

kinematics - practice problems

1. A dynamics cart rolls along a straight track in a classroom. It moves 0.120 km to the right in 15 s while a motion sensor samples its position 50 times each second. What is its average velocity?
2. A runner leaves the starting line and speeds up from 3 m/s to 21 m/s in 6 s. The track is 400 m around, but only this short interval matters. What is the runner's average acceleration?
3. A skateboard starts at 14.4 km/h and accelerates at 2.5 m/s^2 for 8 s. What is its final velocity?
4. A bike is moving at 30 m/s and brakes with an acceleration of -4 m/s^2 for 5 s. What is its final velocity?
5. A sled starts at 21.6 km/h on a packed snow path and accelerates at 1.5 m/s^2 for 10 s. The rider has a 4 kg backpack, but the motion information is enough. How far does it move?

6. A toy car goes from 5 m/s to 29 m/s in 8 s with constant acceleration. What is its acceleration?

7. A cart starts at 2 m/s and reaches 20 m/s while accelerating at 3 m/s². How long does this take?

8. A cart is already moving at 12 m/s. It accelerates at 2 m/s² over a 50 m track. What is its speed at the end of the track?

9. A car moving at 100.8 km/h brakes at -7 m/s² until it stops. How much distance does it need to stop?

10. A ball is thrown straight upward and is in the air for 4.0 s. Its mass is 0.20 kg. How high does it go above the launch point?

11. A cart moves 90 m in 6 s while accelerating uniformly. Its final velocity is 18 m/s. What was its initial velocity?

12. A ball is dropped from rest. How far does it fall in 3 s?

13. A ball is thrown upward at 18 m/s. What is its velocity after 2 s?

14. A ball is thrown straight upward at 16 m/s. How high above the release point does it rise?

15. A tennis ball is hit straight upward at 24 m/s. How long does it take to reach its highest point?

16. A stone is dropped from a bridge 20 m above the water. What is its velocity just before it hits the water?

17. A rock is dropped from rest from a height of 45 m. How long does it take to hit the ground?

18. A stone is thrown downward at 5 m/s from a 30 m cliff. What are its impact velocity and fall time?

19. A ball rolls horizontally off an 1800 cm tall ledge at 12 m/s. How long is it in the air, and how far from the base of the ledge does it land?

20. A marble leaves a tabletop horizontally at 15 m/s. The tabletop is 20 m above the floor. How far from the table does the marble land?

21. A ball is launched at 25 m/s at an angle of 37° above horizontal. What are its initial horizontal and vertical velocity components?

22. A projectile starts with horizontal velocity 20 m/s and vertical velocity 15 m/s. Where is it after 2 s?

23. A ball is launched from the ground at 72 km/h and 30° above horizontal. How long is it in the air, and what is its range?

24. The same ball is launched from the ground at 20 m/s and 30° above horizontal. What is its maximum height above the launch point?

25. A soccer ball is kicked from 150 cm above the ground at 43.2 km/h and 40° above horizontal. How long is it in the air, and how far forward does it travel?

26. A water balloon is thrown from a balcony 2.0 m above the ground at 18 m/s and 25° above horizontal. How far from the balcony does it land?

27. A ball has horizontal velocity 14 m/s and initial vertical velocity 9 m/s. A wall is 21 m away. How high above launch height is the ball when it reaches the wall?

28. A launcher gives a ball horizontal velocity 12 m/s. A target opening is 18 m away and 4.0 m above launch height. What initial vertical velocity is needed to pass through the opening?

29. A ball is launched with horizontal velocity 16 m/s and vertical velocity 12 m/s. A 6.0 m tall wall is 24 m away. Does the ball clear the wall?

30. A small launcher fires a ball from level ground with horizontal velocity 18 m/s and vertical velocity 24 m/s. The launch stand is 0.80 m wide, but take the launch and landing heights as the same. How far away does it land?