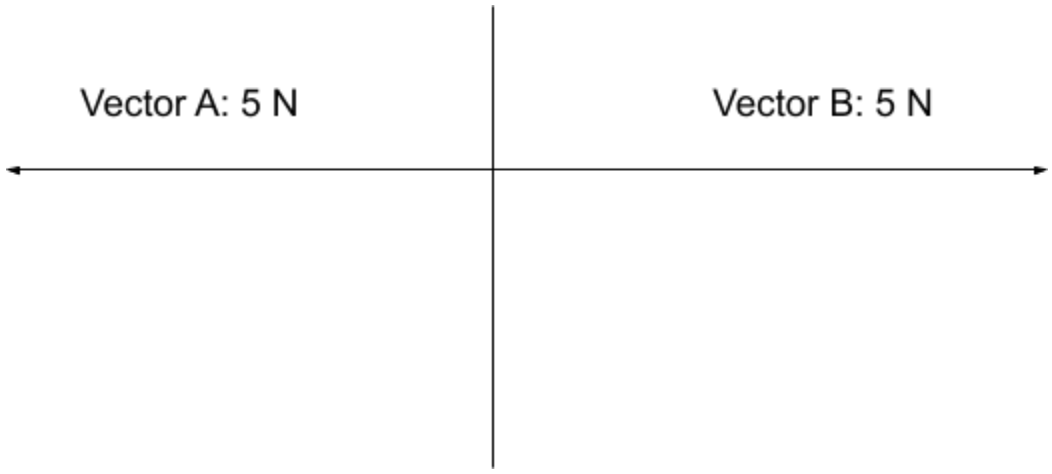
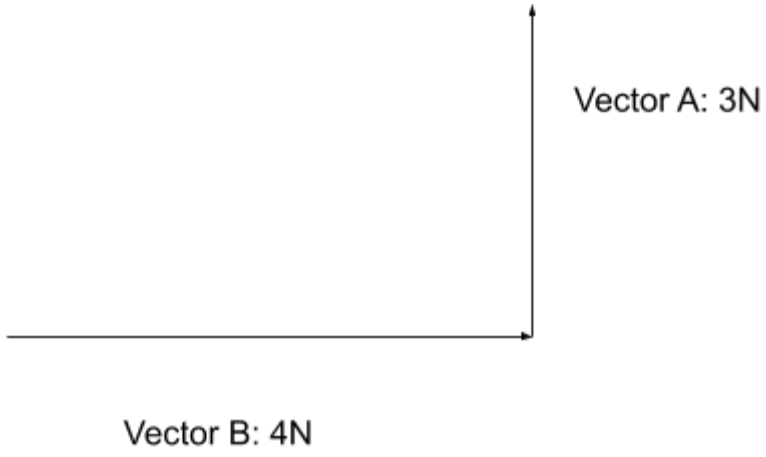
Quiz 1: Vector Operators and Examples of Vectors

1. What is the vector addition of the following two vectors:



2. What is the vector addition of the following two vectors, could you add them properly if Vector A was on the tail side of Vector B? Explain?

(draw and give magnitude)



3. Draw the following vectors and compute their sum if asked to do so:

a) Vector A = 5 N, east
b) Vector B = 4 N, east
c) Vector C = 3 N, west
d) Vector D = 2 N, west
e) Vector E = Vector A + Vector B

f) Vector F = Vector C + Vector D
g) Vector G = Vector A + Vector C
h) Vector H = Vector B + Vector D

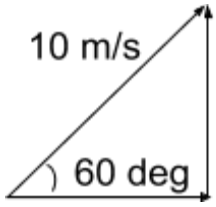
4. What defines a vector?
   a) Magnitude only
   b) Extent only
   c) Magnitude and direction
   d) Extent and direction
   e) Direction only
   f) None of the above

5. Which of the following quantities are vectors:

I speed
II acceleration
III velocity
IV work
V momentum
VI torque
VII force
VIII displacement
IX distance

Quiz 2: Isolating Vector Parts

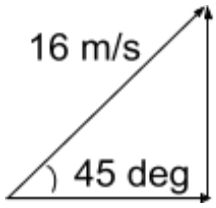
1. Isolate the horizontal component of the velocity if given the following:



2. Isolate the vertical component of the velocity of the above figure

3. Calculate the resultant vector of Vector A which has magnitude of 5 N pointing east and Vector B which has magnitude of 5 N pointing north. Give the magnitude of the resultant vector as well as the direction in terms of degrees north of east.

