Name:_____

ID:_____

Physics 201 | Ecampus
Midterm Exam 1
10/20/2021

Collaboration is not allowed. Allowed on your desk are: ten 8.5 x 11 inch doubled sided sheets of notes that are bound together, non-communicating graphing scientific calculator, 1 page of scratch paper, writing utensils, and the exam. You will have 80 minutes to complete this exam.

1. (9 points) Below are two figures representing the motion of two different scary objects, a zombie and a ghost. One of the plots represents the zombie traveling at constant speed in a 2-D plane. The other plot represents the ghost traveling along a straight line. Answer the following questions using a combination of words, figures, math, or any other way to communicate your understanding.

   (a) Which graph goes with which scary object?
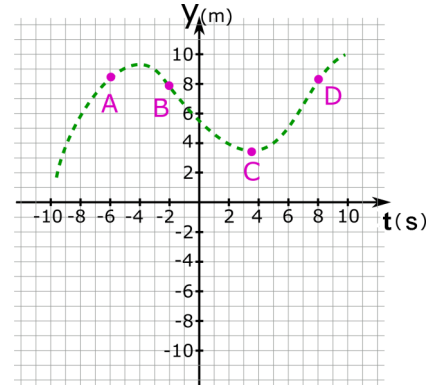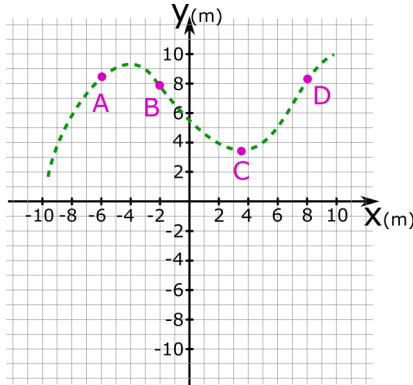
   (b) Are the zombie and the ghost undergoing the same motion? Explain?

   (c) Describe the velocity of both the zombie and the ghost at point A and compare any similarities and/or differences.

   (d) Acceleration can be caused by either changing speed or the direction of motion. Describe the acceleration of both the zombie and the ghost at point C and compare any similarities and/or differences. If they are accelerating, state whether it is due to changing speed, or direction of motion, or both.

For questions 2 through 5 **fill in the square** next to all correct answers. A given problem may have more than one correct answer. Each correctly bubbled answer will receive two points. There are **6** correct answers in this section and only the first **6** filled in answers will be graded. There is no partial credit.

2. A ghost is confined to move only along the x-axis (it is haunting only the x-axis). At time $t = 0$ the ghost is at location $x = 0$ and is slowing down. Which of the following statements must be true?

   ☐ (a) The x-component of the ghost's velocity is positive
   ☐ (b) The x-component of the ghost's velocity is negative
   ☐ (c) The x-component of the ghost's acceleration is a non-zero value
   ☐ (d) The x-component of the ghost's acceleration is negative
   ☐ (e) The x-component of the ghost's velocity is a non-zero value
   ☐ (f) The x-components of the ghost's velocity and acceleration have opposite signs

3. You are driving your car directly south, away from the zombie apocalypse. Which of the following actions could result in your car accelerating in the northwestern direction?

   ☐ (a) Turning towards the east and pressing on the gas.
   ☐ (b) Turning towards the west and pressing on the gas.
   ☐ (c) Continuing straight while pressing on the gas.
   ☐ (d) Continuing straight while pressing on the brakes.
   ☐ (e) Turning towards the east and pressing on the brakes.
   ☐ (f) Turning towards the west and pressing on the brakes.

4. Consider the dodecahedron Jack-O-Lantern of side length **a**. Which of the following equations could represent the surface area of this dodecahedron?

