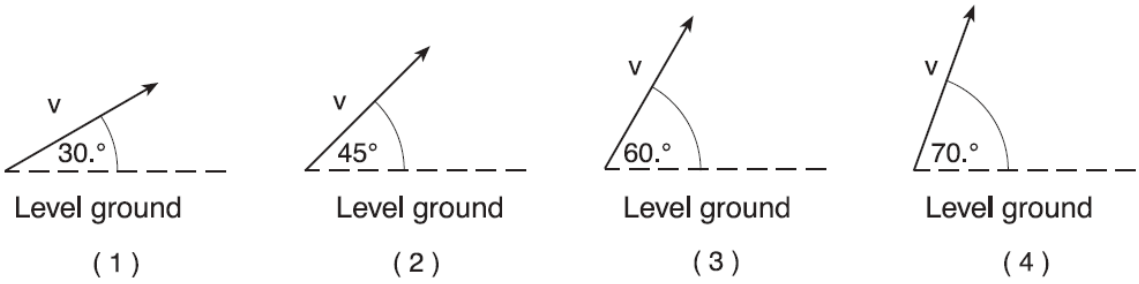
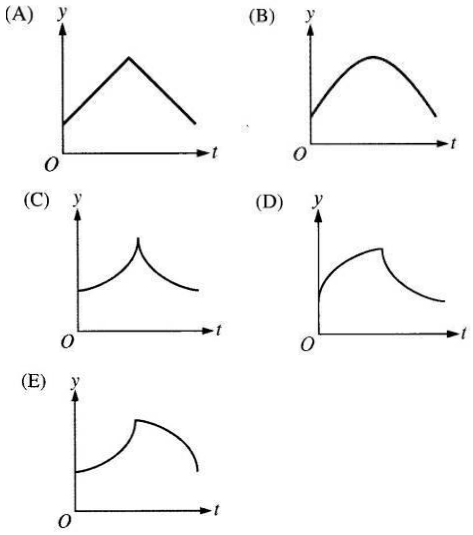
Name: Kinematics Test MC

1. A rock is dropped from a bridge. What happens to the magnitude of the acceleration and the speed of the rock as it falls? [Neglect friction.]
   (A) Both acceleration and speed increase.
   (B) Both acceleration and speed remain the same.
   (C) Acceleration increases and speed decreases.
   (D) Acceleration remains the same and speed increases.

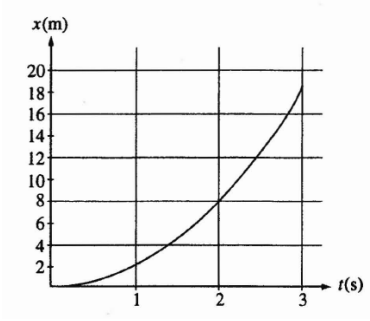
2. Four identical projectiles are launched with the same initial speed *v*, but at various angles above the level ground. Which diagram represents the initial velocity of the projectile that will have the largest total horizontal displacement?



3. A person throws a marble straight up into the air, releasing it a short height above the ground and catching it at that same height. If air resistance is negligible, which of the following graphs of position *y* versus time *t* is correct for the motion of the marble as it goes up and then comes down?



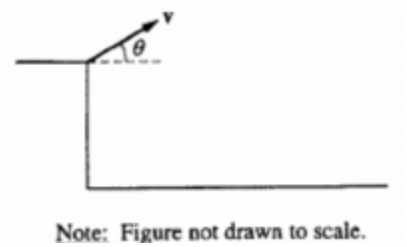
4. The graph above represents position x versus time t for an object being acted on by a constant force. The average speed during the interval between 1 s and 2 s is most nearly
   a. 2 m/s
   b. 4 m/s
   c. 5 m/s
   d. 6 m/s
   e. 8 m/s



Questions 5-6
An object is thrown with an initial speed *v* near the surface of Earth. Assume that air resistance is negligible and the gravitational field is constant.

