

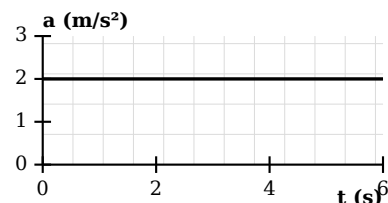
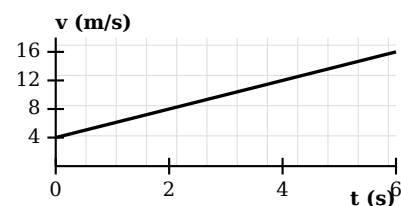
IB Physics - A.2 Kinematics

Uniformly Accelerated Motion

IB-Style Problems

Higher-level practice | Constant acceleration | No gravitational-motion questions

1. A car travelling at 12 m/s accelerates uniformly over 95 m and reaches 26 m/s.
 - (a) Without first calculating the time, determine the acceleration.
 - (b) Hence determine the time taken to travel the 95 m.
 - (c) Calculate the distance travelled during the final 2.0 s.
2. A train moving at 32 m/s brakes uniformly and comes to rest after travelling 256 m.
 - (a) Determine the acceleration using an equation that does not contain time.
 - (b) Calculate the stopping time.
 - (c) A second train has the same initial speed but twice the deceleration. Determine its stopping distance.
3. A particle has initial velocity -6.0 m/s and constant acceleration +2.5 m/s². Its displacement is +20 m.
 - (a) Determine its final velocity using the no-time equation.
 - (b) Determine the time taken.
 - (c) Explain the significance of the signs of velocity and acceleration.
4. A car is travelling at 28 m/s when the brakes are applied. After travelling 60 m its speed is 16 m/s.
 - (a) Determine the acceleration without calculating time.
 - (b) Calculate the additional distance required for the car to stop.
 - (c) Determine the total braking time.
5. A particle starts at $x = -12$ m with velocity +5.0 m/s and constant acceleration +1.5 m/s².
 - (a) Determine its velocity when it reaches $x = 30$ m without first finding the time.
 - (b) Determine the time at which it reaches $x = 30$ m.
 - (c) Sketch the velocity-time graph up to this instant.
6. A test vehicle increases its speed uniformly from 14 m/s to 30 m/s while travelling 176 m.
 - (a) Determine its acceleration using the no-time equation.
 - (b) Determine the time taken.
 - (c) Find the distance travelled while its speed increases from 22 m/s to 30 m/s.
7. A particle has velocity 18 m/s at $x = 0$ and constant acceleration -3.0 m/s².
 - (a) Determine the position at which it first comes to rest.
 - (b) Determine its velocity when it next passes $x = 0$.
 - (c) Determine the total distance travelled between the two passages through $x = 0$.
8. The velocity-time graph shows an object accelerating uniformly from 4 m/s to 16 m/s in 6 s.
 - (a) Determine the acceleration from the gradient.
 - (b) Determine the displacement from the area under the graph.
 - (c) State how the graph would change for a larger constant acceleration.
9. A train slows uniformly from 30 m/s to 18 m/s while covering 144 m.
 - (a) Determine the acceleration without using time.
 - (b) Calculate the time for this change in speed.
 - (c) If the same acceleration continues, determine the additional stopping distance.
10. The acceleration-time graph shows an object with initial velocity 3.0 m/s moving with constant acceleration 2.0 m/s² for 6.0 s.
 - (a) State what the area under the graph represents.
 - (b) Determine the velocity after 6.0 s.
 - (c) Calculate the displacement during these 6.0 s.



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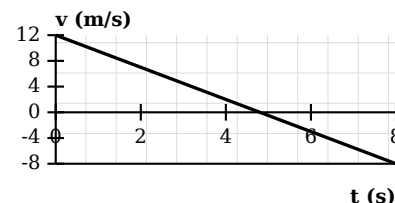
11. The velocity-time graph shows an object accelerating, moving at constant velocity, and then decelerating.

(a) Identify each interval of motion.
(b) Determine the total displacement from the graph.
(c) State during which interval the acceleration has the greatest magnitude.



12. The velocity-time graph shows motion with constant negative acceleration and crosses the time axis.

(a) Describe the motion before and after the crossing.
(b) State the physical meaning of the point where $v = 0$.
(c) Determine the displacement and total distance over the complete interval.



13. A vehicle starts from rest and accelerates uniformly at 1.2 m/s^2 for 2.5 s. It then moves at constant speed for 6.0 s before decelerating uniformly to rest in 2.0 s.

(a) Determine the maximum speed.
(b) Calculate the total displacement.
(c) Sketch a velocity-time graph for the complete motion.

14. Two cars A and B move along the same straight road. At $t = 0$, A passes B at 12 m/s. A continues at constant speed while B starts from rest with acceleration 2.0 m/s^2 .

(a) Write expressions for the displacement of each car.
(b) Determine when B catches A.
(c) Find the velocity of B at that instant.

15. A particle moves in a straight line with initial velocity 15 m/s and constant acceleration -3.0 m/s^2 .

(a) Determine when it first comes to rest.
(b) Find its displacement at that instant.
(c) Determine its displacement and total distance travelled during the first 8.0 s.

16. A driver travelling at 22 m/s sees an obstacle. The reaction time is 0.70 s. The brakes then produce a constant deceleration of 6.5 m/s^2 .

(a) Calculate the reaction distance.
(b) Calculate the braking distance using the no-time equation.
(c) Determine the total stopping distance.

17. A rocket sled increases its speed uniformly from 5.0 m/s to 35 m/s while travelling 200 m.

(a) Calculate its acceleration without first calculating time.
(b) Determine the time taken.
(c) Explain how the average velocity can be obtained without further calculation.

18. A vehicle enters a test section at 10 m/s and accelerates uniformly. It leaves the 180 m section at 26 m/s.

(a) Determine the acceleration using the no-time equation.
(b) Determine the time spent in the test section.
(c) Determine the displacement covered while its speed increases from 18 m/s to 26 m/s.

19. A car passes point P at 8.0 m/s and accelerates uniformly. It reaches Q, 120 m from P, 10 s later.

(a) Calculate the acceleration.
(b) Determine its speed at Q.
(c) Calculate the distance travelled during the final 2.0 s.

20. A train travelling at 30 m/s slows uniformly to 18 m/s while covering 144 m.

(a) Determine the acceleration without using time.
(b) Calculate the time for this change in speed.
(c) If the same acceleration continues, determine the additional distance before the train stops.

21. A particle moving at 25 m/s undergoes constant acceleration and covers 80 m in the next 4.0 s.

(a) Determine the acceleration.
(b) Calculate the velocity after 4.0 s.
(c) State whether the particle changes direction, justifying your answer.

22. A car starts from rest at a traffic light. At the same instant, a bus travelling at constant 15 m/s passes it. The car accelerates uniformly at 2.5 m/s^2 .

(a) Determine the time at which the car catches the bus.
(b) Calculate the distance from the traffic light where this occurs.
(c) Determine the speed of the car at that instant.