Name:

Physics 6A   **Introduction to Physics**   **Winter 2001**

Midterm Exam 1

January 26, 2001

Problem	Possible	Score
1–4	12	
5–13	27	
14,15	9	
16	20	
17	16	
18	16	
Ver. A	Total	

- **Closed book. No notes.**
- **Calculators with cleared memory are okay.**
- **Show your work on all calculations.**

You should have 3 sheets and 5 pages, with 18 questions or problems.
All numerical constants should be assumed to be accurate to two significant figures.
Don't spend too much time on the multiple-choice questions before working the problems! All calculations in the problems should be very short—no more than a few lines per section—and should easily fit in the provided space.

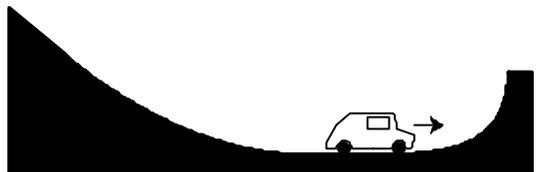Equations for motion in one dimension, x, with constant acceleration:

$$x = x_0 + v_0 t + \tfrac{1}{2} at^2 \qquad x = x_0 + \tfrac{1}{2}(v_0 + v)\cdot t \qquad v = v_0 + at$$

Newton's second law: $\vec{a} = \dfrac{1}{m}\cdot\vec{F}_{net}$

Magnitude of the acceleration of gravity at the surface of the earth: 9.8 m/s^2

1) (3 pnts) The acceleration of a falling body is measured in an elevator sitting at rest on the 4th floor, and a result of 9.8 m/s^2 is obtained. It is then measured again in the elevator while traveling upward past the 4th floor at a constant speed. What result is then obtained?
   a) Less than 9.8 m/s^2.
   b) 9.8 m/s^2.
   c) Greater than 9.8 m/s^2.
   d) The question cannot be answered without knowing whether the falling body is more massive than the elevator.

2) (3 pnts) A package of supplies is dropped from a plane, and one second later a second package is dropped. If air resistance is negligible, then
   a) the packages will fall with a constant vertical separation.
   b) the vertical separation between the packages will steadily decrease with time.
   c) the vertical separation between the packages will steadily increase with time.
   d) the vertical separation between the packages will decrease with time only if the second package is more massive than the first.

3) (3 pnts) An object is thrown straight up. At the top of its trajectory,
   a) the velocity is zero and the acceleration is zero.
   b) the velocity is zero and the acceleration is directed downward.
   c) the velocity is directed downward and the acceleration is zero.
   d) the velocity is decreasing and the acceleration is increasing.

4) (3 pnts) An airplane in level flight at constant velocity v drops a bomb, which hits the ground after some time t. Assuming negligible air resistance, where should the pilot look in order to see the explosion on the ground?
   a) Behind the airplane a distance $\tfrac{1}{2}gt^2$.
   b) Behind the airplane a distance vt.
   c) Straight down.
   d) Ahead of the airplane a distance vt.

5) (3 pnts) Two projectiles are propelled with the same initial horizontal speed but with different initial vertical speeds. If air resistance is negligible, how will their time in the air and horizontal flight distance compare?
   a) They will remain in the air different amounts of time but will travel the same distance.
   b) They will remain in the air different amounts of time and travel different distances.
   c) They will remain in the air the same amount of time and travel the same distance.
   d) They will remain in the air the same amount of time but travel different distances.

6) (3 pnts) Consider a tug-of-war between Team A and Team B. Team A is winning the contest by pulling Team B steadily toward them at increasing speed. Which statement is true?
   a) Team A is exerting a larger force on Team B than Team B is exerting on Team A.
   b) Team B is exerting a larger force on Team A than Team A is exerting on Team B.
   c) The force exerted by Team A on Team B is equal in magnitude to the force exerted by Team B on Team A.

