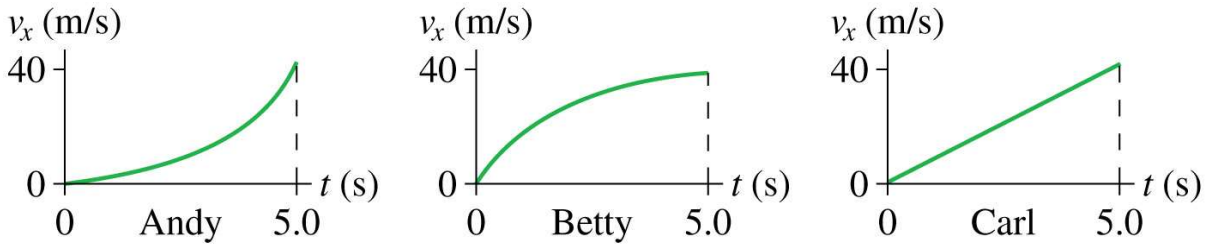
1.3 Acceleration: Rate of Change of Velocity

1. You are travelling east in an aeroplane. Can your acceleration vector ever point west? Explain.

2. The following options describe the motion of four cars A-D. Which car has the largest acceleration?
    a. Goes from 0 m/s to 4.0 m/s in 2.0 s
    b. Goes from 0 m/s to 6.0 m/s in 4.0 s
    c. Goes from 0 m/s to 28 m/s in 9.0 s
    d. Goes from 0 m/s to 3.0 m/s in 1.0 s

3. Velocity-versus-time graphs for three drag racers are shown. Which of the three cars had the greatest acceleration at t = 0 s?



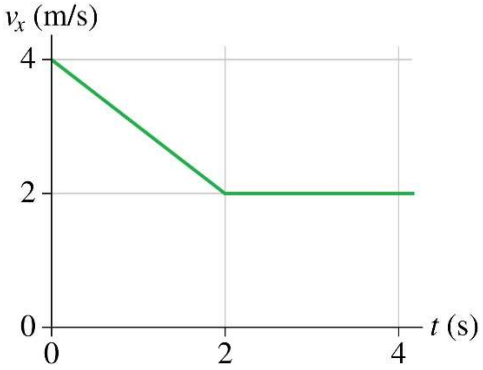
    a. Andy
    b. Betty
    c. Carl
    d. All had the same acceleration

4. A vehicle can go from 0 to 60 km/h in 7.0 s. Assuming that it could maintain the same acceleration at higher speeds, how long would it take the vehicle to go from 0 to 120 km/h?
    a. 10 s
    b. 14 s.
    c. 21 s
    d. 28 s

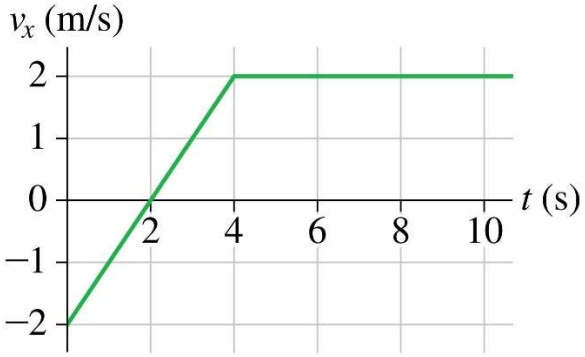
5. A car can go from 0 to 60 km/h in 12 s. A second car is capable of twice the acceleration of the first car. Assuming that it could maintain the same acceleration at higher speeds, how much time will this second car take to go from 0 to 120 km/h?
    a. 12 s
    b. 9.0 s
    c. 6.0 s
    d. 3.0 s

6. Certain animals are capable of running at great speeds; other animals are capable of tremendous accelerations. Speculate on which would be more beneficial to a predator – large maximum speed or large acceleration.