5. If the object is thrown vertically upward, the direction and magnitude of its acceleration while it is in the air is
   (A) upward and decreasing
   (B) upward and constant
   (C) downward and decreasing
   (D) downward and increasing
   (E) downward and constant

6. If the object is thrown horizontally, the direction and magnitude of its acceleration while it is in the air is
   (A) upward and decreasing
   (B) upward and constant
   (C) downward and decreasing
   (D) downward and increasing
   (E) downward and constant



Note: Figure not drawn to scale.

7. A student is testing the kinematic equations for uniformly accelerated motion by measuring the time it takes for light-weight plastic balls to fall to the floor from a height of 3 m in the lab. The student predicts the time to fall using *g* as 9.8 m/s/s but finds the measured time to be 35% greater. Which of the following is the most likely because of the large percent error?
   a. The acceleration due to gravity is 70% greater than 9.8 m/s/s at this location
   b. The acceleration due to gravity is 70% less than 9.8 m/s/s at this location
   c. Air resistance increases the downward acceleration
   d. The acceleration of the plastic balls is not uniform

Use this statement for the next two questions
Two stones, *A* and *B,* are thrown horizontally from the top of a cliff. Stone *A* has an initial speed of 15 meters per second and stone *B* has an initial speed of 30. meters per second.

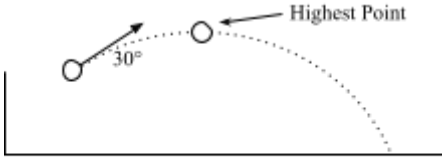
8. Compared to the time it takes stone *A* to reach the ground, the time it takes stone *B* to reach the ground is
   (1) the same (3) half as great (2) twice as great (4) four times as great

9. Compared to the distance it takes stone *A* travels in the air, the distance stone *B* travels is
   (1) the same (3) half as great (2) twice as great (4) four times as great

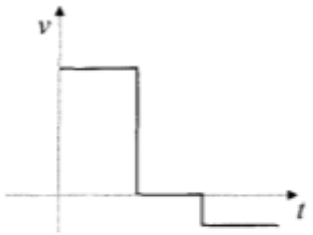
10. A car traveling at 20 m/s can come to a stop after traveling 30 m. If the car is traveling at 40 m/s, how far must it travel to stop, assuming the same acceleration?
    (A) 40 m (B) 30 m (C) 90 m (D) 120 m (E) 60 m

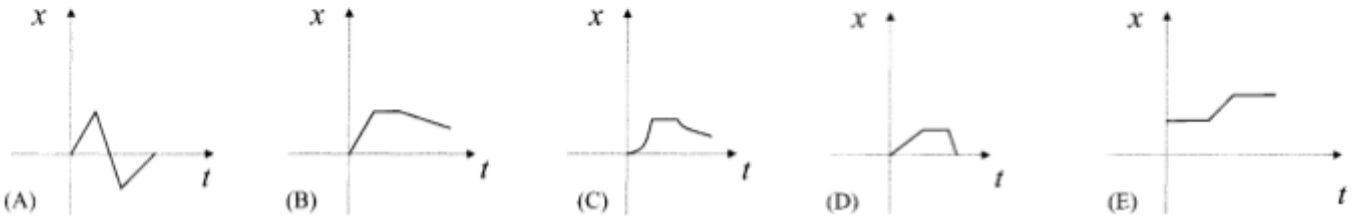
11. Starting from rest, a ball rolls down a long incline with a constant acceleration. After 2 s, it has traveled 2 m. In the next second it will travel
    (A) 1.25 m (B) 2.5 m (C) 3 m (D) 1 m (E) 2 m

12. At the highest point of its trajectory, a projectile fired at 30° above the horizontal from a starting height of 20 m.
    (A) is instantaneously at rest
    (B) has traveled half the distance to its impact point
    (C) has 0 acceleration
    (D) has a horizontal velocity component equal to its initial value
    (E) has more than one of the above properties

