INSTRUCTIONS: Write your NAME and your LECTURE (01: 8:30/Eskildsen, 02: 10:40/Goussiou, 03: 3:00/Bunker) on the front of the blue exam booklet. The exam is closed book, and you may have only pens/pencils and a calculator (no stored equations or programs and no graphing). Show all of your work in the blue book. For problems II-V, an answer alone is worth very little credit, even if it is correct – so show how you get it.

Suggestions: Draw a diagram when possible, circle or box your final answers, and cross out parts which you do not want us to consider.

I. Multiple Choice Questions

1. An object experiences a net force and accelerates in response. Which of the following is always true?
   A) The object moves in the direction of the force
   B) The acceleration is in the same direction as the force
   C) The velocity of the object increases
   D) The acceleration is in the same direction as the velocity
   E) Both B and C

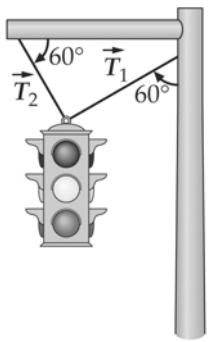
2. A stone is dropped from the top of a 100-m building at the same time that an identical stone is thrown horizontally from the top of the building.
   Ignoring air resistance,

   A) the thrown stone hits the ground first.
   B) the dropped stone hits the ground first.
   C) the two stones hit the ground simultaneously.
   D) we need more information to make a conclusion.

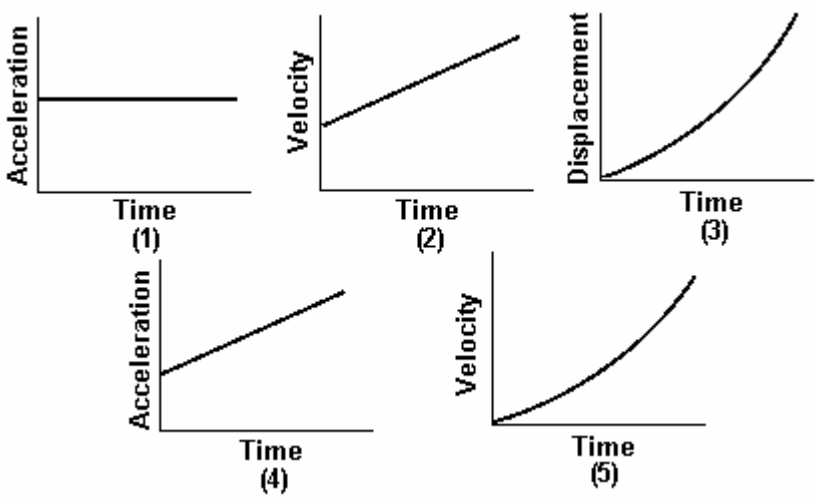
3. A person is on an elevator accelerating downward at a 1 m/s^2. On his way down, the normal force exerted on him by the floor of the elevator is

   A) greater than his weight when he is off the elevator.
   B) equal to his weight when he is off the elevator.
   C) less than his weight when he is off the elevator.
   D) dependent on the velocity of the elevator.
   E) unknown; insufficient information is given to answer correctly.

4. A traffic light is supported by two wires as shown in the figure. What is the relative magnitude of the tension in the two wires?



   A) $T_1 = T_2$
   B) $T_1 > T_2 > 0$
   C) $T_1 > T_2 = 0$
   D) $T_2 > T_1 > 0$
   E) $T_2 > T_1 = 0$



5. Two of the above graphs shown are INCORRECT for a particle undergoing one-dimensional motion with constant acceleration. They are

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

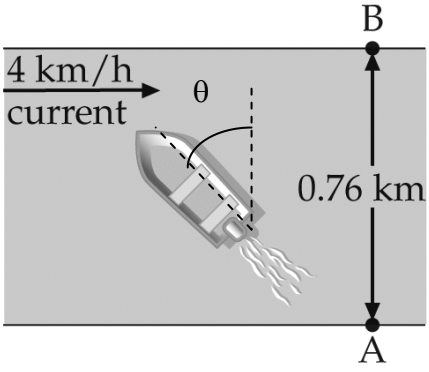
Problems

II. A river is 0.76 km wide. The banks are straight and parallel, as shown in the figure. The current is 4 km/hr and the boat has a maximum speed of 5 km/hr in still water. The pilot of the boat wishes to go on a straight line across the river.

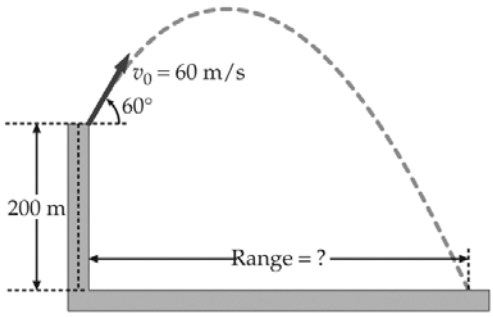
a) At what angle θ should the boat point upstream?
b) How long will it take for the boat to reach the far side of the river?

If instead of aiming upstream, the boat aimed straight across the river,

c) how long would it take to cross the river?
d) How far down the river (downstream from "B") would it end up before reaching the far side?



III. A projectile is fired into the air from the top of a 200-m cliff above a valley. Its initial velocity is 60 m/s above the horizontal.
   a) How long is the projectile in the air?
   b) How far from the cliff does the projectile land (the range as shown in the figure)?

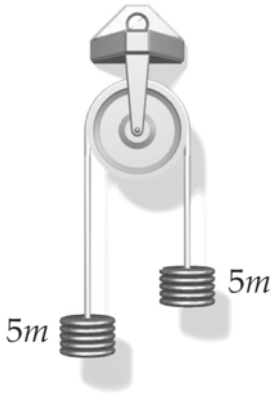


IV. The masses attached to each side of an Atwood's Machine consists of a stack of five washers, each of mass *m*, as shown in the figure. Each washer has a mass of 10 g. One washer is moved from the left side to the right side.

   a) What is the acceleration of the washers?
   b) What is the tension in the string?

   Now all washers are moved to the right side.

   c) What is the acceleration and tension?



V. Suppose that a frictionless surface is inclined at an angle of 30º to the horizontal. The 270-g block is attached to a 75-g hanging weight using a pulley as shown in the figure..

   a) Draw two free-body diagrams, one for the block and the other for the hanging weight.
   b) Find the tension in the string.
   c) Find the acceleration of the block.
   d) The block is release from rest. How long does it take to slide down a distance of 1.0 m down the surface?