4. Isolate the horizontal component of the velocity vector if given the following:

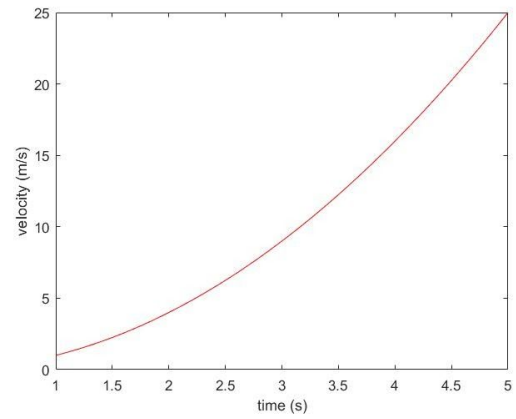


5. Isolate the vertical component of the velocity vector if given the above figure.

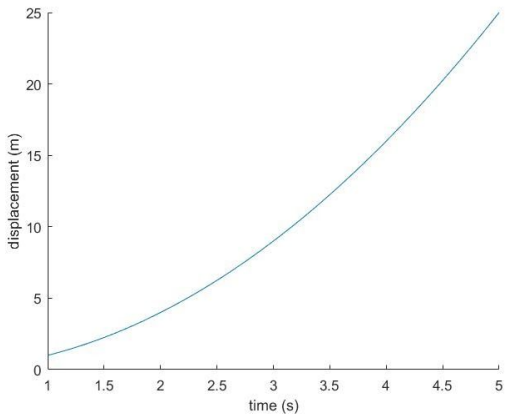
Quiz 3: Motion Graphs

1. Which of the following graphs shows an object in uniformly accelerated motion (UAM)?

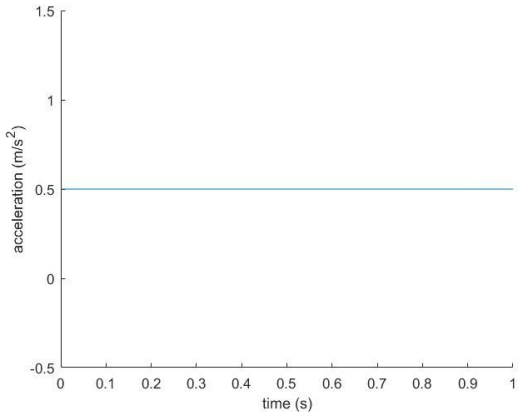
I



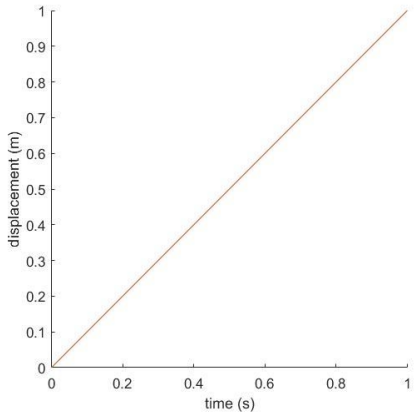
II



III



IV



2. In order to get the change in displacement from a velocity versus time graph, one must do which of the following?

a) Find the slope of the graph
b) Find the area under the curve
c) Find the x intercepts
d) Find the y intercepts
e) None of the above

3. In order to get the acceleration from a velocity versus time graph, one must do which of the following?

a) Find the slope of the graph
b) Find the area under the curve
c) Find the x intercepts
d) Find the y intercepts
e) None of the above

4. In order to get the change in velocity from an acceleration versus time graph, one must do which of the following?

a) Find the slope of the graph
b) Find the area under the curve
c) Find the x intercepts
d) Find the y intercepts
e) None of the above

5. In order to get the velocity from a displacement versus time graph, one must do which of the following?

a) Find the slope of the graph
b) Find the area under the curve
c) Find the x intercepts
d) Find the y intercepts
e) None of the above

6. In order to get acceleration from a displacement versus time graph, one must do which of the following only?

a) Find the slope of the graph
b) Find the area under the curve
c) Find the x intercepts
d) Find the y intercepts
e) None of the above

