

1. The average speed of a runner in a 400.-meter race is 8.0 meters per second. How long did it take the runner to complete the race?

- (1) 80. sec
- (2) 50. sec
- (3) 40. sec
- (4) 32. sec

2. How long will it take an object to move 100 meters if the object is traveling with an average speed of 0.5 meter per second?

- (1) 200 s
- (2) 2 s
- (3) 5 s
- (4) 50 s

3. An object with an initial speed of 4.0 meters per second accelerates uniformly at 2.0 meters per second<sup>2</sup> in the direction of its motion for a distance of 5.0 meters. What is the final speed of the object?

- (1) 6.0 m/s
- (2) 10. m/s
- (3) 14 m/s
- (4) 36 m/s

4. A roller coaster, traveling with an initial speed of 15 meters per second, decelerates uniformly at -7.0 meters per second<sup>2</sup> to a full stop. Approximately how far does the roller coaster travel during its deceleration?

- (1) 1.0 m
- (2) 2.0 m
- (3) 16 m
- (4) 32 m

5. Oil drips at 0.4-second intervals from a car that has an oil leak. Which pattern best represents the spacing of oil drops as the car accelerates uniformly from rest?

- (1) . . . . .
- (2) . . . . .
- (3) . . . . .
- (4) . . . . .

6. A child riding a bicycle at 15 meters per second decelerates at the rate of 3.0 meters per second<sup>2</sup> for 4.0 seconds. What is the child's speed at the end of the 4.0 seconds?

- (1) 12 m/s
- (2) 27 m/s
- (3) 3.0 m/s
- (4) 7.0 m/s

7. If the mass of an object were doubled, its acceleration due to gravity would be

- (1) halved
- (2) doubled
- (3) unchanged
- (4) quadrupled

8. A ball is thrown straight up with a speed of 12 meters per second near the surface of Earth. What is the maximum height reached by the ball? [Neglect air friction.]

- (1) 15 m
- (2) 7.3 m
- (3) 1.2 m
- (4) 0.37 m

9. As the angle between two concurrent forces is increased from 10° to 75°, the magnitude of the resultant force

- (1) decreases
- (2) increases
- (3) remains the same

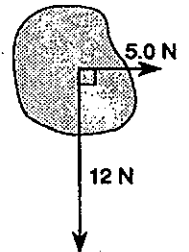
10. Two forces of 100 Newtons and 25 Newtons act concurrently on an object. These two forces could have a resultant force of

- (1) 0 N
- (2) 50 N
- (3) 100 N
- (4) 150 N

11. The diagram at the right represents two concurrent forces acting on a point. Which vector best represents their resultant?

- (1)
- (2)
- (3)
- (4)

12. Two perpendicular forces act on an object as shown in the diagram to the right.



What is the magnitude of the resultant force on the object?

- (1) 17 N
- (2) 13 N
- (3) 7.0 N
- (4) 5.0 N

13. Which is a vector quantity?

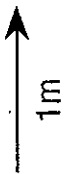
- (1) momentum
- (2) energy
- (3) speed
- (4) power

14. Which is a scalar quantity?

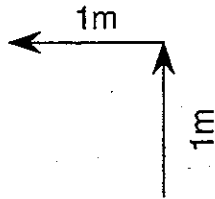
- (1) kinetic energy
- (2) momentum
- (3) force
- (4) weight

15. Which vector diagram represents the greatest magnitude of displacement for an object?

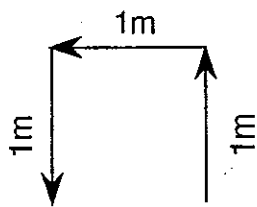
(1)



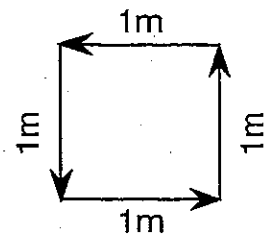
(2)



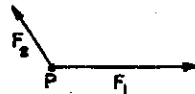
(3)



(4)



16. Which vector best represents the resultant of forces  $F_1$  and  $F_2$  acting concurrently on point  $P$  as shown in the diagram to the right?



