

**Phy131 First Homework Assignment**  
**Due Wednesday April 9**

*Figures for the questions can be found the the last page of the assignment*

**Question 1.**

Two forces act on a small object:

Force  $\vec{A}$ : The magnitude is 50 units in a direction  $30^\circ$  South of East

Force  $\vec{B}$ : The magnitude is 80 units in a direction  $50^\circ$  South of West

- a) Express these two forces as vectors using the unit vectors  $\hat{i}$  and  $\hat{j}$ .
- b) What is the net force acting on the object? Express your answer in terms of the unit vectors and also in terms of the magnitude and direction.
- c) If one wants to add a third force, such that the net force on the object is zero, what force (direction and magnitude) would you add?

**Question 2**

Katrina, Katya, and Katie are playing a game of three-way tug of war. There are three ropes attached to a circular ring, and each player pulls on a rope. Katrina pulls directly **North** with a force of 100 units. Katya pulls directly **West** with a force of 150 units. Katie pulls with a force of 150 units in a direction  $30^\circ$  **South of East**.

What is the net force (direction and magnitude) on the ring?

**Question 3**

There are two forces on an object. The net force on the object is 50 units to the north. If one force is 30 units to the west, what is the other force (direction and magnitude)?

**Question 4**

Devi observes a bumble bee, and measures it's position to be:

$$\vec{r}(t) = (2t^3 + t^2 + 2t + 5)\hat{i} + (3t^2 + t + 7)\hat{j} \quad (1)$$

where  $\vec{r}$  is in meters and  $t$  is in seconds. Determine the following:

- a) The bee's initial velocity (magnitude and direction).
- b) The bee's acceleration at a time  $t=2$  seconds.
- c) The average **velocity** between the times  $t = 1$  and  $t = 3$  seconds.

### Question 5

Baseball pitcher Roger Clemens can throw a fastball with a horizontal speed of 160 km/hr (100 mph). How long does it take for the ball to reach home plate, which is 18.4 meters away?

### Question 6

You travel on I5 from L.A. to Sacramento, **half the time** at 60 km/hr and the other **half the time** at 90 km/hr. On the way back, you travel **half the distance** at 60 km/hr and the other **half the distance** at 90 km/hr.

What is your average speed for the following cases:

- a) from L.A. to Sacramento?
- b) from Sacramento to L.A.?
- c) for the entire trip?

### Question 7

Michael Jordan can jump vertically into the air a distance of 5 feet. What is the total time that he is in the air?

### Question 8

A meter stick is resting against a wall when Emily pulls out the bottom of the stick with a constant velocity of 0.5 m/s. The other end of the meter stick slides down the wall. What is the velocity of the end of the stick at the wall at time  $t = 0.6$  seconds?

### Question 9

Lt. Charlotte's boat is at anchor. A lighthouse is located 200 meters due east of her boat. A bouy is located 300 meters from her in a direction  $60^\circ$  North of West.

What is the location, Distance and Direction, of the bouy from an observer at the lighthouse?

**Question 10**

When Ernie Li sprints the 100 meter dash, his speed  $v$  down the track is  $v(t) = 11(1 - e^{-t})$  m/s, where  $t$  is in seconds. At  $t = 0$ , he starts off at  $x(0) = 0$ .

- a) What is Ernie's acceleration after 10 seconds?
- b) Find Ernie's position  $x(t)$  down the track as a function of time. Hint: Use  $v(t) = dx/dt$  and integrate.  $\int e^{-t} dt = -e^{-t}$ .
- c) Does Ernie run the 100 meter race in under 10 seconds?

*See the next page for the figures*

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