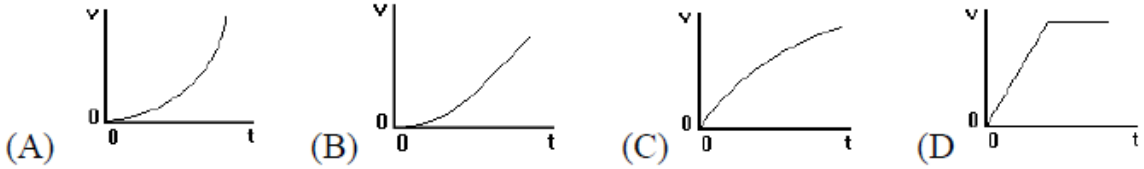


13. An abject moves with a velocity vs. time graph as shown at the right. The position vs. time graph for the same time period would be

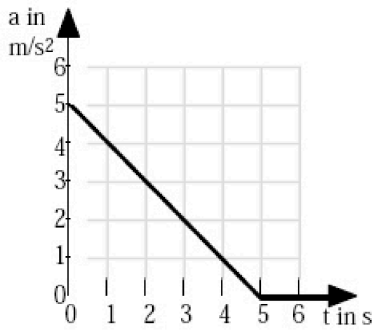




14. A large beach ball is dropped from the ceiling of a school gymnasium to the floor about10 meters below. Which of the following graphs would best represent its velocity as a function of time?



The accompanying graph describes the motion of a toy car across the floor for 10 seconds?



15. What is the acceleration of the toy car at t=4s?
(A)-1 m/s^2 (B) -1 m/s^2 (C) 1 m/s^2 (D) 2 m/s^2

16. What was the total displacement of the toy car for the entire 10 second interval?
(A) 0 meters (B) 6.5 meters (C) 9 meters (D) 10 meters

17. An object is thrown upward with a velocity of 30 m/s near the surface of the earth. After two seconds what would be the direction of the displacement, velocity and acceleration?

	Displacement	velocity	acceleration
(A)	up	up	up
(B)	up	up	down
(C)	up	down	down
(D)	up	down	up

18. A snail is moving along a straight line. Its initial position is x_o = -5 meters and it is moving away from the origin and slowing down. In this coordinate system, the signs of the initial position, initial velocity and acceleration respectively, are

Choice	x_0	v_0	a
(A)	–	+	+
(B)	–	–	+
(C)	–	–	–
(D)	–	+	–

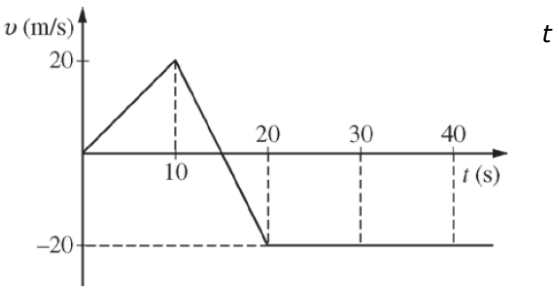
Questions 19 to 20

During a recent winter storm, bales of hay had to be dropped from an airplane to a herd of cattle below. Assume the airplane flew horizontally at an altitude of 180 m with a constant velocity of 50 m/s and dropped one bale of hay every two seconds. It is reasonable to assume that air resistance will be negligible for this situation.

19. As the bales are falling through the air, what will happen to their distance of separation?
    (A) the distance of separation will increase
    (B) the distance of separation will decrease
    (C) the distance of separation will remain constant
    (D) the distance of separation will depend on the mass of the bales

20. About how far apart from each other will the bales land on the ground?
    (A) 300 m (B) 180 m (C) 100 m (D) 50 m

21. An object begins at position x=0 and moves one-dimensionally along the x-axis with a velocity *v* expressed as a function of time according to the graph above. At what time does the object pass through x=0 again?
    A) Between 10 s and 20 s
    B) Between 20 s and 30 s
    C) at 30 s exactly
    D) Between 30s and 40s
    E) After 40s