(1)



(3)



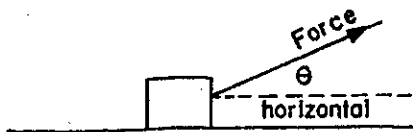
(2)



(4)



17. A constant force is exerted on a box as shown in the diagram.



As the angle  $\theta$  decreases to  $0^\circ$ , the magnitude of the horizontal component of the force

(1) decreases

(3) remains the same

(2) increases

18. A baseball player throws a ball horizontally. Which statement best describes the ball's motion after it is thrown? [Neglect the effect of friction.]

(1) Its vertical speed remains the same, and its horizontal speed increases.

(2) Its vertical speed remains the same, and its horizontal speed remains the same.

(3) Its vertical speed increases, and its horizontal speed increases.

(4) Its vertical speed increases, and its horizontal speed remains the same.

19. A rock is thrown horizontally from the top of a cliff at 12 meters per second. Approximately how long does it take the rock to fall 45 meters vertically? [Assume negligible air resistance.]

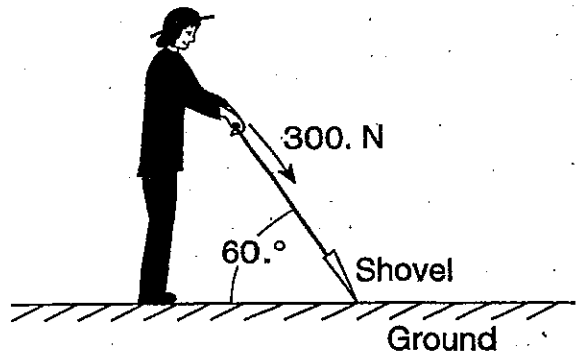
(1) 1.0 s

(3) 3.0 s

(2) 5.0 s

(4) 8.0 s

20. The diagram below shows a person exerting a 300.-newton force on the handle of a shovel that makes an angle of  $60^\circ$  with the horizontal ground.



The component of the 300.-newton force that acts perpendicular to the ground is approximately

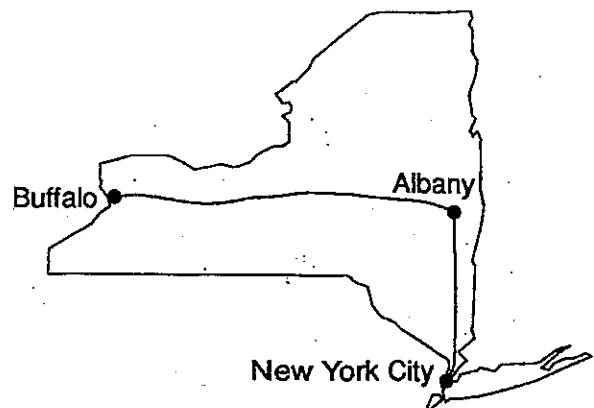
(1) 150. N

(3) 300. N

(2) 260. N

(4) 350. N

21. A car is driven from Buffalo to Albany and on to New York City, as shown in the diagram below.



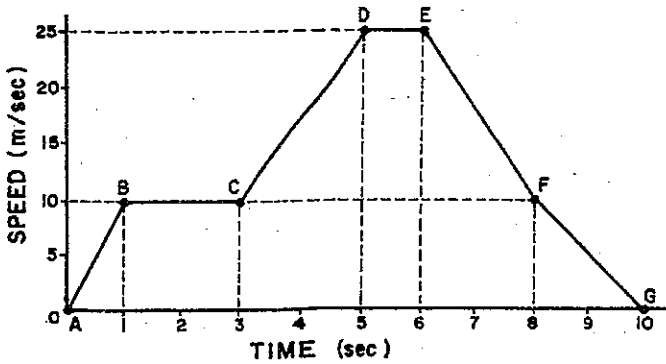
Compared to the magnitude of the car's total displacement, the distance driven is

(1) shorter

(3) the same

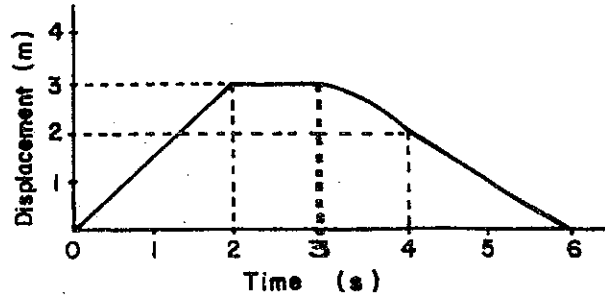
(2) longer

Base your answers to questions 22 through 25 on the graph below which represents the relationship between speed and time for an object in motion along a straight line.



