Flipping Physics Lecture Notes:
Projectile Motion - AP Physics 1: Kinematics Review Supplement
http://www.flippingphysics.com/ap1-kinematics-projectile-motion.html

First off, understand this video assumes you have already watched my video:
AP Physics 1: Kinematics Review (http://www.flippingphysics.com/ap1-kinematics-review.html)
So, if you haven't watched that video yet. Go do that now, eh!

Also, if you find this video (and lecture notes) helpful, please consider signing up for my AP Physics 1 Ultimate Review Packet at www.UltimateReviewpPacket.com! You'll find more of these supplemental videos there, along with practice multiple choice problems, free response questions, a practice AP Physics 1 exam, and solutions to all of those, of course! Anyway, let's get to the lecture notes for this video…

Kinematics serves as the backbone of the AP Physics 1 curriculum. It's where you get your first experience understanding motion graphs which leads to better understanding of more graphs in physics. It's where you first begin working with multiple variables and multiple equations. It's where you first begin breaking vectors into components. These are all skills you need to master for the entire course. So, please, take the time to understand Kinematics. It will help you understand the rest of the topics in AP Physics 1 much better.

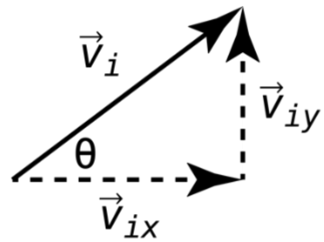
And now we review Kinematics through multiple-choice problems, starting with projectile motion problems:

1) A projectile is launched with speed v_i at an angle of θ above the horizontal. At its maximum height, the horizontal and vertical components of the projectile's velocity and acceleration are:

	Horizontal Velocity Component	Vertical Velocity Component	Horizontal Acceleration Component	Vertical Acceleration Component
(A)	$v_i \cos\theta$	0	0	-g
(B)	$v_i \sin\theta$	$v_i \cos\theta$	0	-g
(C)	$v_i \cos\theta$	$v_i \sin\theta$	-g	0
(D)	$v_i \sin\theta$	0	-g	0

*At the very top of its path, the velocity of a projectile changes from moving up to moving down, therefore, at the very top, it has **zero velocity in the y-direction**.*

*The **acceleration of a projectile in the x-direction is zero**, therefore, the velocity of a projectile in the x-direction is constant. We need to find the x-component of the initial velocity, which is the constant horizontal velocity of the projectile.*

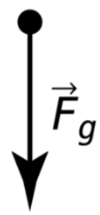


$$\cos\theta = \frac{A}{H} = \frac{v_{ix}}{v_i} \Rightarrow v_{ix} = v_i\cos\theta = v_x$$

The acceleration of a projectile in the y-direction has a magnitude of g and is directed downward, therefore, $\boldsymbol{a_y = -g}$.

The correct answer is (A).

Once you learn about Newton's Second Law and Dynamics, you can understand all of this using a free body diagram and Newton's Second Law. The only force acting on the projectile is the force of gravity which acts down.



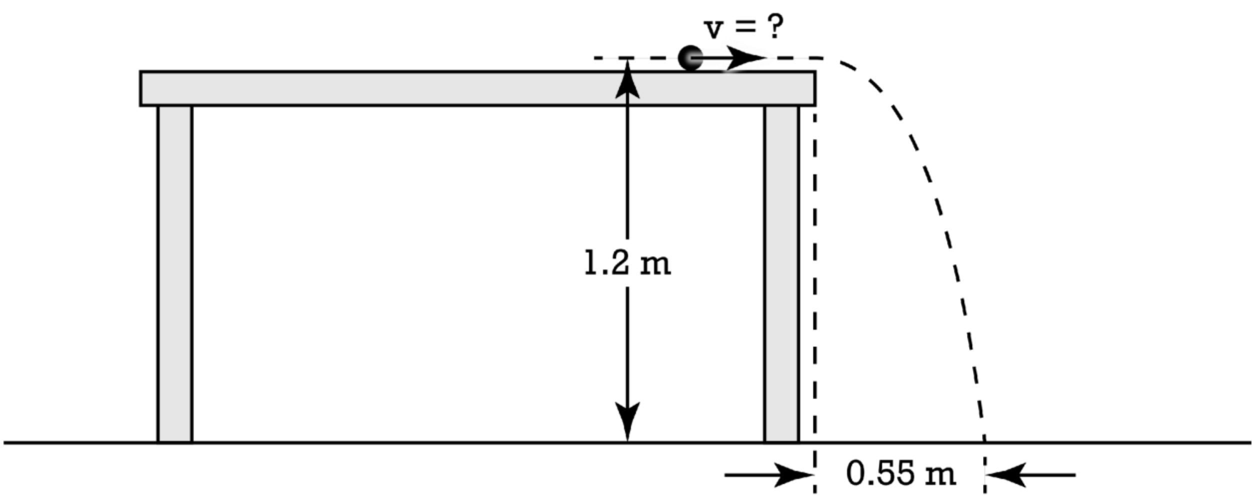
$$\sum F_y = -F_g = ma_y \Rightarrow -mg = ma_y \Rightarrow a_y = -g$$