7) (3 pnts) If you drop an object in the absence of air resistance, it accelerates downward at 9.8 m/s^2. If instead you throw it downward, its downward acceleration after release is
   a) greater than 9.8 m/s^2.
   b) 9.8 m/s^2.
   c) less than 9.8 m/s^2.

8) (3 pnts) A roller coaster descends a steep hill, goes through a valley, and rapidly climbs the next hill. At the lowest point in its motion, the passengers feel pushed against the seat by much more than their normal weight because
   a) there is a force in addition to gravity that is pushing them downward.
   b) their mass increases.
   c) the seat is accelerating upward and exerts an upward force on them.
   d) the earth's gravity is stronger at the lower elevation.

9) (3 pnts) A rock is suspended from a helicopter by a string. As the helicopter is accelerates upwards,
   a) the tension in the string is less than the weight of the rock.
   b) the tension in the string is equal to the weight of the rock.
   c) the tension in the string is greater than the weight of the rock.
   d) the tension in the string increases with the square of the time.

10) (3 pnts) A bullet is fired horizontally from a rifle held 1 m above level ground at the same time that an identical bullet is dropped from the same height. Which bullet hits the ground first?
    a) The bullet fired from the rifle hits first.
    b) The dropped bullet hits first.
    c) They both hit at the same time.

11) (3 pnts) A couple is riding on a Ferris wheel turning at constant speed. When their seat is at its lowest point in the rotation, their acceleration is
    a) momentarily zero.
    b) greater in magnitude than at any other point in the rotation.
    c) directed straight upward.
    d) directed straight down.

12) (3 pnts) A car rolls down the incline shown below and then up the curved ramp at the end of the track. As the car proceeds beyond the point where it is shown in the figure, its
    a) acceleration decreases in magnitude and its speed decreases.
    b) acceleration decreases in magnitude and its speed increases.
    c) acceleration increases in magnitude and its speed increases.
    d) acceleration increases in magnitude and its speed decreases.

13) (3 pnts) Consider a horse pulling a buggy. The weight of the horse and the normal force exerted by the ground on the horse constitute an interaction pair that are always equal and opposite according to Newton's 3rd law.
   a) TRUE
    b) FALSE