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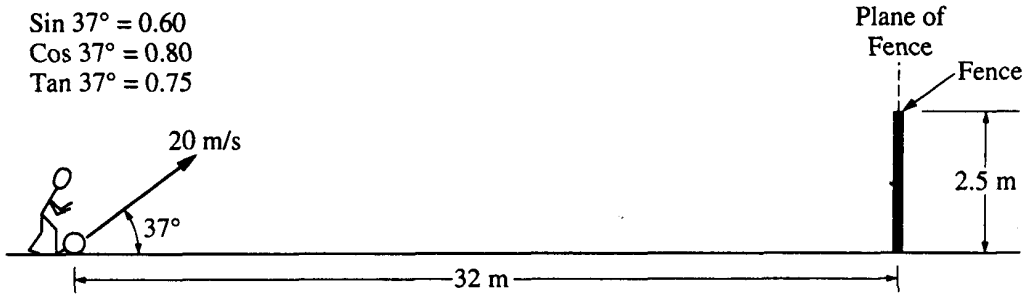
Name: **Projectile Motion SA**



Note: Diagram not drawn to scale.

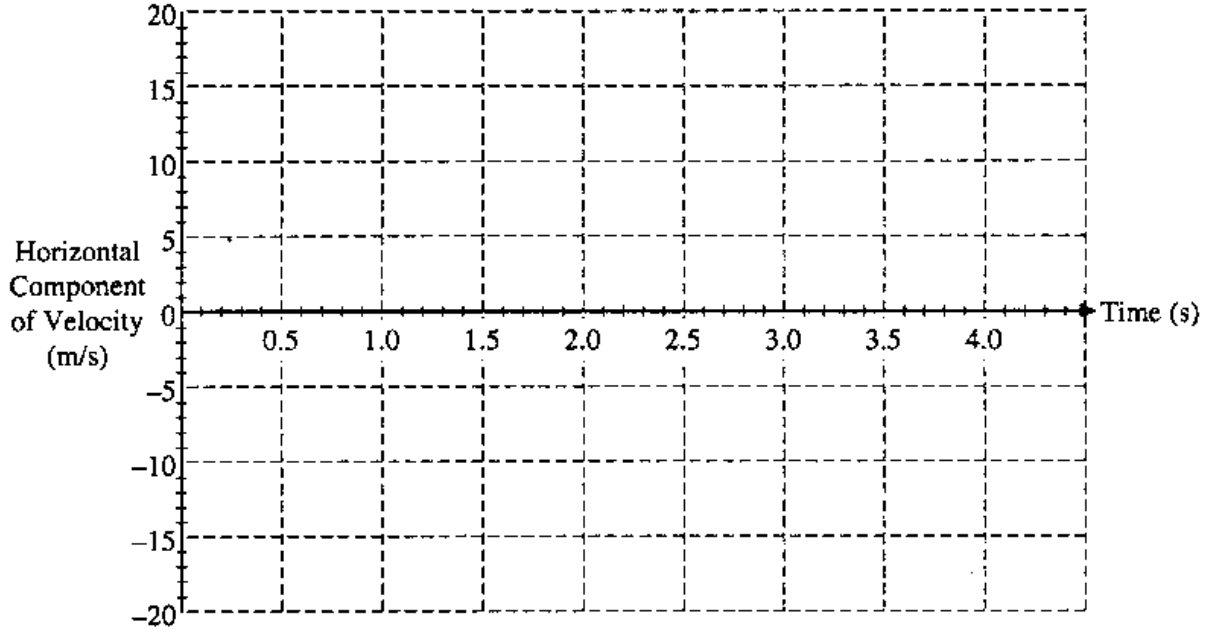
A ball of mass 0.5 kilogram, initially at rest, is kicked directly toward a fence from a point 32 meters away, as shown above. The velocity of the ball as it leaves the kicker's foot is $\mathbf{v_0}$ = 20 meters per second at an angle of 37° above the horizontal. The top of the fence is 2.5 meters high.