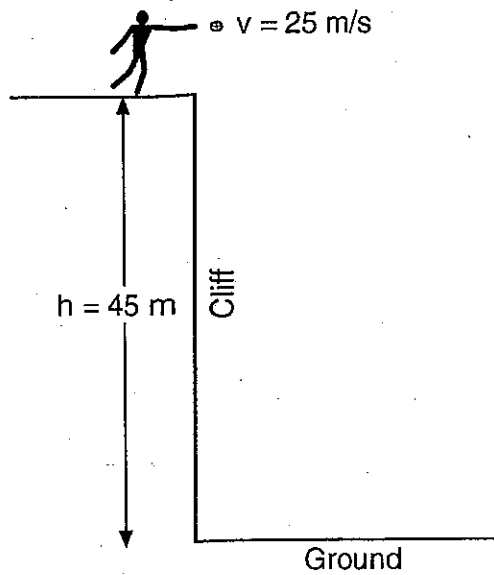
22. What is the acceleration of the object during the time interval  $t = 3$  seconds to  $t = 5$  seconds?
- (1)  $5.0 \text{ m/sec}^2$                       (3)  $12.5 \text{ m/sec}^2$   
 (2)  $7.5 \text{ m/sec}^2$                       (4)  $17.5 \text{ m/sec}^2$
23. What is the average speed of the object during the time interval  $t = 6$  seconds to  $t = 8$  seconds?
- (1)  $7.5 \text{ m/sec}$                       (3)  $15 \text{ m/sec}$   
 (2)  $10 \text{ m/sec}$                       (4)  $17.5 \text{ m/sec}$
24. What is the total distance traveled by the object during the first 3 seconds?
- (1) 15 m                      (3) 25 m  
 (2) 20 m                      (4) 30 m
25. During which interval is the object's acceleration the greatest?
- (1) AB                      (3) DE  
 (2) CD                      (4) EF
- 
26. A baseball player throws a baseball at a speed of 40. meters per second at an angle of  $30.^\circ$  to the ground. The horizontal component of the baseball's speed is approximately
- (1) 15 m/s                      (3) 30. m/s  
 (2) 20. m/s                      (4) 35 m/s

Base your answers to questions 27 through 31 on the graph below which represents the displacement of an object as a function of time.



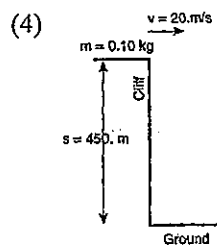
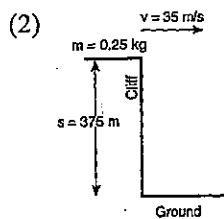
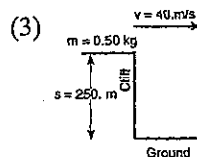
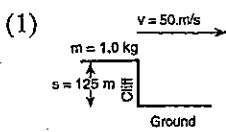
27. How far is the object from the starting point at the end of 3 seconds?
- (1) 0 m                      (3) 3.0 m  
 (2) 2.0 m                      (4) 9.0 m
28. What is the velocity of the object at  $t = 1$  second?
- (1) 1.0 m/s                      (3) 3.0 m/s  
 (2) 2.0 m/s                      (4) 1.5 m/s
29. During which time interval is the object at rest?
- (1) 0-2 s                      (3) 3-4 s  
 (2) 2-3 s                      (4) 4-6 s
30. What is the average velocity of the object from  $t = 0$  to  $t = 3$  seconds?
- (1) 1.0 m/s                      (3) 3.0 m/s  
 (2) 2.0 m/s                      (4) 0 m/s
31. During which time interval is the object accelerating?
- (1) 0-2 s                      (3) 3-4 s  
 (2) 2-3 s                      (4) 4-6 s

32. The diagram below shows a student throwing a baseball horizontally at 25 meters per second from a cliff 45 meters above the level ground.

