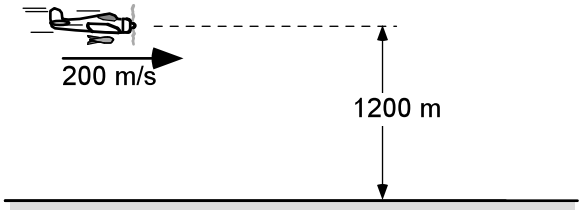
1. A military airplane is flying 1200 m above the ground at a speed of 200 m/s. It drops a practice bomb that hits the ground after traveling a horizontal distance of 3130 m. Ignore air resistance.



For each of the numbered changes below, use the lettered choices below to identify what will happen to the horizontal distance the bomb travels while falling compared to the situation above.

(a) The horizontal distance will be *greater than* 3130 m.
(b) The horizontal distance will be *less than* 3130 m but not to zero.
(c) The horizontal distance will be *equal to* 3130 m.
(d) The horizontal distance will be *zero,* i.e., the bomb will drop straight down.
(e) We *cannot determine* how this change will affect the horizontal distance.

For each of the following changes, only the feature(s) identified is(are) modified from the given situation above.

1) The plane's speed is tripled. _____
Explain.

2) The plane is climbing straight up at the release point. _____
Explain.

3) The plane is flying in level flight at an altitude of 1100 m. _____
Explain.

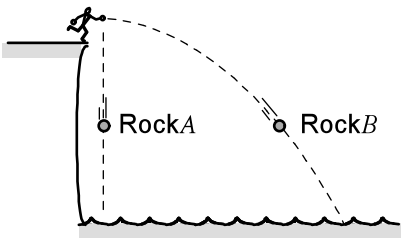
_____

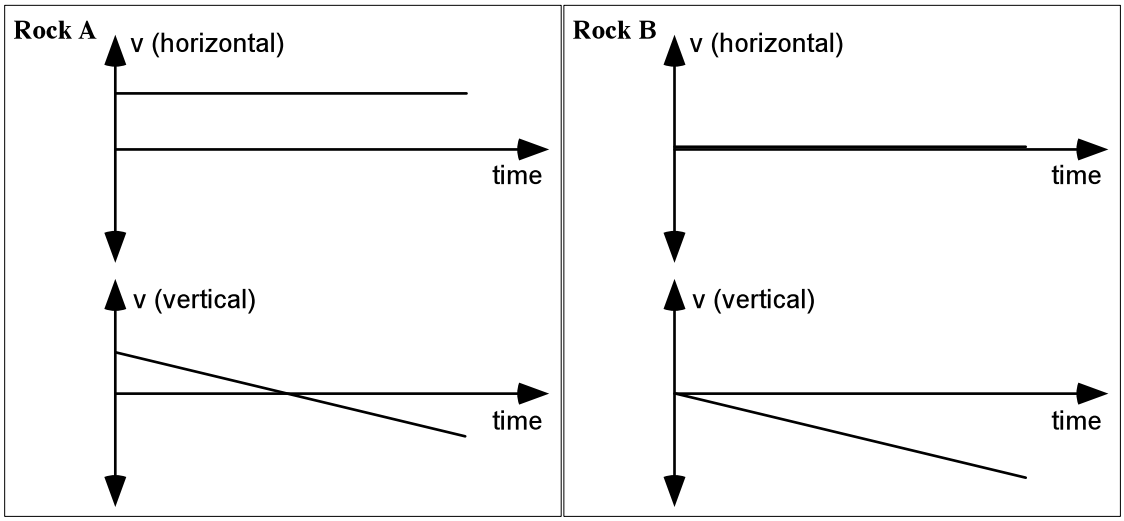
5) The bomb is thrown from the plane with a vertical downward velocity of 15 m/s. _____
Explain.

6) The plane is diving at a 20° angle and is at a height of 1200 m. _____
Explain.