7. A linear displacement versus time graph tells us what about the object?

a) The object is uniformly accelerated
b) The object's acceleration is zero
c) The object's velocity is constant
d) The object is non-uniformly accelerated
e) Both b and c
f) None of the above

8. A parabolic displacement versus time graph tells us what about the object?

a) The object is uniformly accelerated
b) The object's acceleration is zero
c) The object's velocity is constant
d) The object is non-uniformly accelerated
e) Both b and c
f) None of the above

9. A linear velocity versus time graph tells us what about the object?

a) The object is uniformly accelerated
b) The object's acceleration is zero
c) The object's velocity is constant
d) The object is non-uniformly accelerated
e) Both b and c
f) None of the above

10. A parabolic velocity versus time graph tells us what about the object?

a) The object is uniformly accelerated
b) The object's acceleration is zero
c) The object's velocity is constant
d) The object is non-uniformly accelerated
e) Both b and c
f) None of the above

11. A linear velocity versus time graph would tell us what about the shape of the acceleration versus time graph?

a) The acceleration versus time graph would also be linear
b) The acceleration versus time graph would be a horizontal line
c) The acceleration versus time graph would be parabolic
d) None of the above

12. A parabolic displacement versus time graph would tell us what about the shape of the velocity versus time graph?

a) It is linear
b) It is also parabolic
c) It is cubic
d) It is a nonzero horizontal line
e) It is zero
f) None of the above

Quiz 4 : Kinematics in One Dimension

1. Suppose a ball is dropped from a cliff that lays a height h above the ground below and lands a time t later (assume no air-resistance).
    a. What is the impact velocity of the ball?
    b. What is the acceleration of the ball?
    c. What is the initial velocity of the ball?
    d. What would the impact velocity of the ball be if the height was changed to 2h?
    e. What would the impact velocity of the ball be if the height was changed to kh, where k is any real number?
    f. What would the initial velocity of the ball be if the height was 2h?
    g. What would the initial velocity of the ball be if the height was kh?
    h. What would the acceleration of the ball be if the height was 2h?
    i. What would the acceleration of the ball be if the height was kh?

2. Suppose a tennis ball is thrown up with a velocity v and falls back into your hand at time t.
    a. What is the velocity of the ball at t/2?
    b. What is the acceleration of the ball?
    c. What is the velocity of the ball at t? (keep in mind velocity is a vector)
    d. What is the maximum height of the ball?
    e. What is the maximum height of the ball if its initial velocity changed to 2v?
    f. What is the maximum height of the ball if its initial velocity changed to kv?
    g. What would the initial velocity of the ball be if the time changed to 2t?
    h. What would the initial velocity of the ball be if the time changed to kt?
    i. What would the acceleration of the ball after leaving your hand be if the initial velocity was 2v?
    j. What would the acceleration of the ball after leaving your hand be if the initial velocity was kv?

3. Suppose a jet plane travels at a constant 885 km/hr between time t = 0 s and t = 2 s, after t = 2s, an enemy jet begins approaching and you must change direction, your acceleration after t = 2s is 7 m/s in the negative direction.
    a. After what time would you return to your initial position?
    b. After what time would you have a velocity of -100 km/hr?
    c. At time t = 12 s, what would your position be?
    d. At time t = k s, what would your position be?

e. Find a formula that would allow you to find the velocity of the jet plane starting from t = 0 s. (hint: this is possibly a piecewise formula)
f. Find a formula that would tell you the acceleration of the jet plane starting from t = 0 s.
g. Find a formula that would allow you to find the position of the jet plane starting from t = 0 s.

4. Joe gains the power of telekinesis one night after studying physics, he is training his telekinetic abilities by pushing a boulder with his mind and in his most successful attempt, he was able to cause a boulder of mass 250 kg to go from rest to 50 m/s in 2 seconds, what is the acceleration of the boulder assuming the boulder is undergoing uniformly accelerated motion?

