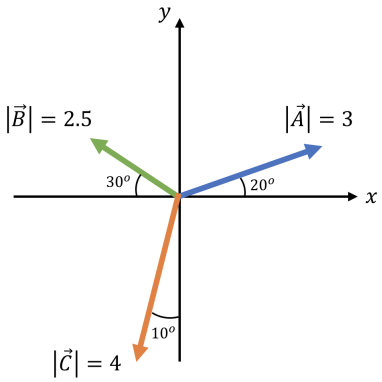
PHY2048 Fall 2018 Exam 1 Review Questions

Prof. Douglas H. Laurence
Department of Physical Sciences, Broward College

Chapter 1: Vectors



1. Find the x and y components of the vectors $\vec{A}$, $\vec{B}$, and $\vec{C}$ shown in the figure above.
2. Consider the vectors:

$$\vec{A} = 2.4\hat{i} + 5.7\hat{j}$$

$$\vec{B} = -\hat{i} + 3\hat{j}$$

   Find the magnitude and direction of each vector.

3. Consider the following vectors:

$$\vec{a} = 3\hat{i} - 2\hat{j} - \hat{k}$$

$$\vec{b} = 4\hat{i} + \hat{j} + 2\hat{k}$$

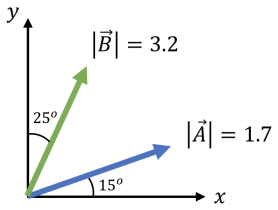
   (a) What is $\vec{a} + \vec{b}$?
   (b) What is $\vec{a} - \vec{b}$?
   (c) What is $3\vec{a} - 2\vec{b}$?

4. Consider the following vectors:

$$\vec{a} = \hat{i} + 4\hat{j}$$

$$\vec{b} = 2\hat{i} + 3\hat{j}$$

   What is the angle between $\vec{a}$ and $\vec{b}$?



5. Consider the vectors in the figure above.
   (a) What is $\vec{A} \cdot \vec{B}$?
   (b) What is $|\vec{A} \times \vec{B}|$?

6. Consider the following vectors:

$$\vec{A} = 2\hat{i} - 3\hat{j} + \hat{k}$$

$$\vec{B} = -\hat{j} + 4\hat{j}$$

   (a) What is $\vec{A} \cdot \vec{B}$?
   (b) What is $\vec{A} \times \vec{B}$?

Chapter 2: Motion Along a Straight Line

1. An object has an initial velocity of $\vec{v}_1 = (20m/s)\hat{i} - (10m/s)\hat{j}$. After 5s, the object has a new velocity of $\vec{v}_2 = (15m/s)\hat{j}$. What was the object's average acceleration during these 5s?

2. A jogger runs on a circular track with a radius of 100m. If each lap takes the jogger 100s to complete,
   (a) What is the jogger's average velocity over one lap?
   (b) What is the jogger's average speed over one lap?

3. If an airplane has a take-off speed of 100 m/s, and can accelerate at 15 m/s^2, what is the minimum length of runway the airplane needs to take off? How long will it take the airplane leave the ground?

4. An Olympic sprinter can run the 100m dash in 10s. Assuming the sprinter's acceleration is constant, with what speed does the sprinter cross the finish line? What was the sprinter's acceleration during the run?

5. A car, starting from rest, accelerates at 5 m/s^2 for 4s. Then, the driver brakes the car at 10 m/s^2 until stopped. How far does the car travel during the braking process? How long does it take the car to stop?

6. An object is dropped from the top of a building and is observed to take 7.2s to hit the ground. How tall is the building?

7. If a ball is thrown upwards at 7 m/s, how high will the ball rise? If you catch the ball at the same height which you threw it from, how long would the ball be in the air for?

8. You want to toss an object from the ground up to your friend on a second-story balcony. If your friend is about 4m above you, what minimum initial speed do you have to throw the object up with for it to reach your friend?

9. A ball is dropped from a height of 7m, and bounces off the ground. If the ball leaves the ground with 50% the speed that it hits the ground with, how high will the ball bounce?

