Potentially useful information:

$g = 9.8\ m/s^2$

$\vec{A} \bullet \vec{B} = A_x B_x + A_y B_y + A_z B_z$

If acceleration a_x is constant, then:

$$v_x = v_{xo} + a_x t$$

$$x = x_o + v_{xo} t + \frac{1}{2} a_x t^2$$

$$v_x^2 = v_{xo}^2 + 2a_x (x - x_o)$$

If a_y is a function of time, a(t), then:

$$v_y(t) = v_{yo} + \int_o^t a(t)dt$$

$$y(t) = y_o + \int_o^t v_y(t)dt$$

$a_c = \omega^2 r = v^2/r$

Physics 4A Winter 2005 January 21, 2005
Professor C. M. Surko Quiz 1

Be sure to indicte your Code Number and the Test Form on the front of your Blue Book
The Test Form is indicated on the bottom of this page.

Please see preceeding page for potentially useful formulae. This exam contains 11 problems.

Problems 1 - 4, inclusive count 4 points each; and problems 5 - 11 count 8 points each.

Partial credit will be given for Problems 7 - 11, so please show your work clearly.

There will be no partial credit for problems 1 - 4.

Please put the answers to problems 1 - 4 on the first page inside your blue book.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Please note: If no answer is correct, choose the answer that is closest.

Situation I. Three vectors are given as follows:

$\vec{A} = +6\,\vec{i} - 1\,\vec{j} - 1\,\vec{k}$ $\quad \vec{B} = -2\,\vec{i} - 7\,\vec{j} + 2\,\vec{k}$ $\quad \vec{C} = -5\,\vec{i} - 2\,\vec{j} - 2\,\vec{k}$

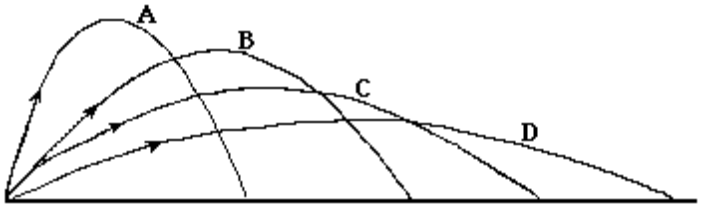
1) In Situation I, the vector with the smallest magnitude is:

A) Vector $\vec{A}$ B) Vector $\vec{B}$ C) Vector $\vec{C}$

2) In Situation I, the scalar (i.e., "dot") product $\vec{A} \cdot \vec{B}$ is closest to

A) -7 B) zero C) +9 D) -3 E) -16

Figure 1



3) Shown in Figure 1 are the trajectories of four artillery shells. Each was fired with the same speed. Which was in the air the longest time?

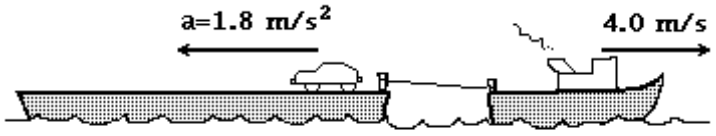
A) Trajectory A
B) Trajectory D
C) Trajectory B
D) Trajectory C
E) All were in the air for the same time.

4) A racquetball strikes a wall with a speed of 30 m/s and rebounds with a speed of 26 m/s. The collision takes 20 ms. What is the average acceleration of the ball during collision?

A) 200 m/s^2 B) 2800 m/s^2 C) 1500 m/s^2 D) Zero E) 1300 m/s^2

The following questions are not multiple choice. Please show your work in addition to the answer in your blue book.

Figure 2



A flat-topped barge is being towed by a tugboat at a constant velocity of 4.0 m/s. A car, on the barge at the front end, starts from rest at time t = 0 s and moves towards the rear of the barge with a constant acceleration of 1.8 m/s^2. (Consider all velocities in the direction of the towing as positive.)

5) For the situation described in Fig. 2, at what time is the velocity of the car relative to land is equal to zero?

6) For the situation described in Fig. 2, what is the velocity of the car, relative to land, when it has moved 22 m on the barge?

Situation II. The x- and y-coordinates of a particle in motion, as functions of time t, are given by:

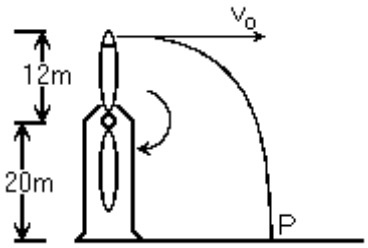
$$x = 3t^2 - 2t + 2 \qquad y = 2t^3 - 3t^2 - 12t - 4$$

where x and y are in meters and t is in seconds.

7) For the situation described in Situation II, at what time, t, is the velocity of the particle oriented in (exactly) the y direction?

8) For the situation described in Situation II and t > 0, what is the smallest magnitude of acceleration that the particle experiences?

Figure 3



A wind farm generator uses a two-bladed propeller mounted on a pylon at a height of 20 m. The length of each propeller blade is 12 m. A tip of the propeller breaks off when the propeller is vertical. At that instant, the period of the motion of the propeller is 1.2 s. The fragment flies off horizontally, falls, and strikes the ground at P.

9) For the situation described in Fig. 3, at what distance from the base of the pylon will the fragment strike the ground?

10) For the situation described in Fig. 3, what is the magnitude of the velocity (in m/s) with which the tip strikes the ground?

11) A woman stands on a carousel (i.e., merry-go-round) a distance of 4 meters from the axis of rotation. What is the rotation period of the carousel if the horizontal acceleration required to keep her stationary on the rotating platform is 0.5g, where g is the acceleration due to gravity?