5. A student doubts that the acceleration of gravity is 9.8 $\frac{m}{s^2}$, which of the following setups can prove to the student that the acceleration due to gravity is, in fact, 9.8 $\frac{m}{s^2}$?
   a) The student takes a basketball and drops it from a table of a recorded height and times how long it takes the ball to reach the floor.
   b) The student takes a basketball and rolls it off a table of a recorded height and times how long it takes the ball to reach the floor.
   c) The student throws a ball up in the air and records the maximum height and the time it takes the ball to reach its maximum height.
   d) B and c
   e) A and b
   f) None of the above
   g) A b and c

Quiz 5: Horizontal Launch

1. After Mr. Mancuso concludes his latest physics lesson, two students get into a heated debate, the two students named Jack and Jim argue about which would hit the ground first, a ball dropped from a table or a ball rolled off a table. Jack argues that both would hit the ground at the same time because they both start off with 0 velocity in the y direction, while Jim argues that the ball dropped would hit the ground first because the ball that rolls covers more distance. Which student is right, explain?

2. Jack and Jim continue to argue, but this time over a different topic, they argue about if a metal ball or a ping pong ball of equal radius, but different mass, would hit the ground first if dropped from a table of known height. Jack argues that the metal ball would land first because it is heavier and so gravity pulls down on it harder, Jim argues that both would land at the same time because the mass of the object is irrelevant. Which student is right, explain?

3. Joe has returned and now his mission is to telekinetically push a boulder as far off a cliff as possible. The cliff has a height of h and the boulder is pushed off the cliff with a velocity of v.
    a. What is the boulder's initial velocity in the x direction?
    b. What is the boulder's initial velocity in the y direction?
    c. How far has the boulder traveled in the x direction?
    d. How long did it take the boulder to land on the ground?
    e. How fast was the boulder crashing into the ground as it landed (impact velocity, think resultant vector of the x and y final velocities)?
    f. How far would the boulder travel if Joe pushed it off the cliff with double the velocity?
    g. How far would the boulder travel if Joe pushed it off the cliff with k times more than the original velocity?
    h. How long would it take the boulder to land on the ground if Joe pushed it off the cliff with double the velocity?
    i. How long would it take the boulder to land on the ground if Joe pushed it off the cliff with k times more than the original velocity?
    j. How long would it take the boulder to land on the ground if the height of the next cliff he will push the boulder off of is two times that of the original cliff's height?
    k. How long would it take the boulder to land on the ground if the new cliff's height was k times that of the original cliff height?

l. The current record in the Order of Telekinetics for the farthest a boulder has ever been pushed off the cliff stands at a whopping 3 km, how fast must Joe push the boulder off the cliff in order to achieve this record?

4. The statement “perpendicular vectors are independent” is true
a) Always
b) Sometimes
c) Never

5. True or False: no matter how fast an object is launched off a cliff (assuming it doesn’t escape the gravitational force of the Earth), it will always hit the floor at the same time

Quiz 6: Projectile Motion

1. Professional Soccer player, Angelo, kicks a soccer ball with such force so as to send it off at a speed of 10 m/s at an angle 30 degrees above the ground. Assume air resistance is negligible and that the soccer field is level.
    a. What is the vertical component of the ball's velocity?
    b. What is the horizontal component of the ball's velocity?
    c. What is the acceleration of the ball in the horizontal direction?
    d. What is the acceleration of the ball in the vertical direction?
    e. What direction does the acceleration of the ball across its trajectory always face? Why?
    f. Compared to the speed of the ball at its maximum height, its speed anywhere else on its path is _____?
    g. Corresponding parts of the ball's trajectory have ____ speeds and _____ and ____ velocities.

2. What launch angle gives the maximum range? Why?

3. What launch angle gives the maximum height? Why?

4. True or False: A ball thrown up and allowed to drop down a cliff of height h will land at the same time that a ball dropped down the cliff.

5. True or False: A ball thrown up, reaches its maximum height, and then falls back takes longer to fall back down than it does to be thrown up.

6. The statement "the impact velocity of a projectile is always equal to its initial launch velocity" is true

a) Always
b) Sometimes
c) Never

7. Explain your answer to 6

8. Telekinetic Joe has been training and he's now able to not only push objects but lift them up and throw them. With his newfound powers, he threw a car weighing 120 kg 30 m/s at 60 degrees above the horizontal.

a. What is the horizontal component of the car's velocity
b. What is the vertical component of the car's velocity
c. What is the acceleration of the car in the horizontal direction
d. What is the acceleration of the car in the vertical direction, what is it caused by?
e. What is the car's maximum height along its path?
f. In order to increase the car's maximum height, what quantity(s) must be changed? Explain?