

Answer on Question#56259 - Physics - Relativity

12. A bird flies parallel to a railway track at a speed of $v_b = 60 \frac{\text{km}}{\text{h}}$. What is the speed of the bird as observed by a passenger in a coach of a train moving on the track in the same direction as the bird at a speed of $v_t = 160 \frac{\text{km}}{\text{h}}$?

220 km/h

240 km/h

100 km/h

120 km/h

13. A driver does a round trip to Ibadan from Lagos, returning to his take-off point in five hours. The distance of Ibadan from Lagos is 130 km. What is his average velocity?

52 km/h

26 km/h

0 km/h

104 km/h

14. A boat can travel at a speed of 12 km/h on still water of a river. When the river is flowing at a speed of 3 km/h the boat can also travel at a speed of 3 km/h relative to the water in the river. A boatman using this boat aims to cross the river from point a on the river bank to point b directly opposite to point a on the other bank of the river. How should he aim the boat to achieve this goal?

75.5 degrees upstream

14.5 degrees downstream

75.5 degrees downstream

14.5 degrees upstream

Solution:

12. In the system of reference of the train bird flies with velocity

$$v'_b = v_b - v_t = 160 \frac{\text{km}}{\text{h}} - 60 \frac{\text{km}}{\text{h}} = -100 \frac{\text{km}}{\text{h}}$$

Therefore the bird's speed in this system of reference is $100 \frac{\text{km}}{\text{h}}$.

13. Since the average velocity is given by the full displacement divided by the time of the trip, driver's average velocity is $0 \frac{\text{km}}{\text{h}}$. He returned to the same position after 5h (displacement is zero).

14. His speed in the direction opposite to the direction of water flow must be $v_{\parallel} = 3 \frac{\text{km}}{\text{h}}$ to compensate the displacement due to river flow. His speed in direction to the point on the other bank of the river is $v_{\perp} = 12 \frac{\text{km}}{\text{h}}$. These two speeds are related to the direction angle α by the following relation

$$\tan \alpha = \frac{v_{\perp}}{v_{\parallel}}$$

Therefore

$$\alpha = \tan^{-1} \frac{v_{\perp}}{v_{\parallel}} = \tan^{-1} \frac{12}{3} = 75.5^\circ$$

Answer:

12. $100 \frac{\text{km}}{\text{h}}$

13. $0 \frac{\text{km}}{\text{h}}$

14. 75.5°