

Review - Kinematic Equations

Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question.

- _____ 1. In an emergency braking exercise, a student driver stops a car travelling at 83 km/h [W] in a time of 4.0 s. What is the car's acceleration during this time? (The answer is expressed in units of m/s^2 .)
A) 5.8 [W] D) 21 [W]
B) 21 [E] E) -5.8 [E]
C) 5.8 [E]
- _____ 2. An object is thrown vertically upward with a speed of 25 m/s. How much time passes before it comes back down at 15 m/s? (Air resistance is negligible.)
A) 1.0 s D) 18 s
B) 4.1 s E) 27 s
C) 9.8 s
- _____ 3. An object is thrown vertically upward at 18 m/s from a window and hits the ground 1.6 s later. What is the height of the window above the ground? (Air resistance is negligible.)
A) 3.7 m D) 37 m
B) 16 m E) 41 m
C) 21 m
- _____ 4. How long does it take a car to slow down from a speed of 54 km/h to 32 km/h over a distance of 65 m? Answer in seconds.
A) 21 D) 2.7
B) 5.9 E) 1.5
C) 5.4
- _____ 5. A jogger is running at 4.2 m/s when she begins to accelerate uniformly. If she runs a distance of 14 m in the next 3.0 s, what is her new speed?
A) 17 m/s D) 5.1 m/s
B) 14 m/s E) 4.9 m/s
C) 7.7 m/s
- _____ 6. An object is thrown vertically downward at 3.2 m/s. How long will the object take to hit the ground 12 m below?
A) 3.8 s D) 1.0 s
B) 3.1 s E) 1.3 s
C) 2.0 s
- _____ 7. A bullet accelerates uniformly along a barrel, exiting the gun in 24 ms with a speed of 196 m/s. The acceleration of the bullet, expressed in units of metre per second squared, is
A) 1.7×10^5 D) 1.7×10^3
B) 1.8×10^4 E) 3.6×10^2
C) 8.2×10^3
- _____ 8. A car accelerates at 2.7 m/s^2 for 5.4 s, reaching a speed of 18 m/s. During the period of acceleration, the car travels a distance of
A) $1.8 \times 10^2 \text{ m}$ D) 58 m
B) $1.4 \times 10^2 \text{ m}$ E) 18 m
C) $9.0 \times 10^1 \text{ m}$

- _____ 9. A toy car is moving at 13 cm/s when it begins accelerating at 1.4 cm/s^2 . If the acceleration is uniform, what is the speed of the car after it has travelled a distance of 27 cm?
- A) $2.4 \times 10^2 \text{ cm/s}$ D) 16 cm/s
B) 93 cm/s E) $1.0 \times 10^1 \text{ cm/s}$
C) 62 cm/s
- _____ 10. What distance does an object travel during a period of uniform acceleration ($a = 2.5 \text{ m/s}^2$) when its speed changes from 35 m/s to 45 m/s?
- A) $6.5 \times 10^2 \text{ m}$ D) 32 m
B) $3.2 \times 10^2 \text{ m}$ E) 2.0 m
C) $1.6 \times 10^2 \text{ m}$
- _____ 11. Three identical objects are thrown from the same height through a window at the same time. Object A is thrown horizontally at 4.0 m/s, object B is thrown horizontally at 8.0 m/s, and object C is simply dropped. If air resistance is negligible, which object will reach the ground first?
- A) object A
B) object B
C) object C
D) objects B and C will land first and together
E) all three will land at the same time
- _____ 12. Over a period of 3.0 s a car's velocity changes from 18 m/s [W] to 12 m/s [W]. What is the value of the car's acceleration during this time?
- A) 2.0 m/s^2 [E] D) 10 m/s^2 [E]
B) 10 m/s^2 [W] E) 2.0 m/s [E]
C) 2.0 m/s^2 [W]
- _____ 13. If an object accelerates at 6.2 m/s^2 [N], how long will it take to reach a velocity of 25 m/s [N] if starting from rest?
- A) 25 s D) 0.25 s
B) 4.0 m/s E) 4.0 s
C) 31 s
- _____ 14. A car is driving along the highway behind a slower vehicle when it pulls out to pass. If the car's acceleration is uniform at 2.0 m/s^2 for 4.0 s and it reaches a speed of 28 m/s, what was its speed when it first pulled out to pass the slower vehicle?
- A) 18 m/s D) 24 m/s
B) 20 m/s E) 26 m/s
C) 22 m/s
- _____ 15. A motorcycle accelerates from rest at 6.0 m/s^2 . How much farther will it travel during the second 3.0 s of its motion than during the first 3.0 s?
- A) 98 m D) 27 m
B) 81 m E) 15 m
C) 54 m
- _____ 16. An object is thrown vertically upward at 25.0 m/s. If it experiences an acceleration due to gravity of 9.8 m/s^2 [down], what is the object's velocity 3.0 s later?
- A) 22 m/s [down] D) 4 m/s [down]
B) 22 m/s [up] E) zero (it has hit the ground)
C) 4 m/s [up]

17. A stone is thrown vertically downward with a speed of 10 m/s from a bridge. Accelerating under gravity (9.8 m/s^2), the stone strikes the water 1.8 s later. From what height above the water was the stone thrown? (Assume 2 significant digits.)
- A) 50 m D) 15 m
B) 34 m E) 3 m
C) 27 m
18. A ball is thrown vertically downward from a window. Accelerating under gravity (9.8 m/s^2), the ball hits the ground 2.6 s later with a speed of 20.0 m/s. From what height above the ground was it thrown?
- A) 85 m D) 19 m
B) 39 m E) 10 m
C) 29 m

