

Part A

1. Despite the fact that the Earth is hurtling through space really quickly (it's orbiting the sun and spinning), you don't feel any movement when, for example, you're standing next to a building. Why not?

2. At what speed is the Earth travelling around the sun?
3. Mars is about 228 million km from the sun and it takes 687 days (Earth days) to complete one orbit. How fast is it going around the sun (in km/hr)? ($C = 2\pi r$)

Part B

4. A car's speedo indicates a speed of **50 km/hr**. This is its speed relative to the _____.
5. (a) Car A, travelling at 80 km/hr, passes Car B which is travelling at 50 km/hr. Both cars are travelling in the same direction. Draw a simple diagram of the situation.

(b) What is Car A's velocity relative to Car B?

(c) What is Car B's velocity relative to Car A?

6. Marie and James are on a train carriage which is travelling at a speed of 60 km/hr (relative to the Earth). Marie walks towards the front at a speed of 4 km/hr (relative to the carriage) and James walks towards the rear at 3 km/hr (relative to the carriage).
 - (a) Draw a diagram of the situation.

(b) What is Marie's speed relative to the Earth?

(c) What is James's speed relative to the Earth?

(d) What is Marie's speed relative to James?

7. The water in a river is flowing with a velocity of 2 m/s. Kim can swim with a maximum speed of 2 m/s. What will Kim's speed relative to the Earth be when swimming downstream and when swimming upstream?

8. (a) Elizabeth walks up a 15-metre flight of stairs at a speed of 1 m/s. Calculate the time it will take her to get to the top.

(b) Calculate the time it will take her to get to the top if she stands on a 15-metre escalator travelling at 0.5 m/s.

(c) Calculate the time it will take her to get to the top of the same escalator if she walks up it (at her normal stair-climbing speed). (Hint: you may want to calculate her speed relative to the Earth first.)

9. Even though skydivers plummet towards the earth at a speed of about 200 km/hr, video footage of skydivers makes it appear as if they're not really moving at all. Why is this?

10. The ancient Greek philosophers believed that the sun rose every morning because it was travelling around the Earth, but, in the 1600s, the famous scientist Galileo started saying that the sun only "rises" because the Earth is spinning. Who was correct? (HINT: this is a little bit of a trick question.)

Part C

11. You are in a bus that is moving with a constant velocity and you are throwing a ball up and down. How would a passenger inside the bus describe what they see and how would someone outside the bus describe what they see. Draw diagrams to supplement your answer (showing the apparent path of the ball).

View from inside the bus.

View from outside the bus.

12. William is in a stationary bus facing forward and he is throwing a ball up and down. The bus suddenly accelerates as soon as the ball leaves his hand. What appears to happen?

13. James is standing at the back of a train carriage facing Rosie who is standing at the front of the carriage facing James. The train is travelling in a straight line at 90 km/hr. James throws a ball to Rosie who then throws the ball back again. Both James and Rosie throw the ball at 40 km/hr relative to the train.

(a) Draw a diagram of the situation and use an arrow to indicate the speed and direction of the train.

(b) When James throws the ball, at what speed and in what direction does it travel relative to the ground?

(c) When Rosie throws the ball, at what speed and in what direction does it travel relative to the ground?

(d) If James and Rosie were playing a simple bat tennis game on the train, explain why neither of them would have any kind of advantage due to their position on the train.