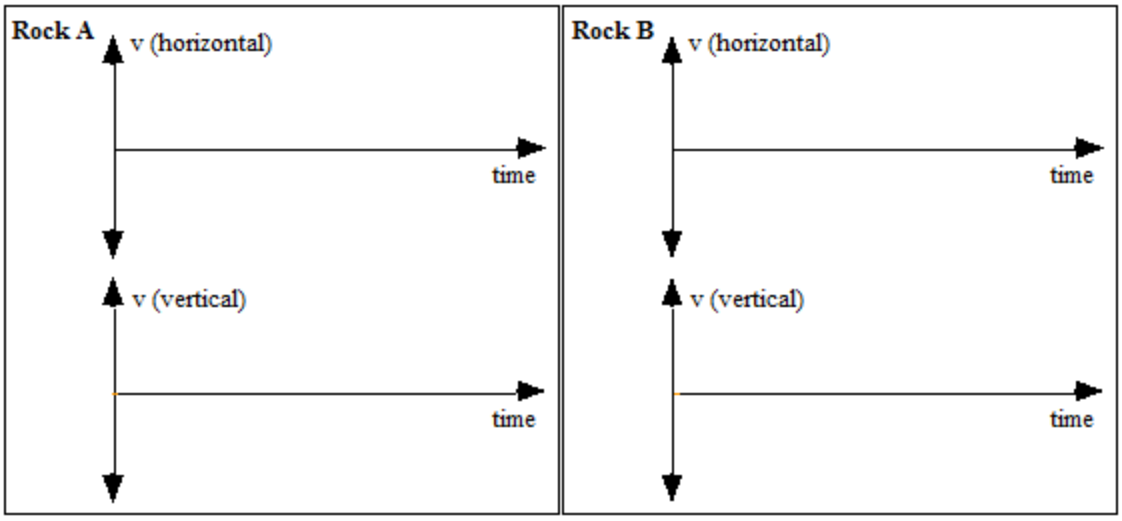
7) The plane's speed decreases, and it is flying at an altitude of 1800 m. _____
Explain.

1. Rock *A* is dropped from the top of a cliff at the same instant that Rock *B* is thrown horizontally away from the cliff. The rocks are identical. A student draws the following graphs to describe part of the motion of the rocks. He uses a coordinate system in which up is the positive vertical direction, and the positive horizontal direction is away from the cliff, with the origin at the point the rocks were released.

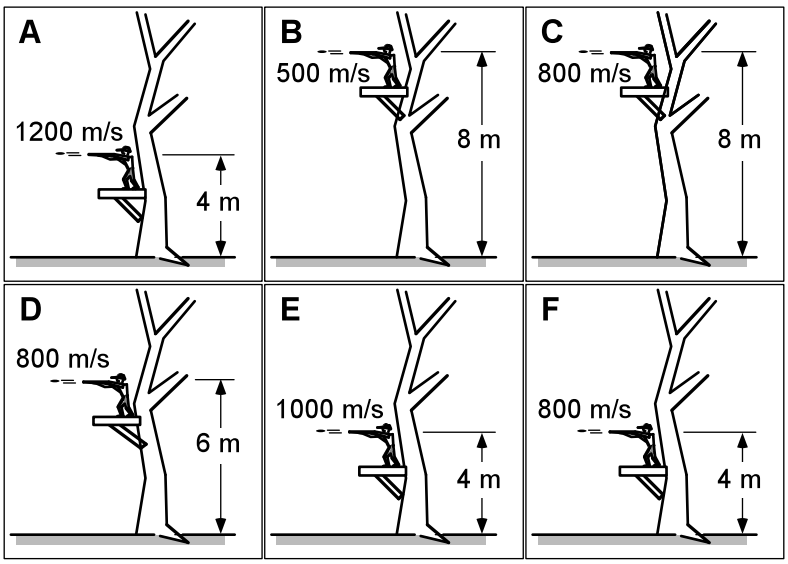




What, if anything, is wrong with these graphs for the motions of the two rocks? If something is wrong, identify it and explain how to correct it. If the graphs are correct, explain why.



