roof on its way down. Determine,
   (a) the time needed for the stone to reach its maximum height,
   (b) the maximum height,
   (c) the time needed for the stone to return to the height from which it was thrown and the velocity of the stone at that instant,
   (d) the time needed for the stone to reach the ground,
   (e) the velocity and position of the stone at $t = 5.00 \text{ s}$.

Question (2)
1. Define the following
   (a) Mechanical energy,
   (b) Dissipative energy,
   (c) Conservative force

2. A block with mass of 5.00 kg is attached to a horizontal spring with spring constant $k = 4.00 \times 10^2 \text{ N/m}$. The surface the block rests upon is frictionless. If the block is pulled out to $x_i = 0.0500 \text{ m}$ and released,
   (a) find the speed of the block at the equilibrium point,
   (b) find the speed when $x = 0.0250 \text{ m}$, and
   (c) repeat part (a) if friction acts on the block, with coefficient $\mu_k = 0.150$

Question (3)
1. Define the types of collisions

2. A truck with mass $1.80 \times 10^3 \text{ kg}$ is traveling eastbound at $+15.0 \text{ m/s}$, while a compact car with mass $9.00 \times 10^2 \text{ kg}$ is traveling westbound at $-15.0 \text{ m/s}$. The cars collide head-on, becoming entangled.
   (a) Find the speed of the entangled cars after the collision.
Question (4) [15 marks]

1. **Prove that** “The tangential speed of a point on a rotating object equals the distance of that point from the axis of rotation multiplied by the angular speed”.

2. In a compact disc player, as the read head moves out from the center of the disc, the angular speed of the disc changes so that the linear speed at the position of the head remains at a constant value about 1.3 m/s.

   (a) Find the angular speed of the compact disc when the read head is at \( r = 2.0 \) cm and again at \( r = 5.6 \) cm.

   (b) An old-fashioned record player rotates at a constant angular speed, so the linear speed of the record groove moving under the detector (the stylus) changes.

   Find the linear speed of a 45.0-rpm record at points 2.0 and 5.6 cm from the center.

   (c) In both the CD and phonograph record, information is recorded in a continuous spiral track. Calculate the total length of the track for a CD designed to play for 1.0 h.

Question (5) [15 marks]

1. **Write down** the kinematic equations for rotational motion about a fixed axis with constant angular acceleration.

2. A wheel rotates with a constant angular acceleration of 3.50 rad/s\(^2\). If the angular speed of the wheel is 2.00 rad/s at \( t = 0 \),

   (a) through what angle does the wheel rotate between \( t = 0 \) and \( t = 2.00 \) s?

   Give your answer in radians and in revolutions.

   (b) What is the angular speed of the wheel at \( t = 2.00 \) s?

3. An airplane propeller slows from an initial angular speed of 12.5 rev/s to a final angular speed of 5.00 rev/s. During this process, the propeller rotates through 21.0 revolutions.

   Find the angular acceleration of the propeller in radians per second squared, assuming it’s constant.

End of Questions

*With my best wishes*