



Assignment 2.02 - Relative Motion KEY

1. George is riding his bicycle to the east at 10 m/s. There is a car, 100 meters away, coming toward him at 30 m/s. How long does George have to react in order to avoid a collision?

$$v_{relative} = v_{bicycle} + v_{car} = 10m/s + 30m/s = 40m/s$$

$$v = \frac{d}{t} \implies t = \frac{d}{v} = \frac{100m}{40m/s} = 2.5s$$

2. Monique leaves her house and walks to school at a rate of 1.5 m/s. At the same time, Rick leaves the school and walks toward Monique's house at a speed of 2 m/s. Monique's house is 1200 meters from the school.

- (a) How long does it take for Monique and Rick to meet?

$$v_{relative} = v_{Monique} + v_{Rick} = 1.5m/s + 2m/s = 3.5m/s$$

$$v = \frac{d}{t} \implies t = \frac{d}{v} = \frac{1200m}{3.5m/s} \approx 342.857s \approx 5 \text{ min } 42.857s$$

- (b) How far from Monique's house do they meet?

$$v = \frac{d}{t} \implies d = v \times t = 1.5m/s * 342.857s \approx 514.286m$$

3. Ernest, a police officer, is in pursuit of a car that has been stolen by the notorious criminal Bert. Bert is 5 km ahead of the police car. Bert drives 30 m/s, and the Ernest is catching up by driving 45 m/s. *Note: 5 km = 5000 m

- (a) How long does it take for Ernest to catch up?

$$v_{relative} = v_{Ernest} - v_{Bert} = 45m/s - 30m/s = 15m/s$$

$$v = \frac{d}{t} \implies d = \frac{d}{v} = \frac{5000m}{15m/s} \approx 333.333s \approx 5 \text{ min } 33.333s$$

- (b) How far does the Bert drive during that time?

$$v = \frac{d}{t} \implies d = v \times t = 30m/s * 333.333s \approx 10000m = 10km$$

- (c) A car, coming from the other direction, driven by an innocent bystander named Zoey, is traveling 20 m/s. How fast does she see the thief go by?

$$v_{relative} = v_{Zoey} + v_{Bert} = 20m/s + 30m/s = 50m/s$$



4. Billy-Bob is flying 100 m/s in a plane directly above a road. He sees a car driving in the same direction, 550 meters in front of him. It takes the plane 7.25 seconds to pass the car. How fast is the car driving? ***Note: There are multiple correct ways to solve this problem.**

$$v_{relative} = \frac{d}{t} = \frac{550m}{7.25s} \approx 75.826m/s$$

$$v_{relative} = v_{plane} - v_{car} \implies v_{car} = v_{plane} - v_{relative} = 100m/s - 75.862m/s \approx 24.138m/s$$

5. Louis is in a fighter plane, chasing an imperial Zero fighter near Hawaii. He is flying 60 m/s, and his guns have a forward velocity of 300 m/s. He fires a single shot at the fighter, which is 450 m away. The Zero fighter is fleeing at a speed of 95 m/s.

(a) What is the speed of his bullet, as measured by an observer on the ground?

(b) What speed does the pilot of the Zero fighter see the bullet coming toward him at?

(c) How long does it take for the bullet to hit the imperial fighter?

(d) What is the total distance that the bullet travels?

(e) What is the date that these events took place?

6. Salma is swimming 40m west of the shore when she sees a shark 78m west of her. She attempts to swim to the shore at a speed of 4 m/s. The shark pursues her at a speed of 12 m/s. Does Salma make it to the shore safely?