7. The figure shows the velocity graph of a bicycle. Draw the bicycle's acceleration graph for the interval 0 s ≤ t ≤ 4 s. Give both axes an appropriate numerical scale.

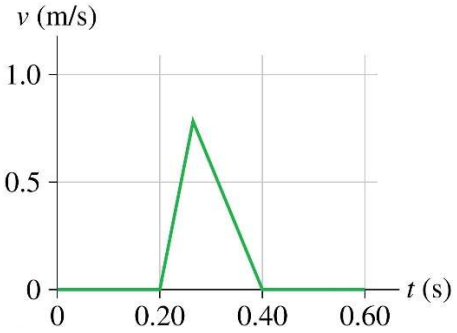


8. We set the origin of a coordinate system so that the position of a train is x = 0 m at t = 0 s. The figure below shows the train's velocity graph.

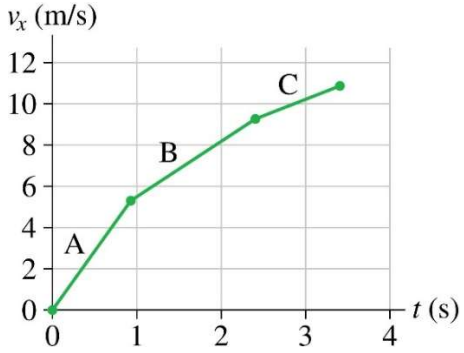


   a. Draw an acceleration-versus-time graph for the train.
   b. Find the acceleration of the train at t = 3.0 s?

9. The figure shows data for the speed of blood in the ascending aorta during one heartbeat. Determine the magnitude of the acceleration for both phases, speeding up and slowing down.



10. The figure below shows a simplified velocity graph for an Olympic sprinter starting a 100 m dash. Estimate the acceleration during each of the intervals A, B, and C.



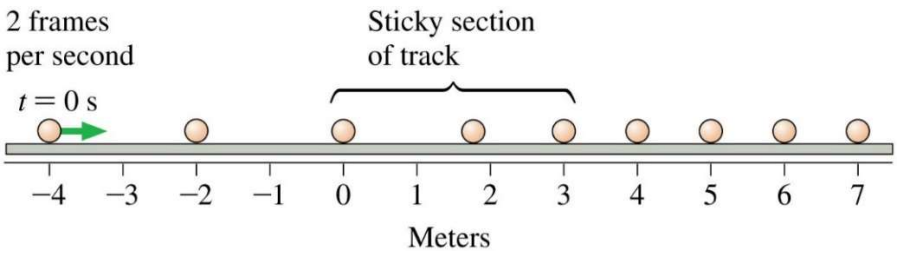
11. Small frogs that are good jumpers are capable of remarkable accelerations. One species reaches a takeoff speed of 3.5 m/s in 50 ms. What is the frog's acceleration during the jump?

12. A Thomson's gazelle can reach a speed of 13 m/s in 3.0 s. A lion can reach a speed of 9.5 m/s in 1.0 s. A trout can reach a speed of 2.8 m/s in 0.12 s. Which animal has the largest acceleration?

13. When striking, the pike, a predatory fish, can accelerate from rest to a speed of 4.0 m/s in 0.11 s. What is the acceleration of the pike during this strike?

14. When you sneeze, the air in your lungs accelerates from rest to approximately 150 km/h in about 0.50 seconds. What is the acceleration of the air in m/s^2?

15. The figure shows the motion diagram, made at frames of film per second, of a ball rolling along a track. The track has a 3.0-m-long sticky section.



a. Make a graph of x versus t for the ball.
b. What is the *change* in the ball's position from t = 0 s to t = 1.0 s?
c. What is the *change* in the ball's position from t = 2.0 s to t = 4.0 s?
d. What is the ball's velocity before reaching the sticky section?
e. What is the ball's velocity after reaching the sticky section?
f. Determine the ball's acceleration on the sticky section of the track.