10. An object has a position at any time t given by the following function:

$$x(t) = at^3 + bt - c$$

where $a = 10\text{m/s}^3$, $b = 5\text{m/s}$, and $c = 6\text{m}$. What is the velocity of the object at any time t? What is the acceleration of the object at any time t? Could you use kinematics to study the object's motion?

11. An object moves with a position at any time t given by the function:

$$x(t) = (2\text{m/s})t - (13\text{m/s}^2)t^2 + 4\text{m}$$

At what time will the object be at rest? Does this object move with a constant or non-constant acceleration? Could you use kinematics to study the motion of this object?

Chapter 3: Motion in Two or Three Dimensions

1. A projectile is launched at 40^o with a speed of 15 m/s. What is it's height after 0.3s?

2. A projectile is launched at 35^o with a speed of 45 m/s from a height of 1m. At what time(s) after launch will the projectile be at a height of 2.5m? *Note: there may be more than one time that the projectile will be at this height.*

3. A projectile is launched horizontally at 12 m/s from a cliff with a height of 15m. How far, horizontally, from the cliff will the projectile hit the ground below?

4. At what angle will a projectile achieve a maximum theoretical range, assuming the projectile starts and ends at the same height? At what angle will a projectile achieve a maximum theoretical height?

5. An object moves through space with an acceleration of 4m/s^2 at an angle of 30^o to some imaginary x-axis. If the object starts at rest,

   (a) What distance does it travel along the x-direction in 1s? What about along the y-direction? What total distance does it travel in 1s?

   (b) What is the total speed of the object after 1s?

6. A person rides on a ferris wheel that has a radius of 60m. If the bucket the person sits in travels at 4.5 m/s,

   (a) What is the angular velocity of the ferris wheel?

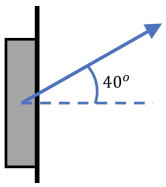
   (b) What is the centripetal acceleration of the bucket?

   (c) How long does it take the ferris wheel to complete one revolution?

Chapter 4: Newton's Laws of Motion

1. When braking, a 1500kg car going 30 m/s will stop in 50m. What is the braking force of the car?

2. A 1.2kg book lays flat on a table. If someone places their hand on top of the book and pushes down on the book with a force of 5N, what is the magnitude of the normal force acting on the book?



3. A 1kg book is pressed against a wall with a force of 40N made with a 40^o angle from the horizontal, as shown in the figure above. The wall will place a normal force on the book. In what direction is that normal force? What is the magnitude of that normal force?

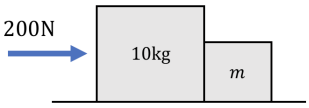
4. A 7kg box is being pushed through the grass with a forward force of 150N. The grass puts a backwards, impeding force on the box of 60N.

   (a) Draw the free body diagram for this box.

   (b) Is there anything you know to be true about the acceleration of the box?

   (c) How far would the box travel after pushing it for 10s?

   (d) What would the box's speed be after pushing it for 10s?

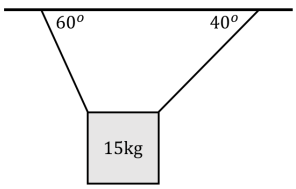


5. A small box of mass m is placed in front of a larger box of mass 10kg, as shown in the figure above. If the 15kg box is pushed forward with a force of 200N, and accelerates at 15 m/s^2,

   (a) What is the force that box m puts on the 10kg box?

   (b) What is the force that the 10kg box puts on box m?

   (c) If box m accelerates at the same rate as the 10kg box, what is the mass m?



6. A 15kg box hangs from two ropes, as shown in the figure above. What is the magnitude of the tension in each rope?

7. A person rides on a ferris wheel that has a radius of 60m. If the bucket the person sits in travels at 4.5 m/s,

   (a) What is the normal force on the person at the bottom of the ferris wheel?

   (b) What is the normal force on the person at the top of the ferris wheel?