2023 F=ma Exam: Problem 24

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$V + 2v$

$V - 2v$

V

V

v

v
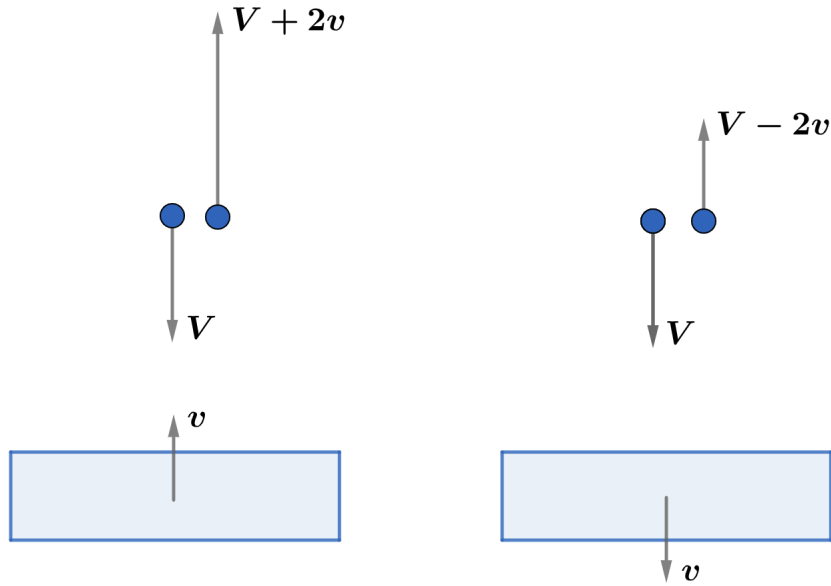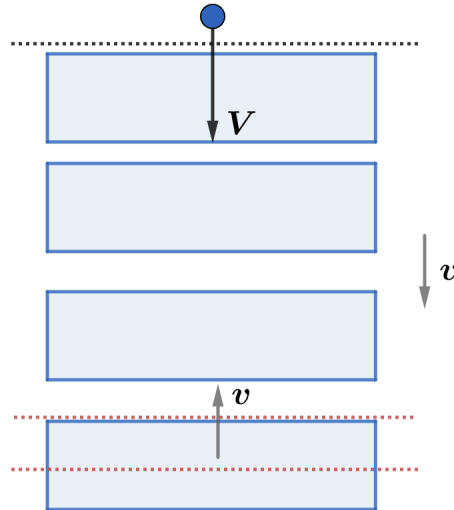
If the ball collides with the plate when it is traveling upward, the ball's speed increases by $2v$ after the collision, which can be seen by going to the frame of the plate. Similarly, if the ball collides with the plate when it is traveling downward, the ball's speed decreases by $2v$ after the collision.

Now consider when the ball reaches the top of the region where the plate moves. The plate is equally likely to be anywhere in the region moving up or down.
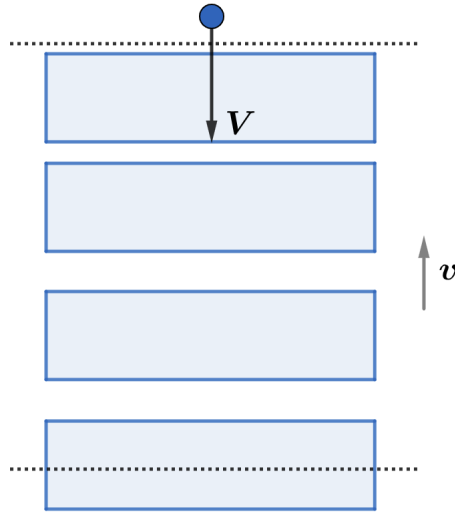
If the plate is moving up at any location, then the ball's speed will increase after it collides with the plate.

If the plate is moving down, then most of the time the ball's speed will decrease after it collides with the plate. However, if the plate is near the bottom of the region, then it has time to reverse direction as the ball moves through the region. The subsequent collision would then increase the speed of the ball.

Thus, the ball is more likely to speed up than slow down so the answer is $\boxed{\text{D}}$.