Name: _____ Date: _____

PHYSICS
Distance & Displacement Calculations Practice

- **Distance**: Total path length of motion or travel. Add together all of the segments of motion.
- **Displacement**: The absolute change in position. The straight-line difference in position between the start of motion and the end of motion. Displacement is a vector. For linear motion, add vectors using + and – values for directions. For 2-dimensional motion, use the Pythagorean Theorem.

Motion in 1-Dimension

The motion is linear, movement is in a straight line in direction or in straight lines in opposite directions. North and East are positive directions. West and South are negative directions.

Examples of linear motion in 1-dimension

The black arrows are the actual paths of travel. The red arrow represents the displacement.

Move 10 km North.

d = 10 km
Δx = 10 km N

Move 10 km North → 6 km South.

d = 10 km + 6 km = 16 km
Δx = +10 + -6 = +4 km = 4 km N

Distance = 16 km
Displacement = 4 km N (red vector)
The final stopping place is 4 km north of the start.

Move 40 km West → 80 km East → 100 km West

d = 220 km
Δx = 60 km W

d = 40 km + 80 km + 100 km = 220 km
Δx = -40 + +80 + -100 = -60 km = 60 km W

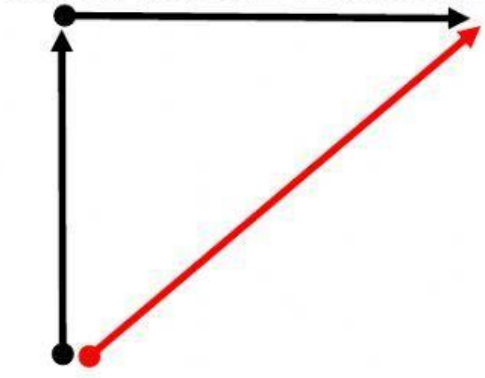
Part 1: Calculate the distance & Displacement using the segments of travel

Motion (Path of travel)	Distance, d (km)	Displacement, Δx (km)
8 km north		
8 km north → 4 km north		
8 km north → 4 km south		
8 km north → 16 km south		
10 km east → 4 km west		
10 km east → 16 km west		
12 km south → 20 km north		
14 km east → 8 km west → 6 km west		
20 km south → 4 km south → 14 km north		
20 km west → 10 km east → 5 km west		
10 km north → 10 km south → 5 km north		

Motion in 2-Dimension (Perpendicular Directions):

The motion is in 2-dimensions. Motion Add absolute values to solve for distance. Use Pythagorean Theorem to solve for displacement. The displacement is the hypotenuse of the right triangle formed by the perpendicular direction vectors.

Move 10 km North → 14 km East



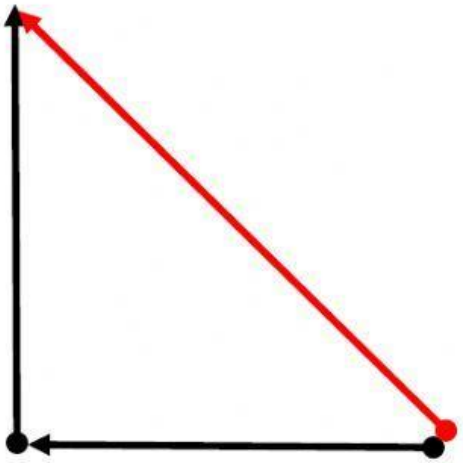
$d = 10\text{ km} + 14\text{ km} = 24\text{ km}$

$\Delta x = \sqrt{10^2 + 14^2} = \sqrt{296} = 17.2\text{ km}$

Distance is 24 km total
Displacement = 17.2 km NE

The path of travel is represented by the black arrows. The displacement is represented by the red arrow.