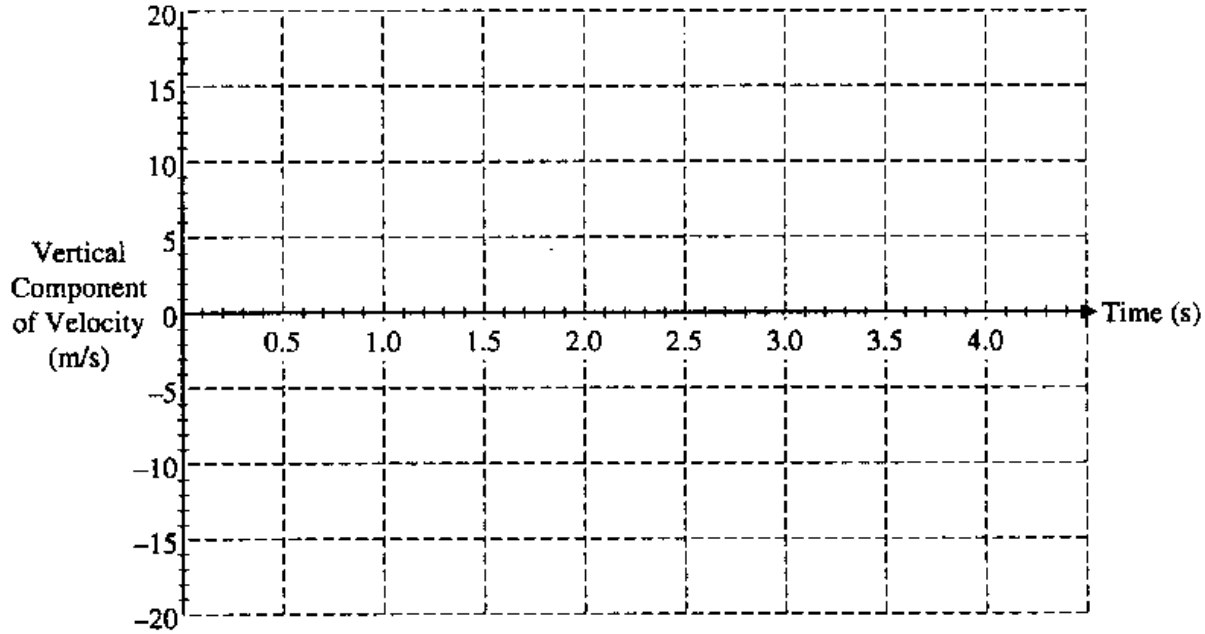
Determine the vertical and horizontal components of $\mathbf{v_0}$, the ball's initial velocity.

In a complete, coherent paragraph, describe how both the horizontal and vertical component of the velocity affect whether or not the ball will clear the fence.

Calculate where the ball will hit the fence or how far above the top of the fence it will pass.

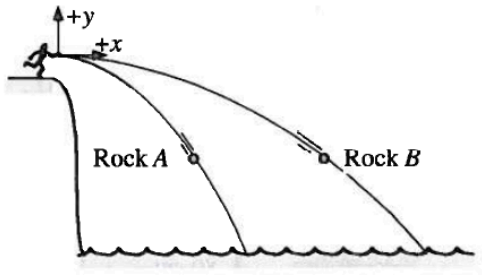
On the axes below, sketch the horizontal and vertical components of the velocity of the ball as functions of time **until the ball reaches the plane of the fence**.





B2-CT25: PROJECTILE MOTION FOR TWO ROCKS—VELOCITY AND ACCELERATION

Two identical rocks are thrown horizontally from a cliff with different velocities. The rocks are thrown at the same time and are shown below while they are still in the air after a few seconds.



For the instant shown:

(a) Will the magnitude of the horizontal velocity of Rock A be (i) *greater than,* (ii) *less than,* or (iii) *equal to* the magnitude of the horizontal velocity of Rock B? _____

Explain your reasoning.

(b) Will the magnitude of the vertical velocity of Rock A be (i) *greater than,* (ii) *less than,* or (iii) *equal to* the magnitude of the vertical velocity of Rock B? _____

Explain your reasoning.

(c) Will the magnitude of the horizontal acceleration of Rock A be (i) *greater than,* (ii) *less than,* or (iii) *equal to* the magnitude of the horizontal acceleration of Rock B? _____

Explain your reasoning.

(d) Will the magnitude of the vertical acceleration of Rock A be (i) *greater than,* (ii) *less than,* or (iii) *equal to* the magnitude of the vertical acceleration of Rock B? _____

Explain your reasoning.