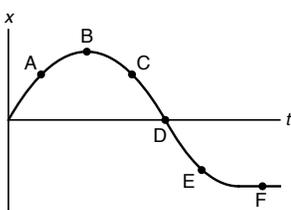


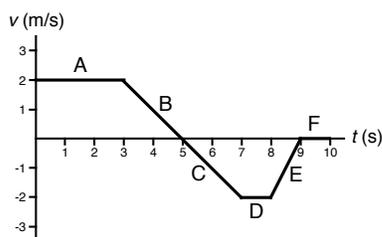
Kinematics Review Sheet

Multiple choice. Circle the best answer.

1. Consider the position vs. time graph on the right. At which lettered point or points is the object a) moving the fastest? b) moving to the left? c) speeding up? d) slowing down? e) turning around?

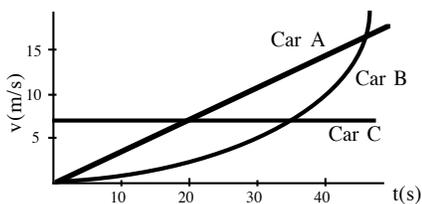


2. Consider the velocity vs. time graph on the right. During which segment(s) is the object a) moving with constant velocity? b) speeding up? c) slowing down? d) standing still? e) moving to the right?



3. On a highway, a car is driven 80 km/h during the first 1.0 hour of travel, 50 km/h during the next 0.5 hour, and 40 km/h in the final 0.5 hour. What is the car's average speed for the entire trip?
 (A) 45 km/h (C) 85 km/h
 (B) 62.5 km/h (D) 170 km/h
4. As a car is driven south in a straight line with decreasing speed, the acceleration of the car must be
 (A) directed northward (C) zero
 (B) directed southward (D) constant, but not zero
5. A race car starting from rest accelerates uniformly at a rate of 4.9 m/s^2 . What is the car's speed after it has traveled 200 m?
 (A) 1960 m/s (C) 44.3 m/s
 (B) 62.6 m/s (D) 31.3 m/s
6. Velocity is to speed as displacement is to
 (A) acceleration (C) momentum
 (B) time (D) distance

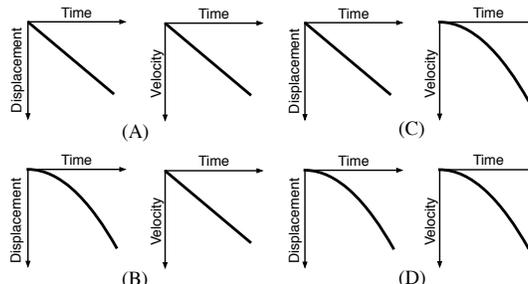
For the next three questions consider the graph below, which shows the motion of three cars.



7. (Honors only) From 0 s to 20 s, which car has been displaced the most?
 (A) car A (B) car B (C) car C
8. At 30 s which car has the most velocity?
 (A) car A (B) car B (C) car C
9. At 40 s which car has the most acceleration?
 (A) car A (B) car B (C) car C

10. A penny is dropped near the surface of the earth and free falls without any air resistance. After 1 second the displacement and the velocity of the penny are
 (A) -4.9 m , -4.9 m/s (C) -4.9 m , -9.8 m/s
 (B) -9.8 m , -4.9 m/s (D) -9.8 m , -9.8 m/s

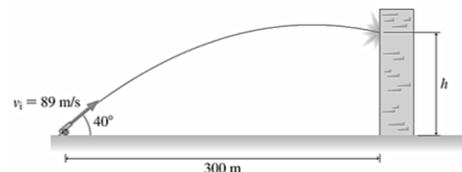
11. Referring to the last question, which graphs represents the vertical motion of the object free falling from rest?



12. Two vectors having magnitudes of 5 and 8 cannot have a resultant with a magnitude of
 (A) 3 (B) 7 (C) 13 (D) 15
13. When a softball, thrown vertically upwards, gets to the top of its path, it has
 (A) velocity = 0 m/s; acceleration = 0 m/s²
 (B) velocity = -9.8 m/s ; acceleration = 0 m/s²
 (C) velocity = 0 m/s; acceleration = -9.8 m/s^2
 (D) velocity = -9.8 m/s ; acceleration = -9.8 m/s^2
14. Starting from rest a rock falls from a cliff. Its average speed during 8 s of freefall is
 (A) 19.6 m/s (B) 9.8 m/s^2 (C) 39.2 m/s (D) 9.8 m/s
15. A golfer putts the ball 5.0 m due east, then 2.1 m due north, and then finally 0.5 m due west, into the hole. What is the magnitude and direction of the resultant vector for the three putts?
 (A) 5.89 m, at 69.0° from N (C) 4.97 m, at 65.0° from N
 (B) 5.89 m, at 21.0° from N (D) 4.97 m, at 25.0° from N

16. A ball thrown horizontally from a 20.0 m high building strikes the ground 15.0 m from the base of the building. What are the *initial* (v_x) and *final* (v_f) speeds of the ball?
 (A) 25.0 m/s, 9.80 m/s (C) 10.5 m/s, 19.80 m/s
 (B) 7.42 m/s, 19.80 m/s (D) 7.42 m/s, 21.1 m/s

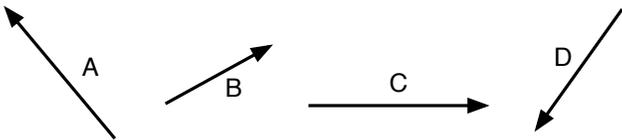
17. A cannon, elevated at 40° is fired at a wall 300 m away on level ground, as shown. The initial speed of the cannonball is 89 m/s



- How long does it take for the ball to hit the wall?
 (A) 1.3 s (B) 3.3 s (C) 4.4 s (D) 6.8 s
18. Referring to the previous question, at what height h does the ball hit the wall?
 (A) 39 m (B) 47 m (C) 137 m (D) 157 m

Problem solving. On separate paper, show all your work, (general equation, substitutions, calculations, and units).