Problem

19. A box accidentally falls from the back of a truck and hits the ground with a speed of 15 m/s. It slides along the ground for a distance of 45 m before coming to rest. Determine
 - (a) the length of time the box slides before stopping
 - (b) the average acceleration of the box while it's sliding
 - (c) the time it takes to slide the last 10 m
20. Within 4.0 s of lift-off, a space shuttle reaches an altitude of 4.50×10^2 m, uniformly accelerating during the entire time.
 - (a) What is its acceleration?
 - (b) At what speed is the shuttle travelling when it reaches this altitude?
 - (c) How long would it take the shuttle to travel the next 450 m if it stops accelerating after 4.0 s?
21. A cyclist is travelling with a speed of 12.0 m/s when she applies the brakes. After slowing for 3.0 s, her speed has been reduced to 4.0 m/s.
 - (a) What distance does she travel during this time?
 - (b) What is her acceleration?
 - (c) If she continues braking, how much longer will it take her to stop?
 - (d) If she continues to travel with her new speed, how far will she travel during the next 3.0 s?
22. A ball is thrown vertically upward from a window that is 3.6 m above the ground. The ball's initial speed is 2.8 m/s and the acceleration due to gravity is 9.8 m/s^2 .
 - (a) What is the ball's speed when it hits the ground?
 - (b) How long after the first ball is thrown should a second ball be simply dropped from the same window so that both balls hit the ground at the same time?
23. A pedestrian is running at his maximum speed of 6.0 m/s trying to catch a bus that is stopped at a traffic light. When he is 16 m from the bus, the light changes and the bus pulls away from the pedestrian with an acceleration of 1.0 m/s^2 .
 - (a) Does the pedestrian catch the bus and, if so, how far does he have to run? (If not, what is the pedestrian's distance of closest approach?)
 - (b) How fast is the bus moving when the pedestrian catches it? (or at the distance of closest approach)
 - (c) On a single set of axes, plot the corresponding position-time graphs of both the bus and pedestrian to confirm your answer in (a).
24. What was the initial velocity of an object that moved 120 m in 5.60 s, reaching a final velocity of 15.0 m/s in that time? Was the object speeding up or slowing down?

25. A dragster accelerates from rest for a distance of 450 m at 14 m/s^2 . A parachute is then used to slow it down to a stop. If the parachute gives the dragster an acceleration of 7.0 m/s^2 , how far has the dragster travelled before stopping?
26. If 100.0 m sprinters accelerate from rest for 3.5 s at 2.8 m/s^2 , how far have they run to this point? How long will it take them to complete their 100.0 m sprint, assuming they maintain their speed the rest of the way?
27. A car moving with a constant acceleration covers the distance between two points 60.0 m apart in 6.0 s. Its velocity as it passes the second point is 15.0 m/s.
- (A) What was the speed at the first point?
 - (B) What is the constant acceleration
 - (C) How far behind the first point was the car at rest?
28. A car moves at 12 m/s for 30.0 seconds. It then accelerates at 1.5 m/s^2 for 8.00 seconds. Finally, it continues on at this top speed for another 12.0 seconds. Calculate the net displacement during the whole time interval
29. A sprinter who is running a 250 m race accelerates from rest at 7.5 m/s^2 for 1.2 s and maintains this speed for the remainder of the race. What is her time for the race?
30. A model rocket blasts off with a constant acceleration of 12.3 m/s^2 until its fuel runs out 10.2 s later. It then enters free fall for the remainder of its flight.
- a) Calculate the maximum height above the ground reached by the model rocket.
 - b) Calculate the total time the rocket is in the air. (Careful: There are two different accelerations on the way up, but only one on the way down. This creates three parts to the motion.)
31. A police car stopped at a set of lights has a speeder pass it at 100.0 km/h. If the police car can accelerate at 3.6 m/s^2 ,
- (A) how long does it take to catch the speeder?
 - (B) how far would the police car have to go before it catches the speeder?
 - (C) what would be its speed when it caught up with the speeder? Is this speed reasonable?
32. You are driving at a constant speed of 22 m/s, when a child suddenly steps into the path of your vehicle 52 m away. When you fully apply the brakes, your car slows down at a rate constant rate of 5.0 m/s^2 . What is the **minimum reaction time (ie. how long does he have to apply the brakes)** that is required so that the child will not be hit?
33. A car is travelling along the highway at 95 km/h when the driver sees a moose crossing the road. About 0.50 s after he sees the moose he applies the brakes and stops the car. The braking acceleration of the car is -6.5 m/s^2 . Calculate:
- (a) the distance travelled by the car during the time period from the first sighting of the moose to the time the brakes are applied
 - (b) distance travelled after the brakes are applied
 - (c) total stopping distance.
34. An astronaut drops a feather from 1.2 m above the surface of the moon. If the acceleration of gravity on the moon is 1.62 m/s^2 , how long does it take the feather to hit the surface?

35. Thrilled by Romeo's emotion, Juliet jumps into the air with joy, at a velocity of 5.00 m/s . Rather than landing on the balcony, she misses and falls to the ground, 7.00 m below.
- A) What will Juliet's impact speed with the ground be?
 - B) How long will it take Juliet to hit the ground?
36. You are standing on a cliff that is 40.0 m above the water level and you throw a ball upward at 25.0 m/s .
- A) With what speed will the ball hit the water?
 - B) How much time will elapse before it hits the water?
37. Number 69 pag 74 -75 in textbook

