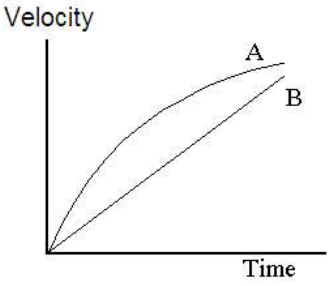
Sample Exam I

MULTIPLE CHOICE (4 pts each)

1) Define up as being positive. Suppose an object is moving downward, but slowing down. Then,

A) the velocity is negative and the acceleration is positive.
B) the velocity is negative and the acceleration is negative.
C) the velocity is positive and the acceleration is positive.
D) the velocity is positive and the acceleration is negative.
E) the velocity is negative and the acceleration is zero.

2) Consider the figure, which reports the velocities of two cars in a race on a straight highway as a function of time. Which of the statements below is (or are) true?



(1) There is a time other than t=0 when both cars have the same displacement from the start line.
(2) There is a time other than t=0 when both cars have the same velocity.
(3) There is a time when both cars have the same acceleration.

A) (1) only
B) (2) only
C) (3) only
D) (1) and (2) only
E) (2) and (3) only

3) Consider two vectors, $\vec{A}$ ↑ and $\vec{B}$ →. Which of the following choices best represents the general direction of $\vec{B}$ - $\vec{A}$?

A) ↗ B) ↖ C) ↙ D) ↘ E) ←

4) If a cannonball is fired at an angle of 53 degrees above the horizontal and leaves the muzzle with a speed of 400 m/s, what is the magnitude of the acceleration of the ball three seconds into its flight (neglect air resistance and assume that the ball is still in flight)? Pick the closest answer.

A) 0 m/s^2
B) 10 m/s^2
C) 60 m/s^2
D) 180 m/s^2
E) 240 m/s^2

5) We found in class that the range R of an object thrown with initial speed v_i at an elevation θ_o over a flat plain is given by (if air drag is ignored)

$$R = \frac{v_o^2 \sin(2\theta_o)}{|a_g|} .$$

Find the angle(s) at which one could launch an object with initial speed 400 m/s and have it land 10,000 m downrange.

A) 34° and 56°
B) 19° and 71°
C) 26° and 64°
D) 45° only
E) There are no such angles.

PROBLEM I (20 pts)

Starting from the definitions of the average velocity and of the average acceleration,

$$v = \frac{x - x_i}{t} \quad \text{and} \quad a = \frac{v - v_i}{t}$$

and the relation,

$$v_{AVE} = \frac{v_i + v_f}{2} ,$$

derive the relation,

$$x = x_i + v_i t + \tfrac{1}{2} a t^2 .$$

Be sure to show all effort for full credit.

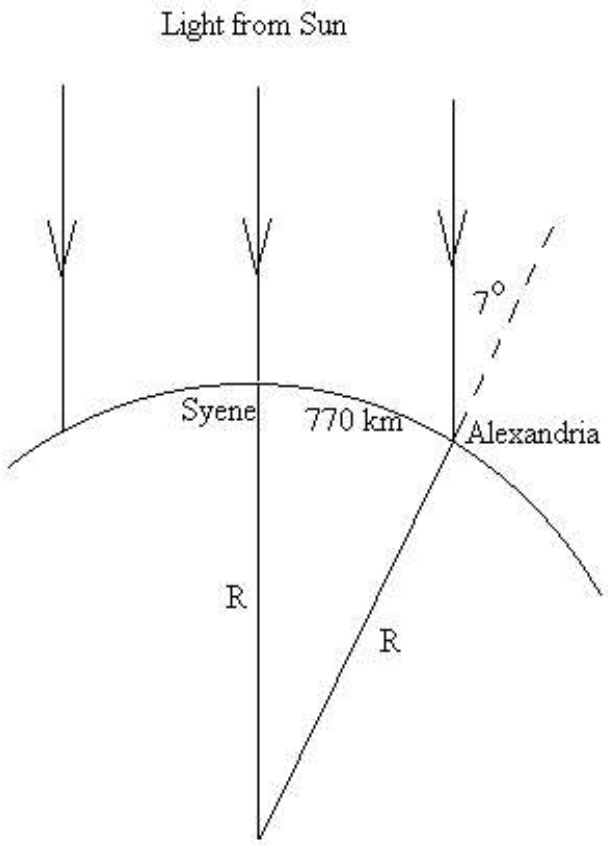
PROBLEM II (20 pts)

Using the component method, find the magnitude and direction angle of vector $\vec{D}$.

$\vec{A}$ = 6m , θ_A= -75°
$\vec{B}$ = 5m, θ_B = 45°
$\vec{C}$ = 8m, θ_C = - 135°
$\vec{D} = \vec{A} + \vec{B} - \vec{C}$

PROBLEM III (20 pts)

The size of the earth has been known since antiquity. Eratosthenes assumed that since the sun is very far from the earth, light rays from the sun are essentially parallel (one can show the sun is distant by observing solar and lunar eclipses.). He noticed that when the sun was directly overhead at Syene (in southern Egypt), it was 7º away from overhead in Alexandria, 770 km to the north. From the information given, calculate the radius of the earth. An approximate solution earns most of the points.



PROBLEM IIII (20 pts)

A ball is thrown downward with speed 9 m/s from the top of a 40m tall building.

A) How long will it take for the ball to hit the ground? (10 pts)

B) How will be the ball's velocity just before hitting the ground? (10 pts)