19. A car accelerates from rest at 4.50 m/s^2 .
- What is its velocity after it's been displaced 100 m?
 - If the car now brakes and comes to rest after 6 s of braking, how far did it travel in total from its start?
 - How much time elapsed from start to stop?
 - Draw x vs. t and v vs. t graphs for the car until it stops.
20. A hot air balloon descends vertically at a constant speed of 2 m/s. When it is 40 m above the ground, a phone is dropped from the balloon and free falls to the ground.
- What is the phone's velocity when it strikes ground?
 - What is the balloon's height above the ground when the phone hits the ground?
 - Draw a y vs. t graph for the phone and the balloon.
21. A tennis player hits a ball 2.0 m above the ground. The ball leaves the racquet at 20 m/s and -5° below horizontal. The net is 7.0 m away, and 1.0 m high. Does the ball clear the net? If so, by how much? If not, by how much?
22. A baseball is thrown at an unknown angle, from 2.0 m above the ground, and it lands at a horizontal distance of 90, away. If the baseball takes 3.5 s to hit the ground:
- What is the horizontal component of the ball's velocity when it leaves the hand?
 - What is the vertical component of the ball's velocity when it leaves the hand?
 - What is the resultant velocity of the ball when it leaves your hand?
23. Draw a head-to-tail addition of the four vectors below, and then show the resultant vector. Then draw them in reverse order. Tracing is the best method.



24. A football is kicked from the ground at an angle of 40° and a speed of 23 m/s. To score a field goal, the football has to clear a 3.05 m high crossbar. How far away can the kick be made to for the football to just clear the crossbar (on its way downward)?
25. A rocket is fired straight up and accelerates from rest at 30 m/s^2 for 5 s, and then it runs out of fuel. Assuming no air friction, a) What is the rocket's maximum altitude? b) How long in total does it take the rocket to return to the ground? (Hint: it free falls up, then down to the ground)
26. A boat that can travel at 9.0 km/hr in still water is used to cross a river flowing at a speed of 4.0 km/hr.
- At what angle must the boat head so that its motion is straight across the river?
 - Find the resultant speed relative to shore.
27. A hiker walks four vectors (θ in bearing from north): 20 m, 60° N; 30 m, 0° N; 40 m, 270° N; 20 m, 135° N. Find the resultant (θ in bearing from north.) Use graphical method (on graph paper is best).

Questions 28-34 are Honors only

28. Do the last question analytically, and check answer.
29. A racecar completes one lap around a track at 200 miles per hour, and the second lap at 220 miles per hour. What is the average speed of the racecar? (Hint: you don't know the length of one lap, but show how that distance d cancels in the solution. By the way, the answer is called a *harmonic average*, and it's *not* the arithmetic average!)
30. A motorist is driving at 20 m/s when she sees that a traffic light 200 m ahead has just turned red. She knows that this light stays red for 15 s, and she wants to reach the light just as it turns green again. It takes her 1.0 s to step on the brakes and begins slowing at a constant acceleration. What is her speed as she reaches the light at the instant it turns green?
31. An airplane whose air speed is 580 km/h is supposed to fly in a path 32° N, but a steady 110 km/h wind is blowing *from* the north. In what direction should the plane head? (For a short cut, use law of cosines on the vector triangle; for harder version: use Pythagorean Theorem on triangle!)
32. A stone is thrown downward at 8 m/s from a height of 22 m. At the same time, a stone is thrown upward from 2 m the ground with a speed of 17 m/s.
- At what point in time do their paths intersect?
 - At what height do their paths intersect?
34. A golfer hits a ball at a 38° angle to a 6.0 m elevated green, and it lands 72 m away on the green.
- Determine the flight time for the ball. Hint: solve for t in the horizontal equation, substitute into the vertical equation, but *only* in the linear term for that equation!
 - Determine the ball's speed when it leaves the club.
33. *Extra Challenge:* In a 100-m race, a sprinter accelerates from rest at 2.68 m/s^2 . After reaching a top speed, he runs the rest of the race at constant speed, finishing the race in 12 s total.
- For how much time does the runner accelerate? (time to reach max. speed)
 - How far does he run during while maintaining constant speed?

Answers

1. a) D b) C,D,E c) C d) A,E e) B
 2. a) A,D b) C c) B,E d) F e) A,B
 3. B
 4. A 5. C 6. D 7. C 8. A
 9. B 10. C 11. B 12. D 13. C
 14. C 15. C 16. D 17. C 18. D
 19. a. 30.0 m/s b. 190 m c. 12.67 s
 20. a. -28.1 m/s b. 34.7 m
 21. hits the net 0.217 m below the top
 22. a. 25.7 m/s b. 16.6 m/s
 c. 30.6 m/s at 32.8° from horizontal
 23. see solutions page for vector drawings
 24. 49.2 m 25. a. 1523 m b. 37.9 s
 26. a. 63.6° from river b. 8.06 km/hr
 27. 27.2 m, 341.3° 28. same as last answer
 29. 209.5 km/h 30. 5.71 m/s
 31. 26.2° N 32. a. 0.8 s b. 12.5 m
 33. a. 3.20 s b. 28.5 m/s 33. a. 3.67 s b. 81.9 m