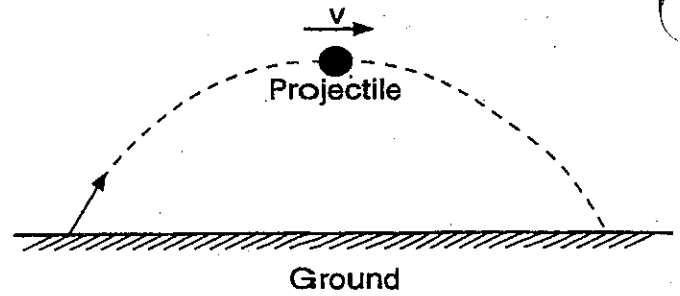


Approximately how far from the base of the cliff does the ball hit the ground? [Neglect air resistance.]

- (1) 45 m  
 (2) 75 m  
 (3) 140 m  
 (4) 230 m
33. Four different balls are thrown horizontally off the top of four cliffs. In which diagram does the ball have the shortest time of flight?



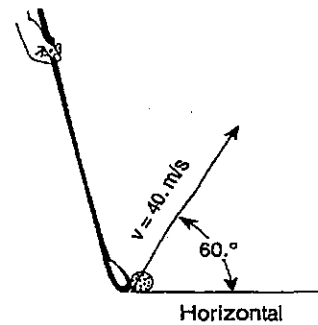
34. The diagram below shows a projectile moving with speed  $v$  at the top of its trajectory.



Which vector best represents the acceleration of the projectile in the position shown?

- (1) (3)   
 (2) (4)

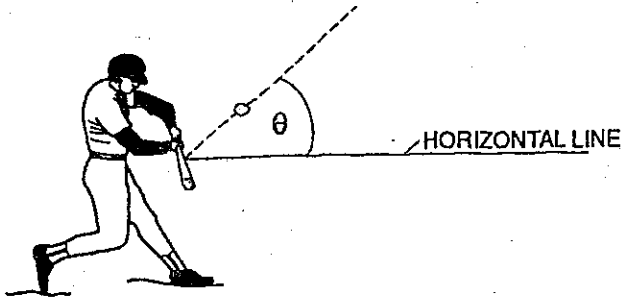
35. The diagram below shows a golf ball being struck by a club. The ball leaves the club with a speed of 40. meters per second at an angle of  $60^\circ$  with the horizontal.



If the ball strikes the ground 7.1 seconds later, how far from the golfer does the ball land? [Assume level ground and neglect air resistance.]

- (1) 35 m  
 (2) 71 m  
 (3) 140 m  
 (4) 280 m

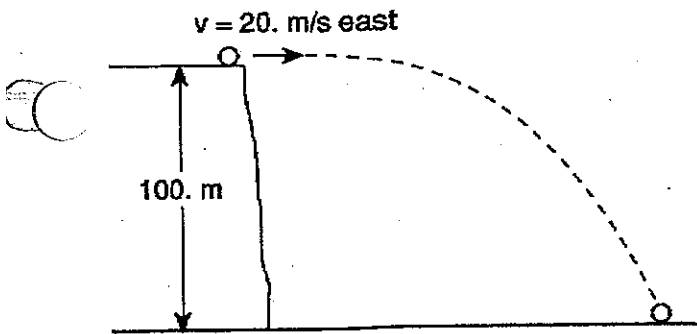
36. The diagram below shows a baseball being hit with a bat. Angle  $\theta$  represents the angle between the horizontal and the ball's initial direction of motion.



Which value of  $\theta$  would result in the ball traveling the longest horizontal distance? [Neglect air resistance.]

- (1)  $30^\circ$                       (3)  $60^\circ$   
(2)  $45^\circ$                       (4)  $75^\circ$

Base your answers to questions 37 and 38 on the diagram below which shows a ball projected horizontally with an initial velocity of 20. meters per second east, off a cliff 100. meters high. [Neglect air resistance.]



37. How many seconds does the ball take to reach the ground?  
(1) 4.5 s                      (3) 9.8 s  
(2) 20. s                      (4) 2.0 s
38. During the flight of the ball, what is the direction of its acceleration?  
(1) downward                      (3) westward  
(2) upward                      (4) eastward

## Long Answer Questions

1. Find the resultant of a 30 Newton force pulling due North, and a 40 Newton force pulling  $30^\circ$  South of East, following the instructions below...
  - a. Sketch the situation. It does not have to be to scale, you just want to get some idea of what it looks like.
  - b. Draw it to scale, using a scale of  $5 \text{ N} = 1 \text{ cm}$
  - c. Construct the resultant.