There are no forces acting in the x-direction, therefore, the acceleration in the x-direction is zero.

$$\sum F_x = 0 = ma_x \Rightarrow a_x = 0$$

2) A small steel ball rolls off a horizontal table with a height of 1.2 m and lands a horizontal distance of 0.55 m from the edge of the table. What was the speed of the ball as it rolled on the table? (Friction is negligible)

(A) 0.27 m/s (B) 0.49 m/s (C) 0.89 m/s (D) 1.1 m/s



y-direction: $v_{iy} = 0; \Delta y = -1.2m; a_y = -g = -10\frac{m}{s^2}$

$$\Delta y = v_{iy}\Delta t + \frac{1}{2}a_y\Delta t^2 \Rightarrow -1.2 = \frac{1}{2}(-10)\Delta t^2 = -5\Delta t^2$$

$$\Rightarrow \Delta t = \sqrt{\frac{1.2}{5}} = 0.489898s$$

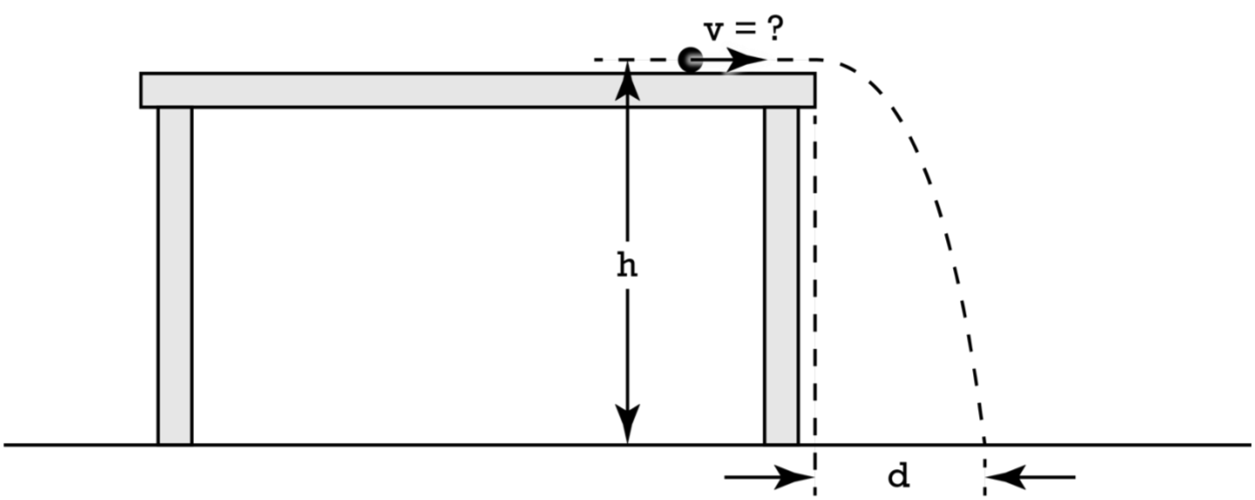
x-direction: $\Delta t = 0.489898s; \Delta x = 0.55m; v_x = \frac{\Delta x}{\Delta t} = \frac{0.55}{0.489898} \approx 1.1\frac{m}{s}$

The correct answer is (D).

It is also plausible they would ask you questions like this without numbers. That would look like this:

2a) A small steel ball rolls off a horizontal table with a height of h and lands a horizontal distance of d from the edge of the table. What was the speed of the ball as it rolled on the table? (Friction is negligible)

(A) $\sqrt{\frac{2d^2h}{g}}$ (B) $\sqrt{\frac{2h}{g}}$ (C) $\sqrt{\frac{2h}{d^2g}}$ (D) $\sqrt{\frac{d^2g}{2h}}$



y-direction: $v_{iy} = 0; \Delta y = -h; a_y = -g$

$$\Delta y = v_{iy}\Delta t + \frac{1}{2}a_y\Delta t^2 \Rightarrow -h = \frac{1}{2}(-g)\Delta t^2 = -\frac{g\Delta t^2}{2} \Rightarrow \Delta t = \sqrt{\frac{2h}{g}}$$

x-direction: $\Delta t = \sqrt{\frac{2h}{g}}; \Delta x = d; v_x = \frac{\Delta x}{\Delta t} = \frac{d}{\sqrt{\frac{2h}{g}}} \Rightarrow v_x = \sqrt{\frac{d^2g}{2h}}$

The correct answer is still (D).