Student #: _____   Student Name: _____

Physics 12 Homework   Class 1: Kinematics

_____ 1. A ball is thrown towards the north. What are the directions of the acceleration and instantaneous velocity, respectively, of the ball at maximum height (e.g. the peak of its trajectory)?

   (a) north, north
   (b) up, north
   (c) down, north
   (d) north, down
   (e) down, down

_____ 2. A cyclist cycles $50.0\,\mathrm{km}$ [N] and then $30.0\,\mathrm{km}$ [E]. The total time taken for the trip is $3.00\,\mathrm{h}$. What is its average velocity?

   (a) $80.0\,\mathrm{km/h}$ [$31°$ E of N]
   (b) $19.4\,\mathrm{km/h}$ [$31°$ E of N]
   (c) $26.7\,\mathrm{km/h}$ [$31°$ E of N]
   (d) $19.4\,\mathrm{km/h}$ [$59°$ E of N]
   (e) $19.4\,\mathrm{km/h}$ [NE]

_____ 3. A car is travelling west and approaching a stop sign. As it is slowing to a stop, the directions associated with the object's velocity and acceleration, respectively, are

   (a) West, East
   (b) West, West
   (c) East, East
   (d) East, West
   (e) There is not enough information to tell

_____ 4. A baseball player is trying to maximize her throwing distance. She must release the ball

   (a) at an angle that lets the ball reach the highest possible height
   (b) horizontally
   (c) at an angle of $45°$
   (d) so that it has maximum possible speed, regardless of angle
   (e) at an angle between $45°$ and $90°$

_____ 5. A boy throws a ball off of a second floor balcony by throwing it up into the air at some angle. It comes back down, landing on the ground. Neglecting air resistance, the magnitude of velocity is greatest

   (a) just after it leaves the boy's hand
   (b) at the peak of the ball's trajectory
   (c) just before it hits the ground
   (d) It remains the same throughout the motion
   (e) Impossible to tell without knowing the angle of projection

_____ 6. Two velocity vectors v_1 and v_2 each have a magnitude of $10\,\text{m/s}$. Graph 1 shows the velocity v_1 at $t = 0\,\text{s}$, and then the same object has a velocity v_2 at $t = 2\,\text{s}$, shown in Graph 2. Which of the following vectors best represents the average acceleration vector that causes the object's velocity to change from v_1 to v_2 ?

Graph 1 Graph 2

(a) (b) (c) (d) (e)
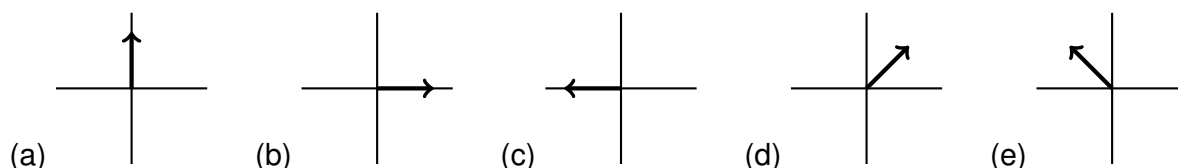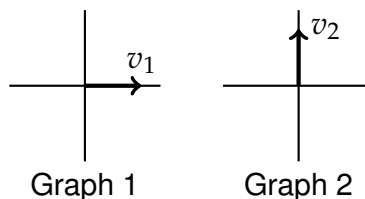
_____ 7. A passenger on a train moving horizontally at a constant speed relative to the ground drops a ball from his window. A stationary observer on the ground sees the ball falling with a speed v_1 at an angle to the vertical at an instant after it is dropped from the train window, but the ball appears to be falling vertically with a speed v_2 at the same instant as viewed by the train passenger. What is the speed (magnitude of velocity) of the train relative to the ground after the ball is dropped? Neglect air resistance.

(a) $v_1 + v_2$
(b) $v_1 - v_2$
(c) $v_1^2 + v_2^2$
(d) $v_1^2 - v_2^2$
(e) $\sqrt{v_1^2 - v_2^2}$

8. Because of an oncoming storm, a boat must cross a river in the shortest amount of time possible regardless of where it lands on the opposite shore. Given that the river has a current, in what direction should the boat point? Explain.

9. While hiking in the wilderness, you come to the top of a cliff that is $60.0\,\text{m}$ high. You throw a stone from the cliff, giving it an initial velocity of $21.0\,\text{m/s}$ at $35°$ above the horizontal. How far from the base of the cliff does the stone land?

10. You want to shoot a stone with a sling shot and hit a target on the ground $14.6\,\text{m}$ away. If you give the stone an initial speed of $12.5\,\text{m/s}$, neglecting friction, what is/are the launch angle(s) in order for the stone to hit the target? What would be the maximum height(s) by the stone? What would be its time of flight? Assume motion is symmetric.

11. A sharpshooter shoots a bullet horizontally over level ground with a velocity of $3.0 \times 10^2\,\text{m/s}$. At the instant that the bullet leaves the barrel, its empty shell casing falls vertically and strikes the ground with a vertical velocity of $5.00\,\text{m/s}$.

    (a) Neglecting air friction, how far does the bullet travel?
    (b) What is the vertical component of the bullet's velocity at the instant before it hits the ground?

12. A baseball is thrown by an outfielder (O) towards the catcher (C) with an initial speed of $20\,\text{m/s}$ at an angle of $45°$ with the horizontal. At the moment that the ball is thrown, C is $50\,\text{m}$ from O. At what speed and in what direction must C run to catch the ball at the same height at which it was released?

13. A car is travelling north on a highway at $25\,\text{m/s}$. Just as the car crosses a perpendicularly intersecting crossroad, the passenger throws out a can horizontally, towards the east. The initial speed of the can relative to the car is $10\,\text{m/s}$. It is released at a height of $1.2\,\text{m}$ above the road.

    (a) What is the initial velocity of the can relative to the road?
    (b) Where does the can land?