Move 20 km West → 28 km North



$d = 20\ km + 28\ km = 48\ km$

$\Delta x = \sqrt{20^2 + 28^2} = \sqrt{1184} = 34.4\ km$

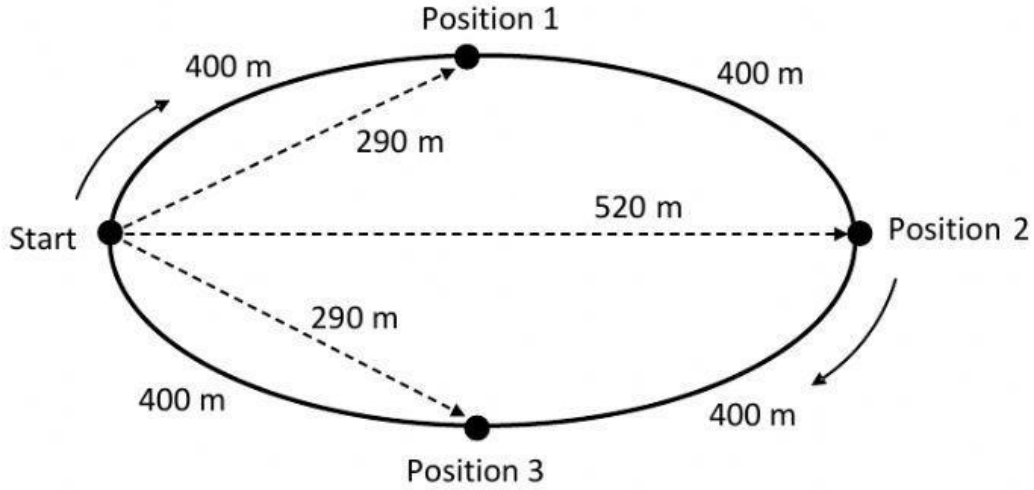
Distance is 48 km total
Displacement = 24.4 km NW

The path of travel is represented by the black arrows. The displacement is represented by the red arrow.

Part 2: Calculate the distance & displacement using the segments of travel.

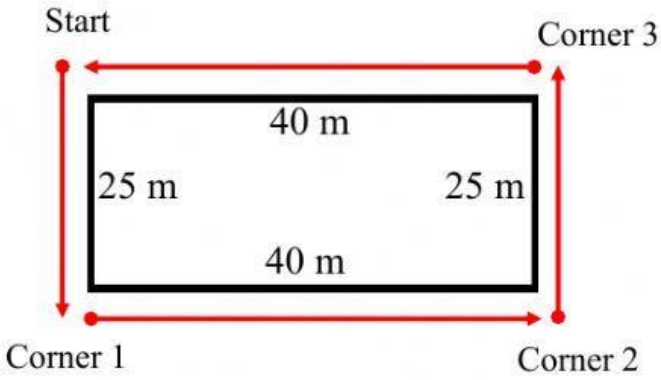
Motion (Path of travel)	Distance, d (km)	Displacement, Δx (km)
10 km north → 8 km east		
8 km north → 2 km west		
6 km west → 4 km south		
12 km north → 12 km west		
10 km south → 6 km west		

Part 3: Interpreting diagrams. The oval is a racetrack. Cars must move around the oval on the solid black line. Cars move from Start to position 1, 2, 3, and back to start. Using the diagram, determine the distances and displacement moved by the car from Start to 1, Start to 2, Start to 3, and Start back to start. Determine the direction of the car at Position 1, 2, 3, and Start relative to Start.



	Distance	Displacement (m)	direction
Start → Position 1			
Start → Position 2			
Start → Position 3			
Start → Start			

Part 4: Interpreting diagrams. Jorge walked around the playground. The playground perimeter is a rectangle in shape. Jorge walked from Start to corner 1, to corner 2, to corner 3, then returned to start. The red arrows show Jorge's path and direction of travel. Calculate the distance and displacement that Jorge walked.



	Distance	Displacement (m)	direction
Start → Corner 1			
Start → Corner 2			
Start → Corner 3			
Start → Start			