14) (3 pnts) In the 17th century, Otto von Güricke, a physicist in Magdeburg, fitted two hollow bronze hemispheres together and removed the air from the resulting sphere with a pump. Two eight-horse teams could not pull the halves apart even though the hemispheres fell apart when air was re-admitted. Suppose von Güricke had tied *both* teams of horses to one side and bolted the other side to a heavy tree trunk. In that case, the tension trying to pull apart the hemispheres would be
   a) half as much as before.
   b) the same as before.
   c) twice as much as before.
15) (6 pnts) Consider the graph of position versus time shown below for an object moving in one dimension. Complete the sketches of the corresponding plots for velocity versus time and acceleration versus time.
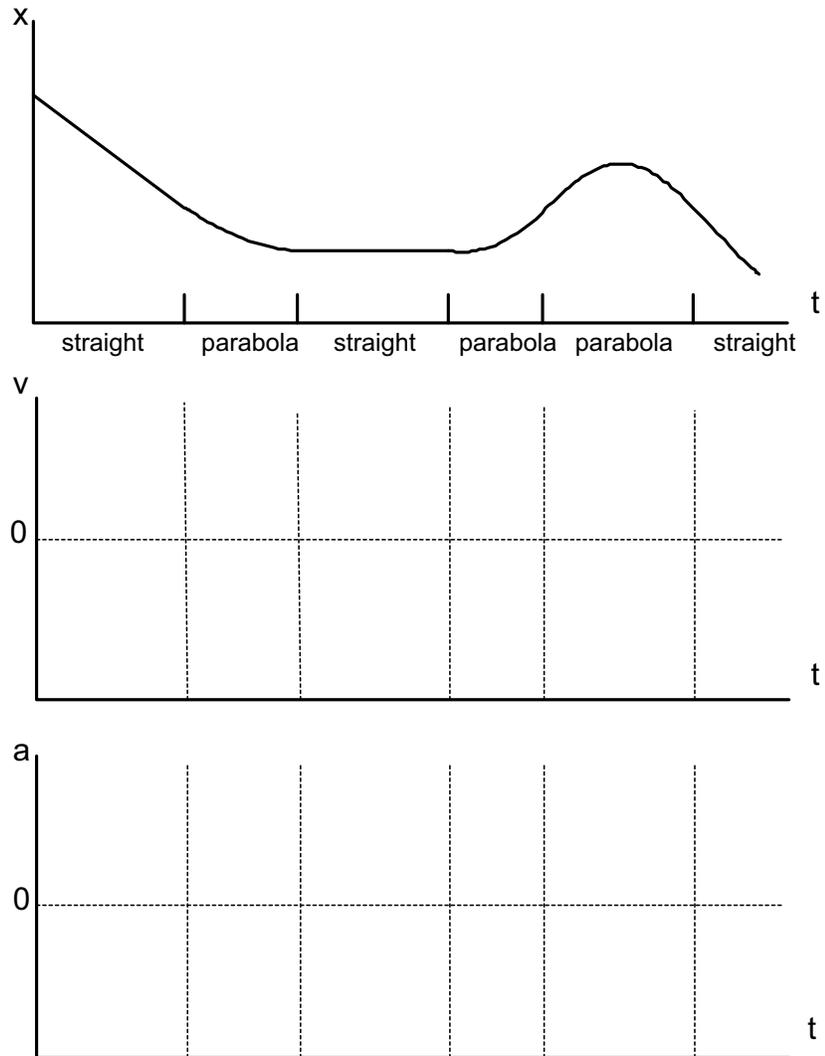
16) (20 pnts) A car drives up a ramp, inclined at an angle $\alpha=34°$, at constant speed $v_0 = 15$ m/s. At the end of the ramp the car flies across the 10 m deep chasm and hits the wall a horizontal distance of $d=20$ m from the end of the ramp.

a) What are the x and y components of the car's velocity as it flies off of the ramp?

Wall

15 m/s

10 m

20 m

34 deg.
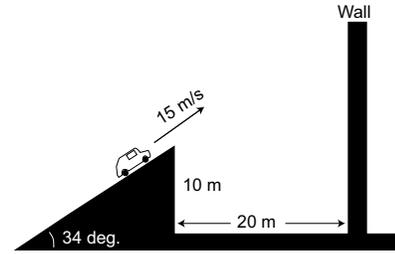
b) How much time elapses between when the car leaves the ramp and when it hits the wall?

c) What is the speed of the car just before impact with the wall?

17) (16 pnts) A 10 kg bucket of water is being raised from or lowered into a well. The tension in the rope is 70 N.
   a) Draw a free body diagram showing the forces acting on the bucket of water.

10 kg

   b) From this information, which of the following conclusions is valid?
      i) The bucket is being lowered into the well.
      ii) The bucket is being raised from the well.
      iii) We cannot tell from the information given whether the bucket is going up or down.
   c) What are the magnitude and direction of the acceleration of the bucket of water?

18) (16 pnts) A boat crosses a river that is 200 m wide and is flowing southward (in the $-y$ direction) at a speed of v_{we}=1.0 m/s. The boat travels at a speed of v_{bw}=2.0 m/s relative to the water, and the pilot points the boat due eastward (in the $+x$ direction).
   a) How long does it take the boat to cross the river?

200 m

v_{bw}=2.0 m/s

v_{we}=1.0 m/s
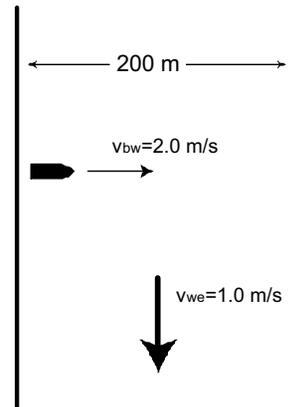
   b) What are the magnitude and direction of the velocity of the boat relative to the land?