**Physics 1 Unit 1 – 1D Kinematics and Error Analysis Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**IB 2.1 Motion, 1D**

**Position, Distance, and Displacement**

1. What is the displacement of the cross-country team if they begin at the school, run 10 miles and finish back at the school?
2. What is the distance and the displacement of the race car drivers in the Indy 500?
3. Look at the picture given below. An object moves from point A through B, C, D, E and stops at point F.

a) Find the final displacement. b) Find distance taken from point A to F.

0

2

4

6

8

10

12

2

12

10

8

6

4

**A**

**B**

**C**

**D**

**E**

**F**

**N**

**S**

**E**

**Average Speed, Average Velocity**

1. In the 2008 Olympics, Jamaican sprinter Usain Bolt shocked the world as he ran the 100-meter dash in 9.69 seconds. In the 2016 Olympics he ran the same race in 9.81 seconds for a repeat gold performance. Determine Usain's average speed for each race.
2. In the Funny Car competition at the Joliet Speedway in Joliet, Illinois in October of 2004, John Force complete the ¼-mile dragster race in a record time of 4.437 seconds. Determine the average speed of the dragster in mi/hr and m/s. GIVEN: (1.000 mi =1609 m)
3. In the qualifying round of the 50-m freestyle in the sectional swimming championship, Dugan got an early lead by finishing the first 25.00 m in 10.01 seconds. Dugan finished the return leg (25.00 m distance) in 10.22 seconds.
	1. Determine Dugan's average speed for the entire race.
	2. Determine Dugan's average speed for the first 25.00 yd leg of the race.
	3. Determine Dugan's average velocity for the entire race.
4. Ken Runfast is the star of the cross-country team. During a recent morning run, Ken averaged a speed of 5.8 m/s for 12.9 minutes. Ken then averaged a speed of 6.10 m/s for 7.1 minutes. Determine the total distance which Ken ran during his 20 minute jog.

**Reading X vs T Graphs**

## Use the following graph to answer Questions #8 - #14. Justify your choices.

F

G



8.Which object(s) is(are) maintaining a state of motion (i.e., maintaining a constant velocity)?

9. Which object(s) is(are) accelerating?

10. Which object(s) is(are) not moving?

11. Which object(s) change(s) its direction?

12. On average, which object is traveling fastest?

13. On average, which moving object is traveling slowest?

14. Which object has a positive acceleration?

15. Which object has a negative acceleration?

## Reading V vs T Graphs

## Use the following graph to answer Questions #16 -#21 .



F

1. Which object(s) is(are) maintaining its state of motion?
2. Which object(s) is(are) accelerating?
3. Which object(s) is(are) not moving?
4. Which object(s) change(s) its direction?
5. Which accelerating object has the smallest acceleration?
6. Which object has the greatest velocity?

**Drawing X vs T and V vs T Graphs (Use graph paper or draw freehand)**

1. Sketch a position-time graph for an object which is moving with a constant, positive velocity.
2. Sketch a position-time graph for an object which is moving with a constant, negative velocity.
3. Sketch a position-time graph for an object moving in the + direction and accelerating from a low velocity to a high velocity.
4. Sketch a position-time graph for an object moving in the + direction and accelerating from a high velocity to a low velocity.
5. Sketch a position-time graph for an object moving in the - direction and accelerating from a high velocity to a low velocity.
6. Sketch a position-time graph for an object moving in the - direction and accelerating from a low velocity to a high velocity.
7. Sketch a position-time graph for an object moving in the + direction with constant speed; first a slow constant speed and then a fast constant speed.
8. Sketch a position-time graph for an object moving in the + direction with constant speed; first a fast constant speed and then a slow constant speed.
9. Sketch a position-time graph for an object moving in the - direction with constant speed; first a slow constant speed and then a fast constant speed.
10. Sketch a position-time graph for an object moving in the - direction with constant speed; first a fast constant speed and then a slow constant speed.
11. Sketch a position-time graph for an object which moves in the + direction at a slow constant speed and then in a - direction at a fast constant speed.
12. Sketch a position-time graph for an object which moves in the + direction at a fast constant speed and then in a - direction at a slow constant speed.
13. Sketch a position-time graph for an object which moves in the - direction at a slow constant speed and then in a + direction at a fast constant speed.
14. Sketch a velocity-time graph for an object moving with a constant speed in the positive direction.
15. Sketch a velocity-time graph for an object moving with a constant speed in the negative direction.
16. Sketch a velocity-time graph for an object which is at rest.
17. Sketch a velocity-time graph for an object moving in the + direction, accelerating from a slow speed to a fast speed.
18. Sketch a velocity-time graph for an object moving in the + direction, accelerating from a fast speed to a slow speed.
19. Sketch a velocity-time graph for an object moving in the - direction, accelerating from a slow speed to a fast speed.
20. Sketch a velocity-time graph for an object moving in the - direction, accelerating from a fast speed to a slow speed.
21. Sketch a velocity-time graph for an object which first moves with a slow, constant speed in the + direction, and then with a fast constant speed in the + direction.
22. Sketch a velocity-time graph for an object which first moves with a fast, constant speed in the + direction, and then with a slow constant speed in the + direction.
23. Sketch a velocity-time graph for an object which first moves with a constant speed in the + direction, and then moves with a positive acceleration.
24. Sketch a velocity-time graph for an object which first moves with a constant speed in the + direction, and then moves with a negative acceleration.

**1D Accelerated Motion**

1. A 747 airliner reaches its takeoff speed of 77.3 m/s in 35.2 seconds. What is the magnitude of its average acceleration?
2. A car is traveling due north at 18.1 m/s. Find the velocity of the car after 7.5 seconds if its acceleration is a) 1.30 m/s2 due north, or b) 1.15 m/s2 due south.
3. When you see a traffic light turn red, you apply the brakes until you come to a stop. If your initial speed was 12 m/s, and you were heading due west, what was your average velocity during braking?
4. Brad slides down a hill on a sled with an acceleration of 1.8 m/s2. If he starts at rest, how far has he traveled in a) 1.0 s, b) 2.0 s, c) 3.0 s?
5. After crossing the road to his baseball game, the infamous chicken is dashing toward home plate with a speed of 5.8 m/s when he decides to hit the dirt. The chicken slides for 1.1 s, just reaching the plate as he stops (SAFE!). a) What are the magnitude and direction of the chicken’s acceleration? b) How far did the chicken slide?

**Freefall**

1. A volcano launches a lava bonb straight upward with an initial speed of 28 m/s. Taking upward to be the positive direction, find the speed and direction of the motion of the lava bomb a) 2.0 seconds and b) 3.0 seconds after it is launched.
2. A hot-air balloon is descending at a rate of 2.0 m/s when a passenger drops a camera. If the camera is 45 m above the ground when it is dropped, a) how long does it take for the camera to reach the ground, and b) what is its velocity just before it lands? c) Answer a) and b) if the balloon was ascending at 2.0 m/s when the camera was dropped.
3. To celebrate graduation, the graduate throws his cap straight upward with an initial speed of 6.0 m/s. a) How long does it take for the cap to return to the graduate? b) How long does it take for the cap to reach its maximum height? c) What is this maximum height? d) What is the velocity of the cap at this maximum height?
4. You shoot an arrow into the air. Two seconds later the arrow has gone straight upward to a height of 30.0 m above its launch point. a) What was the arrow’s initial velocity? b) How long did it take for the arrow to reach its maximum height? c) How fast is the arrow falling when it reaches a height 15.0 m above its launch point on the way down?