   ☐ (a) $3a\sqrt{10}$

   ☐ (b) $3a^2\sqrt{25 + 10\sqrt{5}}$

   ☐ (c) $3\sqrt{5a^3} + 2\sqrt{a}$

   ☐ (d) $3a^3\sqrt{3 - 25a}$

   ☐ (e) $3a\sqrt{5} - 25a^2$
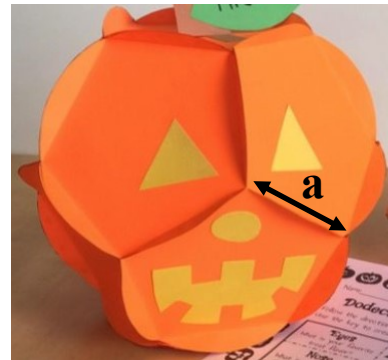
5. Which vector(s) must point in the same direction as average velocity?

   ☐ (a) Initial position.
   ☐ (b) Final position.
   ☐ (c) Change in position.
   ☐ (d) Change in velocity.
   ☐ (e) Average acceleration.

6. (8 points) A spooky ghost is spotted initially < 3 , 1 > blocks from a haunted house. After 50 seconds later, the spooky ghost was spotted < -2 , - 3 > blocks away from the same haunted house. A standard coordinate system was used with the haunted house at the origin to determine the initial and final positions of the ghost; use the same coordinate system for all parts of this problem. Note that 1 block = 76.2 meters.

(a) Sketch the initial position vector, final position vector, and change in position vector on the provided grid.

(b) What is the average velocity of this ghost in component form with SI units (meters, seconds, kg, Newtons, etc).

1 Block

1 Block

Haunted House
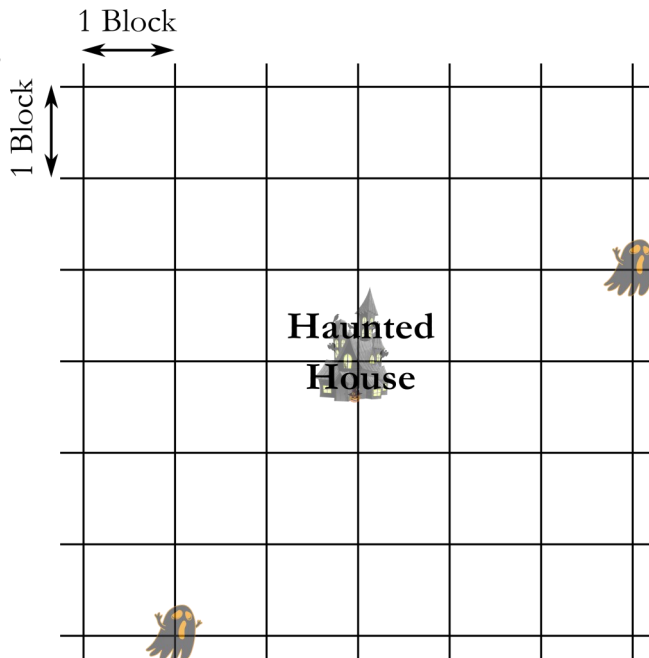
(c) What is the magnitude and direction of the average velocity of this ghost?

(d) Can we determine the direction of the average acceleration of this ghost? If so, what is it? If not, explain.

7. (12 points) Woozy from her battle with the Heffalumps, a witch and her broom, initially at rest in the air, free-fall straight down towards the Earth (no magic is involved here!) for 6.3 seconds. When she is 50 meters above the ground, her broom's automatic safety mechanism gives her a constant upwards acceleration. Unfortunately, her broom is not calibrated correctly, and after 1.43 seconds, she and her broom hit the ground with a non-zero velocity. Note: please use the back of this sheet if needed. Make sure to label your solution with the parts (a), (b), and (c).

   (a) What is the magnitude of the upwards acceleration the witch has due to the broom's safety mechanism?

   (b) With what speed does she hit the ground?

   (c) Are the signs of your answers to questions (a) and (b) as you would expect them to be? Why or why not? Explain. (This is sign sensemaking!)