1. A ball is thrown horizontally at a speed of 20 meters per second from the top of a cliff. How long does the ball take to fall 19.6 meters to the ground?

   (1) 1.0 s  
   (2) 2.0 s  
   (3) 9.8 s  
   (4) 4.0 s

2. A book is pushed with an initial horizontal velocity of 5.0 meters per second off the top of a desk. What is the initial vertical velocity of the book?

   (1) 0 m/s  
   (2) 2.5 m/s  
   (3) 5.0 m/s  
   (4) 10 m/s

3. The diagram here shows a ball projected horizontally with an initial velocity of 20 meters per second east, off a cliff 100 meters high. [Neglect air resistance.]

   ![Diagram of a ball being thrown horizontally with a height of 100 meters.]

   How many seconds does the ball take to reach the ground?

   (1) 4.5 s  
   (2) 20 s  
   (3) 9.8 s  
   (4) 2.0 s

4. During the flight of the ball, what is the direction of its acceleration?

   (1) downward  
   (2) upward  
   (3) westward  
   (4) eastward

5. In the diagram shown, a 10-kilogram sphere, A, is projected horizontally with a velocity of 30 meters per second due east from a height of 20 meters above level ground. At the same instant, a 20-kilogram sphere, B, is projected horizontally with a velocity of 10 meters per second due west from a height of 80 meters above level ground. [Neglect air friction.]

   ![Diagram of two spheres being thrown horizontally with different heights and speeds.]

   Initially, the spheres are separated by a horizontal distance of 100 meters. What is the horizontal separation of the spheres at the end of 1.5 seconds?

   (1) 15 m  
   (2) 30 m  
   (3) 40 m  
   (4) 45 m
6. The magnitude of the horizontal acceleration of sphere A is

(1) 0.0 m/s²  (2) 2.0 m/s²  (3) 9.8 m/s²  (4) 15 m/s²

7. Compared to the vertical acceleration of sphere A, the vertical acceleration of sphere B is

(1) the same  (2) twice as great  (3) one-half as great  (4) four times as great

8. A ball rolls down a curved ramp as shown in the diagram. Which dotted line best represents the path of the ball after leaving the ramp?

(1) A  (2) B  (3) C  (4) D

9. A ball is projected horizontally to the right from a height of 50 meters, as shown in the diagram. Which diagram best represents the position of the ball at 1.0-second intervals? [Neglect air resistance.]

(1)  

(2)  

(3)  

(4)  
10. Four different balls are thrown horizontally off the top of four cliffs. In which diagram does the ball have the shortest time of flight?

11. A student standing on a knoll throws a snowball horizontally 4.5 meters above the level ground toward a smokestack 15 meters away. The snowball hits the smokestack 0.65 second after being released. [Neglect air resistance.]

Approximately how far above the level ground does the snowball hit the smokestack?

12. At the instant the snowball is released, the horizontal component of its velocity is approximately
13. In the accompanying diagram, a stationary observer on the ground watches a seagull flying horizontally to the right drops a clamshell. Which diagram best represents the path of the falling clamshell as seen by the observer? [Neglect air resistance.]

(1)  

(2)  

(3)  

(4)  

14. Base your answer(s) to the following question(s) on the information and diagram below.

A ball is thrown horizontally with an initial velocity of 20.0 meters per second from the top of a tower 60.0 meters high.

What is the approximate total time required for the ball to reach the ground? [Neglect air resistance.]

(1) 12.2 s  (2) 2.04 s  
(3) 3.00 s  (4) 3.50 s
15. The accompanying diagram 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
1. Answer: 3
2. Answer: 1
3. Answer: 1
4. Answer: 1
5. Answer: 3
6. Answer: 1
7. Answer: 1
8. Answer: 2
9. Answer: 4
10. Answer: 1
11. Answer: 3
12. Answer: 4
13. Answer: 4
14. Answer: 4
15. Answer: 2