2. Rifles are fired horizontally from platforms at various heights. The bullets fired from these rifles are identical, but they leave the rifle barrels at different speeds as shown in the diagrams. All of the bullets miss their targets and hit the ground. Ignore air resistance in this task.



Students who are asked to rank these situations on the basis of how long it takes the bullets to hit the ground respond as follows:

Anja: "I think the ranking should be C > B > D > A> E > F, because if two bullets are shot from the same height at different speeds, their y-acceleration is the same, meaning the one shot faster would have to cover more of the horizontal distance before hitting the ground, thereby making the time longer. So we rank first by height then by velocity."

Brina: "The higher the platform, the longer it will take, but the faster the bullet the smaller the time to hit the ground. So using rate times time equals distance we get time = height/velocity, which gives us the ranking B > C > D > F > E> A."

Charlie: "I think the ranking should be A > E > C > D > F > B. I agree that the height of the platform matters as does the velocity. The faster a bullet is moving, the longer it takes to hit the ground and the higher the longer too. So we rank first by velocity, then by the height if the velocities are the same."

Deepa: "I get B = C > D > A = E = F. The time that each bullet is in the air depends on the initial vertical velocity and the height. Since the initial vertical velocity is zero we only need to worry about the height, with the larger height giving a longer time. The horizontal velocity does not matter."

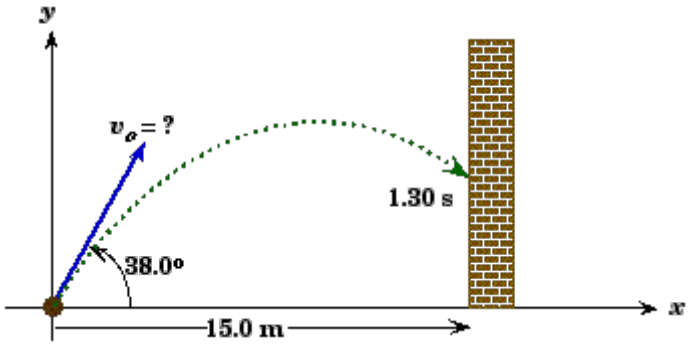
Ellie: "I think the ranking is A > E > C = D = F > B, since the time to reach the ground is directly related to the horizontal velocity."

Which, if any, of these students do you agree with?

Anja ___ *Brina* ___ *Charlie* ___ *Deepa* ___ *Ellie*___ None of them___

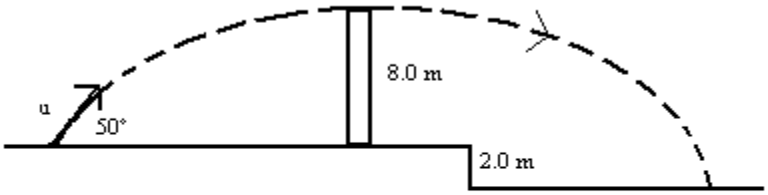
Explain.

1) An object is launched from the ground into the air at an angle of 38.0^{o} (above the horizon) towards a vertical brick wall that is 15.0 m horizontally from the launch point. If the ball takes 1.30 seconds to collide with the wall, with what speed was the ball launched ?



Sketch

2) A ball was kicked over a 8.0m wall as shown below with a velocity u at an angle of 50° above the horizontal. At the highest point of the trajectory, the ball managed to just go over the wall. It landed into a depression 2.0 m deep.



a) Express the initial horizontal velocity and initial vertical velocity in terms of u.
b) Calculate the initial speed of the ball (the actual value, not in terms of u)
c) Calculate the vertical velocity of the ball v_y just before it hits the depression.
d) Calculate the velocity of the ball v just before it hits the depression.
e) Calculate the time of flight

3) A baseball is hit at a velocity of 54m/s at an angle of 35˚. The ball was struck 1m above home plate. The outfield wall is 172m away. A) At what time will the ball reach the plane of the fence? B) What is the maximum height of the wall in order for the ball to make it over the fence? C) Is the ball rising or falling when it gets to the fence? How do you know?